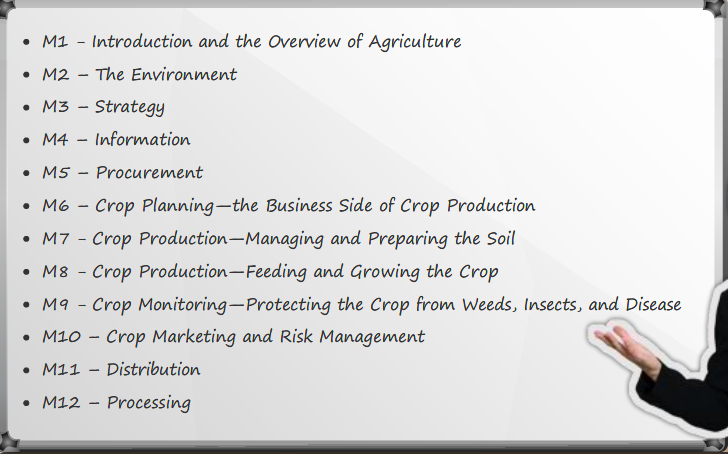
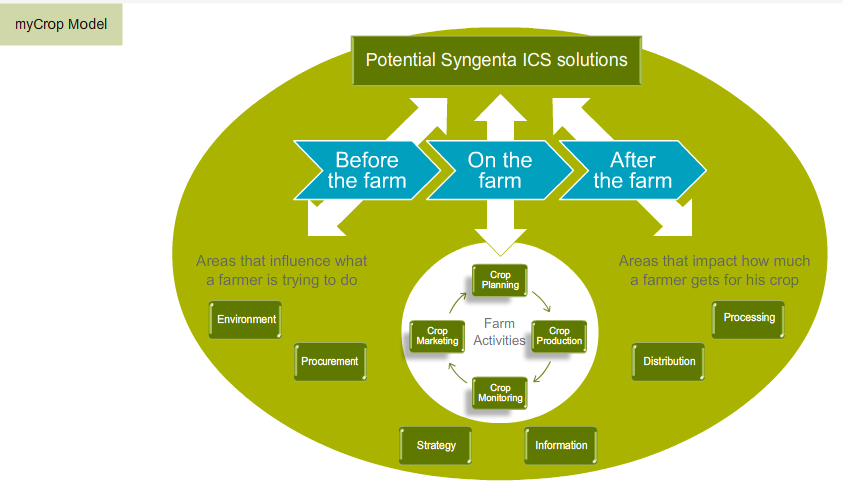
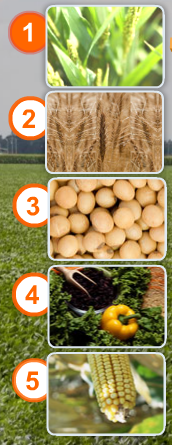
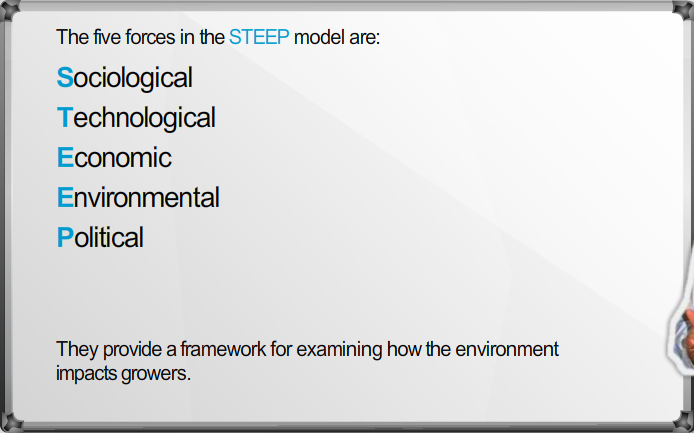
Thinking like a grower











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# Integrated Project Execution, Monitoring, and Control **Glossary**

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## A

AC

See [actual cost](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#actualncost).

acceptance criteria

Those criteria, including performance requirements and essential conditions, which must be met before project deliverables are accepted.

Acquire Project Team

The process of confirming human resource availability and obtaining the team necessary to complete project assignments.

activity

A component of work performed during the course of a project.

activity attributes

Multiple attributes or characteristics associated with each schedule activity that can be included within the activity list. Activity attributes include activity codes, predecessor activities, successor activities, logical relationships, leads and lags, resource requirements, imposed dates, constraints, and assumptions.

activity code

One or more numerical or text values that identify characteristics of the work or in some way categorize the schedule activity that allows filtering and ordering of activities within reports.

activity duration

The time in calendar units between the start and finish of a schedule activity. See also [duration](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#duration).

activity identifier

A short unique numeric or text identification assigned to each schedule activity to differentiate that project activity from other activities. Typically unique within any one project schedule network diagram.

activity list

A documented tabulation of schedule activities that shows the activity description, activity identifier, and a sufficiently detailed scope of work description so project team members understand what work is to be performed.

actual cost

Abbreviated to AC, total costs actually incurred and recorded in accomplishing work performed during a given time period for a schedule activity or work breakdown structure component. Actual cost can sometimes be direct labor hours alone, direct costs alone, or all costs including indirect costs.

actual cost of work performed

Abbreviated to ACWP. See [actual cost](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#actualncost).

actual duration

The time in calendar units between the actual start date of the schedule activity and either the data date of the project schedule if the schedule activity is in progress or the actual finish date if the schedule activity is complete.

ACWP

Acronym for actual cost of work performed. See [actual cost](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#actualncost).

Administer Procurements

The process of managing procurement relationships, monitoring contract performance, and making changes and corrections as needed.

ADR

See [alternative dispute resolution](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#alternativendisputenresolution).

alternative dispute resolution

A component of the procurement contract award output. This mechanism can be decided in advance as part of the procurement award.

analogous estimating

An estimating technique that uses the values of parameters, such as scope, cost, budget, and duration or measures of scale such as size, weight, and complexity from a previous, similar activity as the basis for estimating the same parameter or measure for a future activity.

application area

A category of projects that have common components significant in such projects, but are not needed or present in all projects. Application areas are usually defined in terms of either the product (i.e., by similar technologies or production methods) or the type of customer (i.e., internal versus external, government versus commercial) or industry sector (i.e., utilities, automotive, aerospace, information technologies, etc.). Application areas can overlap.

approved change request

A change request that has been processed through the integrated change control process and approved.

assumptions

Assumptions are factors that, for planning purposes, are considered to be true, real, or certain without proof or demonstration.

assumptions analysis

A technique that explores the accuracy of assumptions and identifies risks to the project from inaccurate, inconsistent, or incomplete assumptions.

authority

The right to apply project resources, expend funds, make decisions, or give approvals.

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## B

backward pass

The calculation of late finish dates and late start dates for the uncompleted portions of all schedule activities. Determined by working backwards through the schedule network logic from the project's end date. See also [schedule network analysis](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#schedulennetworknanalysis).

baseline

An approved plan for a project, plus or minus approved changes. It is compared to actual performance to determine if performance is within acceptable variance thresholds. Generally refers to the current baseline, but may refer to the original or some other baseline. Usually used with a modifier (e.g. cost performance baseline, schedule baseline, performance measurement baseline, technical baseline).

bottom-up estimating

A method of estimating a component of work. The work is decomposed into more detail. An estimate is prepared of what is needed to meet the requirements of each of the lower, more detailed pieces of work, and these estimates are then aggregated into a total quantity for the component of work. The accuracy of bottom-up estimating is driven by the size and complexity of the work identified at the lower levels.

brainstorming

A general data gathering and creativity technique that can be used to identify risks, ideas, or solutions to issues by using a group of team members or subject-matter experts.

budget

The approved estimate for the project or any work breakdown structure (WBS) component or any schedule activity. See also [estimate](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#estimate).

budget at completion

Abbreviated to BAC, the sum of all the budgets established for the work to be performed on a project or a work breakdown structure component or a schedule activity. The total planned value for the project.

budgeted cost of work performed

Abbreviated to BCWP. See [earned value](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#earnednvalue).

budgeted cost of work performed

Abbreviated to BCWP.

budgeted cost of work scheduled

Abbreviated to BCWS. See [planned value](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#plannednvalue).

budgeted cost of work scheduled

Abbreviated to BCWS.

buffer

See [reserve](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#reserve).

buyer

The acquirer of products, services, or results for an organization.

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## C

calendar unit

The smallest unit of time used in scheduling a project. Calendar units are generally in hours, days, or weeks, but can also be in quarter years, months, shifts, or even in minutes.

CCB

See [change control board](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#changencontrolnboard).

change control

The process of identifying, documenting, approving or rejecting, and controlling changes to the project baselines.

change control board

Abbreviated to CCB, a formally constituted group of stakeholders responsible for reviewing, evaluating, approving, delaying, or rejecting changes to a project, with all decisions and recommendations being recorded.

change control system

A collection of formal documented procedures that define how project deliverables and documentation will be controlled, changed, and approved. In most application areas, the change control system is a subset of the configuration management system.

change request

A request to expand or reduce the project scope, modify policies, processes, plans, or procedures, modify costs or budgets, or revise schedules.

charter

See [project charter](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#projectncharter).

claim

A request, demand, or assertion of rights by a seller against a buyer, or vice versa, for consideration, compensation, or payment under the terms of a legally binding contract, such as for a disputed change.

Close Procurements

The process of completing each project procurement.

Close Project or Phase

The process of finalizing all activities across all of the project management process groups to formally complete the project or phase.

Closing processes

Those processes performed to finalize all activities across all project management process groups to formally close the project or phase.

code of accounts

Any numbering system used to uniquely identify each component of the work breakdown structure (WBS).

Collect Requirements

The process of defining and documenting stakeholders' needs to meet the project objectives.

co-location

An organizational placement strategy where the project team members are physically located close to one another in order to improve communication, working relationships, and productivity.

common cause

A source of variation that is inherent in the system and predictable. On a control chart, it appears as part of the random process variation (i.e., variation from a process that would be considered normal or not unusual), and is indicated by a random pattern of points within the control limits. Also referred to as random cause. Contrast with [special cause](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#specialncause).

communication management plan

The document that describes: the communications needs and expectations for the project; how and in what format information will be communicated; when and where each communication will be made; and who is responsible for providing each type of communication. The communication management plan is contained in, or is a subsidiary plan of, the project management plan.

Conduct Procurements

The process of obtaining seller responses, selecting a seller, and awarding a contract.

configuration management system

A subsystem of the overall project management system. It is a collection of formal documented procedures used to apply technical and administrative direction and surveillance to: identify and document the functional and physical characteristics of a product, result, service, or component; control any changes to such characteristics; record and report each change and its implementation status; and support the audit of the products, results, or components to verify conformance to requirements. It includes the documentation, tracking systems, and defined approval levels necessary for authorizing and controlling changes.

constraint

The state, quality, or sense of being restricted to a given course of action or inaction. An applicable restriction or limitation, either internal or external to a project, which will affect the performance of the project or a process. For example, a schedule constraint is any limitation or restraint placed on the project schedule that affects when a schedule activity can be scheduled and is usually in the form of fixed imposed dates.

contingency

See [reserve](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#reserve).

contingency allowance

See [reserve](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#reserve).

contingency reserve

The amount of funds, budget, or time needed above the estimate to reduce the risk of overruns of project objectives to a level acceptable to the organization.

contract

A contract is a mutually binding agreement that obligates the seller to provide the specified product or service or result and obligates the buyer to pay for it.

control

Comparing actual performance with planned performance, analyzing variances, assessing trends to effect process improvements, evaluating possible alternatives, and recommending appropriate corrective action as needed.

control account

A management control point where scope, budget (resource plans), actual cost, and schedule are integrated and compared to earned value for performance measurement. See also [work package](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#worknpackage).

control chart

A graphic display of process data over time and against established control limits, and that has a centerline that assists in detecting a trend of plotted values toward either control limit.

Control Costs

The process of monitoring the status of the project to update the project budget and managing changes to the cost baseline.

control limits

The area composed of three standard deviations on either side of the centerline, or mean, of a normal distribution of data plotted on a control chart that reflects the expected variation in the data. See also [specification limits](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#specificationnlimits).

Control Schedule

The process of monitoring the status of the project to update project progress and managing changes to the schedule baseline.

Control Scope

The process of monitoring the status of the project and product scope and managing changes to the scope baseline.

controlling

See [control](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#control).

COQ

See [cost of quality](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#costnofnquality).

corrective action

Documented direction for executing the project work to bring expected future performance of the project work in line with the project management plan.

cost management plan

The document that sets out the format and establishes the activities and criteria for planning, structuring, and controlling the project costs. The cost management plan is contained in, or is a subsidiary plan of, the project management plan.

cost of quality

Abbreviated to COQ, a method of determining the costs incurred to ensure quality. Prevention and appraisal costs (cost of conformance) include costs for quality planning, quality control (QC), and quality assurance to ensure compliance to requirements (i.e., training, QC systems, etc.). Failure costs (cost of non-conformance) include costs to rework products, components, or processes that are non-compliant, costs of warranty work and waste, and loss of reputation.

cost performance baseline

A specific version of the time-phased budget used to compare actual expenditures to planned expenditures to determine if preventive or corrective action is needed to meet the project objectives.

cost performance index

See [CPI](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#CPI).

cost variance

Abbreviated to CV, a measure of cost performance on a project. It is the difference between earned value (EV) and actual cost (AC). CV = EV minus AC.

cost-plus-fixed-fee contract

Abbreviated to CPFF, a type of cost-reimbursable contract where the buyer reimburses the seller for the seller's allowable costs (allowable costs are defined by the contract) plus a fixed amount of profit (fee).

cost-plus-incentive-fee contract

Abbreviated to CPIF, A type of cost-reimbursable contract where the buyer reimburses the seller for the seller's allowable costs (allowable costs are defined by the contract), and the seller earns its profit if it meets defined performance criteria.

cost-reimbursable contract

A type of contract involving payment to the seller for the seller's actual costs, plus a fee typically representing seller's profit. Cost-reimbursable contracts often include incentive clauses where, if the seller meets or exceeds selected project objectives, such as schedule targets or total cost, then the seller receives from the buyer an incentive or bonus payment.

CPFF

See [cost-plus-fixed-fee contract](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#costn45nplusn45nfixedn45nfeencontract).

CPI

Acronym for cost performance index, a measure of cost efficiency on a project. It is the ratio of earned value (EV) to actual costs (AC). CPI = EV divided by AC.

CPIF

See [cost-plus-incentive-fee contract](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#costn45nplusn45nincentiven45nfeencontract).

CPM

Acronym for critical path methodology, a schedule network analysis technique used to determine the amount of scheduling flexibility (the amount of float) on various logical network paths in the project schedule network, and to determine the minimum total project duration. Early start and finish dates are calculated by means of a forward pass, using a specified start date. Late start and finish dates are calculated by means of a backward pass, starting from a specified completion date, which sometimes is the project's early finish date determined during the forward pass calculation. See also [critical path](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#criticalnpath).

crashing

A specific type of project schedule compression technique performed by taking action to decrease the total project schedule duration after analyzing a number of alternatives to determine how to get the maximum schedule duration compression for the least additional cost. Typical approaches for crashing a schedule include reducing schedule activity durations and increasing the assignment of resources on schedule activities. See also [fast tracking](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#fastntracking) and [schedule compression](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#schedulencompression).

Create Work Breakdown Structure

The process of subdividing project deliverables and project work into smaller, more manageable components.

criteria

Standards, rules, or tests on which a judgment or decision can be based, or by which a product, service, result, or process can be evaluated.

critical activity

Any schedule activity on a critical path in a project schedule. Most commonly determined by using the critical path method. Although some activities are "critical," in the dictionary sense, without being on the critical path, this meaning is seldom used in the project context.

critical chain method

A schedule network analysis technique that modifies the project schedule to account for limited resources.

critical path

Generally, but not always, the sequence of schedule activities that determines the duration of the project. It is the longest path through the project. See also [CPM](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#CPM).

critical path methodology

See [CPM](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#CPM).

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## D

data date

The date up to or through which the project's reporting system has provided actual status and accomplishments. Also called as-of date and time-now date.

decision tree analysis

A diagram that describes a decision under consideration and the implications of choosing one or another of the available alternatives. It is used when some future scenarios or outcomes of actions are uncertain. It incorporates probabilities and the costs or rewards of each logical path of events and future decisions, and uses expected monetary value analysis to help the organization identify the relative values of alternate actions. See also [expected monetary value analysis](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#expectednmonetarynvaluenanalysis).

decomposition

A planning technique that subdivides the project scope and project deliverables into smaller, more manageable components, until the project work associated with accomplishing the project scope and providing the deliverables is defined in sufficient detail to support executing, monitoring, and controlling the work.

defect

An imperfection or deficiency in a project component where that component does not meet its requirements or specifications and needs to be either repaired or replaced.

Define Activities

The process of identifying the specific actions to be performed to produce the project deliverables.

Define Scope

The process of developing a detailed description of the project and product.

deliverable

Any unique and verifiable product, result, or capability to perform a service that must be produced to complete a process, phase, or project. Often used more narrowly in reference to an external deliverable, which is a deliverable that is subject to approval by the project sponsor or customer. See also [product](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#product) and [result](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#result).

Delphi technique

An information gathering technique used as a way to reach a consensus of experts on a subject. Experts on the subject participate in this technique anonymously. A facilitator uses a questionnaire to solicit ideas about the important project points related to the subject. The responses are summarized and are then re-circulated to the experts for further comment. Consensus may be reached in a few rounds of this process. The Delphi technique helps reduce bias in the data and keeps any one person from having undue influence on the outcome.

Determine Budget

The process of aggregating the estimated costs of individual activities or work packages to establish an authorized cost baseline.

Develop Human Resource Plan

The process of identifying and documenting project roles, responsibilities, and required skills, reporting relationships, and creating a staffing management plan.

Develop Project Charter

The process of developing a document that formally authorizes a project or a phase and documenting initial requirements that satisfy the stakeholder's needs and expectations.

Develop Project Management Plan

The process of documenting the actions necessary to define, prepare, integrate, and coordinate all subsidiary plans.

Develop Project Team

The process of improving the competencies, team interaction, and the overall team environment to enhance project performance.

Develop Schedule

The process of analyzing activity sequences, durations, resource requirements, and schedule constraints to create the project schedule.

Direct and Manage Project Execution

The process of performing the work defined in the project management plan to achieve the project's objectives.

Distribute Information

The process of making relevant information available to project stakeholders as planned.

duration

The total number of work periods (not including holidays or other nonworking periods) required to complete a schedule activity or work breakdown structure component. Usually expressed as workdays or workweeks. Sometimes incorrectly equated with elapsed time. Contrast with [effort](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#effort).

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## E

EAC

See [estimate at completion](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#estimatenatncompletion).

early finish date

Abbreviated to EF, in the critical path method, the earliest possible point in time on which the uncompleted portions of a schedule activity (or the project) can finish, based on the schedule network logic, the data date, and any schedule constraints. Early finish dates can change as the project progresses and as changes are made to the project management plan.

early start date

Abbreviated to ES, in the critical path method, the earliest possible point in time on which the uncompleted portions of a schedule activity (or the project) can start based on the schedule network logic, the data date, and any schedule constraints. Early start dates can change as the project progresses and as changes are made to the project management plan.

earned value

Abbreviated to EV, the value of work performed expressed in terms of the approved budget assigned to that work for a scheduled activity or work breakdown structure component. Also referred to as the budgeted cost of work performed (BCWP).

earned value management

See [EVM](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#EVM).

earned value technique

Abbreviated to EVT, a specific technique for measuring the performance of work, used to establish the performance measurement baseline.

EF

See [early finish date](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#earlynfinishndate).

effort

The number of labor units required to complete a schedule activity or work breakdown structure component. Usually expressed as staff hours, staff days, or staff weeks. Contrast with [duration](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#duration).

EMV

See [expected monetary value analysis](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#expectednmonetarynvaluenanalysis).

enterprise environmental factors

Any or all external environmental factors and internal organizational environmental factors that surround or influence the project's success. These factors are from any or all of the enterprises involved in the project, and include organizational culture and structure, infrastructure, existing resources, commercial databases, market conditions, and project management software.

ES

See [early start date](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#earlynstartndate).

estimate

A quantitative assessment of the likely amount or outcome. Usually applied to project costs, resources, effort, and durations and is usually preceded by a modifier (i.e., preliminary, conceptual, feasibility, order-of-magnitude, definitive). It should always include some indication of accuracy (e.g., X percent). See also [budget](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#budget).

Estimate Activity Durations

The process of approximating the number of work periods needed to complete individual activities with estimated resources.

Estimate Activity Resources

The process of estimating the type and quantities of material, people, equipment or supplies required to perform each activity.

estimate at completion

Abbreviated to EAC, the expected total cost of a schedule activity, a work breakdown structure component, or the project when the defined scope of work will be completed. May be calculated based on performance to date or estimated by the project team based on other factors, in which case it is often referred to as the latest revised estimate. See also [earned value technique](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#earnednvaluentechnique) and [estimate to complete](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#estimatentoncomplete).

Estimate Costs

The process of developing an approximation of the monetary resources needed to complete project activities.

estimate to complete

See [ETC](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#ETC).

ETC

Acronym for estimate to complete, the expected cost needed to complete all the remaining work for a schedule activity, work breakdown structure (WBS) component, or the project. See also [earned value technique](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#earnednvaluentechnique) and [estimate at completion](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#estimatenatncompletion).

EV

See [earned value](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#earnednvalue).

EVM

Acronym for earned value management, a management methodology for integrating scope, schedule, and resources, and for objectively measuring project performance and progress. Performance is measured by determining the budgeted cost of work performed (earned value) and comparing it to the actual cost of work performed.

EVT

See [earned value technique](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#earnednvaluentechnique).

execute

Directing, managing, performing, and accomplishing the project work, providing the deliverables, and providing work performance information.

Executing processes

Those processes performed to complete the work defined in the project management plan to satisfy the project objectives.

expected monetary value analysis

Abbreviated to EMV, a statistical technique that calculates the average outcome when the future includes scenarios that may or may not happen. A common use of this technique is within decision tree analysis.

expert judgment

Judgment provided based upon expertise in an application area, knowledge area, discipline, industry, etc. as appropriate for the activity being performed. Such expertise may be provided by any group or person with specialized education, knowledge, skill, experience, or training.

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## F

failure mode and effect analysis

See [FMEA](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#FMEA).

fast tracking

A specific project schedule compression technique that changes network logic to overlap phases that would normally be done in sequence, such as the design phase and construction phase, or to perform schedule activities in parallel. See also [crashing](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#crashing) and [schedule compression](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#schedulencompression).

FF

See [finish-to-finish](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#finishn45nton45nfinish).

FFP

See [firm-fixed-price contract](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#firmn45nfixedn45npricencontract).

finish date

A point in time associated with a scheduled activity's completion. Usually qualified by one of the following: actual, planned, estimated, scheduled, early, late, baseline, target, or current.

finish-to-finish

Abbreviated to FF, the logical relationship where completion of work of the successor activity cannot finish until the completion of work of the predecessor activity. See also [logical relationship](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#logicalnrelationship).

finish-to-start

Abbreviated to FS, the logical relationship where initiation of work of the successor activity depends upon the completion of work of the predecessor activity. See also [logical relationship](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#logicalnrelationship).

firm-fixed-price contract

Abbreviated to FFP, a type of fixed price contract where the buyer pays the seller a set amount (as defined by the contract), regardless of the seller's costs.

fixed-price-incentive-fee contract

Abbreviated to FPIF, a type of contract where the buyer pays the seller a set amount (as defined by the contract), and the seller can earn an additional amount if the seller meets defined performance criteria.

float

Also called slack. See [total float](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#totalnfloat) and [free float](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#freenfloat).

flowcharting

The depiction in a diagram format of the inputs, process actions, and outputs of one or more processes within a system.

FMEA

Acronym for failure mode and effect analysis, an analytical procedure in which each potential failure mode in every component of a product is analyzed to determine its effect on the reliability of that component and, by itself or in combination with other possible failure modes, on the reliability of the product or system and on the required function of the component; or the examination of a product (at the system and/or lower levels) for all ways that a failure may occur. For each potential failure, an estimate is made of its effect on the total system and of its impact. In addition, a review is undertaken of the action planned to minimize the probability of failure and to minimize its effects.

forecast

An estimate or prediction of conditions and events in the project's future based on information and knowledge available at the time of the forecast. The information is based on the project's past performance and expected future performance, and includes information that could impact the project in the future, such as estimate at completion and estimate to complete.

forward pass

The calculation of the early start and early finish dates for the uncompleted portions of all network activities. See also [schedule network analysis](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#schedulennetworknanalysis) and [backward pass](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#backwardnpass).

FPIF

See [fixed-price-incentive-fee contract](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#fixedn45npricen45nincentiven45nfeencontract).

free float

The amount of time that a schedule activity can be delayed without delaying the early start date of any immediately following schedule activities. See also [total float](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#totalnfloat).

FS

See [finish-to-start](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#finishn45nton45nstart).

functional manager

A hierarchical organization where each employee has one clear superior, and staff are grouped by areas of specialization and managed by a person with expertise in that area.

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## G

Gantt chart

A graphic display of schedule-related information. In the typical bar chart, schedule activities or work breakdown structure components are listed down the left side of the chart, dates are shown across the top, and activity durations are shown as date-placed horizontal bars.

grade

A category or rank used to distinguish items that have the same functional use (e.g., "hammer"), but do not share the same requirements for quality (e.g., different hammers may need to withstand different amounts of force).

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## H

hammock activity

See [summary activity](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#summarynactivity).

historical information

Documents and data on prior projects including project files, records, correspondence, closed contracts, and closed projects.

human resource plan

A document describing how roles and responsibilities, reporting relationships, and staffing management will be addressed and structured for the project It is contained in or is a subsidiary plan of the project.

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## I

Identify Risks

The process of determining which risks may affect the project and documenting their characteristics.

Identify Stakeholders

The process of identifying all people or organizations impacted by the project, and documenting relevant information regarding their interests, involvement, and impact on project success.

IFB

See [invitation for bid](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#invitationnfornbid).

imposed date

A fixed date imposed on a schedule activity or schedule milestone, usually in the form of a "start no earlier than" and "finish no later than" date.

influence diagram

A graphical representation of situations showing causal influences, time ordering of events, and other relationships among variables and outcomes.

Initiating processes

Those processes performed to define a new project or a new phase of an existing project by obtaining authorization to start the project or phase.

input

Any item, whether internal or external to the project that is required by a process before that process proceeds. May be an output from a predecessor process.

inspection

Examining or measuring to verify whether an activity, component, product, result, or service conforms to specified requirements.

invitation for bid

Abbreviated to IFB. Generally, this term is equivalent to request for proposal (RFP). However, in some application areas, it may have a narrower or more specific meaning.

issue

A point or matter in question or in dispute, or a point or matter that is not settled and is under discussion or over which there are opposing views or disagreements.

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## L

lag

A modification of a logical relationship that directs a delay in the successor activity. For example, in a finish-to-start dependency with a ten-day lag, the successor activity cannot start until ten days after the predecessor activity has finished. See also [lead](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#lead).

late finish date

Abbreviated to LF, in the critical path method, the latest possible point in time that a schedule activity may be completed based upon the schedule network logic, the project completion date, and any constraints assigned to the schedule activities without violating a schedule constraint or delaying the project completion date. The late finish dates are determined during the backward pass calculation of the project schedule network.

late start date

Abbreviated to LS, in the critical path method, the latest possible point in time that a schedule activity may begin based upon the schedule network logic, the project completion date, and any constraints assigned to the schedule activities without violating a schedule constraint or delaying the project completion date. The late start dates are determined during the backward pass calculation of the project schedule network.

lead

A modification of a logical relationship that allows an acceleration of the successor activity. For example, in a finish-to-start dependency with a ten-day lead, the successor activity can start ten days before the predecessor activity has finished. A negative lead is equivalent to a positive lag. See also [lag](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#lag).

lessons learned

The knowledge gained from the process of performing the project. Lessons learned may be identified at any point. Also considered a project record to be included in the lessons learned knowledge base.

lessons learned knowledge base

A store of historical information and lessons learned about both the outcomes of previous project selection decisions and previous project performance.

Leveling

See [resource leveling](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#resourcenleveling).

LF

See [late finish date](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#latenfinishndate).

life cycle

See [project life cycle](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#projectnlifencycle).

log

A document used to record and describe or denote selected items identified during execution of a process or activity. Usually used with a modifier, such as issue, quality control, action, or defect.

logical relationship

A dependency between two project schedule activities, or between a project schedule activity and a schedule milestone. The four possible types of logical relationships are: finish-to-start; finish-to-finish; start-to-start; and start-to-finish. See also [precedence relationship](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#precedencenrelationship).

LS

See [late start date](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#latenstartndate).

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## M

Manage Project Team

The process of tracking team member performance, providing feedback, resolving issues, and managing changes to optimize project performance.

Manage Stakeholder Expectations

The process of communicating and working with stakeholders to meet their needs and addressing issues as they occur.

master schedule

A summary-level project schedule that identifies the major deliverables and work breakdown structure (WBS) components and key schedule milestones. See also [milestone schedule](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#milestonenschedule).

material

The aggregate of things used by an organization in any undertaking, such as equipment, apparatus, tools, machinery, gear, material, and supplies.

matrix organization

Any organizational structure in which the project manager shares responsibility with the functional managers for assigning priorities and for directing the work of persons assigned to the project.

methodology

A system of practices, techniques, procedures, and rules used by those who work in a discipline.

milestone

A significant point or event in the project.

milestone schedule

A summary-level schedule that identifies the major schedule milestones. See also [master schedule](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#masternschedule).

monitor

Collect project performance data with respect to a plan, produce performance measures, and report and disseminate performance information.

Monitor and Control Project Work

The process of tracking, reviewing, and regulating the progress to meet the performance objectives defined in the project management plan.

Monitor and Control Risks

The process of implementing risk response plans, tracking identified risks, monitoring residual risks, identifying new risks, and evaluating risk process throughout the project.

Monitoring and Controlling processes

Those processes required to track, review, and regulate the progress and performance of the project, identify any areas in which changes to the plan are required, and initiate the corresponding changes.

Monte Carlo simulation

A process which generates hundreds or thousands of probable performance outcomes based on probability distributions for cost and schedule on individual tasks. The outcomes are then used to generate a probability distribution for the project as a whole.

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## N

near-critical activity

A schedule activity that has low total float. The concept of near-critical is equally applicable to a schedule activity or schedule network path. The limit below which total float is considered near critical is subject to expert judgment and varies from project to project.

network

See [project schedule network diagram](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#projectnschedulennetworkndiagram).

network analysis

See [schedule network analysis](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#schedulennetworknanalysis).

node

One of the defining points of a schedule network; a junction point joined to some or all of the other dependency lines.

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## O

objective

Something toward which work is to be directed, a strategic position to be attained, or a purpose to be achieved, a result to be obtained, a product to be produced, or a service to be performed.

OBS

See [organizational breakdown structure](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#organizationalnbreakdownnstructure).

opportunity

A condition or situation favorable to the project, a positive set of circumstances, a positive set of events, a risk that will have a positive impact on project objectives, or a possibility for positive changes. Contrast with [threat](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#threat).

organizational breakdown structure

Abbreviated to OBS, a hierarchically organized depiction of the project organization arranged so as to relate the work packages to the performing organizational units.

organizational process assets

Any or all process related assets, from any or all of the organizations involved in the project that are or can be used to influence the project's success. These process assets include formal and informal plans, policies, procedures, and guidelines. The process assets also include the organizations' knowledge bases such as lessons learned and historical information.

output

A product, result, or service generated by a process. May be an input to a successor process.

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## P

parametric estimating

An estimating technique that uses a statistical relationship between historical data and other variables (e.g., square footage in construction, lines of code in software development) to calculate an estimate for activity parameters, such as scope, cost, budget, and duration. An example for the cost parameter is multiplying the planned quantity of work to be performed by the historical cost per unit to obtain the estimated cost.

Pareto chart

A histogram, ordered by frequency of occurrence, that shows how many results were generated by each identified cause.

path convergence

The merging or joining of parallel schedule network paths into the same node in a project schedule network diagram. Path convergence is characterized by a schedule activity with more than one predecessor activity.

path divergence

Extending or generating parallel schedule network paths from the same node in a project schedule network diagram. Path divergence is characterized by a schedule activity with more than one successor activity.

PDM

Acronym for precedence diagramming method, a schedule network diagramming technique in which schedule activities are represented by boxes (or nodes). Schedule activities are graphically linked by one or more logical relationships to show the sequence in which the activities are to be performed.

percent complete

An estimate, expressed as a percent, of the amount of work that has been completed on an activity or a work breakdown structure (WBS) component.

Perform Integrated Change Control

The process of reviewing all change requests, approving changes, and managing changes to the deliverables, organizational process assets, project documents, and project management plan.

Perform Qualitative Analysis

The process of prioritizing risks for further analysis or action by assessing and combining their probability of occurrence and impact.

Perform Quality Assurance

The process of auditing the quality requirements and the results from quality control measurements to ensure appropriate quality standards and operational definitions are used.

Perform Quality Control

The process of monitoring and recording results of executing the quality activities to assess performance and recommend necessary changes.

Perform Quantitative Analysis

The process of numerically analyzing the effect of identified risks on overall project objectives.

performance measurement baseline

An approved integrated scope-schedule-cost plan for the project work against which project execution is compared to measure and manage performance. Technical and quality parameters may also be included.

performance reports

Documents and presentations that provide organized and summarized work performance information, earned value management parameters and calculations, and analysis of project work progress and status.

performing organization

The enterprise whose personnel are most directly involved in doing the work of the project.

PERT

Acronym for program evaluation and review technique, a technique for estimating that applies a weighted average of optimistic, pessimistic, and most likely estimates when there is uncertainty with the individual activity estimates.

phase

See [project phase](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#projectnphase).

Plan Communications

The process of determining project stakeholder information needs and defining a communication approach.

Plan Procurements

The process of documenting project purchasing decisions, specifying the approach, and identifying potential sellers.

Plan Quality

The process of identifying quality requirements and/or standards for the project and product, and documenting how the project will demonstrate compliance.

Plan Risk Management

The process of defining how to conduct risk management activities for a project.

Plan Risk Responses

The process of developing options and actions to enhance opportunities and to reduce threats to project objectives.

planned value

Abbreviated to PV, the authorized budget assigned to the scheduled work to be accomplished for a schedule activity or work breakdown structure component. Also referred to as the budgeted cost of work scheduled (BCWS).

planning package

A work breakdown structure (WBS) component below the control account with known work content but without detailed schedule activities. See also [control account](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#controlnaccount).

Planning processes

Those processes performed to establish the total scope of the effort, define and refine the objectives, and develop the course of action required to attain those objectives.

PM

See [project manager](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#projectnmanager).

PMBOK®

Acronym for Project Management Body of Knowledge, an inclusive term that describes the sum of knowledge within the profession of project management. As with other professions, such as law, medicine, and accounting, the body of knowledge rests with the practitioners and academics that apply and advance it. The complete PMBOK® includes proven traditional practices that are widely applied and innovative practices that are emerging in the profession. The body of knowledge includes both published and unpublished materials, and is constantly evolving. The Project Management Institute's (PMI®'s) Guide to the Project Management Body of Knowledge (PMBOK® Guide) identifies that subset of the PMBOK® that is generally recognized as good practice.

PMIS

Acronym for project management information system, an information system consisting of the tools and techniques used to gather, integrate, and disseminate the outputs of project management processes. It is used to support all aspects of the project from initiating through closing, and can include both manual and automated systems.

portfolio

A collection of projects or programs and other work that are grouped together to facilitate effective management of that work to meet strategic business objectives. The projects or programs of the portfolio may not necessarily be interdependent or directly related.

portfolio management

The centralized management of one or more portfolios, which includes identifying, prioritizing, authorizing, managing, and controlling projects, programs, and other related work, to achieve specific strategic business objectives.

practice

A specific type of professional or management activity that contributes to the execution of a process and that may employ one or more techniques and tools.

precedence diagramming method

See [PDM](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#PDM).

precedence relationship

The term used in the precedence diagramming method for a logical relationship. In current usage, however, precedence relationship, logical relationship, and dependency are widely used interchangeably, regardless of the diagramming method used. See also [logical relationship](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#logicalnrelationship).

predecessor activity

The schedule activity that determines when the logical successor activity can begin or end.

preventive action

A documented direction to perform an activity that can reduce the probability of negative consequences associated with project risks.

probability and impact matrix

A common way to determine whether a risk is considered low, moderate, or high by combining the two dimensions of a risk: its probability of occurrence and its impact on objectives if it occurs.

procurement documents

The documents utilized in bid and proposal activities, which include the buyer's [invitation for bid](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#invitationnfornbid) (IFB), invitation for negotiations, [request for information](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#requestnforninformation) (RFI), [request for quotation](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#requestnfornquotation) (RFQ), [request for proposal](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#requestnfornproposal) (RFP), and sellers' responses.

procurement management plan

The document that describes how procurement processes from developing procurement documentation through contract closure will be managed.

product

An artifact that is produced, is quantifiable, and can be either an end item in itself or a component item. Additional words for products are material and goods. Contrast with [result](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#result). See also [deliverable](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#deliverable).

product life cycle

A collection of generally sequential, non-overlapping product phases whose name and number are determined by the manufacturing and control needs of the organization. The last product life cycle phase for a product is generally the product's retirement. Generally, a project life cycle is contained within one or more product life cycles.

product scope

The features and functions that characterize a product, service, or result.

product scope description

The documented narrative description of the product scope.

program

A group of related projects managed in a coordinated way to obtain benefits and control not available from managing them individually. Programs may include elements of related work outside of the scope of the discrete projects in the program.

program evaluation and review technique

See [PERT](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#PERT).

program management

The centralized coordinated management of a program to achieve the program's strategic objectives and benefits.

progressive elaboration

Continuously improving and detailing a plan as more detailed and specific information and more accurate estimates become available as the project progresses, and thereby producing more accurate and complete plans that result from the successive iterations of the planning process.

project

A temporary endeavor undertaken to create a unique product, service, or result.

project calendar

A calendar of working days or shifts that establishes those dates on which schedule activities are worked and nonworking days that determine those dates on which schedule activities are idle. Typically defines holidays, weekends, and shift hours. See also [resource calendar](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#resourcencalendar).

project charter

A document issued by the project initiator or sponsor that formally authorizes the existence of a project, and provides the project manager with the authority to apply organizational resources to project activities.

Project Communications Management

The [project management knowledge area](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#projectnmanagementnknowledgenarea) that includes the processes required to ensure timely and appropriate generation, collection, distribution, storage, retrieval, and ultimate disposition of project information.

Project Cost Management

The [project management knowledge area](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#projectnmanagementnknowledgenarea) that includes the processes involved in estimating, budgeting, and controlling costs so that the project can be completed within the approved budget.

Project Human Resource Management

The [project management knowledge area](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#projectnmanagementnknowledgenarea) that includes the processes that organize and manage the project team.

project initiation

Launching a process that can result in the authorization of a new project.

Project Integration Management

The [project management knowledge area](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#projectnmanagementnknowledgenarea) that includes the processes and activities needed to identify, define, combine, unify, and coordinate the various processes and project management activities within the project management process groups.

project life cycle

A collection of generally sequential project phases whose name and number are determined by the control needs of the organization or organizations involved in the project. A life cycle can be documented with a methodology.

project management

The application of knowledge, skills, tools, and techniques to project activities to meet the project requirements.

Project Management Body of Knowledge

See [PMBOK®](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#PMBOKn174n).

project management information system

See [PMIS](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#PMIS).

project management knowledge area

An identified area of project management defined by its knowledge requirements and described in terms of its component processes, practices, inputs, outputs, tools, and techniques.

project management office

Abbreviated to PMO, an organizational body or entity assigned various responsibilities related to the centralized and coordinated management of those projects under its domain. The responsibilities of a PMO can range from providing project management support functions to actually being responsible for the direct management of a project.

project management plan

A formal, approved document that defines how the project is executed, monitored, and controlled. It may be a summary or detailed and may be composed of one or more subsidiary management plans and other planning documents.

project management process group

A logical grouping of project management inputs, tools and techniques, and outputs. The project management process groups include [Initiating processes](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#Initiatingnprocesses), [Planning processes](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#Planningnprocesses), [Executing processes](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#Executingnprocesses), [Monitoring and Controlling processes](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#MonitoringnandnControllingnprocesses), and [Closing processes](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#Closingnprocesses). Project management process groups are not project phases.

project management system

The aggregation of the processes, tools, techniques, methodologies, resources, and procedures to manage a project.

project management team

The members of the project team who are directly involved in project management activities. On some smaller projects, the project management team may include virtually all of the project team members.

project manager

Abbreviated to PM, the person assigned by the performing organization to achieve the project objectives.

project organization chart

A document that graphically depicts the project team members and their interrelationships for a specific project.

project phase

A collection of logically related project activities, usually culminating in the completion of a major deliverable. Project phases are mainly completed sequentially, but can overlap in some project situations. A project phase is a component of a [project life cycle](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#projectnlifencycle). A project phase is not a [project management process group](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#projectnmanagementnprocessngroup).

Project Procurement Management

The [project management knowledge area](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#projectnmanagementnknowledgenarea) that includes the processes to purchase or acquire the products, services, or results needed from outside the project team to perform the work.

Project Quality Management

The [project management knowledge area](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#projectnmanagementnknowledgenarea) that includes the processes and activities of the performing organization that determine quality policies, objectives, and responsibilities to ensure the project will satisfy the needs for which it was undertaken.

Project Risk Management

The [project management knowledge area](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#projectnmanagementnknowledgenarea) that includes the processes concerned with conducting risk management planning, identification, analysis, responses, and monitoring and control on a project.

project schedule

The planned dates for performing schedule activities and the planned dates for meeting schedule milestones.

project schedule network diagram

Any schematic display of the logical relationships among the project schedule activities. Always drawn from left to right to reflect project work chronology.

project scope

The work that must be performed to deliver a product, service, or result with the specified features and functions.

Project Scope Management

The [project management knowledge area](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#projectnmanagementnknowledgenarea) that includes the processes required to ensure that the project includes all the work required, and only the work required, to complete the project successfully.

project scope statement

The narrative description of the project scope, including major deliverables, project assumptions, project constraints, and a description of work, that provides a documented basis for making future project decisions and for confirming or developing a common understanding of project scope among the stakeholders.

project team directory

A documented list of project team members, their project roles, and communication information.

Project Time Management

The [project management knowledge area](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#projectnmanagementnknowledgenarea) that includes the processes required to manage the timely completion of a project.

projectized organization

Any organizational structure in which the project manager has full authority to assign priorities, apply resources, and direct the work of persons assigned to the project.

PV

See [planned value](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#plannednvalue).

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## Q

quality

The degree to which a set of inherent characteristics fulfills requirements.

quality management plan

The document that describes how the project management team will implement the performing organization's quality policy. The quality management plan is a component or a subsidiary plan of the project management plan.

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## R

RAM

See [responsibility assignment matrix](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#responsibilitynassignmentnmatrix).

regulation

Requirements imposed by a governmental body. These requirements can establish product, process, or service characteristics, including applicable administrative provisions that have government mandated compliance.

Report Performance

The process of collecting and distributing performance information, including status reports, progress measurements, and forecasts.

request for information

Abbreviated to RFI, a type of procurement document whereby the buyer requests a potential seller to provide various pieces of information related to a product or service or seller capability.

request for proposal

Abbreviated to RFP, a type of procurement document used to request proposals from prospective sellers of products or services. In some application areas, it may have a narrower or more specific meaning.

request for quotation

Abbreviated to RFQ, a type of procurement document used to request price quotations from prospective sellers of common or standard products or services. Sometimes used in place of request for proposal and in some application areas, it may have a narrower or more specific meaning.

requested change

A formally documented [change request](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#changenrequest) that is submitted for approval to the integrated change control process.

requirement

A condition or capability that must be met or possessed by a system, product, service, result, or component to satisfy a contract, standard, specification, or other formally imposed document. Requirements include the quantified and documented needs, wants, and expectations of the sponsor, customer, and other stakeholders.

requirements traceability matrix

A table that links requirements to their origin and traces them throughout the [project life cycle](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#projectnlifencycle).

reserve

A provision in the project management plan to mitigate cost and/or schedule risk. Often used with a modifier (e.g., management reserve, contingency reserve) to provide further detail on what types of risk are meant to be mitigated.

reserve analysis

An analytical technique to determine the essential features and relationships of components in the project management plan to establish a reserve for the schedule duration, budget, estimated cost, or funds for a project.

residual risk

A risk that remains after risk responses have been implemented.

resource

Skilled human resources (specific disciplines either individually or in crews or teams), equipment, services, supplies, commodities, material, budgets, or funds.

resource breakdown structure

A hierarchical structure of resources by resource category and resource type used in resource leveling schedules and to develop resource-limited schedules, and which may be used to identify and analyze project human resource assignments.

resource calendar

A calendar of working days and nonworking days that determines those dates on which each specific resource is idle or can be active. Typically defines resource specific holidays and resource availability periods. See also [project calendar](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#projectncalendar).

resource histogram

A bar chart showing the amount of time that a resource is scheduled to work over a series of time periods. Resource availability may be depicted as a line for comparison purposes. Contrasting bars may show actual amounts of resources used as the project progresses.

resource leveling

Any form of schedule network analysis in which scheduling decisions (start and finish dates) are driven by resource constraints (e.g., limited resource availability or difficult-to-manage changes in resource availability levels).

responsibility assignment matrix

Abbreviated to RAM, a structure that relates the project organizational breakdown structure to the work breakdown structure to help ensure that each component of the project's scope of work is assigned to a person or team.

result

An output from performing project management processes and activities. Results include outcomes (e.g., integrated systems, revised processes, restructured organization, tests, trained personnel, etc.) and documents (e.g., policies, plans, studies, procedures, specifications, reports, etc.). Contrast with [product](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#product). See also [deliverable](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#deliverable).

rework

Action taken to bring a defective or nonconforming component into compliance with requirements or specifications.

RFI

See [request for information](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#requestnforninformation).

RFP

See [request for proposal](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#requestnfornproposal).

RFQ

See [request for quotation](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#requestnfornquotation).

risk

An uncertain event or condition that, if it occurs, has a positive or negative effect on a project's objectives.

risk acceptance

A risk response planning technique that indicates that the project team has decided not to change the project management plan to deal with a risk, or is unable to identify any other suitable response strategy.

risk avoidance

A risk response planning technique for a threat that creates changes to the project management plan that are meant to either eliminate the risk or to protect the project objectives from its impact.

risk breakdown structure

Abbreviated to RBS, A hierarchically organized depiction of the identified project risks arranged by risk category and subcategory that identifies the various areas and causes of potential risks. The risk breakdown structure is often tailored to specific project types.

risk category

A group of potential causes of risk. Risk causes may be grouped into categories such as technical, external, organizational, environmental, or project management. A category may include subcategories such as technical maturity, weather, or aggressive estimating.

risk management plan

The document describing how project risk management will be structured and performed on the project. It is contained in or is a subsidiary plan of the project management plan. Information in the risk management plan varies by application area and project size. The risk management plan is different from the risk register that contains the list of project risks, the results of risk analysis, and the risk responses.

risk mitigation

A risk response planning technique associated with threats that seeks to reduce the probability of occurrence or impact of a risk to below an acceptable threshold.

risk register

The document containing the results of the qualitative risk analysis, quantitative risk analysis, and risk response planning. The risk register details all identified risks, including description, category, cause, probability of occurring, impact(s) on objectives, proposed responses, owners, and current status.

risk tolerance

The degree, amount, or volume of risk that an organization or individual will withstand.

risk transference

A risk response planning technique that shifts the impact of a threat to a third party, together with ownership of the response.

role

A defined function to be performed by a project team member, such as testing, filing, inspecting, or coding.

rolling wave planning

A form of [progressive elaboration](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#progressivenelaboration) planning where the work to be accomplished in the near term is planned in detail at a low level of the work breakdown structure, while the work far in the future is planned at a relatively high level of the work breakdown structure (WBS), but the detailed planning of the work to be performed within another one or two periods in the near future is done as work is being completed during the current period.

root cause analysis

An analytical technique used to determine the basic underlying reason that causes a variance or a defect or a risk. A root cause may underlie more than one variance or defect or risk.

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## S

schedule

See [project schedule](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#projectnschedule) and see also [schedule model](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#schedulenmodel).

schedule baseline

A specific version of the schedule model used to compare actual results to the plan to determine if preventive or corrective action is needed to meet the project objectives.

schedule compression

Shortening the project schedule duration without reducing the project scope. See also [crashing](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#crashing) and [fast tracking](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#fastntracking).

schedule management plan

The document that establishes criteria and the activities for developing and controlling the project schedule. It is contained in, or is a subsidiary plan of, the project management plan.

schedule model

A model used in conjunction with manual methods or project management software to perform schedule network analysis to generate the project schedule for use in managing the execution of a project. See also [project schedule](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#projectnschedule).

schedule network analysis

The technique of identifying early and late start dates, as well as early and late finish dates, for the uncompleted portions of project schedule activities. See also [critical path methodology](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#criticalnpathnmethodology), [critical chain method](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#criticalnchainnmethod), and [resource leveling](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#resourcenleveling).

schedule performance index

See [SPI](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#SPI).

schedule variance

Abbreviated to SV, a measure of schedule performance on a project. It is the difference between the earned value (EV) and the planned value (PV). SV = EV minus PV.

scheduled finish date

The point in time that work was scheduled to finish on a schedule activity. The scheduled finish date is normally within the range of dates delimited by the early finish date and the late finish date. It may reflect resource leveling of scarce resources. Sometimes called planned finish date.

scheduled start date

The point in time that work was scheduled to start on a schedule activity. The scheduled start date is normally within the range of dates delimited by the early start date and the late start date. It may reflect resource leveling of scarce resources. Sometimes called planned start date.

scope

The sum of the products, services, and results to be provided as a project. See also [project scope](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#projectnscope) and [product scope](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#productnscope).

scope baseline

An approved specific version of the detailed scope statement, work breakdown structure (WBS), and its associated WBS dictionary.

scope change

Any change to the project scope. A scope change almost always requires an adjustment to the project cost or schedule.

scope creep

Adding features and functionality (project scope) without addressing the effects on time, costs, and resources, or without customer approval.

scope management plan

The document that describes how the project scope will be defined, developed, and verified and how the work breakdown structure (WBS) will be created and defined, and that provides guidance on how the project scope will be managed and controlled by the project management team. It is contained in or is a subsidiary plan of the project management plan.

S-curve

Graphic display of cumulative costs, labor hours, percentage of work, or other quantities, plotted against time. Used to depict planned value, earned value, and actual cost of project work. The name derives from the S-like shape of the curve (flatter at the beginning and end, steeper in the middle) produced on a project that starts slowly, accelerates, and then tails off. Also a term used to express the cumulative likelihood distribution that is a result of a simulation, a tool of quantitative risk analysis.

secondary risk

A risk that arises as a direct result of implementing a risk response.

seller

Also known as vendor, a provider or supplier of products, services, or results to an organization.

sensitivity analysis

A quantitative risk analysis and modeling technique used to help determine which risks have the most potential impact on the project. It examines the extent to which the uncertainty of each project element affects the objective being examined when all other uncertain elements are held at their baseline values. The typical display of results is in the form of a tornado diagram.

Sequence Activities

The process of identifying and documenting relationships among the project activities.

SF

See [start-to-finish](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#startn45nton45nfinish).

simulation

A simulation uses a project model that translates the uncertainties specified at a detailed level into their potential impact on objectives that are expressed at the level of the total project. Project simulations use computer models and estimates of risk, usually expressed as a probability distribution of possible costs or durations at a detailed work level, and are typically performed using Monte Carlo analysis.

slack

Also called float. See [total float](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#totalnfloat) and [free float](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#freenfloat).

SOW

Acronym for [statement of work](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#statementnofnwork), a narrative description of products, services, or results to be supplied.

special cause

A source of variation that is not inherent in the system, is not predictable, and is intermittent. It can be assigned to a defect in the system. On a control chart, points beyond the control limits, or non-random patterns within the control limits, indicate it. Also referred to as assignable cause. Contrast with [common cause](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#commonncause).

specification

A document that specifies, in a complete, precise, verifiable manner, the requirements, design, behavior, or other characteristics of a system, component, product, result, or service and, often, the procedures for determining whether these provisions have been satisfied. Examples are: requirement specification, design specification, product specification, and test specification.

specification limits

The area, on either side of the centerline, or mean, of data plotted on a control chart that meets the customer's requirements for a product or service. This area may be greater than or less than the area defined by the control limits. See also [control limits](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#controlnlimits).

SPI

Acronym for schedule performance index, a measure of schedule efficiency on a project. It is the ratio of earned value (EV) to planned value (PV). The SPI = EV divided by PV.

sponsor

The person or group that provides the financial resources, in cash or in kind, for the project.

SS

See [start-to-start](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#startn45nton45nstart).

staffing management plan

The document that describes when and how human resource requirements will be met. It is contained in, or is a subsidiary plan of, the human resource plan.

stakeholder

Person or organization (e.g., customer, sponsor, performing organization, or the public) that is actively involved in the project, or whose interests may be positively or negatively affected by execution or completion of the project. A stakeholder may also exert influence over the project and its deliverables.

standard

A document that provides, for common and repeated use, rules, guidelines, or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context.

start date

A point in time associated with a schedule activity's start, usually qualified by one of the following: actual, planned, estimated, scheduled, early, late, target, baseline, or current.

start-to-finish

Abbreviated to SF, the logical relationship where completion of the successor schedule activity is dependent upon the initiation of the predecessor schedule activity. See also [logical relationship](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#logicalnrelationship).

start-to-start

Abbreviated to SS, the logical relationship where initiation of the work of the successor schedule activity depends upon the initiation of the work of the predecessor schedule activity. See also [logical relationship](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#logicalnrelationship).

statement of work

See [SOW](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#SOW).

subnetwork

A subdivision (fragment) of a project schedule network diagram, usually representing a subproject or a work package. Often used to illustrate or study some potential or proposed schedule condition, such as changes in preferential schedule logic or project scope.

subphase

A subdivision of a phase.

subproject

A smaller portion of the overall project created when a project is subdivided into more manageable components or pieces.

successor activity

The schedule activity that follows a predecessor activity, as determined by their logical relationship.

summary activity

A group of related schedule activities aggregated at some summary level, and displayed/reported as a single activity at that summary level. See also [subproject](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#subproject) and [subnetwork](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#subnetwork).

SV

See [schedule variance](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#schedulenvariance).

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## T

T&M

See [time and material contract](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#timenandnmaterialncontract).

TCPI

Acronym for to-complete-performance-index, the calculated projection of cost performance that must be achieved on the remaining work to meet a specified management goal, such as the budget at completion (BAC) or the estimate at completion (EAC). It is the ratio of "remaining work" to the "funds remaining."

technical performance measurement

A performance measurement technique that compares technical accomplishments during project execution to the project management plan's schedule of planned technical achievements. It may use key technical parameters of the product produced by the project as a quality metric. The achieved metric values are part of the work performance information.

technique

A defined systematic procedure employed by a human resource to perform an activity to produce a product or result or deliver a service, and that may employ one or more tools.

template

A partially complete document in a predefined format that provides a defined structure for collecting, organizing, and presenting information and data.

threat

A condition or situation unfavorable to the project, a negative set of circumstances, a negative set of events, a risk that will have a negative impact on a project objective if it occurs, or a possibility for negative changes. Contrast with [opportunity](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#opportunity).

three-point estimate

An analytical technique that uses three cost or duration estimates to represent the optimistic, most likely, and pessimistic scenarios. This technique is applied to improve the accuracy of the estimates of cost or duration when the underlying activity or cost component is uncertain.

threshold

A cost, time, quality, technical, or resource value used as a parameter, and which may be included in product specifications. Crossing the threshold should trigger some action, such as generating an exception report.

time and material contract

Abbreviated to T&M, a type of contract that is a hybrid contractual arrangement containing aspects of both cost-reimbursable and fixed-price contracts. Time and material contracts resemble cost reimbursable type arrangements in that they have no definitive end, because the full value of the arrangement is not defined at the time of the award. Thus, time and material contracts can grow in contract value as if they were cost-reimbursable-type arrangements. Conversely, time and material arrangements can also resemble fixed-price arrangements. For example, the unit rates are preset by the buyer and seller, when both parties agree on the rates for the category of senior engineers.

time-scaled schedule network diagram

Any project schedule network diagram drawn in such a way that the positioning and length of the schedule activity represents its duration. Essentially, it is a bar chart that includes schedule network logic.

to-complete-performance-index

See [TCPI](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#TCPI).

tool

Something tangible, such as a template or software program, used in performing an activity to produce a product or result.

total float

The total amount of time that a schedule activity may be delayed from its early start date without delaying the project finish date, or violating a schedule constraint. Calculated using the critical path method technique and determining the difference between the early finish dates and late finish dates. See also [free float](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#freenfloat).

trend analysis

An analytical technique that uses mathematical models to forecast future outcomes based on historical results. It is a method of determining the variance from a baseline of a budget, cost, schedule, or scope parameter by using prior progress reporting periods' data and projecting how much that parameter's variance from baseline might be at some future point in the project if no changes are made in executing the project.

triggers

Indications that a risk has occurred or is about to occur. Triggers may be discovered in the risk identification process and watched in the risk monitoring and control process. They are sometimes called risk symptoms or warning signs.

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## V

validation

The assurance that a product, service, or system meets the needs of the customer and other identified stakeholders. It often involves acceptance and suitability with external customers. Contrast with [verification](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#verification).

value engineering

An approach used to optimize project life cycle costs, save time, increase profits, improve quality, expand market share, solve problems, and/or use resources more effectively.

variance

A quantifiable deviation, departure, or divergence away from a known baseline or expected value.

variance analysis

A method for resolving the total variance in the set of scope, cost, and schedule variables into specific component variances that are associated with defined factors affecting the scope, cost, and schedule variables.

vendor

See [seller](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#seller).

verification

The evaluation of whether or not a product, service, or system complies with a regulation, requirement, specification, or imposed condition. It is often an internal process. Contrast with validation.

Verify Scope

The process of formalizing acceptance of the completed project deliverables.

virtual team

A group of persons with a shared objective who fulfill their roles with little or no time spent meeting face to face. Various forms of technology are often used to facilitate communication among team members. Virtual teams can be comprised of persons separated by great distances.

voice of the customer

Abbreviated to VOC, a planning technique used to provide products, services, and results that truly reflect customer requirements by translating those customer requirements into the appropriate technical requirements for each phase of project product development.

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## W

WBS

Acronym for work breakdown structure, a deliverable-oriented hierarchical decomposition of the work to be executed by the project team to accomplish the project objectives and create the required deliverables. It organizes and defines the total scope of the project.

work authorization

A subsystem of the overall project management system. It is a collection of formal documented procedures that defines how project work will be authorized (committed) to ensure that the work is done by the identified organization, at the right time, and in the proper sequence. It includes the steps, documents, tracking system, and defined approval levels needed to issue work authorizations.

work breakdown structure

See [WBS](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#WBS).

work breakdown structure component

An entry in the work breakdown structure that can be at any level.

work breakdown structure dictionary

A document that describes each component in the work breakdown structure (WBS). For each WBS component, the WBS dictionary includes a brief definition of the scope or statement of work, defined deliverable(s), a list of associated activities, and a list of milestones. Other information may include: responsible organization, start and end dates, resources required, an estimate of cost, charge number, contract information, quality requirements, and technical references to facilitate performance of the work.

work package

A deliverable or project work component at the lowest level of each branch of the work breakdown structure. See also [control account](http://127.0.0.1:9090/Content/cca/proj_06_a02_bs_enus/output/html/glossary.html#controlnaccount).

work performance information

Information and data, on the status of the project schedule activities being performed to accomplish the project work, collected as part of the direct and manage project execution processes. Information includes: status of deliverables; implementation status for change requests, corrective actions, preventive actions, and defect repairs; forecasted estimates to complete; reported percent of work physically completed; achieved value of technical performance measures; start and finish dates of schedule activities.

workaround

A response to a negative risk that has occurred. Distinguished from a contingency plan in that a workaround is not planned in advance of the occurrence of the risk event.

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Project management overview

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**SkillBrief**

**The Project Life Cycle**

**The project life cycle**

Projects can be very different from one another, but all projects follow a basic life cycle.

A project's life cycle consists of all the work required to bring a product to the market, or to make a service or process operational. It consists of four sequential stages:

1. starting the project
2. organizing and preparing
3. carrying out the work
4. closing the project

Each stage has different characteristics in terms of three factors:

* cost and staffing levels
* level of uncertainty
* cost of changes

At the start of a project, **cost and staffing levels** are low. More resources are needed as project work is carried out, but these levels drop as the project is closing. This pattern creates a **bell curve shape** on a graph that illustrates cost and staffing levels over a project's life cycle.

At the start of a project, **the level of uncertainty** is at its highest, as is the risk of project failure. There's less uncertainty and risk as the project progresses and starts meeting goals. Uncertainty reaches its lowest point as the project closes.

The **cost of changes** is the lowest at the start of a project. As more planning and work is done, the cost of making changes continues to rise.

As a project manager, you'll be involved in different activities as a project moves through each of the four life cycle stages:

* **starting the project** – Here, you determine the need for the project and its feasibility, and set the project's goals. You create a proposal and convince stakeholders that the project is needed. You decide on resources, create a budget, and appoint staff.
* **organizing and preparing** – You typically conduct research and use the results to design a prototype or service for testing. You prepare and implement a schedule, identify targets, distribute tasks and resources to the team, and adjust members of the project team as needed.
* **carrying out the work** – This involves getting materials, and building and producing a product or service. It also entails testing quality and performance, and making necessary modifications. Finally, the product or service is prepared for delivery.
* **closing the project** – Closing a project involves transferring the product or service to those who will maintain or use it. You complete all contractual commitments, transfer responsibility, and train personnel to use the product or service. You also reward the project team, reassign team members to new work, and transfer resources to other projects.

**The product life cycle**

A product has its own life cycle. The product life cycle is made up of all the activities that take place from a product's creation to the end of its production and use.

The product life cycle consists of five stages:

1. product inception and development
2. market introduction
3. market growth
4. market maturity
5. sales decline

**The relationship between the life cycles**

The project and the product life cycle are **separate cycles**.

If a single-phase project aims to develop a product, then all the stages of a project life cycle occur within the product life cycle's product inception and development stage. So the project life cycle can finish before the product life cycle. The product is complete and ready for release and the project life cycle may end with a final sign-off, but the product's life cycle continues until the product sales decline.

A project life cycle can run at the same time as a product life cycle, so a single project may be used to develop, market, oversee, and eventually decommission a new product.

More typically, many smaller projects form part of the product life cycle.

All projects have a basic life cycle of four stages – starting the project, organizing and preparing, carrying out the work, and closing the project. Each stage has specific characteristics in terms of cost and staffing level, level of uncertainty, and the cost of changes. A product also has a life cycle which has five stages – inception and development, market introduction, market growth, market maturity, and sales decline. A project life cycle can exist independently of a product life cycle, run concurrently with it, or many project life cycles can form part of the product life cycle.

**Course:** Project Management Overview  
**Topic:** Project Life Cycle

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**SkillBrief**

**Process Groups**

**Processes**

The PMBOK® Guide describes a process as a "set of interrelated actions and activities performed to achieve a pre-specified product, result, or service." You use processes to ensure that each step in a project produces the right results.

Managing a project well means that you and the project team may need a large number of processes.

**Process groups**

To manage processes, it's useful to group them based on their purposes. The PMBOK® Guide categorizes processes into five different process groups:

* **Initiating** – The Initiating process group includes processes that help to start a new project or a new phase of a project that's already underway. These processes involve defining new ideas and obtaining authorization to proceed with the project or phase.
* **Planning** – This process group defines the plans and courses of action for a project. This group determines the scope and objectives of the project, and helps to establish a better idea of project requirements.
* **Executing** – Processes of this group relate to performing the work that's required to create the final output of a project and typically uses up the most time and resources. They focus on managing the project team and communicating information to stakeholders.
* **Monitoring & Controlling** – The processes in this group regulate and control a project's progress. This involves monitoring, reviewing, and identifying any problematic areas, as well as initiating any necessary changes. Monitoring and controlling processes interact with the other four process groups throughout the project.
* **Closing** – The processes in this group aim to finalize all activities and contracts for a project or phase.

The process groups span over the duration of a project. All of them also usually occur in each phase of a project.

**Process group interactions**

Many individual project management processes are iterative. This means they are repeated throughout a project. The PMBOK® Guide describes iterations as "repeated feedback loops that allow additional analysis. Processes aren't necessarily linear either – they may overlap or run at the same time.

Process groups may also overlap and iterate in each phase of a project. And each group interacts in some way with the other process groups:

* The Initiating process group collects information that allows the project or a phase of the project to start. The Planning process group uses that output as an input for its work.
* Most planning occurs before the Executing process group starts its work. However, plans are continually modified and updated with new information as work progresses. So the planning processes continue to iterate until all project or phase work is complete.
* Activities of the Executing process group are repeated as plans change throughout a phase or project. This group uses the outputs from the Planning process group.
* All stages of a project or phase need some kind of control. So the Monitoring & Controlling process group activities are regularly repeated. They occur from when a project starts to when it's closed. These processes use outputs from all the other process groups, so they can effectively keep track of the whole project
* Once project or phase objectives have been met and all the work has been carried out, the Closing process group ensures that all loose ends are tied up. This occurs only once in a project or phase.

At the end of a phase, the Initiating processes will kick off a new phase. During the new phase, Planning and Executing processes are repeated, until the Closing processes end the phase. The Monitoring & Controlling processes take place throughout each phase.

The PMBOK® Guide divides project management processes into five process groups – Initiating, Planning, Executing, Monitoring & Controlling, and Closing. The Initiating processes occur once to start a project or a project phase. The Planning and Executing processes iterate as plans change and new work must be done. Once all work is completed, the Closing processes occur once, to finalize the project or phase. The Monitoring & Controlling processes are repeated throughout a project or phase, from its start to when it's closed.

**Course:** Project Management Overview  
**Topic:** Introduction to Project Management Process Groups

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**SkillBrief**

**Phases of a Project**

**Phases**

Projects are always made up of groups of activities known as phases. These are not the same as the different stages of the project life cycle. Phases of a project are logical divisions in the way the work is carried out, to make managing the work easier.

A simple project can include just one phase. A large or complex project needs a lot of time and planning, so may contain multiple phases.

**Characteristics**

Phases in a project have distinct characteristics. They

* are sequential
* each involve distinct work, so skills are focused in a particular area
* repeat project management processes
* each end with a handoff of work, often referred to as a deliverable
* have natural end points, also called phase exits, phase gates, decision gates, or kill points, to assess continued viability

**Phase-to-phase relationships**

Phases are likely to be followed in a sequential order, but a project may have overlapping or concurrent phases.

There are three types of phase-to-phase relationships:

* **sequential** – One phase is fully completed before the next phase starts. The project is carried out in a definite sequence, but may take longer to complete.
* **overlapping** – Phases may overlap, with one phase starting before the previous phase finishes. This can help in speeding up a project. Phases can't overlap if one phase depends on accurate and complete information from a previous phase.
* **iterative** – Phases are carried out while still being planned. Planning is updated as the work progresses and new information is gathered. This is used for projects that are uncertain by nature, but team members must be available at all times and the project cannot require long-term planning or strict control.

You can tailor phases to suit current demands or adapt to new information. How you structure phases depends on the nature of the project and management style.

**Phases and the project life cycle**

Sometimes, project phases map very closely to life cycle stages. At other times, phases don't have a one-to-one relationship with the basic stages.

A project often starts with a feasibility study, or research phase. This phase aligns to the first life cycle stage of starting the project.

The next phase is to convert the idea for the project into a plan. This usually happens during a design phase. This phase aligns with the organizing and preparing stage of the life cycle.

The third stage of the project life cycle is when project work is carried out. It's here that project phases often stop aligning directly to the life cycle stages. This stage can have several phases. In a typical manufacturing project, these include the

* **prototype phase** – A model is created and tested to check that the product meets requirements before full-scale production begins. If a project is to deliver a service, this phase would be the pilot phase, where you would first test the service on a small scale.
* **production phase** – The product or service is produced. This phase often requires the most work and resources, so it's often divided into smaller subphases or components.
* **marketing phase** – You may want to market the product or service you've created, so this phase may take place after the production phase finishes. It may also take place at the same time as other phases, as a separate project.
* **deployment phase** – Some projects have a deployment phase. This is when the final product or service is put into use, or handed over and installed for a customer.

The last phase in a project is a closing phase. This involves wrapping up activities. It corresponds directly with the final stage of the project life cycle – closing the project.

A project is divided into phases to make it easier to manage. Phases usually run sequentially and each includes a distinct type of work. Processes in the project management process groups typically repeat across phases. Each phase ends with a handoff of its work, and assessment for continued viability. The research, design, and closing phases of a project tend to align with the activities in the life cycle stages for starting the project, organizing and preparing, and closing the project. However, the stage of carrying out project work is usually divided into several phases.

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**Topic:** Project Phases

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**SkillBrief**

**PMI® and the PMBOK® Guide**

**Project Management Institute**

A multitude of projects are carried out on a daily basis and they all need project managers and team members. Those managers need the skills to carry out projects effectively.

In 1969, the Project Management Institute, or PMI®, was founded as a nonprofit association for the project management profession. Today, PMI® is the leading membership association for anyone involved in project management, and currently has hundreds of thousands of members across the globe.

**PMI® resources**

PMI® provides these resources for project managers:

* **advocacy for the profession** – PMI® actively promotes the project management profession. Its advocacy programs facilitate meetings with governments, organizations, and industries around the world.
* **information and standards** – PMI® conducts research and makes a wealth of information available to project management professionals. It also sets professional standards for project management.
* **code of ethics and conduct** – PMI® promotes a code of ethics and professional conduct for its members. It identifies best practices and the responsibilities of project managers.
* **accreditation** – PMI® provides accreditation, such as the Project Management Professional, or PMP®, certification for project managers. PMP® is the only globally recognized certification in the profession. PMI® also provides certifications such as the Certified Associate in Project Management certification and the Program Management Professional certification. It also provides education and training through PMI® Registered Education Providers and accreditation of project management educational programs.

**Project Management Body of Knowledge**

PMI® offers guidelines for managing projects in the form of A Guide to the Project Management Body of Knowledge, commonly known as the PMBOK® Guide.

The PMBOK® Guide is a trusted source of best practices for project managers. These practices have evolved over many years, based on the experiences of project managers throughout the world.

Benefits of the PMBOK® Guide include

* **global application** – The PMBOK® Guide describes generally recognized practices and knowledge that apply globally. In other words, project managers anywhere can benefit from applying the practices and knowledge it contains to almost all projects
* **accepted standards** – The PMBOK® Guide provides a globally accepted standard for the project management profession. It's a valuable and trusted source of guidelines and information.
* **up-to-date information** – Project management is a profession that's always evolving according to changing times and needs. The PMBOK® Guide provides continually updated information to reflect these changes.
* **common vocabulary** – The PMBOK® Guide provides project managers around the world with a common vocabulary to ensure consistency and clarity in the profession.

**Applying PMBOK® standards**

For a project to succeed, it's important that the management you provide meets accepted standards of quality.

However, all projects are different. You need to adjust the processes a project team uses based on what a project must do. This is known as project tailoring. You and the project team should agree on tailoring requirements and state these clearly in the project management plan, so you have a defined set of standards to follow.

**Structure of the PMBOK® Guide**

The PMBOK® Guide neatly draws all aspects of project management together. It starts with a chapter that lays the foundation for understanding project management. Chapter 2 examines the project life cycle and how projects fit into an organization. Chapter 3 explains project management processes and the five process groups. And chapters 4 to 12 focus on the knowledge areas in project management.

The Project Management Institute (PMI®) is the leading membership association for project managers. It has many members across the world. PMI® actively advocates the project management profession. It provides trusted standards and resources, a code of ethics and conduct, and globally recognized accreditation for project managers. PMI® publishes A Guide to the Project Management Body of Knowledge (PMBOK® Guide). The PMBOK® Guide provides globally applicable best practices and knowledge, and is a standard for the project management profession. It also provides continually updated information and a common vocabulary for project managers around the world.

**Course:** Project Management Overview  
**Topic:** PMI® and the PMBOK® Guide

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**SkillBrief**

**The Nine Knowledge Areas**

**Knowledge areas**

A lot of processes go into making a project a success. You can organize processes into groups by **knowledge areas**.

Each knowledge area includes the knowledge needed for one aspect of managing a project. The PMBOK® Guide identifies nine knowledge areas:

* **Project Integration Management** – Integration management coordinates all the elements of a project so they work together to achieve objectives. This means identifying and defining what work must be done, and managing and coordinating this work.
* **Project Scope Management** – The purpose of this knowledge area is to identify and define all work that's needed to meet project goals. It also involves managing a project's scope as it progresses.
* **Project Time Management** – This is necessary to ensure that a project is completed on time. It includes processes for creating and monitoring project schedules.
* **Project Cost Management** – The purpose of this knowledge area is to ensure that a project meets its objectives without going over budget. It includes processes for calculating budgets, conducting estimates, and controlling costs.
* **Project Quality Management** – Quality management involves ensuring that a project meets the standards and requirements that were set out for it. It includes processes for measuring project performance, comparing results to the required standards, and identifying where improvement is needed.
* **Project Human Resource Management** – This knowledge area is concerned with the processes for putting together and managing a project team. This includes keeping track of roles and responsibilities, and managing changes in team members.
* **Project Communications Management** – This knowledge area is responsible for the exchange of accurate information in a project. It involves ensuring that information is properly generated, collected, distributed, stored, and retrieved.
* **Project Risk Management** – This involves ensuring that risks to the success of a project are identified and analyzed, and that appropriate responses are developed.
* **Project Procurement Management** – This knowledge area is concerned with obtaining goods and services for a project from various suppliers.

You should memorize the nine knowledge areas for the Project Management Professional, or PMP®, certification exam.

**Knowledge areas and process groups**

Process groups organize processes based on their purpose and on when they generally occur, whereas knowledge areas group processes based on how they contribute to project management, regardless of when they are carried out.

Process groups and knowledge areas organize the same processes using different criteria. At different points, the process groups and knowledge areas correspond.

You can examine which knowledge areas are active in each process group to get a better idea of where processes fit in:

* **Initiating process group** – A key processes in this group is Develop Project Charter, which fits in the Project Integration Management knowledge area because the charter informs all other areas of a project. Another key process is Identifying Stakeholders, which fits in the Project Communications Management knowledge area because communication with all stakeholders must be managed.
* **Planning process group** – Theses processes define the scope and course of action for a project. They are repetitive because plans are regularly updated. Nearly all aspects of a project involve some kind of planning, so all nine knowledge areas include Planning processes.
* **Executing process group** – This process group contains the processes needed to carry out the work in a project or phase, including coordinating resources, people, and activities according to the project plan. The knowledge areas that interact with the Execution group are Project Integration, Quality, Human Resources, Communications, and Procurement Management.
* **Monitoring & Controlling process group** – The processes in this group play an important role in tracking, reviewing, and controlling a project's progress. Eight of the nine knowledge areas are active here, and the processes are often control processes for the knowledge areas themselves
* **Closing process group** – The Closing process group aims to wrap up a project or phase. It includes processes in the Project Integration Management and Project Procurement Management knowledge areas.

You should know which processes fit in each knowledge area, to help you answer questions in the PMP® certification exam.

Project management processes can be grouped differently – into knowledge areas or process groups. Each knowledge area identifies a needed aspect of project management. The PMBOK® Guide identifies nine knowledge areas. Each process falls within a particular process group and a knowledge area.

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**Topic:** The Knowledge Areas

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**Job Aid**

**Key Life Cycle Concepts**

**Purpose:** *Use this job aid to identify the key concepts of the project and product life cycles, including their relationship and differences*.

**The project life cycle**

The project life cycle consists of all the work required to bring a product to the market, or to make a service or process operational. It consists of four stages. Each stage in the project life cycle has different characteristics in terms of cost and staffing levels, level of uncertainty, and the cost of changes.

| **Life cycle characteristics** | | | |
| --- | --- | --- | --- |
| **Stage** | **Cost and staffing** | **Uncertainty** | **Cost of changes** |
| 1. Starting the project | Low | High | Low |
| 2. Organizing and preparing | Increases | Decreases | Increases |
| 3. Carrying out the work | Peaks | Decreases | Increases |
| 4. Closing the project | Decreases | Low | High |

**The product life cycle**

The product life cycle includes all the activities that take place from the creation of a product to the end of its production or use. This cycle has five phases:

1. product inception and development
2. product introduction
3. product growth
4. product maturity
5. product decline

**The relationship between the cycles**

A project life cycle and a product life cycle may run concurrently. More typically, however, a project life cycle will fall within the product life cycle. The product life cycle may include several project life cycles.

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**Topic:** Project Life Cycle

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**Job Aid**

**Process Groups and Knowledge Areas**

**Purpose:** *Use this job aid to remind yourself of the definitions of each of the process groups and knowledge areas*.

**The process groups**

Process groups organize the project management processes according to their purpose. These groups tend to follow a sequential or logical flow throughout a project or a project phase. The five groups are

* Initiating
* Planning
* Executing
* Monitoring and Controlling
* Closing

The Initiating process group contains processes that help to kick off a phase or project.

The processes in the Planning group are aimed at creating the plans and objectives for a project. These processes tend to be repeated throughout a project or phase as new information is gathered and plans have to be altered.

The Executing process group consists of the processes that are required to carry out the work of a project or phase. These processes are repeated until all the work is done.

The Monitoring and Controlling group includes processes for tracking, assessing, and managing the process of a project. These processes occur throughout a project because they are crucial for spotting problems and implementing changes and corrections.

The processes in the Closing group wrap up, or finish, a project or phase.

**The knowledge areas**

An alternative method of grouping processes is according to which aspect of project management they relate to. These groups are known as knowledge areas, and there are nine of them. They are

* Project Integration Management
* Project Scope Management
* Project Time Management
* Project Cost Management
* Project Quality Management
* Project Human Resource Management
* Project Communications Management
* Project Risk Management
* Project Procurement Management

Project Integration Management is concerned with identifying the work and processes needed in a project, and for coordinating these.

Project Scope Management includes processes for identifying and defining all the work needed to meet project goals. It also involves managing a project's scope as it progresses.

The processes in the Project Time Management knowledge area ensure that a project is completed according to schedule.

Project Cost Management processes are responsible for ensuring that budgets and cost estimates are created, and for controlling project costs.

Project Quality Management is concerned with ensuring that a project meets the standards and requirements that were set out for it.

The processes that make up Project Human Resource Management relate to forming and managing the project team. This includes managing team members' roles and responsibilities, and needed changes to the team.

Project Communications Management processes ensure that information throughout a project is correctly generated, collected, distributed, stored, and retrieved.

Project Risk Management is important to ensure that risks are identified and analyzed, and that appropriate responses are developed.

Project Procurement Management is concerned with obtaining a project's required goods and services from various suppliers.

**Course:** Project Management Overview  
**Topic:** The Knowledge Areas

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**Learning Aid**

**Knowledge Areas and Process Groups Table**

**Purpose:** *Use this learning aid to learn about the interactions between knowledge areas and the process groups*.

| **Knowledge areas and process groups** | | | | | |
| --- | --- | --- | --- | --- | --- |
| **Knowledge area** | **Initiating process group** | **Planning process group** | **Executing process group** | **Monitoring & Controlling process group** | **Closing process group** |
| **Project Integration Management** | Develop Project Charter | Develop Project Management Plan | Direct and Manage Project Execution | Monitor and Control Project Work  Perform Integrated Change Control | Close Project or Phase |
| **Project Scope Management** |  | Collect Requirements  Define Scope  Create Work Breakdown Structure |  | Verify Scope  Control Scope |  |
| **Project Time Management** |  | Define Activities  Sequence Activities  Estimate Activity Resources  Estimate Activity Durations  Develop Schedule |  | Control Schedule |  |
| **Project Cost Management** |  | Estimate Costs  Determine Budget |  | Control Costs |  |
| **Project Quality Management** |  | Plan Quality | Perform Quality Assurance | Perform Quality Control |  |
| **Project Human Resource Management** |  | Develop Human Resource Plan | Acquire Project Team  Develop Project Team  Manage Project Team |  |  |
| **Project Communications Management** | Identify Stakeholders | Plan Communications | Distribute Information  Manage Stakeholder Expectations | Report Performance |  |
| **Project Risk Management** |  | Plan Risk Management  Identify Risks  Perform Qualitative Risk Analysis  Perform Quantitative Risk Analysis  Plan Risk Responses |  | Monitor and Control Risks |  |
| **Project Procurement Management** |  | Plan Procurements | Conduct Procurements | Administer Procurements | Close Procurements |

**Course:** Project Management Overview  
**Topic:** The Knowledge Areas

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**Follow-on Activity**

**Categorizing Processes**

**Purpose:** *Use this follow-on activity to practice identifying the process group and knowledge area into which each process falls*.

**Instructions for use:** To use this tool, print out the table and fill in the processes according to the knowledge areas and process groups they fit into, or create and use a similar table yourself. A list of all the processes is provided.

The 42 project management processes, in alphabetical order, are

* Acquire Project Team
* Administer Procurements
* Close Procurements
* Close Project or Phase
* Collect Requirements
* Conduct Procurements
* Control Costs
* Control Schedule
* Control Scope
* Create Work Breakdown Structure
* Define Activities
* Develop Schedule
* Define Scope
* Determine Budget
* Develop Human Resource Plan
* Develop Project Charter
* Develop Project Management Plan
* Develop Project Team
* Direct and Manage Project Execution
* Distribute Information
* Estimate Activity Durations
* Estimate Activity Resources
* Estimate Costs
* Identify Risks
* Identify Stakeholders
* Manage Project Team
* Manage Stakeholder Expectations
* Monitor and Control Project Work
* Monitor and Control Risks
* Perform Integrated Change Control
* Perform Qualitative Risk Analysis
* Perform Quantitative Risk Analysis
* Perform Quality Assurance
* Perform Quality Control
* Plan Communications
* Plan Quality
* Plan Risk Management
* Plan Procurements
* Plan Risk Responses
* Report Performance
* Sequence Activities
* Verify Scope

| **Knowledge areas and process groups** | | | | | |
| --- | --- | --- | --- | --- | --- |
| **Knowledge area** | **Initiating process group** | **Planning process group** | **Executing process group** | **Monitoring & Controlling process group** | **Closing process group** |
| **Integration** | Row 2 Column 2 | Row 2 Column 3 | Row 2 Column 4 | Row 2 Column 5 | Row 2 Column 6 |
| **Scope** | Row 3 Column 2 | Row 3 Column 3 | Row 3 Column 4 | Row 3 Column 5 | Row 3 Column 6 |
| **Time** | Row 4 Column 2 | Row 4 Column 3 | Row 4 Column 4 | Row 4 Column 5 | Row 4 Column 6 |
| **Cost** | Row 5 Column 2 | Row 5 Column 3 | Row 5 Column 4 | Row 5 Column 5 | Row 5 Column 6 |
| **Quality** | Row 6 Column 2 | Row 6 Column 3 | Row 6 Column 4 | Row 6 Column 5 | Row 6 Column 6 |
| **Human Resources** | Row 7 Column 2 | Row 7 Column 3 | Row 7 Column 4 | Row 7 Column 5 | Row 7 Column 6 |
| **Communications** | Row 8 Column 2 | Row 8 Column 3 | Row 8 Column 4 | Row 8 Column 5 | Row 8 Column 6 |
| **Risk** | Row 9 Column 2 | Row 9 Column 3 | Row 9 Column 4 | Row 9 Column 5 | Row 9 Column 6 |
| **Procurement** | Row 10 Column 2 | Row 10 Column 3 | Row 10 Column 4 | Row 10 Column 5 | Row 10 Column 6 |

**For online use, complete each row as described in the instructions. If you would like to work with the page as hard copy, simply print it out using the Print link at the top of this page.**

**Course:** Project Management Fundamentals  
**Topic:** The Knowledge Areas

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Managing projects within organizations

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**Project Characteristics**

Projects make up almost half of the work that most organizations do. Organizations use projects to help meet their strategic goals. In terms of strategic goals, projects may help an organization meet changes in

* market demands
* customer requests
* organizational requirement
* technological advances
* legal requirements

So projects form an important role in organizations. But what exactly is a project, and how is it any different from other types of work?

1. First, a project is work that produces a unique product, service, or result.
2. Second, a project has a temporary duration. It has a definite beginning and an ending.

Although projects are temporary, they are not necessarily short-lived. A project's life span can vary from a few days to several years. The key is that a project has a set beginning and an end point.

**Progressive elaboration**

When a project starts, you are unlikely to know all the details required for its success. However, you will have an idea of the required end result. This is where the concept of progressive elaboration comes in. Progressive elaboration is a characteristic of a project. The Guide to the Project Management Body of Knowledge, usually known as the PMBOK® Guide, defines progressive elaboration as "an incremental process that allows changes to be incorporated into a project without significantly affecting scope." So progressive elaboration involves clarifying and refining a project over time. Project teams continuously improve and adjust project plans as more information becomes available.

Progressive elaboration should not be confused with **scope creep**. Scope creep happens when there are unwanted and uncontrolled changes to a project. The PMBOK® Guide defines scope creep as "changes to the original scope of a project without addressing the effects this may have on resource use or on customer expectations." The same issues that might trigger scope creep, such as customer requests and human resource changes, actually trigger progressive elaboration when a project is properly managed. Project managers must be on the look-out for issues and new information that must result in updates to plans. Almost any change to the scope of a project affects its budget and timeline. So the project team and the customer need to discuss and agree on changes before they take any action.

Examples of changes that can trigger progressive elaboration include changes in legislation, organizational structure, technology, or the context in which a project occurs. As a project manager, it's vital that you understand progressive elaboration. Knowing about how this works helps you to adjust and elaborate on project deliverables, objectives, and scope. You also need to understand how these adjustments affect project timelines, life cycles, and budgets. This knowledge assists with decision making for the project.

**Project versus operational work**

The work that organizations do on a day-to-day basis is either operational work or project work. You need to be able to distinguish between these types of work. Operational work is ongoing and repetitive. Its purpose is to keep a business going. The objectives for this type of work may change frequently. Project work is temporary, unique, and finished when specific objectives have been met.

Projects are important to all types of businesses. They help organizations meet strategic goals and adapt to the changing business environment. Operational work is as necessary as project work. It ensures organizations can thrive and last. Without operations, organizations cannot function.

Projects have distinct characteristics. They are temporary and produce a unique product, service, or result through the use of progressive elaboration. Operational work, unlike project work, is ongoing and repetitive.

**Course:** Managing Projects within Organizations   
**Topic:** What is a Project?

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**Portfolios, Programs, and Sub-projects**

There is a saying that "context is everything." This is certainly true when you are trying to understand or make sense of something. For example, a simple shape in a diagram could mean anything, but when seen in context, you are able to determine what it represents. Similarly, to better understand how a project works, you need to understand the project in its context within an organization. This context effects everything that happens in a project, from the nature of the product, to how the work is planned, to how resources are applied.

Organizations group work in ways that enable them to manage it more efficiently. Typically, groups of work are classified as

* **portfolios** – A portfolio is a collection of programs, projects, and ongoing work. The work is grouped into these categories to facilitate centralized and effective management, which helps an organization meet its strategic objectives. However, the projects and other work types in a portfolio may not be directly related.
* **programs** – A program is a group of related projects and ongoing work. It is managed in a coordinated way to achieve benefits and a level of control not available through managing the projects individually.
* **projects** – A project is a temporary body of work that produces a unique product, service, or result to meet a specific strategic objective or set of objectives.
* **sub-projects** – A sub-project is a smaller portion of an overall project. It is created by subdividing a project into more manageable components. A sub-project may be called a project, but it really is a smaller part of the whole.

**Sub-projects**

For ease of management, large, complex projects are often broken into sub-projects. So several project managers may work together on a single project. Some sub-projects may even be contracted out to external companies to complete. How projects are broken into sub-projects depends on the organization and the project itself. There is no one correct way to split a project into sub-projects.

Some organizations rely on a single model that they use for all projects. For example, they may divide each project into sub-projects according to project phases such as design, manufacturing, and testing. Other organizations expect project managers and their teams to determine the model that best suits their needs. The key in identifying sub-projects is to decide on the best way to manage work for a particular company.

**Programs**

A program is essentially a group of related projects and ongoing work that is **centrally** managed. Managers use this structure to obtain additional benefits and control. Placing related projects and ongoing work in a single program enables better management of schedules, priorities, and shared resources. It ensures more consolidated control of related work. Programs increase management control because projects also feed back to programs. You can identify a change to one project and then adjust all affected projects and ongoing work accordingly. Projects contribute to consolidated program benefits, as well as generating discrete benefits.

So programs are used to organize and control related projects and ongoing work. This, in turn, generates benefits for a company. Two-way communication occurs between a program and its related projects. A program also coordinates project objectives and outcomes. This enables a program to achieve consolidated benefits that a single project could not.

**Portfolios**

A portfolio is a collection of projects, programs, and ongoing work. They are created to make it easier to manage work in a way that ensures strategic business objectives are met. Portfolio managers are expected to identify, authorize, manage, prioritize, and control projects and programs within their portfolios.

Organizations run portfolios based on their strategic plans. The relationship between portfolios and projects is not a one-way relationship. Changes occurring at project level are communicated back to the portfolio. The portfolio manager may then use this information to develop new strategic plans. Also, changes made in one project may affect others within the same program or portfolio.

The way an organization groups work into projects, portfolios, and programs depends on its needs and preferences. Groupings may be made according to the nature of products or services, by functional area, by geographic area, or by client or customer type. A project's context includes the program and the portfolio it belongs to, and the organization in which the project runs. The context of each project affects what the project objectives are and what resources will be made available. Similarly, changes to projects and project outcomes may affect every other aspect of a business.

The context in which a project occurs affects all aspects of the project. Organizations group work in ways that enable them to manage it more efficiently. Typically, groups of work are classified as portfolios, programs, projects, and sub-projects. The highest grouping of work is known as a portfolio, which includes a collection of programs, projects, and ongoing work. A portfolio manager determines which projects should be authorized and which should be prioritized based on how they impact strategic objectives.

A program contains related projects and ongoing work. It enables managers to achieve greater control of shared resources and outcomes. By managing projects through a program, additional consolidated benefits can be achieved. Sub-projects are smaller portions of an overall project that have been identified to provide ease of management.

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**Topic:** Portfolios, Programs, and Sub-projects

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# SkillBrief

# Project Manager Competencies and Responsibilities

What does it take to manage a project? It's easier to understand project management if you know what your fundamental duties as a project manager are. Your responsibilities are to

* **accomplish a project's objectives** – You want to accomplish a project's objectives within budget and on schedule.
* **balance stakeholders' expectations** – You're responsible to your stakeholders and for ensuring a project meets its objectives. You can do both only when you balance expectations with objectives. You need to keep expectations realistic and in line with a project's objectives.
* **update project plans throughout a project** – As part of progressive elaboration. As you gather more accurate estimates and information, you adjust project plans to include these details.
* **balance the competing demands of budget, schedule, quality, and scope** – A change in one of these interdependent factors impacts the others.

## Project Management Competencies

As a project manager, your value is assessed in terms of knowledge-based, performance-based, and personal competency.

### Knowledge-based competency

Project management knowledge competency includes knowing project management techniques, processes, and standards. The PMBOK® Guide is the most widely distributed source of knowledge about project management. The Project Management Institute, also known as PMI®, uses the guide to offer professional certification. The PMBOK® Guide provides information on nine knowledge areas for project management. The knowledge areas associated with project management include:

* **Project Integration Management** – identifies, defines, combines, unifies, and coordinates all the processes and activities that support a project. It requires knowledge of the processes for developing a project charter and a project management plan, directing and managing project execution, monitoring and controlling project work, performing integrated change control, and closing the project or phase.
* **Project Scope Management** – ensures that a project includes only the work required to complete it. This requires knowledge of the processes for collecting project requirements, defining project scope, creating a work breakdown structure (WBS), and verifying and controlling a project's scope.
* **Project Time Management** – ensures that a project is completed on time. It requires knowledge of the processes for defining and sequencing activities, estimating needed resources and the durations of activities, and developing and controlling a project schedule.
* **Project Cost Management** – plans, controls, and manages project costs. This requires knowledge of the processes for estimating costs, determining a budget, and controlling costs.
* **Project Quality Management** – ensures that a project satisfies its quality objectives. It requires knowledge of the processes for quality planning, performing quality assurance reviews, and performing quality control.
* **Project Human Resource Management** – ensures that people are deployed effectively within a project. This requires knowledge of the processes for human resources planning, acquiring and developing a project team, and managing the project team.
* **Project Risk Management** – manages all factors that place a project's success at risk. It requires knowledge of the processes for planning risk management, identifying risks, performing project risk analyses, planning risk responses, and monitoring and controlling risk as the project evolves.
* **Project Procurement Management** – manages the acquisition of materials, products, goods, and services for a project. It requires knowledge of processes for planning, conducting, and administering procurements, and for performing the relevant closure processes.
* **Project Communications Management** – ensures the timely and appropriate communication of key project information. It requires knowledge of the processes for identifying stakeholders, planning communication, distributing information, managing stakeholders' expectations, and reporting on performance.

As a project manager, you need to know what the stages of a project are and the best practices for applying each knowledge area. You also need to know about cost and risk management and the best practices for managing people within a project environment. Finally, you need to know how to use project management tools, such as budgets, risk analyses, Pareto diagrams, and schedules.

### Performance competency

Project management performance competency includes your qualifications for the job and your experience and skills. The usual reference for determining a project manager's qualifications and experience is a résumé. Employers generally look for experience on similar projects in similar organizations, and are interested in the success of these projects. In terms of performance-based competencies, employers need to consider the types of things a project manager is able to do.

### Personal competency

This area of competency comprises your motives, attitude, values, and concept of yourself. Each personal competency relates to aspects of your character that affect how you apply your knowledge and skills. People with different personality traits may apply knowledge and practices differently, but still achieve similar results. However, there are specific personal competencies that a project manager should have. Successful project managers can manage changes as a project develops because they're innovative and willing to take calculated risks. You need to find creative solutions for problems that arise as a project develops. You also need to find flexible ways of responding to unexpected changes, even when this involves some risk.

Another personal quality of good project managers is the ability to get things done. This means you should be able to ensure that effort is sustained from the start of a project to its end. To be able to do this, you need to move between focusing on details to focusing on the big picture. So the ability to manage change and to get things done are important personal qualities for a project manager.

People skills is a third personal competency. You need leadership ability, good communication skills, and the ability to negotiate and to persuade.

As a project manager, your responsibility is to meet project objectives, balance stakeholders' expectations, update project plans, and balance project budget, schedule, quality, and scope.

Successful project managers need to be competent in terms of what they know, what they can do, and who they are as leaders. Knowledge-based competency is based on the nine knowledge areas. Performance-based competency is determined by qualifications, experience, and skills. Personality-based competency includes leadership, the ability to get things done, negotiation and persuasion skills, the ability to manage change, good communication skills, and a tendency to be innovative and take calculated risks.

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**Topic:** Managing Projects

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**Stakeholder Roles**

Managing a project is also about managing work in relation to people's expectations. All projects involve stakeholders with conflicting interests and priorities. A stakeholder is a person or organization that is affected by a project or that influences the project. Examples of stakeholders include

* **the project sponsor** – A senior executive of the organization or a management group for which a project is carried out. The sponsor provides financial resources and is the primary risk taker within the project.
* **Vendors or business partners** – Organizations that supply goods or services that a project needs. Vendors, also called sellers, are typically external suppliers or contractors. Business partners have a special relationship with the organization, often acquired through a certification process.
* **the project manager** – The person who is authorized to manage a project.
* **the project team** – The team that performs the work of the project
* **customers or users** – Persons or organizations that use the product or service created by a project. Customers and users may be internal or external to the company.

Some project stakeholders aren't easy to identify because they don't work directly with a project or use the product or service it creates. They are called "hidden stakeholders." Hidden stakeholders may include the physical, cultural, or political environment. They may also include the organizational structure and culture of a company.

Stakeholders can have positive or negative influences on a project. They can encourage and support the project or they can work against it. **Positive stakeholders** normally expect to benefit if a project is successful. **Negative stakeholders** expect the success of a project to lead to harm or negative consequences.

If you **identify all project stakeholders** early on and determine their interests, you're likely to avoid unpleasant surprises later in a project. You also need to anticipate conflicting interests early in a project. Although it might be impossible to meet all stakeholders' demands and expectations, you can balance these demands once you know what they are. If you understand stakeholders' roles at the start of a project, you'll know what to expect from each stakeholder in terms of their contributions and responsibilities. The stakeholders themselves also need to be clear on their roles and responsibilities.

**Project managers' responsibilities**

When dealing with stakeholders, your key responsibilities are to balance stakeholder interests and manage stakeholder expectations. **Balancing stakeholder interests** requires awareness of the political nature of project management. There are three basic tasks involved in balancing stakeholder interests:

1. communicate the purpose and benefits of the project to all stakeholders to motivate them to buy in to the project
2. ensure stakeholders see the project as a win-win for everyone
3. ensure you have senior management backing for the project

The three best practices when **managing stakeholder expectations** are:

1. Before the project starts, communicate clearly to all stakeholders what the expected end results of the project will be.
2. Throughout the project, keep stakeholders informed about how the project is going. This is especially important if there are significant changes to the project.
3. Resolve issues with stakeholders in a timely fashion. This is especially true for those stakeholders who have a lot of influence.

**Stakeholder responsibilities**

To ensure that you work well with stakeholders, you need to understand their responsibilities:

* **customers or users** – They provide key information about a project's scope and required results. They may also be involved in testing the product or service. Customer feedback can identify potential risks and problems. Customers are also often expected to respond to issues that arise during the project life cycle.
* **project sponsor** – The sponsor champions a project at its outset, develops the initial project scope and charter, and authorizes the start of the project. The sponsor also provides project resources, including financial resources. The sponsor bears ultimate responsibility for the project's success. This means that she may be expected to remove roadblocks, provide guidance and feedback, encourage the team, authorize major changes in scope, and have the final say in high-risk decisions. Sponsors are also typically responsible for communicating with senior management on behalf of the project manager.
* **vendors or business partners** – Vendors, also called sellers, carry out all contracts and duties as subcontractors according to agreed levels of quality and professionalism. Business partners provide specialized expertise or services. Both groups may interact with the project team and customer or user groups.
* **project team** – The team includes a project manager and team members. Each member of the team requires the skills and talents to carry out their tasks. The role of team members is to work and communicate well together. They should also be aware of how their work affects others on the team. Finally, the team needs to commit to producing quality work while meeting project deadlines.
* **project manager** – This high-profile role changes rapidly over the course of a project, so you have to be flexible and exercise good judgment. You need to be able to move from a big-picture view of the project to one that focuses on the details. Your role as a communicator is always important. You act as the interface between all stakeholders for the project.

As a project manager, you are in charge of all aspects of a project and are responsible for its success. A project manager has several responsibilities:

* developing project and component plans
* providing reports on project metrics
* ensuring the project remains on schedule and within budget
* identifying, monitoring, and responding to risks

Project stakeholders within and outside an organization can have a major impact on a project and its potential for success. Key stakeholders include the project sponsor, customers and users, vendors or business partners, and the project manager and team. Hidden stakeholders don't work directly with a project or use the product or service it creates. Failure to identify the hidden stakeholders in a project can jeopardize the project's success.

As a project manager, your key responsibilities in terms of stakeholders are to balance stakeholders' interests and to manage stakeholders' expectations.

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**Topic:** Project Stakeholders

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**Organizational Influencers**

Projects are created and run within the context of an organization. So what influence does the organization have on projects? Three main organizational influences are

* **organizational culture** – refers to the unique ways in which an organization operates and conducts business. It includes the unwritten rules and expectations that members of the organization share.
* **organizational structure** – refers to how positions and departments are defined. This includes the organization's reporting structure and its hierarchical structure.
* **organizational process assets** – are the processes that a project uses when working with project assets.

Organizational culture consists of the following elements:

* **values** – filter down from its vision and mission statements – the publicly announced principles and values that it aims to achieve.
* **norms** – are a set of implied or unwritten rules, values, and standards about how things should be done. A particular language or way of communicating also develops.
* **beliefs** – are the shared meanings developed by a group working together. They include both habits of thinking and of speaking.
* **policies and procedures** – include broad policies and ideological principles that guide how a group interacts with employees, customers, and other stakeholders. Procedures include how tasks are normally performed within the organization, as well as what steps should be followed for particular situations. Some procedures may be explicit while others are implicit.
* **views of authority** – affect communication between upper management, the project manager, and the project team.

Culture arises from the accumulated shared learning of a group, so coming in from the outside can be difficult. And if you are part of the organization and its culture, your beliefs and ways of doing things may be so ingrained that they are difficult to define or communicate.

How an organization is structured can have a profound influence on how a project is run, and on its chances of success. Two basic organizational structures are projectized and functional. Most companies use a hybrid of these two forms called the matrix organization.

In a classic **projectized organization**, project team members are typically located in the same office. Project managers tend to have high levels of independence and authority, and the majority of the organization's resources are involved in project work. These organizations may have units termed "departments" that provide centralized administrative support. However, these generally report directly to the project manager.

In a classic **functional organization**, each employee has one clear superior to report to. Employees are divided according to their function. Each functional department works separately from the other departments and completes its project tasks independently.

Each organizational structure has advantages and disadvantages.

* **functional organizations** – Advantages of a functional organization are its defined roles, simple reporting structure, and cohesive teams. Disadvantages include a lack of communication and collaboration between functions, and slow decision making due to the sharing of the management role between project and functional managers. Other problems with this structure include a high level of bureaucracy, competition for resources, and limited project scope.
* **projectized organizations** – Advantages of a projectized organization include frequent collaboration and communication, rapid decision making via a single authority, and an increased organizational focus on project work. Disadvantages include employees working on many projects at once, idle time, and competition. Also, team members need to be reassigned after each project is completed.

Most organizations blend functional and projectized structures to form a **matrix organization**. This type of organization uses strengths from both structures. In a matrix organization, you typically find project teams that operate within functional groups. Project and functional managers share responsibility for assigning priorities and directing the work of individuals.

A range of project characteristics are directly affected by the organizational structure:

* **authority** – Project managers have very little authority in functional structures and almost complete authority in projectized structures
* **resource availability** – Project resources are readily available in projectized structures, but availability in functional structures is very low. This is because all resources need to be approved via functional managers first.
* **control of the budget** – In functional organizations, the functional manager is in charge of the budget, whereas in projectized structures, this control is in the hands of the project manager.
* **project manager's role** – This role is typically part-time in functional organizations and full-time in projectized organizations. This is largely due to the amount of responsibility and accountability that project managers have in either of these structures. Part-time managers can achieve less and take longer to do so.
* **project administrative staff** – Administrative staff tend to be part-time in functional and full-time in projectized organizations because of different workload distribution.

An organization's history determines the available **process assets** that can contribute to the success of a project. Processes and procedures are one category of process assets. This category includes previous project plans, standard processes and procedures, and project management templates.

A second category of process assets is the corporate knowledge base. This comprises historical data on projects completed in the past, including lessons learned during those projects. Organizations often have information stores containing past measurements related to processes, products, and finances. They also store information on past project issues and defects in what are known as "lessons learned" knowledge bases. Organizational process assets can influence projects by saving time and by improving the quality of plans and forecasts.

Organizational influences on projects include an organization's culture, structure, and process assets. An organization's culture includes the beliefs, norms, and values held by the organization. It also incorporates formal and informal policies and procedures, and the organization's attitude toward authority. The ideal organizational structure is a matrix organization, which is a combination of functional and projectized.

The organizational process assets held by an organization include documentation, guidelines, templates, as well as knowledge gained from previous projects. These assets can help project managers save time and produce higher quality plans and forecasts.

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**Topic:** Organizational Influences on a Project

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**SkillBrief**

**Organizational Stakeholder Interests**

Recognizing a project's organizational stakeholders and their interests can help you ensure a project succeeds. The people and groups in an organization may contribute to, or threaten, a project.

How a business is structured affects the variety and levels of organizational stakeholders. At the executive level, you are likely to find a project management office (PMO), a portfolio review board, and a portfolio manager. The sponsor and the program manager are positioned on the second level. Other organizational stakeholders may be functional managers or operational managers. Each of these stakeholders has specific interests and roles:

* a **project sponsor** is a member of an organization's executive management and acts as the champion for a specific project.
* a **PMO** is often used to organize, manage, and control their projects, programs, and portfolios. This office becomes an organizational stakeholder for a project if it is directly or indirectly responsible for the project's success. An enterprise PMO is placed at the top of an organization's hierarchy, whereas an ordinary PMO is positioned further down.
* the **portfolio review board** and the portfolio manager are responsible for the high-level control of a range of programs and projects.
* a **program manager** is responsible for groups of related projects. Projects managed within a program are expected to achieve greater benefits and control than projects managed separately.
* a **functional manager** plays a management role in particular departments or functional divisions of an organization.
* an **operational manager** plays a management role in a specific operational area of a business.

A **sponsor** is both a project and an organizational stakeholder. As a member of the project team and of upper management, the sponsor can act as a liaison between the two. As an organizational stakeholder, a sponsor is interested in how a project will contribute to the company's strategic goals.

The goal of an enterprise **PMO**, also known as an EPMO, is to meet business objectives at the enterprise level. The responsibilities of an ordinary PMO can range from providing project management support functions to directly managing a project. So it ensures processes are standardized while the enterprise PMO has a stake in the overall performance of all projects, programs, and portfolios within an organization. A PMO is expected to

* promote an organization's overall mission and protect its interests. They may initiate major program changes – or eliminate particular projects – to help achieve an organization's goals.
* create a standardized approach to project work. They identify, develop, and standardize project management methodologies and mentor project managers.

Generally, a PMO is responsible for managing and coordinating shared resources, risks, policies, and documentation among projects. It may audit a project to monitor its compliance with project management standard policies, procedures, and templates. A PMO may also coordinate communication across projects, and facilitate coaching, mentoring, training, and oversight. In terms of managing particular projects, a PMO may be responsible for monitoring project timelines, budgets, and quality.

Other stakeholders that operate at a strategic level are the portfolio review board, portfolio managers, and program managers. These stakeholders keep an eye on the big picture, across all projects. The **portfolio review board** provides additional support for project selection and prioritization. The board reviews projects in terms of their value, risks, and likely return on investment. These reviews are provided to help the organization meet its strategic objectives. In addition, the board often responds to external opportunities, such as tenders or Requests for Proposals.

A **portfolio manager** makes decisions based on business strategy and is responsible for high-level governance of projects. Like the portfolio review board, portfolio managers review projects in terms of their value, risks, and likely return on investment. They authorize and prioritize projects to help the organization meet its strategic objectives.

Unlike project managers, functional and operational managers are responsible for ongoing work and permanent teams. However, they interact closely with project managers and their teams. **Functional managers** oversee administrative functions rather than the core operational work of a business. They are responsible for providing services directly to project teams. They generally have no interaction with other project stakeholders. The services a functional manager provides depend on the manager's functional area.

**Operational managers** oversee the divisions of the company that directly produce and maintain products or services. They generally provide a project with skilled employees who have needed technical expertise. They may provide projects with dedicated full-time or part-time resources, or just ad hoc resources as they're needed. Operational managers and their crews may also work with customers, users, or suppliers on behalf of a project team.

Organizational stakeholders include executive stakeholders, such as the project sponsor, the project management office, the portfolio review board, and portfolio and program managers. Further down the organizational hierarchy, functional and operational managers may provide services and resources for project work. Each stakeholder performs specific roles within a project's life cycle.

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**Topic:** Organizational Stakeholders

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**Job Aid**

**Project Manager Competencies**

**Purpose:** *Use this job aid to review the competencies required of project managers*.

**Project management knowledge competencies**

Knowledge-based competencies relate to the knowledge you have about how to manage a project successfully. The Project Management Body of Knowledge (PMBOK®) Guide identifies nine main knowledge areas – Project Integration Management, Project Scope Management, Project Time Management, Project Cost Management, Project Quality Management, Project Human Resource Management, Project Communication Management, Project Risk Management, and Project Procurement Management.

**Project management performance competencies**

Performance-based competency is the set of behaviors that enables you to produce superior performance and your qualifications for the job. It includes your qualifications and experience, as well as your ability to complete project tasks and use project-related tools and techniques. These tasks, tools, and techniques are related to the knowledge competencies that you need as a project manager.

**Personal competencies**

Personal competencies comprise your motives, attitude, values, and concept of yourself. You should be able to manage the changing environment as a project develops. This requires that you be innovative and willing to take calculated risks. You need to be able to focus on details as well as the big picture. You should also have leadership ability, good communication skills, and the ability to negotiate and to persuade.

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**Topic:** Managing Projects

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**Job Aid**

**Work Characteristics**

**Purpose:** *Use this job aid to review the different ways to structure work within an organization*.

|  |  |
| --- | --- |
| **Work groupings** | |
| **Portfolio** | A collection of lower-level portfolios, programs, projects, and ongoing work. The work is grouped to facilitate centralized and effective management, aimed at meeting strategic objectives. The projects and other work types in the portfolio may not be directly related. |
| **Program** | A group of related projects and operational work. It is managed in a coordinated way to achieve benefits and a level of control not possible when managing the work components individually. |
| **Project** | A temporary body of work that produces a unique product, service, or result to meet a specific strategic objective or set of objectives. It is also characterized by progressive elaboration. |
| **Sub-project** | Smaller portions of an overall project, created to enable easier management. Sub-projects may be called projects, but they're really smaller parts of a whole. |
| **Ongoing work** | Work that is repetitive and does not have a clearly delineated beginning and end. This type of work supports ongoing activity and is usually managed within organizational functions. Its purpose is to enable an organization to continue operating and to support any project work. The specific objectives this type of work meets may change. |

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**Topic:** Portfolios, Programs, and Sub-projects

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**Job Aid**

**Project Stakeholders**

**Purpose:** *Use this job aid to review the stakeholder types associated with projects*.

|  |  |
| --- | --- |
| **Stakeholder categories** | |
| **Sponsor** | Typically, a senior executive of the organization or a management group for which a project is carried out. The sponsor provides financial resources and is the primary risk taker within the project. |
| **Vendors** | External organizations that supply goods or services required by a project. Vendors, also known as sellers, are typically suppliers or contractors that provide material or services for the company. Business partners have a special relationship with the organization, often acquired through a certification process. |
| **Project team** | The people responsible for conducting a project. The project manager is the person who is authorized to manage a project. Project team members are the people who perform the work of a project. |
| **Customer** | The person or organization that purchases or uses the product or service that results from a project. |
| **Hidden** | Stakeholders that may not be immediately apparent. Examples are stakeholders in the physical, cultural, or political environment; future generations; and members of the organization not directly involved in the project but affected by the organization's structure and culture. |

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**Topic:** Project Stakeholders

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**Job Aid**

**Organizational Influencers**

**Purpose:** *Use this job aid to review potential organizational influencers for a project and their impact*.

| **Organizational influencers** | | |
| --- | --- | --- |
| **Influencer** | **Description** | **Example** |
| Organizational culture | The unique nuances of how business is conducted and ways that the organization operates. The shared values, norms, beliefs, expectations, policies, procedures, and views of authority that members of an organization have all make up the organizational culture. | How employees' view authority impacts communication between the team and the project manager. |
| Organizational structure | How positions and departments are defined, and what the reporting structure is in an organization. An organization may use a functional, projectized, or matrix structure. | A matrix structure blends functional and projectized organizations. For example, a company could create a dedicated project team comprised of members from each functional department. The project manager is responsible for the team and its work and has control of project resources. |
| Organizational process assets | Project-related documents or data from previous work that can be used to improve the current project or facilitate project management. They include the plans, policies, procedures, and guidelines that may influence a project's success. They also include knowledge assets. | Plans, templates, policies, and "lessons learned" databases can help the project manager complete tasks quickly and improve quality by avoiding mistakes made in the past on similar projects. |

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**Topic:** Organizational Influences on a Project

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Project management process groups

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# SkillBrief

# Project Management Processes

If you break a big project into smaller steps, you'll find it's much easier to complete it successfully.

In the Project Management Body of Knowledge, or PMBOK® Guide, the "smaller steps" for managing a project are known as project management processes. According to the PMBOK® Guide, a process is "...a set of interrelated actions and activities performed to achieve a pre-specified product, result, or service."

A project management process is a set of activities you use to achieve a required result. The result contributes to your meeting project milestones and objectives.

The PMBOK® Guide defines 42 project management processes. They fall into five project management process groups.

## Components of a process

You can think of each project management process as having three elements:

* **inputs** – An input is any item that is required before you can begin a process. Typically inputs are documents or information you need in order to perform the process. They can be internal or external to the project. Often the input for a process is the output from another preceding process.
* **tools and techniques** – A tool is something tangible, like a template or a software program, that you use to produce a product or result, or to facilitate a technique or systematic procedure. A technique is a defined systematic procedure that you use to perform an activity within a process. It is the method, or one of the methods, you will use to perform the process. A single technique may employ one or more tools.
* **outputs** – An output is a product, result, or service generated by a process. An output from one process often serves as an input to another process later on.

Another example of a project management process is Create Work Breakdown Structure, or Create WBS. The inputs for this process are the project scope statement, requirements documentation, and organizational process assets. The main tool, or technique, for the process is decomposition. Its outputs are the WBS itself, a WBS dictionary, a project scope baseline, and project document updates.

Each time you see a new process, ask yourself "What do the inputs have to do with tools and techniques, and how do they feed into the outputs?" In this example, the act of decomposition, which means breaking down the project deliverables into their component tasks, can't be done without the scope statement. Also, to create the WBS dictionary, you need the requirements documentation. You should be able to find these types of relationships in each project management process.

## Applying processes

The project management processes outlined in the PMBOK® Guide represent best practices, but that doesn't mean you can or should apply all of them to every project.

As project manager, you and your project team must decide which processes to use and how to apply them. This is called project tailoring.

Factors that will affect how you and your team apply project management processes include organizational process assets and enterprise environmental factors.

## Organizational process assets

Organizational process assets are assets in an organization that are already available to a project. One example is an organization's existing financial controls procedure.

Organizational process assets are usually inputs to a process. They can contribute significantly to the success of a project. These are organizational process assets you can use for a project:

* **processes, policies, and procedures** – An organization's environmental policy is an example of an organizational process asset in the processes, policies, and procedures category.
* **corporate knowledge base** – Project closure information is an example of an organizational process asset from an organization's corporate knowledge base. Old project files are archived and lessons learned are logged in a database. You can use information gathered from earlier projects to help you in the planning and execution of later projects.
* The way you tailor a project will depend on enterprise environmental factors as well as organizational process assets.

## Enterprise environmental factors

* Enterprise environmental factors are external and internal factors that contribute to the circumstances around a project. They often provide constraints to project planning and execution.

Government standards and marketplace conditions – like the availability of resources – are examples of enterprise environmental factors.

Because every project is unique, it's the project manager's responsibility to take the following actions to ensure success:

* choose the most relevant processes given the size and nature of the project
* make the processes clear to all team members
* act in accordance with the stakeholders' requirements
* balance competing demands, such as cost, resources, scope, and quality

## Product-oriented processes

You can apply project management processes to any project, in any industry. However, you use product-oriented processes to outline the steps for creating a specific product. Product-oriented processes are also used for projects that deliver services.

In contrast, project management processes apply globally, to projects in any industry.

Project management processes and product-oriented processes interact throughout the life of a project. As you use processes in each of the process groups to manage a project, product-oriented processes are also occurring.

As a project manager, you need to understand product-oriented processes and ensure they're executed in line with project management processes.

The Project Management Body of Knowledge (PMBOK® Guide) identifies 42 project management processes. Each of these is a set of interrelated activities for achieving a prespecified product, result, or service that contributes to achieving project milestones and objectives. Which project management processes you apply and how you apply them will depend on a particular project's needs. Factors that affect this include the organizational process assets available for a project and enterprise environmental factors, which often determine project constraints. In a project, you use product-oriented processes to specify and create a specific product, service, or result. Product-oriented processes intersect with project management processes throughout the project life cycle.

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**Topic:** Project Management Processes

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# SkillBrief

# How Project Management Processes Interact

The PMBOK® Guide defines 42 processes to make project management flow effectively, and many of them are clearly related.

## Process groups

The PMBOK® Guide organizes all project management processes into five process groups, based on how the processes relate to each other. These are the process groups:

* **Initiating** – This process group kicks off a project by defining and authorizing it. The outputs from the Initiating process group become the inputs to the Planning process group.
* **Planning** – This process group uses the outputs from the Initiating process group to develop a blueprint for project implementation, evaluation, and closing. This group contains the greatest number of processes, because you have to consider all aspects of the project in order to create an effective plan. The outputs of this process group are used by all the process groups subsequent to this one.
* **Executing** – The Executing process group contains the actions you take to implement the project plan. The outputs of the Executing processes are used by the Planning and the Monitoring and Controlling process groups. This is because project work is constantly being evaluated and the plans updated. They are also used by the Closing process group.
* **Monitoring and Controlling** – This process group contains the processes that verify, track, control, and report on the project progress. The outputs of these processes serve as feedback to the Executing process group, and can inform revised planning.
* **Closing** – The Closing processes bring the project to an official end. They close procurements and project activities, and they record project information as organizational process assets, to be used as inputs to future projects.

The process groups overlap over the course of a project life cycle. This is how they overlap:

* **Initiating** – Initiating processes are in full swing at the beginning of a project. They tend to wind down once the project is underway.
* **Planning** – Although planning happens from the very beginning of a project, activity in the Planning process group increases as the Initiating processes end. The Planning process group has a high level of interaction with the Executing and Monitoring and Controlling process groups, especially during the phases when the project work is being carried out.
* **Executing** – The Executing processes occur throughout a project life cycle. They speed up as the Initiating processes end. As execution reaches its peak, Planning processes slow down.
* **Monitoring and Controlling** – These processes are active from the beginning to the end of a project. They reach their highest point as planning slows down and execution reaches its peak.
* **Closing** – These processes begin soon after the Initiating processes end. Once the Planning processes are completed, activity in the Closing process group increases rapidly. This activity peaks as the Execution processes are coming to an end. The Closing processes are the final processes to take place within a project.

## Project phases

Process groups are not the same as project phases. A big project typically consists of multiple project phases. All five process groups are needed within each project phase.

## Process group dependencies

A project almost always encounters changes during its life cycle, so the Planning, Executing, and Monitoring and Controlling processes are iterative by nature, often resulting in updates and revisions to the project plan.

Also, a change to one process usually impacts a number of related processes. This is because different processes are connected via their inputs and outputs.

Process groups are also connected. Often one aspect of a project will be addressed across multiple process groups.

## Knowledge areas

When a group of processes relate, they are grouped into a knowledge area. A knowledge area is a collection of processes that center around the same area of concern in project management. Each project management process is mapped to a specific process group and knowledge area, depending on the nature of the process.

Processes that fall within the same knowledge area often depend on one another.

These are examples of processes in the Project Time Management knowledge area and information about the other processes it depends on:

* **Define Activities** – An output of this process is the activity list, which is an input to the Estimate Activity Durations process, the Sequence Activities process, and the Develop Schedule process.
* **Sequence Activities** – This process uses the activity list as an input, and produces a project schedule network diagram as one of its outputs. The project schedule network diagram is then an input to the Develop Schedule process.
* **Estimate Activity Durations** – This process requires the use of the activity list, which is an output from the Define Activities process. The activity duration estimates are then an output of this process and an input to the Develop Schedule process.
* **Develop Schedule** – The Develop Schedule process uses inputs from each of the other processes listed. Those inputs are the activity list, the project schedule network diagram, and the activity duration estimates. Its output is the project schedule.

Table 3-1 in the PMBOK® Guide shows the relationships between the process groups and the knowledge areas. Wherever a process group and a knowledge area intersect and contain multiple processes, there will probably be process dependencies.

Wherever there are dependencies between processes or process groups, the project schedule is vulnerable to change. If the outputs of one process are delayed, the start dates for the processes that rely on those outputs are also affected.

Project management processes are connected by their inputs and outputs. The output of one process is often the input to a subsequent process. Processes with related objectives are organized into process groups. There are five process groups and they overlap extensively throughout a project's life cycle. The project management processes are distributed among nine knowledge areas. The processes within a knowledge area often depend on each other for inputs and outputs. Wherever process dependencies occur, a project management plan is vulnerable to change. It is the project manager's responsibility to identify process dependencies and manage those dependencies when changes occur.

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**Topic:** Project Management Process Interactions

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# SkillBrief

# Outputs and Benefits of Initiating Processes

## The Initiating process group

In project management, organizations need to determine whether a project is in line with organizational goals and whether investment in the project will be worthwhile, before giving a project the green light.

This is done in the Initiating process group.

The main objectives of the Initiating process group are

* giving the project manager formal authorization to start a new project or project phase
* clarifying the basic purpose of a project and identifying who has an interest in the project outcome before detailed project planning goes ahead

## Phases

When a large project is divided into project phases, each phase is kicked off by revisiting the Initiating processes. These are examples of phases in a project, and how returning to the Initiating process group provides an opportunity for deciding whether the project is being developed in line with the business needs of the organization:

* **market research** – The team conducts a set of market research studies to determine project feasibility and gain insight into consumer demand.
* **raw materials sourcing** – Once the project manager and team close the market research phase, they'll use the market information they obtained to see if the project is still in line with the company's business needs. They'll then decide whether to carry on as planned to the next project phase, raw material sourcing.
* **production** – If a decision is taken to proceed, the team will use the Initiating processes to kick off the next project phase – production. A decision can then be made to proceed with this phase, terminate it, or postpone it.

## Processes

To achieve its objectives, the Initiating group focuses on two processes. These are

* **Develop Project Charter** – This process usually begins before the project team is put together. The objectives of this process are to define the initial project scope, identify and assign a project manager, and commit organizational resources to the project. In this way, the Develop Project Charter process formally authorizes and kicks off new projects.
* **Identify Stakeholders** – This process involves listing all the people that have an interest in the project, estimating what impact they can have, and planning how to manage their expectations. This should take place as early in the project life cycle as possible. Stakeholder interests, expectations, and influence can change over the course of a project, so this process is often repeated.

The Initiating processes fall into two of the nine knowledge areas:

* Develop Project Charter is part of Project Integration Management because its outputs unite the activities of the Initiating process group and link it with the other process groups
* The Identify Stakeholders process gives the project team a framework for managing interactions between the project and its stakeholders, so it forms part of Project Communications Management

## Outputs of the Initiating processes

These are the outputs of the Initiating processes:

* **project charter** – The information in the project charter is used in Project Integration Management, Project Scope Management, and Project Communications Management.
* **stakeholder register** – This is a list of all the project stakeholders that have been identified. In the Planning process group, the stakeholder register is used in Project Scope Management, Quality Management, Communications Management, and Risk Management.
* **stakeholder management strategy** – The third output of the Initiating process group is the stakeholder management strategy. This is a document that outlines how relationships and interactions with stakeholders will be managed to maximize positive results and minimize negative outcomes. It contains a list of all project stakeholders with an analysis of each one's interest in the project and the impact they could have on it. This output plays a crucial role in the Project Communications Management knowledge area, where it is used in the Planning and Executing process groups.

These three outputs become inputs to processes in several knowledge areas.

## Benefits of completing the Initiating processes

The outputs of the Initiating processes are critical to many knowledge areas. So you should never underestimate their importance in getting a project off to the right start.

There are several benefits of completing the Initiating processes:

* **starting off with organized, identifiable objectives** – When the Initiating group processes are given the time and attention they need, project objectives are discussed and documented in an organized manner. If the processes are rushed, it may not be clear to project team members what need the project is fulfilling, why the project must take place, or how to proceed.
* **identifying the right project manager** – When the Initiating group processes are completed well, a project manager with the right skills, knowledge, and attitude will be able to lead the project successfully through all five process groups. If the Initiating processes aren't completed well, a project manager may not be identified early enough in the project or may not be a good fit.
* **developing a well-rounded project charter** – With the successful completion of the Initiating group processes, a project charter will be thorough and complete. This will verify that the project is viable and can meet requirements. If the processes are not completed well, this document may not be completed before activities and processes of the Planning or Executing process groups have begun. And you might find out then that aspects of the project cannot be completed in the required way.
* **managing stakeholders** – If stakeholders are identified and strategies developed to take their influence and expectations into account, there is a greater likelihood that project deliverables will be acceptable. If project stakeholders are ineffectively managed, you may neglect to identify key decision makers whose influence could derail the project at a later stage.

The Initiating process group includes the Define Project Charter and Identify Stakeholders processes, which authorize and start a project. Each of the processes falls in a different knowledge area. Develop Project Charter produces the project charter as an output. Outputs of Identifying Stakeholders are the stakeholder register and the stakeholder management strategy. These outputs affect and guide the processes across several other knowledge areas.

**Course:** Project Management Process Groups  
**Topic:** Initiating Processes

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# SkillBrief

# The Planning Processes in a Project

## The aims of planning

Planning is vital to the success of any project. It ensures that everyone in the project team knows what steps to take, and in what order.

During project planning, you convert information about the project as a whole into a detailed outline of the steps needed to reach the project's objectives.

Project planning has three main aims:

* the first is to define the scope of a project. This means coming up with a detailed analysis of the project and its requirements.
* the second aim is to refine the project objectives that were introduced when the project was initiated
* the third aim is to determine the actions the project team must take to meet the project's objectives

Planning a project includes a set of processes. In the PMBOK® Guide, these processes are organized into the Planning process group. Each process in the group fits into a particular knowledge area. Together, the processes are distributed across all nine of the knowledge areas for managing a project. This is because planning has to inform all aspects of project management.

There are some important points to remember about the Planning process group:

* its key output is the project management plan
* all planning is coordinated across the knowledge areas
* planning takes place throughout a project, not just at its start

## The project management plan

The project management plan is the central planning document used throughout a project.

According to the PMBOK® Guide, the project management plan "is the primary source of information for how the project will be planned, executed, monitored and controlled, and closed."

The project management plan is created during the Develop Project Management Plan process. This process falls into the Project Integration Management knowledge area.

In the Planning process group, each knowledge area contains processes that produce a subsidiary plan. For instance, the processes of the Project Cost Management knowledge area produce the cost management plan. Those subsidiary plans are then integrated to form the project management plan.

The plan is linked to other processes in these ways:

* the entire project management plan is linked with processes from the Executing process group and the Monitoring and Controlling process group as well
* it is used as an input to those process groups, which in turn produce outputs that update the project management plan

For instance, in the Planning process group, you create the project management plan. In the Executing process group, you gather work performance information as project work is completed. This data is used in the Monitoring and Controlling process group, where actual work performance is compared to the subsidiary plans and project baselines. Based on this, change requests and baseline updates are generated. These can cause the project management plan to be updated.

## Coordinating planning

In the PMBOK® Guide, the knowledge areas are listed in sequence. But this doesn't mean the processes they include happen one at a time. For example, processes occur at the same time to produce a subsidiary plan for each knowledge area. The project manager coordinates the processes and then integrates the subsidiary plans into the overall project management plan. This is part of Project Integration Management, which ties all the knowledge areas together.

## Continuous planning throughout a project

Initially, many subsidiary plans are based on estimations or projections. But as a project moves through its life cycle, you gather more detailed project information. You use this information to refine the subsidiary plans and update the project management plan.

During project execution, you also gather work performance information. Based on this, you sometimes have to issue change requests to modify procedures that are used while executing the project. If the change requests are approved, plans must be updated to reflect the changes.

So planning is continuous, because project information and change requests cause the plans to be updated throughout the project life cycle.

There are many other conditions and events that will trigger plan updates. However, as project manager, you must establish a date or phase in the project life cycle when updates and iterations to the planning processes will stop.

The Planning process group defines the scope of a project, refines its objectives, and determines what activities are needed to meet these objectives. The main output of the Planning process group is the project management plan, which becomes the primary source of information for managing a project throughout its life cycle. Coordinated Planning processes occur across the knowledge areas. The subsidiary plans for all the knowledge areas are then integrated in the project management plan. Planning for a project is continuous. As a project progresses, subsidiary plans and the project management plan continue to be updated to reflect new information.

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**Topic:** Planning Processes

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# SkillBrief

# The Executing Processes throughout a Project

## The Executing process group

The Executing process group includes the processes for carrying out what's in the project management plan. So its purpose is to complete the work required to meet a project's objectives.

This involves processes spread across five knowledge areas. Each process group includes one or more processes in the Project Integration Management knowledge area. It's these processes that unite all other activities in the groups. In the Executing process group, it's the Direct and Manage Project Execution process that serves this purpose.

The Direct and Manage Project Execution process contains several activities:

* **directing the creation of deliverables** – Project team members create deliverables. But the project manager is responsible for making sure the work done to create them is in line with the project management plan. The manager must also ensure the team has the resources they need to do the work.
* **gathering and reporting work performance information** – As the project progresses, the work performance information is gathered from the project team, software tools, and other information management systems. This data will be used to control project work in the Monitoring and Controlling process group. This output is one way in which the Direct and Manage Project Execution process interfaces with many of the other knowledge areas.
* **creating change requests** – Often, work performance information reveals aspects of project execution that are not effective, even if they're being done according to plan. In these cases, the project manager will create a change request, recommending a different way of executing project work. This request is then submitted for approval. Change requests can be used to influence various aspects of a project, like its scope, budget, or schedule. If approved, they lead to alterations in the way project work is executed.
* **generating updates to the project management plan** – If project execution results in refinements or changes, these are used to generate updates to the project management plan. Updates to the plan may include changes to the schedule or budget, additional risks, or new stakeholders that have been identified. Although you generate updates to the project management plan in the Executing process group, the actual work of updating the plan takes place in the Planning process group.

## Outputs

These outputs link the Executing process group with the Planning and the Monitoring and Controlling process groups:

* **deliverables** – These are used as inputs for performing quality control in the Monitoring and Controlling process group.
* **work performance information** – As you generate work performance information, it's used in the Monitoring and Controlling process group to keep tabs on how the project work is progressing, and to perform needed change control processes.
* **change requests** – Change requests can be created in the Executing process group, but are reviewed through a process in the Monitoring and Controlling process group. Approved change requests are returned to the Executing process group, to inform the way future project work will be done.
* **updates to the project management plan** – You generate updates to the plan as work progresses. These updates are added to the project management plan in the Planning process group. So the Develop Project Management Plan process iterates continually. The updated project management plan is then an input to the Direct and Manage Project Execution process.

## Knowledge areas

As well as Project Integration Management, four other knowledge areas are at work in the Executing process group:

* **Project Quality Management** – This knowledge area includes the Perform Quality Assurance process which ensures the processes that develop the product meets the required quality standards. You monitor the results of quality assurance activities by checking that processes used to create products meet the required standards. The results allow continuous improvements to the project. This process generates change requests, and updates to organizational process assets, the project management plan, and other project documents.
* **Project Human Resource Management** – This knowledge area includes three processes related to managing the people who execute project work. These are the Acquire Project Team, Develop Project Team, and Manage Project Team processes.
* **Project Communications Management** – This knowledge area includes two processes that must happen when project work is carried out. These are the Distribute Information and Manage Stakeholders Expectations processes. The first process ensures information about the project reaches team members and stakeholders, on time and in a suitable format. This is done in line with the project communication plan, as performance reports bring new information to light. You use the Manage Stakeholders Expectations process to communicate with stakeholders to ensure they have realistic expectations, and to meet their needs.
* **Project Procurement Management** – This knowledge area includes the Conduct Procurements process. This is for ensuring that resources are available to the project team when they're needed. You purchase required materials and services for a project, which involves finding suppliers, reviewing offers, and awarding contracts, based on the project's procurement plan.

The Direct and Manage Project Execution process integrates the other processes in the Executing process group. It brings together the different knowledge areas involved in managing project work.

Within the knowledge areas, there are various activities related to project execution:

* monitoring the results of quality assurance activities
* managing the project team
* distributing project information
* purchasing materials

The purpose of the Executing process group is to complete the work required to meet project objectives. In this group, the Direct and Manage Project Execution process falls in the Project Integration Management knowledge area because it's responsible for integrating other processes. It includes activities for directing the creation of project deliverables, reporting work performance information, creating change requests, and updating the project management plan. Executing processes also occur in the Project Quality Management, Human Resource Management, Communications Management, and Procurement Management knowledge areas. Activities in these areas include monitoring the results of quality assurance activities, selecting and managing project team members, distributing information to stakeholders, and purchasing required raw materials and services.

**Course:** Project Management Process Groups  
**Topic:** Executing Processes

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# SkillBrief

# Monitoring and Controlling Processes

## Purpose of monitoring and controlling

When you've invested a lot of energy into planning a project, you want to make sure it turns out right. In project management, you do this using the Monitoring and Controlling process group.

In A Guide to the Project Management Body of Knowledge, or PMBOK® Guide, the Monitoring and Controlling processes are distributed among eight of the nine knowledge areas.

The objectives of the process group are

* to track progress,
* review performance,
* regulate and control variances
* change the project management plan if required

## Processes

The Project Integration Management knowledge area contains the "umbrella" processes that tie together the knowledge areas and connect the process groups. In the Monitoring and Controlling process group, these are the processes:

* **Monitor and Control Project Work** – This process includes the activity that's key to the process group. This is monitoring project work to ensure it complies with the project management plan. If it doesn't, you need either to adjust the baselines in the plan or issue a change request. If a change request is approved, it will affect the way the project is executed.
* **Perform Integrated Change Control** – This process is what you use to ensure only approved changes are made to the way the project work is carried out. Wherever issues are detected and change is needed, the change has to be managed properly. Many projects have a change control board that reviews and approves change requests. This has to be done efficiently so changes can be made in good time.

## Monitor and control scope, time, cost, and quality

It's of vital importance to monitor and control project scope, time, cost, and quality. These four aspects of a project are what determine its success in meeting objectives:

* **scope** – The Verify Scope and Control Scope processes fall in the Project Scope Management knowledge area. Verifying scope involves making sure completed deliverables are formally accepted and making scope changes where needed. Activities for controlling scope focus on checking that a project stays in line with its planned scope and taking action if it doesn't.
* **time** – The Control Schedule process fits in the Project Time Management knowledge area. Here you identify and manage changes to the project schedule.
* **cost** – The Project Cost Management knowledge area contains the Control Costs process. You use this to evaluate project costs against the cost performance baseline and budget. As well as making sure spending stays within the agreed limits, you might need to update the budget and baselines to achieve required results.
* **quality** – The Perform Quality Control process fits in the Project Quality Management knowledge area. It's what you use to check that performance results and deliverables meet the standards outlined in the quality management plan. If you find areas not meeting quality requirements, you need to identify the causes and take corrective action.

## Monitor and control risks, communications, and procurement

In the Project Risk Management knowledge area, the relevant process is Monitor and Control Risks. This is what you use to track risks and make sure they don't hurt a project. Activities in the process include monitoring identified risks, carrying out planned risk responses, and making needed change requests. They also include picking up remaining or new risks. As you identify new risks, you should update project documents and organizational process assets.

In the Project Communications Management knowledge area, you use the Report Performance process. This is where you consolidate information about the results of monitoring and controlling. The results are communicated to stakeholders as outlined in the communication plan. From the results, change requests are sometimes issued, and updates to organizational process assets are made.

The Project Procurement Management knowledge area contains the Administer Procurements process. Using this process, you manage the contracts and relationships between buyers and sellers and review and document sellers' performance. An important part of this process is ensuring that supplies are being received and paid for on time.

You use the Monitoring and Controlling process group to track progress, review performance, regulate and control variances, and change the project management plan if required. Its main objective is to make sure you identify and resolve problems so a project will meet its objectives. Together, the process group includes processes for monitoring and controlling project scope, time, quality, cost, risk, communication, and procurements. Monitoring and control activities in the Project Integration Management knowledge area integrate activities that occur in processes across other knowledge areas.

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**Topic:** Monitoring and Controlling Processes

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# SkillBrief

# Closing Processes and Activities

## Closing process group

The Closing process group ensures you don't leave loose ends in a project. Its objective is to finalize all project activities and formally close a project or phase.

There are two Closing processes:

* **Close Project or Phase** – This process is part of the Project Integration Management knowledge area. This is where most activities for wrapping up a project happen.
* **Close Procurements** – This process involves completing and closing procurement contracts for a project. It fits in the Project Procurement Management knowledge area.

In the Closing process group, it's the Close Project or Phase process that unites activities in other processes. It coordinates activities in the Close Procurements process. It also wraps up activities in the Planning, Executing, and Monitoring and Controlling groups.

## Activities in the Close Project or Phase process

These are three of the main activities in the Close Project or Phase process:

* **conducting phase-end or project-end reviews** – You conduct reviews at the end of each phase and at the end of a project. This is to ensure all requirements have been met. For example, you check deliverables have been completed, no quality issues are outstanding, and performance complies with the baselines in the project management plan. The results of a review may be reported to stakeholders as outlined in the communication management plan.
* **verifying acceptance of deliverables** – It's vital to verify final acceptance of the finished product or service at the end of a project. This is also important after a project phase, if the phase is tied to a deliverable.
* **recording lessons learned** – At the end of each phase and at project end, the project manager should record lessons learned. Examples of lessons learned would be the impacts of any process changes, the results of project control measures, and the realization of identified risks.

As well as recording information about a project, it's important to update organizational process assets. If the project used new processes or improved on existing ones, you should make this information available for use in the future.

Each of the process improvements identified can be added to the companies' organizational process assets. They may then influence the way future projects are handled.

The final activity in the Close Project or Phase process is archiving project information. This includes project files and all relevant documents. Most organizations use some sort of electronic information system to create databases of historical data. The data can help in planning and making estimations for future projects.

Closing a project properly has benefits for the project and for the organization as a whole. By securing formal acceptance of deliverables by stakeholders, you give the team the all-clear to end off all project activity without worrying about negative repercussions down the line. You also add long-term value to your organization by making your experiences on a project available for use in future project work.

The Closing process group contains two processes you use to make sure a project is formally brought to a close. These are the Close Project or Phase and Close Procurements processes. The Close Project or Phase process integrates activities in other knowledge areas, so it's part of the Project Integration Management knowledge area. Key activities in closing a project or phase are conducting phase-end or project-end reviews, verifying acceptance of deliverables, and recording lessons learned. Other important activities are updating organizational process assets and archiving project information for future use.

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**Topic:** Closing Processes

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# Job Aid

# Organizational Process Assets and Enterprise Environmental Factors

**Purpose:** Use this job aid as a reference to help you distinguish between organizational process assets and enterprise environmental factors as you work your way through the Project Management Professional (PMP®) curriculum.

#### Organizational process assets

Organizational process assets are existing assets gained from an organization's processes and procedures or corporate knowledge base. They are used as inputs to the project management processes.

Examples of organizational process assets are:

* standardized organizational guidelines for completing work
* organizational policies and processes:
  + ethics policy
  + safety and health policy
  + recruitment policy
* performance measurement criteria
* project closure guidelines
* change control procedures
* quality policies and procedures
* historical information
* financial databases
* project files
* process measurement databases

#### Enterprise environmental factors

Enterprise environmental factors are internal and external factors that influence the circumstances around a project. They often provide constraints to project management.

Examples of enterprise environmental factors are:

* marketplace conditions
* stakeholder risk tolerances
* existing human resources
* organizational structure
* industry standards
* infrastructure:
  + existing facilities
  + capital equipment
* political climate

**Course:** Project Management Process Groups  
**Topic:** Project Management Processes

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# Job Aid

# Process Groups and Knowledge Areas

**Purpose:** Use this job aid to help you understand interactions between the process groups and knowledge areas.

| **Process group and knowledge area interactions** | | | | | |
| --- | --- | --- | --- | --- | --- |
| **Knowledge area** | **Initiating process group** | **Planning process group** | **Executing process group** | **Monitoring & Controlling process group** | **Closing process group** |
| **Project Integration Management** | Develop Project Charter | Develop Project Management Plan | Direct and Manage Project Execution | Monitor and Control Project Work  Perform Integrated Change Control | Close Project or Phase |
| **Project Scope Management** |  | Collect Requirements  Define Scope  Create Work Breakdown Structure |  | Verify Scope  Control Scope |  |
| **Project Time Management** |  | Define Activities  Sequence Activities  Estimate Activity Resources  Estimate Activity Durations  Develop Schedule |  | Control Schedule |  |
| **Project Cost Management** |  | Estimate Costs  Determine Budget |  | Control Costs |  |
| **Project Quality Management** |  | Plan Quality | Perform Quality Assurance | Perform Quality Control |  |
| **Project Human Resource Management** |  | Develop Human Resource Plan | Acquire Project Team  Develop Project Team  Manage Project Team |  |  |
| **Project Communications Management** | Identify Stakeholders | Plan Communications | Distribute Information  Manage Stakeholders Expectations | Report Performance |  |
| **Project Risk Management** |  | Plan Risk Management  Identify Risks  Perform Qualitative Risk Analysis  Perform Quantitative Risk Analysis  Plan Risk Responses |  | Monitor and Control Risks |  |
| **Project Procurement Management** |  | Plan Procurements | Conduct Procurements | Administer Procurements | Close Procurements |

Table 3-1; PMBOK® Guide - Fourth Edition

**Course:** Project Management Process Groups  
**Topic:** Course Overview

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Integrated initiation and planning

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# SkillBrief

# The Project Integration Management Knowledge Area

Projects are managed using processes from several knowledge areas, each of which relate to the knowledge needed to manage a particular aspect of a project.

The processes in each knowledge area are to represent five types of management activity.

## The process groups

Each process group has activities that Project Integration Management coordinates to meet a project's objectives:

* **Initiating** – The main task of this group is to develop the project charter, which signals the start of a project. Project Integration Management is responsible for coordinating the activities that go into doing this.
* **Planning** – This group develops the project management plan, which informs project stakeholders how the project is planned, executed, monitored and controlled, and closed. Subsidiary plans and baselines, such as the quality management plan, cost management plan, and scope statement comprise the body of the project management plan.
* **Executing** – This group ensures the project team carries out the work outlined in the project management plan. The project manager ensures the team correctly performs the work contained in the scope statement, follows the schedule, spends the budget, and communicates with stakeholders.
* **Monitoring & Controlling** – This group involves a series of activities that Project Integration Management coordinates. The project manager ensures that the scope, budget, schedule, quality, and risks are all controlled in an integrated way. This principle also applies to the way procurements are administered and progress is reported to stakeholders.
* **Closing** – A series of Closing processes finalizes all activities within a phase that is ending and across the project once all work is complete. This includes assessing performance of the project team and subcontractors, and asking whether they met the budget, delivered the work on time, fulfilled all requirements in the scope statement, and that all issues in the quality log have been signed off by the Quality Control team.

## The roles of Project Integration Management

As well as coordinating activities, Project Integration Management has the following roles:

* **manage stakeholder expectations** – A project manager needs to manage stakeholder expectations throughout a project's life cycle. Stakeholders include end users, customers, sponsors, and individuals or organizations that have an interest in the project. Stakeholders are likely to have different opinions on a project's objectives or priorities, so managing their expectations involves balancing the interests of all and creating an atmosphere of cooperation.
* **manage resource allocation** – The project management plan outlines which resources – such as materials, equipment, and facilities – are allocated to a project so it can meet all its objectives. As the project progresses, resource requirements may change, sometimes as a result of inefficient use or failure to deliver. A project manager needs to be in control of the project to reallocate resources at any stage of a project's life cycle, and fix and improve the plan where needed.
* **balance competing objectives** - Project managers need to balance the needs of a project's objectives and the knowledge areas. This means they need to achieve a project's objectives within scope, schedule, budget, and quality requirements. These factors are not static – they may change at any point of a project's life cycle. Project managers need to be aware of these changes so they can balance the new considerations and revise the project management plan.
* **find compromises and alternatives** - A project manager needs to find compromises among stakeholders whose ideas differ on aspects of a project so the project can be approved, planned, executed, monitored and controlled, and closed. A project manager also needs to find alternatives for processes that are not working as planned and could endanger a project's success.
* **balance objectives and knowledge areas** – The project manager ensures collaboration between the project's different activities by balancing the needs of objectives and knowledge areas. This may involve finding compromises between the two.

The main role of the Project Integration Management knowledge area is coordinating a project's processes so its objectives can be met in an organized way. Project Integration Management also entails managing stakeholders' expectations, resource allocation, and the needs of competing objectives and knowledge areas. Throughout a project, it involves finding compromises and alternatives to meet changing needs.

**Course:** Integrated Initiation and Planning  
**Topic:** What is Project Integration Management?

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# SkillBrief

# Interaction of Project Integration Management Processes

## Processes

Project Integration Management coordinates all project activities using a set of six processes that are distributed throughout the project life cycle:

* **Develop Project Charter** – Involves developing a document that outlines the initial requirements for a project, and the needs and expectations of stakeholders.
* **Develop Project Management Plan** – Involves documenting activities needed to execute, manage, and monitor a project. It brings all subsidiary plans together.
* **Direct and Manage Project Execution** – Involves carrying out and managing the activities detailed in the project management plan. These activities achieve a project's objectives.
* **Monitor and Control Project Work** – Involves tracking the progress of a project. It also involves taking corrective actions to ensure the project meets its performance objectives.
* **Perform Integrated Change Control** – Involves managing changes. It ensures that only approved changes are implemented and that plans are updated.
* **Close Project or Phase** – Involves finalizing all activities in a project or phase, including handing over the final product or service.

Each process is linked – the outputs from one process become inputs for one or more other processes.

## Develop Project Charter

The key inputs to this process are the

* **statement of work (SOW)** – The SOW specifies what product or service the project must create.
* **business case** – This explains why a project is justified from a business point of view by identifying the business need. It may include a cost benefit analysis.
* **contract** – A contract is a legally binding agreement that details the responsibilities of an external customer and of the organization running the project.

The output of the Develop Project Charter process is the project charter, which is an input to the Develop Project Management Plan process.

## Develop Project Management Plan

This process is iterated throughout the other process groups.

The subsidiary plans in the project management plan include

* the schedule
* budget plans
* quality plans
* communications plans
* risk plans
* process improvement plans
* procurement plans
* human resource plans

The project management plan is an input for all the other Project Integration Management processes.

## Direct and Manage Project Execution

As work is carried out, the project management plan may need to be updated. The updates become an output of the execution process and feed back into the Develop Project Management Plan process.

Other outputs of the execution process are

* **deliverables** – These are products or results of the project.
* **work performance information** – This is information includes deliverable status, schedule progress, and cost.
* **change requests** – These are requests for changes or adjustments to the way a project was initially planned.

Some of the outputs of the execution process are also the inputs to the Monitor and Control Project Work process.

## Monitor and Control Project Work

During this process, the project team compares actual project performance with planned performance. This is an iterative process.

The outputs of this process are

* change requests
* project management plan updates

These become the inputs to the Perform Integrated Change Control process as requests to change the project's

* scope
* policies
* processes
* plans
* procedures
* budgets
* schedules

The project manager and team review requests, approve changes, and manage them. This may result in project management plan updates, and the team implements the changes during the Direct and Manage Project Execution process.

## Close Project or Phase

Deliverables are the main input to this process. The project management plan is another input. It

* provides an overview of all the stakeholder requirements that the project or phase should have met
* contains the performance baselines that the project manager uses to evaluate overall project success
* The Project Integration Management knowledge area includes six processes – Develop Project Charter, Develop Project Management Plan, Direct and Manage Project Execution, Monitor and Control Project Work, Perform Integrated Change Control, and Close Project or Phase. Each process links through a system of inputs and outputs. Together, they coordinate all activities and other processes in the project life cycle.

**Course:** Integrated Initiation and Planning  
**Topic:** Project Integration Management and the Process Groups

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# SkillBrief

# Inputs to the Project Charter

## The project charter

A project charter is the first official document of a project. It identifies the rights and responsibilities of a project manager. The approval of the project charter formally acknowledges the project start.

The purpose of the project charter is to

* provide a high-level overview of how a project meets a specified business need. It includes constraints and assumptions, as well as an analysis of return on investment.
* outline the scope of the product or service a project must deliver. It includes a preliminary budget and a milestone schedule.
* define key project stakeholders and their expectations. It identifies the criteria stakeholders will use to decide if the project's result meets agreed requirements.

It also identifies key roles and responsibilities in the project team:

* **project manager** – Ideally, the project manager should have an active role in developing the project charter. The charter is what authorizes the manager to assign resources to project activities on a daily basis.
* **project sponsor** – The project sponsor has an executive role, and approves the project charter. The sponsor gets support for the project from stakeholders and the executive management team.

## Inputs

The two main inputs to this document are the business case and statement of work (SOW).

The business case

* explains why a project is necessary, and justifies the value of investing in a project
* assesses the initial risks that may impact the project's success. This includes evaluating the project timing, the impact of not doing the project now, and when the project is expected to show results.
* considers whether the project will comply with legal requirements and business mandates
* lists the impacts and benefits to all key stakeholders

The evaluation factors in the business case should be based on these kinds of careful analysis:

* **risk analysis** – This identifies, assesses, and prioritizes all project risks. These are potential pitfalls that could impede project progress.
* **alternative solution analysis** – This involves analyzing several possible ways to address a business need. This helps ensure the solution that will deliver the greatest value is the one chosen. The business case should contain a high-level summary of the overall impact of each alternative, and reasons for rejecting these.

Once the business case is approved, it becomes the starting point for the SOW.

The SOW provides a high-level description of the product, service, or result the project will deliver. It's a contractual document between the project sponsor or customer and the project team.

The SOW addresses these elements:

* **business need** – The SOW clearly states the business need a project must address and the work that is needed to develop an approved solution.
* **product scope description** – This details the characteristics of the product or service, and how these relate to the business need.
* **strategic plan** – The SOW considers whether the project supports the company's strategic goals and aligns to its strategic plan. It relates the work required to meet project objectives to this. The sponsors' input into the SOW is critical since they know how the project fits in with the organization's overall operation.

## Input providers

The parties that provide the SOW depend on the type of project:

* **external projects** – The buyer or customer provides the SOW as part of a bid document, proposal, or request for information. Once the SOW has been signed, the project may start. The SOW is then used to create the project charter.
* **internal projects** – The project initiator or sponsor usually writes the SOW as a formal way of establishing the parameters for the project. Once upper management approves, a project manager would be assigned to the project and the project charter created.

The project charter provides a high-level description of how a project will meet a specified business need. The key inputs are a formal business case and a SOW. The business case identifies the business need a project will meet and uses the results of analyses to demonstrate that the project is justified. The SOW summarizes the need identified in the business case, how it fits with an organization's strategic plan, and describes the required product scope. The SOW then forms an important part of the project charter.

**Course:** Integrated Initiation and Planning   
**Topic:** Project Charter Inputs: SOW and Business Case

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# SkillBrief

# How to Create a Project Charter

## Project charter inputs

The major inputs you'll rely on when developing the project charter are

* the business case
* the statement of work (SOW)
* a contract if there's an external customer
* enterprise environmental factors
* organizational process assets

The business case provides the justification for investing in a project from a corporate perspective. It assesses the project's value and feasibility, given a business need, and analyzes what value the project would have in terms of business benefits.

The SOW stipulates the high-level characteristics of the product or service the project must deliver. It indicates the relationship between the business need and the project's result. The SOW also considers the company's strategic plan

If there's an external customer for a project, a contract is needed. It identifies project terms and conditions, and fixes the degree of risk sharing between the buyer and the seller.

Enterprise environmental factors are conditions surrounding a project that can have an impact on its success. Here are some examples:

* **marketplace conditions** – These relate to supply and demand, and the economic factors that influence them. What goes into the project charter may be affected by these conditions.
* **organizational infrastructure** – Organizational infrastructure refers to a company's facilities and capital equipment. These may support project requirements. When you create the project charter you consider possible restrictions
* **available tools** – Available tools and resources you can use to support a project should be considered as part of developing the project charter. This will help the team leverage the assets that are already in place
* **personnel** – Personnel-related issues should be considered when creating the project charter. To complete the project on time, you may need to hire additional resources
* Organizational process assets may come from any or all of the organizations involved in a project. These are some examples:
* **processes and policies** – The process assets of all the organizations involved in the project are important. They may have formal and informal policies, procedures, plans, and guidelines whose effects must be considered. These standards for conducting work can influence a project's success
* **historical information** – Historical information that's relevant for a project charter includes what an organization has learned from previous projects, such as past project risks, schedules, and outcomes. These can give you useful insights for a new project of a similar type and scope. Many organizations keep a lessons learned knowledge base, which helps in storing and tracking historical information.

## Tools and techniques for developing the charter

For developing a project charter, the main technique is **expert judgment**. It is used to evaluate the inputs to the project charter. Judgment is expert when it's based on acquired expertise in a specific knowledge area, product area, or discipline.

An expert is someone recognized as a reliable source of knowledge or skills in a particular area.

Expert judgment is used to interpret data that goes into a project charter, and so make it reliable. Experts assist in defining the product and project requirements. Their capabilities can influence the project's outcome.

The types of experts who should help develop a project charter will depend on what the project is. Examples of experts are

* the project manager
* people with relevant expertise in other internal business units
* subject matter experts, such as consultants, customers, the project sponsor, or members of professional and technical associations, or industry groups

You can obtain expert judgment by using individual consultations and interviews. Or you could use focus groups or surveys.

The two key inputs for developing a project charter are the business case and the statement of work, or SOW. Other inputs include a contract, enterprise environmental factors, and organizational process assets. The main technique used to develop the project charter is expert judgment. The project manager and a selection of other, relevant experts use their judgment to interpret and assess inputs, and to help identify project and product requirements.

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**Topic:** Developing the Project Charter

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# Elements of the Project Charter

## The project charter

A project charter helps you map a project's direction in sufficient detail to achieve the desired results.

The process of developing the project charter falls in the Project Integration Management knowledge area. This is because the charter guides everything that follows in a project. It also feeds into all the other processes that have a role in guiding work and pulling everything together.

The process also fits in the Initiating process group. This is because its output – the project charter – serves as the green light for all subsequent planning activities to begin.

## Key elements

For a project charter to serve its function properly throughout a project, it must include specific elements:

* **the business need the project addresses** – The high-level business need is a summarized version of the business case. It describes the reason for initiating the project, specifically stating the business problem that the project will resolve.
* **measurable objectives and success criteria** – The project charter should also address the measurable business goals and objectives and factors that are deemed critical to the success of a project. This criterion is used to measure what must be done for the project to be acceptable to the stakeholders. You can obtain this data from the SOW.
* **project requirements** – The project requirements element of the project charter should state what is needed to perform the work to the required specifications. You can obtain this high-level information from the statement of work (SOW).
* **product scope description** – Another element the project charter should address is the product scope description, which you can obtain from the SOW. It describes the product to be delivered by the project. This helps you to translate the project objectives into tangible deliverables.
* **milestones and deliverables schedule** – This element of the project charter should be abridged from the SOW. The deliverables are a set of outputs for each milestone delivery date. This information provides checkpoints to monitor project progress and revalidate work.
* **summary budget** – The summary budget is an itemized forecast of estimated or intended expenditures assigned to a particular project activity over a set period. You can source this data from the business case.
* **approval requirements** – This element of the project charter is also abridged from the SOW. It should describe the quality objectives for each deliverable in terms of output standards and approval requirements. This includes all the product-related reviews and processes for acceptance testing that will be carried out during the project.
* **the name of the nominated project manager** – The project charter should explicitly name the project manager and provide a delineation of responsibilities. This element establishes the authority of the named individual to make decisions and lead the project.
* **project sponsor approval** – This element names the person who has ultimate responsibility for, and has the formal authority to approve the project charter. Approval indicates an understanding of the purpose and content described, and agrees that work should be initiated and necessary resources should be committed to the project.

Project charter approval formally initiates the project. As the first sanctioned document, it is distributed to key stakeholders. These may include the customer, the management team, and others who might be involved with the project. This marks the beginning of the planning phase of the project.

For a project charter to serve its function properly, it must tie the project to the ongoing work of the organization. The specific elements it must include are the business need the project will address, measurable objectives and related success criteria, high-level project requirements, a product scope description, a milestones and deliverables schedule, a summary budget, and approval requirements. Once approved by the project sponsor, the charter authorizes the project manager to assign resources to the project. It serves as the green light for all subsequent planning activities to begin.

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**Topic:** The Completed Project Charter

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# How a Project Starts

## Project triggers

Business needs trigger projects. It's these needs that projects exist to meet.

Business needs can spring from a lot of different sources, such as

* **customers' requests** – These requests can drive new projects by making it clear how a business can meet their needs.
* **changes in market demand** – Whether demand goes up or down, businesses need to adapt. They may use projects to capitalize on the changes, protect their interests, or meet new demands.
* **organizational needs** – Organizational needs relate to how businesses run. Like other types of business needs, these can trigger projects.
* **social needs** – As well as other types of needs, a business may address a social need. Environmental, political, and social changes can create needs among members of small groups or entire populations.
* **ecological impacts** – A project may be initiated to lessen the ecological impact on the environment.

A business may also need to meet legal requirements and standards. Regulatory types of needs and demands include

* **legal requirements** – new or existing laws can create the need for a project, to bring a business in line with the laws.
* **governmental standards** – Federal, state, and local agencies develop governmental standards that are in line with their objectives. When standards change, this often creates a need for changes to existing – or the development of new – products.
* Finally, a technological advance may create the need for a project, as well as required training.

## Project customers

A project takes its context from its customers, as well as from the business needs it must meet. All projects involve customer relationships.

In a project, you can classify each type of customer as one of the following:

* an internal customer
* an external customer
* a consumer

An internal customer is a person or group of people in your company who uses or depends on the result of a project.

An external customer is a buyer who has contracted your company to create a product or service. As the vendor or seller, your project will involve developing and supplying the product to the requesting company on fixed terms.

For this type of relationship, there will be a formal contract in place between the buyer and vendor companies. As project manager, you may find yourself as both the vendor and a buyer in a given project.

Another type of external customer is the consumer. In this case, the project is initiated to create a product for the public, so there is no contractual relationship with the customer or end user.

Different types of business needs trigger projects. For example, the need to address customer requests, changes in market demand, social needs, organizational, training, or legal requirements, and technological advances. The customers for a project add to its context. They may be internal or external customers, or consumers.

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# Project Management Plan Inputs

## Develop Project Management Plan process

During the Develop Project Management Plan process, the team develops a project management plan.

This plan is a formal document that defines how a project team will execute, monitor, control, and close a project. It brings together the planning that happens for all aspects of a project. This process fits in the Project Integration Management knowledge area, as well as in the Planning process group.

The plan integrates planning from all other knowledge areas. So it brings together plans for

* managing a project's scope
* the time the project will take
* the project cost
* managing the quality of deliverables
* communication with stakeholders and team members
* the resources required
* managing project risks
* the procurement of goods or services.

The project manager updates the project management plan when there are changes, so the Develop Project Management Plan process is iterative.

A plan's complexity depends on the project's complexity. At its most basic, the plan contains a description of the project, desired deliverables, and all the plans needed for the project to succeed.

## Inputs

There are five main inputs for the Develop Project Management Plan process:

* the project charter
* outputs from planning processes in the other knowledge areas
* enterprise environmental factors
* organizational process assets

### The project charter

* The project charter outlines the project's requirements, stakeholder expectations, resources, and formally authorizes the project.

You develop a detailed project management plan using the charter. The charter provides this information:

* an idea about the purpose of a project
* the project's objectives
* a summary milestone schedule
* a summary budget

Once developed, the project management plan contains

* a project overview
* a description of the business need the project must satisfy
* the success criteria
* composition of the project team
* subsidiary plans, such as the cost management plan
* the human resources plan

### Outputs from other planning processes

These include subsidiary plans and baselines.

Subsidiary plans are produced as outputs from the Planning processes for each of eight knowledge areas. They include plans for managing the project's scope, schedule, cost, quality, human resources, communications, risk, and procurement management plans.

### Enterprise environmental factors

* These are conditions surrounding a project that may affect its outcome, and may affect how you must manage aspects of a project. They include
* governmental regulations or industry standards
* project management information systems
* company infrastructure
* personnel administration issues
* organizational structure and culture

### Organizational process assets

* Several types of organizational process assets can affect the way you manage a project.

The following are examples of these:

* **standardized guidelines and policies** – These include an organization's standard processes, policies, and methodologies.
* **project management plan templates** – You can such a template that was used during a previous project if you know it will satisfy the specific requirements of the current project.
* **change control procedures** – These help you manage change during a project's life cycle. You can use a documented change approval procedure you've implemented successfully in the past.
* **project files from previous projects** – These can help you develop your project management plan. You can use scope or quality baselines, performance measurement baselines, or risk registers from previous projects.
* **historical information** – You need to research the historical information and knowledge bases of your company when you develop the project management plan. You can use experience and lessons learned.
* **the configuration management knowledge base** – This information may include versions and baselines of official company standards and procedures that you may want to include.

A project management plan is created through the Develop Project Management Plan process, in the Planning process group. It contains detailed information on how all aspects of the project will be managed. When you develop a project management plan, you use different inputs – the project charter, outputs from planning processes across other knowledge areas, enterprise environmental factors, and organizational process assets.

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# SkillBrief

# Putting Together the Project Management Plan

A project management plan is the output of the Develop Project Management Plan process.

## Expert judgment

Expert judgment is the technique you use to assess each input to the Develop Project Management Plan process.

You use your expertise and that of experts – people who have the skills, training, or specialized knowledge – to help you develop the project management plan.

You use expert judgment to

* tailor processes
* develop technical and management details
* determine resources and skill levels
* define configuration management levels
* specify change control procedures

## Process-related information

You incorporate this process-related information into the plan:

* **the project life cycle and its phases** – This breakdown makes the required work easier to manage, and helps map progress.
* **methods for performing project work** – This information helps you to plan and maintain control of each part of the project's life cycle.
* **project management processes that will achieve project goals** – This details the management processes you'll use, their implementation level, and how you'll tailor them using expert judgment. You also include the inputs for each process, the tools and techniques used, and the outputs.

## Control-related components

This control-related information should be included:

* **how to perform configuration management** – This describes the system you will use to track and control versions of deliverables, their components, and key documents.
* **how to control project changes** – This outlines how changes will be tracked and reported, how their impacts will be assessed, and who has the authority to approve changes. Included is the document control process.
* **how to monitor and manage issues** – This includes measuring and monitoring ongoing project activities, identifying corrective actions for project issues and risks, and outlining communication techniques with stakeholders.

## Performance-related information

This information includes the outputs of planning processes across different knowledge areas. These outputs include project baselines and the subsidiary management plans.

To control a project, you use project baselines to compare planned and actual performance.

These are some examples of project baselines:

* **a scope baseline** –This is composed of the project's scope statement, work breakdown structure – or WBS for short, and the WBS dictionary.
* **a schedule baseline** – You use this to develop a schedule and estimate the durations of individual activities based on available resources.
* **a cost performance baseline** – This is the authorized project budget.

Project baselines are combined to form a performance measurement baseline.

Subsidiary management plans represent the eight knowledge areas:

* **schedule** – Details the processes necessary to achieve on-time completion of the project.
* **cost** – Includes the project's budget, and description of processes involved in planning, controlling, and managing costs so the project can be completed within budget.
* **quality** – Includes all the activities that establish quality policies, objectives, and responsibilities so that the project will meet the needs for which it was undertaken.
* **process improvement** – Details how to analyze processes so you can take steps to make them more efficient. It defines process metrics and process configuration, and includes targets.
* **human resource** – Outlines how human resources requirements will be met. It details the roles and responsibilities of the people in the project.
* **communications** – Outlines what information must be communicated to specified stakeholders, by whom, and in what format.
* **risk** – Identifies and quantifies risk, and outlines responsibilities for managing risks, how contingency plans will be implemented, and how reserves will be allocated. It may include a probability and impact matrix.
* **procurement** – Details the processes necessary to purchase or acquire required materials, products, goods, and services. It outlines how the processes, from start to finish, will be managed.

The type of project determines the extent of the detail contained in the subsidiary plans.

You use expert judgment to develop the project management plan. Process-related information includes information about the project's life cycle and its phases, processes for performing project work, and the project management processes that will be used. Control-related information covers information on configuration management, change control processes, and how to monitor and manage project issues. Performance-related information includes project baselines, performance measurement baseline and subsidiary management plans. All this information is combined to form the project management plan.

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**Topic:** Assembling the Project Management Plan

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# Learning Aid

# Medical Supply Company Project Charter

**Purpose:** Use this learning aid to identify the section or sections missing from the project charter for the medical supply company relocation project.

| **Project charter** | |
| --- | --- |
| **Section** | **Description** |
| **Project title** | Puerto Rico relocation |
| **Project start date** | September 1 |
| **Project finish date** | August 1 |
| **Prepared by** | Rita Sanchez |
| **Measurable objectives and success criteria** | The objective of this project is to establish and launch a medical bandage supply facility in Puerto Rico that will be responsible for the production of 50% of the medical bandage products worldwide. This will reduce current production costs incurred in operating a medical bandage production facility in the Europe by 40%. |
| **Project requirements** | The project activities include   * packing and shipping machinery to Puerto Rico, where it will be converted for US power supplies and commissioned * translating operating procedures from English into Spanish * training operators to work the production line * training quality management staff to inspect and test the products in the new location |
| **Milestones and deliverables schedule** | Sep 10 – Project kickoff   Oct 12 – Complete planning the organizational change program  Dec 20 – Complete translation of operating procedures  Jan 15 – Train offshore operators and quality management staff  Feb 25 – Relocate operations and assess post-implementation needs  Jul 1 – Manage organizational impacts |
| **Summary budget** | Medical products company project total – $587,650  Machinery – Relocating production line: $288,000  Facility – Setting up production line machinery and equipment: $182,240  Training – $117,410 |
| **Approval requirements** | Appendix 1 – Acceptance Process  Appendix 2 – Quality Standards |
| **Nominated project manager** | **Rita Sanchez**  **Authority:**  Manage and integrate all processes to accomplish project objectives within defined procedures.  **Appendix 3** – Role and responsibilities |

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**Topic:** The Completed Project Charter

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# Learning Aid

# Cosmetics Company Project Charter

**Purpose:** Use this learning aid to identify the section or sections missing from the project charter for the cosmetics company remote access project.

| **Project charter** | |
| --- | --- |
| **Section** | **Description** |
| **Project title** | Remote access sales |
| **Project start date** | November 15 |
| **Project finish date** | September 30 |
| **Project manager** | Michelle Sargent |
| **Business need** | There is a business need to provide the field sales force with remote access to the corporate network. This initiative will give the business an edge and rival competitors' products and services.  Appendix 1 – Financial Analyses |
| **Measurable objectives and success criteria** | The objectives of the project are to provide sales agents with remote access to retail account details and enable them to enter sales orders. This strategy will improve business performance and increase sales by 25% for the third quarter. |
| **Project requirements** | The project team must   * purchase 200 laptops * set up Internet service provider accounts for each of the agents * install a virtual private network (VPN) server at the company's headquarters * implement information security policies * design sales order templates * provide a route for centralized support and administration * deliver a method for reliable backup * create a systems training program |
| **Product scope description** | The field sales force will have remote access to the corporate network to access sales order processing and customer relationship management information. When the sales agents access retail accounts, they will be able to secure orders and estimate future demands for products. |
| **Summary budget** | $80,000  Appendix 2 – Budget Tables |
| **Project sponsor approval** | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Michelle Adams  Systems analyst director |

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**Topic:** The Completed Project Charter

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# Learning Aid

# Internet Service Provider Project Charter

**Purpose:** Use this aid to review the project charter from the Internet service provider outsourcing project.

**Instructions for use:**

| **Project charter elements** | |
| --- | --- |
| **Heading** | **Description** |
| **Project Title** | Technical support - India |
| **Project Start Date** | January 1 |
| **Project Finish Date** | December 31 |
| **Prepared By** | Amrit Khan |
| **Dated** | November 31 |
| **Project Requirements** | The outsourcing of inbound technical support administration offshore project will involve   * linking the offshore facility to the corporate computer network using LAN technology, firewall and secure VPN for remote access * installing a multiplex management system that will be designed and configured by the offshore facility to provide tailored technical support services through email, chat, voice and the web to customers worldwide * compiling all product-related queries and problems in usage posed by customers to the offshore facility into database which can be fed back into the development process to make product and service improvements * training offshore agents on all in-house products and services |
| **Product Scope Description** | The offshore facility will be linked to the corporate computer network using LAN technology, firewall, and secure VPN for remote access.  The offshore facility will provide customized technology to support services through email, chat, voice and the web. This software will include real time and historical reporting functionality to control and monitor quality.  Offshore agents will receive training via e-learning videos, web-based training software and online manuals to provide high-quality technical support to global customers. |
| **Milestones and Deliverables Schedule** | **Phase 1:**   Analyze the current system (Jan-Feb)  **Phase 2:**   Create a shared vision for the new system (Mar-May)  **Phase 3:**   Blueprint for future tech support operations (Jun-Jul)  **Phase 4:**   Train offshore agents (Aug-Sep)  **Phase 5:**   Implementation and rollout (Oct-Dec) |
| **Approval requirements** | **Acceptance process:**   * End users have 10 business days from initial delivery to confirm that a deliverable substantially conforms to the specifications. * If an end user does not provide notice to the Project Management Office during the 10 day period, the deliverable will be deemed accepted. * Should any deliverable be rejected, specific reasons must be supplied to the Project Management Office who have 10 business days (or longer, if mutually agreed upon in writing) to correct the issues identified. The deliverable will then be resubmitted to the acceptance process.   **Appendix 5** –Quality Specifications |
| **Project Manager Role** | **Amrit Khan**  **Role:**  Manage the project team to successfully complete the project on time, within budget and according to requirements.  **Responsibility:**   * Analyze and understand the scope, product requirements, assumptions, and constraints. * Develop the project management plan and all subsidiary plans. * Lead the project team in the creation of all project deliverables. * Track and report on overall project progress and performance. * Manage the project's budget. * Balance the competing demands for quality, scope, time and cost. * Perform risk management to control project scope and quality. * Interface with all stakeholders and manage their expectations.   **Authority:**   * Assemble the project team in coordination with the project sponsor. * Manage the project team to the agreed schedule. * Negotiate and approve requirements and changes to project goals, scope and timeline as necessary. * Adapt the project management plan to the needs of the project. |
| **Project Sponsor Approval** | Signing this document records your agreement to the contents of the Project Charter, and confirms the order to proceed with the project.    \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  **Catherine Barden**  Vice President of Operations |

**Course:** Integrated Initiation and Planning  
**Topic:** The Completed Project Charter

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# Job Aid

# Project Charter Elements

**Purpose:** Use this job aid to review the required elements of a project charter.

| **Project charter elements** | |
| --- | --- |
| **Element heading** | **Element description** |
| **Business need** | Describes the business reason for initiating the project, specifically stating the business problem that the project will resolve. |
| **Measurable objectives and success criteria** | Defines the measurable business goals and objectives and factors that are deemed critical to the success of a project. These criteria are used to measure what must be done for the project to be acceptable to stakeholders. |
| **Project requirements** | Describes what is needed to perform the work to the required specifications. |
| **Product scope description** | Describes the product to be delivered and establishes the boundaries of the project. |
| **Milestones and deliverables schedule** | Describes the deliverables which are a set of outputs for each milestone delivery date. This information provides checkpoints for monitoring project progress and validating work. |
| **Summary budget** | Provides an itemized forecast of estimated or intended expenditures. |
| **Approval requirements** | Describes the quality objectives for each deliverable in terms of output standards and approval requirements. This includes all the product-related reviews and processes that will be carried out during the project. |
| **Nominated project manager** | Establishes the authority of the named individual to make decisions and lead the project, and identifies this person's main responsibilities and their authority level. |
| **Project sponsor approval** | Names the person who has ultimate responsibility for the project and who has the formal authority to approve the project charter. |

**Course:** Integrated Initiation and Planning  
**Topic:** The Completed Project Charter

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# Job Aid

# Project Management Plan Template

**Purpose:** Use this job aid to review the types of information that should be included in a project management plan.

## 1.0 Introduction

This section of the project management plan provides an overview of the project. For example, it may contain a project summary, and a summary of the purpose, scope, and project objectives. You can tailor this section as needed to provide additional subsections in which your project may be more fully described. The following is an example of a high-level project overview:

A cosmetics company is planning to provide its field sales force with remote access to the corporate network to access sales order processing and customer relationship management information when the sales agents are on the road. When the sales agents visit retail accounts, they secure orders and estimate future demands for products. They will use remote access to enter the sales orders directly into the corporate system.

## 2.0 Scope

The scope section defines the purpose, scope, and objectives of the project. This usually includes a brief statement of the business needs to be satisfied by the project, a summary of the project objectives, the products to be delivered to satisfy those objectives, and the methods by which satisfaction will be determined. This section also includes a work breakdown structure (WBS), which specifies the various work activities to be performed in the project. The following is an example of the kinds of information that would be included in the scope section of a project management plan.

### Objectives and deliverables

The project comprises all activities required to provide 200 sales agents with remote access to the corporate network. This will involve purchasing 200 laptops, setting up an Internet service provider account for each of the agents, installing a virtual private network (VPN) server at the company headquarters, and training the sales agents to use the new system.

Project deliverables are as follows:

* correctly configured laptops
* VPN server
* training and testing programs
* Internet connections

### 2.1 Scope planning and definition

The project will be carried out in five main phases:

Phase I:    Secure agreement with the Internet service provider (ISP)

Phase II:    Order/install equipment

Phase III:    Install/test software

Phase IV:    Conduct hardware/software testing

Phase V:    Conduct training

Following acquisition of an ISP service agreement and software revision, the project manager, in consultation with the web access management team, will develop a detailed project scope statement. The detailed project scope statement will contain a thorough technical specification of the web access solution architecture, server and software implementation, and training and testing procedures.

#### 2.1.1 Project assumptions:

* The infrastructure of the company network is robust enough to support 200 remote users and the network volume this will generate.
* Users can get through network security constraints.

#### 2.1.2 Project constraints:

* user experience with laptops
* user comfort with remote access
* limited connectivity
* capacity to place orders while off-line

### 2.2 Work Breakdown Structure

From the detailed project scope statement, a detailed, multi-level WBS will be created. The WBS will break down the project deliverables into work packages to a level of detail that can be controlled for cost, schedule, and quality. The initial work breakdown structure is as follows:

#### 2.2.1 VPN server

2.2.1.1 Research

2.2.1.2 Purchase

2.2.1.3 Infrastructure updates

2.2.1.4 Select and implement VPN solutions

#### 2.2.2 Internet connection

2.2.2.1 Resolve security issues

2.2.2.2 Identify and support multiple internet connectivity options

#### 2.2.3 Testing

2.2.3.1 Software

2.2.3.2 Connectivity

2.2.3.3 Data transfer

#### 2.2.4 Training

2.2.4.1 Analysis

2.2.4.2 Design

2.2.4.3 Develop

2.2.4.4 Implement

2.2.4.5 Evaluate

### 2.3 Scope control

Scope changes can generally be classified as external or internal. External scope changes are those scope changes that are originated by the customer or other external parties. Internal scope changes are those originated by the project team during the execution of the project. All scope changes requested will be documented on a change request form and will be investigated by the project manager or the project team for their effect on cost, schedule, and quality. When the full implications of the scope change are known, the scope change request will be approved or rejected by the project manager and the project sponsor.

### 2.4 Scope verification

As each major deliverable is completed, it will be approved and signed off by the project manager. Formal sign-off of deliverables will be documented on a deliverable acceptance form.

## 3.0 Schedule

The schedule section of the project management plan provides a summary of the schedule for the project, which serves as the schedule baseline. The level of detail is usually restricted to an itemization of the major work activities and supporting processes as, for example, those depicted by the top level of the work breakdown structure. The following is an example of the kinds of information that would be included in the schedule section of a project management plan.

### 3.1 Projected schedule milestones:

Software revision    January 5

VPN server availability    January 20

Laptops received    February 1

Laptops configured    February 25

Order processing capability verified    March 15

Beta test results received    April 1

Training completed    May 15

## 4.0 Cost management

This section of the project management plan provides a summary of the project's budget, which serves as the cost performance baseline for the project. The following is an example of the kinds of information that would be included in the cost management section of a project management plan.

Detailed cost estimates will be produced using a project management software application, which will list costs for materials and labor at the level of the work package or lowest level of detail of the WBS.

|  |  |
| --- | --- |
| **Initial order-of-magnitude estimates** | |
| **Laptops** | $450,000 |
| **Software** | $15,000 |
| **Development costs** | $48,000 |
| **Training materials** | $25,000 |
| **Internet accounts** | $6,000 |
| **VPN servers** | $25,000 |
| **Related infrastructure upgrades** | $200,000 |
| **Grand total** | **$769,000** |

The detailed cost estimate will be rolled up through each level of the WBS, and costs will be tracked at all levels.

The detailed cost estimate will be used as a baseline for the project, and all project expenditures will be tracked and compared against this baseline. Earned value analysis will be used to track the cost of work performed and to estimate costs at completion.

Cost variations of greater than 10% of estimates will require formal approval by the project manager and will be handled by means of the change management system.

## 5.0 Quality

The quality control section of the project management plan specifies the mechanisms to be used to measure and control the quality of the work processes and the resulting work products. The following is an example of the kinds of information that would be included in the quality control section of a project management plan.

Overall project quality goals are to meet the acceptance criteria, which are defined as follows:

* As a minimum, the web access solution will require functional and operational readiness testing to ensure that the processes and procedures are in place to allow the system to be used and maintained. This includes testing physical connectivity, user access to network resources, user authentication and security issues, maintenance procedures, and user training.
* The project will be carried out in accordance with the organizations documented ISO9000 quality procedures.
* The quality manager is responsible for overall project quality and will ensure that a high level of customer satisfaction is achieved by ensuring conformance to requirements and preventing poor quality.
* A quality management plan will be drawn up that details all activities necessary to achieve project quality, including quality metrics and quality checklists.
* The quality manager will be responsible for carrying out audits, reviews, and design walk-throughs to ensure that project work meets a high standard of quality.
* All completed project work will be subject to inspection to verify that it conforms to specification and drawing details.
* The quality manager will be responsible for implementing a philosophy of continuous improvement, and all project work will follow a plan-do-check-act cycle.

## 6.0 Human resources

The human resources section of the project management plan specifies how human resources requirements will be met. It may also contain details of the roles and responsibilities of the people who will be needed to complete the project work. The following is an example of the kinds of information that would be included in the human resources section of a project management plan.

The project organizational structure will include the following management positions:

* technical design manager
* quality manager
* network administration manager
* purchasing and accounts manager

Managers will be responsible for identifying the resources required for each of their areas of responsibility. Roles and responsibilities will be identified, and all details will be maintained in a staffing management plan maintained by the project manager.

The individual managers together with the project manager will be responsible for selecting appropriately skilled personnel. Where possible, resources will be drawn from the organization's current staff. Where additional resources are required, the project manager and individual managers will advertise, select, and interview candidates for the relevant positions.

Existing organizational human resources procedures will be used for the selection and hiring of project staff. Project team members and personnel will be assigned responsibility for individual tasks, and resource calendars will be issued that detail what tasks are assigned and their start and finish dates.

Where necessary, appropriate training will be provided to project staff to enable them to perform the tasks assigned to them. Project staff appraisal will be carried out that will take account of the performance of project tasks in respect of quality of work, cost, and timeliness.

## 7.0 Communications

The communications section of the project management plan specifies the information that must be communicated to specified stakeholders, the reporting mechanisms, and the methods, tools, and techniques of communication within the project. The following is an example of the kinds of information that would be included in the communications section of a project management plan.

The project manager is responsible for ensuring timely and appropriate communication of project performance and issues to all project stakeholders.

A communication management plan will be drawn up that will detail what information will be communicated to whom and in what format.

Work performance information will be supplied to the project manager by individual managers on a weekly basis. Detailed project reports of overall project status, including progress and issues, will be circulated to the individual managers responsible for project execution. A monthly status report on project progress will be issued to the project sponsor.

The project manager will be responsible for updating this project management plan and its subsidiary plans and issuing the updated plans to the project team members.

## 8.0 Risks

This section of the project management plan specifies the risk management plan for identifying, analyzing, and prioritizing project risk factors. It also describes the procedures for contingency planning, and the methods to be used in tracking the various risk factors, evaluating changes in the levels of risk factors, and the responses to those changes. The following is an example of the kinds of information that would be included in the risks section of a project management plan.

The following risks have been identified, and may affect the schedule, cost, or quality of the completed infrastructure:

* infrastructure instability
* software incompatibility with legacy system
* hardware failure
* interconnectivity failure
* delays in hardware delivery

The project manager and the project team are responsible for planning and managing risk in the project. A detailed risk management plan will be prepared. Regular risk planning meetings with the project manager and team will be held to carry out documentation reviews and analyze project assumptions to detail and expand on the initial list of risks and to produce and update a risk register. Risks will be assessed for probability of occurrence and potential effect on the project and will be ranked accordingly. The project manager will be responsible for analyzing the overall effect of risk on project cost, and schedule objectives and contingency calculations will be prepared.

Risk responses will be formulated that will seek to avoid, transfer, or mitigate negative risk and to exploit, share, and enhance positive risk.

## 9.0 Procurement

The procurement management plan details the processes necessary to purchase or acquire required materials, products, goods, and services. It outlines how the processes, from developing procurement documentation through contract closure, will be managed. The following is an example of the kinds of information that would be included in the procurement section of a project management plan.

The project manager, in collaboration with individual managers, will review the work packages and activities of the lowest level of the WBS and will arrive at make or buy decisions based on the availability of resources and project expertise.

From this analysis, a detailed project procurement plan will be produced that details the procurement requirements of the project. From the detailed procurement plan and project specifications and drawings, the purchasing and accounts manager will prepare documents for a request for quote (RFQ). The project manager and individual managers will prepare a list of qualified sellers who, in their opinion, are most capable of performing the work. RFQs will be issued to this qualified list of sellers.

A minimum of three responses or quotations must be obtained. The project manager, together with the purchasing and accounts manager, will generally select the lowest cost quotation; however, where the lowest cost seller is not selected, the reasons why it has not been selected will be formally documented.

The purchasing and accounts manager, together with the project manager, will carry out negotiations and draw up the contract with the selected seller. Work carried out under contract will be subject to the same change management system as noncontract work.

Work carried out under contract will be subject to quality inspection to verify that it meets the needs of the project.

Work carried out under contract will be assessed for performance with respect to cost and schedule. Completed contracts will be marked as completed and filed with quality and performance reports for their work.

## 10.0 Configuration management

The configuration management section of the project management plan specifies the processes of configuration management, configuration identification, document control, status accounting, evaluation, and release management. The following is an example of the kinds of information that would be included in the configuration management section of a project management plan.

All project work will be carried out with reference to the approved current version of project specifications, drawings, and documentation.

Master files of approved current project documentation will be maintained in the project library of the project management information system.

All documents will list their revision level along with approval initials and a history of previous changes.

All copies of previous versions or outdated documents will be removed from the project site when they are replaced with a new version.

## 11.0 Change control

The change control section of the project management plan documents the procedures for tracking changes, logging and analysis of change requests, and procedures for notifying concerned parties when changes are made. The following is an example of the kinds of information that would be included in the change control section of a project management plan.

All project documentation will be subject to change control.

Details of proposed changes will be filled in on a change request form along with appropriate supporting detail, including specifications and drawings.

Change requests will be submitted to the project manager for evaluation and approval. The project manager or their delegate will assess the change for its effect on project cost, quality, and schedule.

Where changes include a change to project scope or where costs exceed 10% of estimates, the change will be subject to the approval of the project sponsor. In all other cases, changes will be subject to approval by the project manager.

Formal approval will be indicated by the required signature of the change request form.

Approved change requests will be assigned to individual project team members for implementation. On completion of the change, the assigned team member will sign the change request form as completed.

**Course:** Integrated Initiation and Planning  
**Topic:** Assembling the Project Management Plan

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Integrated Project Execution, Monitoring, and Control

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# SkillBrief

# Directing and Managing Project Execution Activities and Inputs

The Direct and Manage Project Execution process carries out the work identified in the project management plan, to achieve a project's objectives and create its deliverables.

## Process activities

The Direct and Manage Project Execution process falls within the Project Integration Management knowledge area. Because Project Integration Management is all about integrating the different aspects of a project, the activities that make up the Direct and Manage Project Execution process span across other knowledge areas.

For example, activities of this process include

* process improvements – categorized in the Project Quality Management knowledge area
* assigning, training, and managing the project team members – which falls in the Project Human Resource Management knowledge area
* establishing and maintaining internal and external communication channels – which falls within the Project Communications Management knowledge area
* managing identified risks and executing risk response activities – categorized as part of the Project Risk Management knowledge area
* obtaining and managing the resources that the project team needs – which falls within the Project Procurement Management knowledge area

The activities in the Direct and Manage Project Execution process are linked to other processes in the Project Integration Management knowledge area. This is because you use the outputs of these activities as inputs to the Monitor and Control Project Work and Close Project or Phase processes.

Some important activities performed during the Direct and Manage Project Execution process are

* generating work performance information
* executing approved changes
* issuing change requests
* documenting lessons learned

### Generating work performance information

The work performance information generated during the Direct and Manage Project Execution process is used to monitor and control progress, and to create forecasts to determine when work will be completed.

The work performance information generated relates to a project's

* costs
* schedule
* status of deliverables

Work performance information creates inputs for the Monitor and Control Project Work process.

### Executing approved changes

Direct and Manage Project Execution involves executing changes made to the project management plan, once these changes have been approved.

For example, where corrective actions must be taken to ensure project performance is in line with targets, the Direct and Manage Project Execution process is responsible for implementing these actions. This activity lines up with the Project Integration Management knowledge area.

### Issuing change requests

The Direct and Manage Project Execution process involves issuing change requests to prevent negative outcomes, such as repair requests to correct product defects reported during the Perform Quality Control process. This activity ties in with the Project Quality Management knowledge area.

### Documenting lessons learned

During the Direct and Manage Project Execution process, the lessons learned as the project is executed are recorded. This action corresponds to the Project Integration Management knowledge area.

## Process inputs

The Direct and Manage Project Execution process uses four inputs:

* the project management plan
* approved change requests
* enterprise environmental factors
* organizational process assets

### The project management plan

The project management plan sets out how a project will be executed, and defines how it should be monitored, controlled, and closed. As an input to the Direct and Manage Project Execution process, it tells the project team how to execute the work to create the project deliverables.

It also sets out how changes must be monitored and controlled. The project manager needs this information when implementing process improvements and generating the data that will be used to monitor project activities.

The project management plan provides information on how to sustain performance measurement baselines. The project manager uses this information to implement process improvements and collect work performance information.

Techniques for communicating with stakeholders are also part of the project management plan. The project manager uses this information to establish communication channels.

### Approved change requests

Approved change requests expand or reduce the scope of a project. They are recorded in the project management plan and subsidiary plans. Sometimes approved change requests call for preventive or corrective actions to be taken. Actions like these are performed during the Direct and Manage Project Execution process.

### Enterprise environmental factors

Enterprise environmental factors are conditions surrounding a project, like available resources and market conditions that can influence its success.

There enterprise environmental factors that may be used as inputs to the Direct and Manage Project Execution process include

* company structure and culture
* infrastructure
* human resource administration
* stakeholder risk tolerance
* project management information systems

#### Company structure and culture

Company structure and culture influences the way a project is executed because the work must be done within these boundaries.

#### Infrastructure

The infrastructure of the organization – such as its facilities and equipment – provides the means by which the project work is executed.

#### Human resource administration

Human resource administration provides guidelines for hiring and firing procedures, training, and how to conduct performance reviews. The project manager uses these guidelines when choosing, training, and managing the staff for a project.

#### Stakeholder risk tolerance

During the Direct and Manage Project Execution process, the project manager is responsible for managing identified risks and executing risk response activities. The project manager has to factor in the tolerance of stakeholders to risk when doing this.

#### Project management information systems

Project management information systems may include software tools that automate tasks, such as scheduling, gathering information, and creating data reports. These tools help the project manager generate work performance information to forecast when objectives will be met.

### Organizational process assets

Organizational process assets include the plans, guidelines, policies, and procedures used to guide the project work while it's executed. Recorded knowledge, such as lessons learned, is also an organizational process asset.

The Direct and Manage Project Execution process involves carrying out the work specified in the project management plan to meet a project's requirements. Some activities the project manager performs during this process include managing a project team, establishing and maintaining communication channels, managing risks and implementing risk responses, generating work performance information, implementing process improvements, and managing resources.

Inputs to the Direct and Manage Project Execution process are the project management plan, approved change requests, enterprise environmental factors, and organizational process assets.

**Course:** Integrated Project Execution, Monitoring, and Control  
**Topic:** Inputs to Directing and Managing Project Execution

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# Outputs of the Direct and Manage Project Execution Process

The outputs that you generate during the Direct and Manage Project Execution process are

* project deliverables
* work performance information
* change requests
* project management plan updates
* project document updates

## Project deliverables

Project deliverables are the outcomes specified in the project management plan that are achieved through the execution of the project. They include products, results, or services – or a combination of these.

## Work performance information

Work performance information is an output of the activities the project manager performs to keep track of how the project is progressing. This information is collected to determine project performance in terms of factors like costs, the status of project deliverables, and scheduling.

## Change requests

Change requests are issued during the execution of a project to ensure that project goals are met. These changes may expand or reduce the project's scope. They may also modify policies or procedures, modify the budget, or adjust the schedule.

Change requests are created by members of the project team who notice issues while performing the work. The requests are then reviewed by the project manager and dealt with during the Perform Integrated Change Control process.

Change requests may be issued to

* correct actions
* prevent actions
* update project documentation

### Corrective actions

Corrective change requests aim to bring project performance in line with the project management plan. They may also address defects, discovered during quality inspections, that need to be repaired.

### Preventive actions

Preventive change requests reduce the occurrence of negative outcomes that may result because of identified risks.

### Update project documentation

Change requests may involve updating formal project documentation, such as project plans and standards, so they are kept current and reflect any changes or modifications made.

Updates are added to the project management plan throughout the life of a project. So project management plan updates are an output of many of the project management processes, including the Direct and Manage Project Execution process. These updates may relate to human resources, costs, project requirements, project baselines, methods of communication, and the project schedule.

As a project is executed, it creates outputs, which in turn are used in other project management processes. The outputs generated during the Direct and Manage Project Execution process are deliverables, work performance information, change requests, project management plan updates, and project document updates.

**Course:** Integrated Project Execution, Monitoring, and Control  
**Topic:** Products of Integrated Project Execution

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# SkillBrief

# Tools to Direct and Manage Project Execution

There are two important tools you can use to direct and manage the execution of a project. These are

* expert judgment
* project management information systems

## Expert judgment

Expert judgment is one of the tools that a project manager uses to direct and manage the execution of a project. Managers might use their own judgment or consult with an expert.

Where a project manager has the necessary knowledge and experience required to inform a decision relating to the project, they use their own expert judgment. But in situations where a project manager doesn't have the required knowledge, they consult other people who have expertise in that area and are thus able to exercise their expert judgment.

Possible sources of expert judgment for a project include the project manager, people on the project team, consultants, and members of professional and technical associations. They also include people in other branches of the organization, and stakeholders such as sponsors and customers.

As a project manager, you use expert judgment to assess the inputs of the Direct and Manage Project Execution process. This is what ensures you interpret and respond to the inputs in a way that aligns to the project management plan, while project work is executed.

## Project management information systems

In addition to expert judgment, an important tool for directing and managing project execution is a project management information system. This is a system that gathers, records, filters, and disseminates information.

Project managers use various project management information systems to manage project execution. These can include

* project management programs
* collaboration software
* knowledge management software
* accounting programs
* configuration management systems

Project management information systems usually have one or more capabilities in common:

* they enable the project manager to update the project management plan and publish team task assignments
* they allow team members to receive and view tasks assigned to them by the project manager via collaboration software, including e-mail or a browser-based tool
* they inform team members about tasks being assigned or changed

During the Direct and Manage Project Execution process, project managers use expert judgment to assess inputs and manage project work appropriately. They may use their own expert judgment where they have the necessary knowledge, and the expert judgment of others – such as consultants or technical experts.

Project managers also use project management information systems to gather, record, filter, and disseminate information. Examples of these systems include project management programs, collaborative software, knowledge management software, accounting programs, and configuration management systems.

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# SkillBrief

# Controlling Project Work Performance

To monitor and control a project, you need to answer three questions:

* What is needed to determine how the project is performing?
* How do I measure performance?
* How do I address the issues that arise?

## Inputs

There are four main inputs you need for the Monitor and Control Project Work process, which tell you how a project is performing. These include

* the project management plan
* performance reports
* enterprise environmental factors
* organizational process assets

### Project management plan

The project management plan sets out how the project will be carried out, monitored and controlled, and closed. It also includes project baselines for all the knowledge areas. For the purposes of the Monitor and Control Project Work process, the baselines you need as inputs are for

* cost
* time
* scope
* quality

#### Cost

The cost baseline is part of the planned budget. You compare actual costs to the baseline to check that a project is staying within budget and to make changes where necessary.

#### Time

The time baseline is the planned schedule, including important deadlines and delivery dates. You compare actual progress in completing activities against this schedule to ensure a project will be completed on time.

#### Scope

The scope baseline includes the work breakdown structure (WBS) and the WBS dictionary. The WBS breaks down a project and its deliverables into smaller, more manageable components. The dictionary describes the components of the WBS.

#### Quality

The elements of the quality baseline are the standards and acceptance criteria for the project. You compare these to the components or deliverables being created to make sure they're on track to meet requirements.

### Performance reports

You and your project team prepare performance reports using raw performance information. Performance reports include information about

* the current status of the project
* accomplishments for a set period
* scheduled activities
* problems or issues

### Enterprise environmental factors

Enterprise environmental factors are external or internal factors that can impact a project. Some key factors are government and industry standards, stakeholder risk tolerances, and project management information systems.

Enterprise environmental factors often place constraints on project work, so they influence the criteria against which the project is monitored and controlled.

### Organizational process assets

Organizational process assets include organizational processes that may impact the project, as well as historical information and lessons learned from other projects. You use organizational process assets to define how change requests are submitted, approved, and applied.

## Analyzing project performance

You measure performance by subtracting actual performance from planned performance. You can use many formulas and applications to calculate deviations.

First you must know what types of performance you want to measure. These could relate to a project's

* scope
* time
* cost
* quality

### Scope

When measuring scope performance, you inspect deliverables or their components to assess whether they meet the scope baseline. The process that governs this is the Control Scope process.

### Time

You measure time performance by examining the actual schedule to determine if the work is being carried out and completed as planned. You do this as part of the Control Schedule process.

### Cost

You measure cost performance by comparing actual costs to those in the cost baseline. This is part of the Control Costs process.

### Quality

You measure quality performance by totaling any defects in the product or service you're creating and by comparing actual quality to the quality baseline. This is part of the Perform Quality Control process. Once you've used expert judgment to measure performance in all the key areas, you'll be able to identify where corrective action is needed.

## Project control activities

Once you've measured a project's performance, what do you do if actual performance isn't on track? As with measuring performance, this takes expert judgment. You need to assess if a deviation from plan is significant.

If a deviation is a threat to the success of a project, the next step is to determine what action is required to correct it. However, a project can handle a certain amount of variance. You should decide on that threshold early on.

If a deviation is significant, you use one of three types of action to bring performance back in line. These are

* corrective action
* preventive action
* defect repair

### Corrective action

Corrective action is used when you need to repair a deviation that has already occurred or to stop it from recurring in the future. For example, deviations found during a quality review require corrective action.

### Preventive action

Preventive action is used to stop a potential deviation from occurring. For example, if you know that some team members are resigning, there is a risk that the project will fall behind schedule. This requires preventive action.

### Defect repair

Defect repair is the action of correcting product defects found during the Perform Quality Assurance and Perform Quality Control processes. The objective is to bring the product or service back in line with specifications and requirements. Once you've identified the type of project control activity needed, you must determine how to apply it to correct the deviation. For example, a corrective action to address cost overruns might be to add more money to the budget.

The Monitor and Control Project Work process uses six inputs – the project management plan, work performance information, performance reports, forecasts, enterprise environmental factors, and organizational process assets.

Once you've gathered the inputs, you use expert judgment to measure project performance. This involves comparing actual to planned performance, and identifying significant deviations.

If a deviation is significant, there are three types of action you can take – corrective, preventive, and defect repair.

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# SkillBrief

# Outputs of the Monitor and Control Project Work process

The results, or outputs, of the Monitor and Control Project Work process help ensure that your project stays on track and meets objectives. This process also affects other areas of the project.

While you monitor and control project work, you often have to suggest changes to get things back on track or prevent future problems. If these changes are approved, they can impact a project's baselines. So updates to cost performance, quality, scope, and schedule baselines are one output of the process.

There are four principles for updating baselines:

* change requests often lead to project baseline adjustments
* changes to one baseline typically affect other baselines as well
* if baselines aren't adjusted, future monitoring and controlling will be skewed
* project baselines may be increased or decreased

Besides updates to the project baselines, there are three other outputs of the Monitor and Control Project Work process:

* change requests
* project management plan updates
* project document updates

## Change requests

You issue change requests to recommend corrective or preventive action, or to repair defects. For instance, you might issue a change request to incorporate a feature a client requests in a software program. If the request is approved, work to add the feature can go ahead.

## Project management plan updates

Project management plan updates include updates to project baselines and subsidiary project management plans. Say a change to add a feature to a software program has been approved. You need to update the baselines and relevant subsidiary plans based on the new work that's required to add and test the feature.

## Project document updates

Examples of project documents are work instructions, the project risk register, and the resource calendar. As changes are made to the project, all documents containing information impacted by the changes must be updated.

When you monitor and control project work, your aim is to ensure that the project meets its objectives despite unexpected deviations from the plan. You achieve this through the Monitor and Control Project Work process.

The outputs of this process are change requests, project management plan updates, project document updates, and updates to the project baselines.

Change requests often cause project baselines to be adjusted. They can result in project baselines being increased or decreased, depending on the constraints and needs of a project. Typically, a change to one baseline affects other baselines as well. When a change is made, you have to adjust the baselines to reflect those changes, or future efforts to monitor and control project work will be skewed.

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# SkillBrief

# Monitoring and Controlling a Project

Within the nine knowledge areas, Project Integration Management is concerned with identifying and defining various activities and processes within a project, and then bringing them together and coordinating them. In the Monitoring and Controlling process group, it's the Monitor and Control Project Work process that interacts with this knowledge area.

The Monitor and Control Project Work process is not made up of a single type of action. Monitoring and controlling are two distinct activities.

## Monitoring

Monitoring involves gathering information about the project's performance. This helps you detect trends by identifying any deviations from or risks to the project plan. Then you can take preventive or corrective action if needed.

There are several key monitoring activities you perform in a project:

* comparing actual results with planned results
* adding up product defects found during product checks
* reviewing team members' progress reports
* calculating end-of-project costs, completion dates, and other estimates
* assessing if implemented changes have been effective
* reporting project performance to stakeholders

## Controlling

Controlling activities in the Monitor and Control Project Work process involve taking action to correct problems or deviations you discover through monitoring activities.

The following are key controlling activities:

* preparing change requests
* taking corrective action
* adjusting project baselines to account for approved changes
* executing risk response plans

Together, the monitoring and controlling activities ensure you keep adequate control over a project, and that it stays headed in the right direction.

## The monitoring and control cycle

Given the importance of monitoring and controlling throughout the life of a project, it makes sense to break down the Monitoring and Controlling process into a manageable cycle.

The monitoring and controlling activities for a project occur as four stages in the monitoring and control cycle. The stages are:

* setting performance standards, which become part of the plan
* observing performance compared to standards
* comparing actual and planned performance
* taking action to correct deviations

### Setting performance standards

The first stage in the cycle is setting performance standards. These standards identify the minimum set of expectations for a project. A typical project includes many types of performance standards, including the following:

* a project scope statement, which describes what the project must achieve and the required characteristics of deliverables
* a work breakdown structure, or WBS, to divide the project work into smaller, manageable components
* work packages, which are groups of activities defined by the WBS
* cost estimates and budgets to ensure that spending is kept under control
* the project schedule, for documenting the sequence of required activities according to time, resource, and other constraints
* quality standards for all work, deliverables, and products
* stakeholder requirements, which are the requirements of all those who have an interest in the project

Performance standards aren't something you develop through monitoring activities. They are derived from project planning. And the better the planning for a project, the easier it is to monitor and control it once work starts.

### Observing performance

The observing performance stage is the one that really kicks off the monitoring activities of the cycle. This is where you gather information, be it formal or informal, about a project's progress. There are many sources for this information, like review meetings, memoranda, reports, letters, and to conversations with team members. All of these can provide valuable insight and data.

Regular meetings and reports are examples of sources that provide easily revisable formal information. For less formal information, a project manager would have to make a little more effort to pay attention to project goings-on. Chats with team members or casual observation of their work habits should not be disregarded. These can bring new information about a project's progress to your attention.

Once you've gathered information about how a project is progressing, the next steps are to compare actual and planned performance and to take action to correct deviations.

### Comparing actual and planned performance

After gathering information, you use it to compare the actual performance of the project to the planned performance mapped out in the project plan. Doing this will tell you about the progress of the project. You'll be able to spot deviations and identify their cause. At this stage, you may also be able to identify what corrective action is needed.

### Taking action to correct deviations

Finally, you take action to correct deviations, which constitutes the controlling activities of the cycle. The type of corrective action taken can be as small as making adjustments to the project plan, or it can be reprogramming, reassigning resources, or even changing your project management style. And any action depends on budget and schedule considerations. For example, you may not want to correct a very minor deviation if the change is going to have a major impact on the budget and schedule.

The stages of the cycle make it a lot easier to separate the monitoring and controlling activities that make up the Monitor and Control Project Work process. They also make it clear how these activities work together.

Throughout a project, monitoring activities are necessary to ensure that the project is on track. If corrective action is required, this may involve adjusting project baselines. Adjusting these baselines will create new performance standards – and it's the job of the monitoring activities to ensure these are met. So the cycle continues throughout a project.

You use the Monitor and Control Project Work process to keep track of a project's progress and take corrective measures when necessary. Monitoring means you compare actual and planned results, add up product defects, review progress reports, calculate performance forecasts, and assess whether implemented changes have been effective. You control activities by preparing change requests and adjusting baselines as necessary.

The four stages of the Monitor and Control Project Work process are setting performance standards, observing performance, comparing actual and planned performance, and taking action to correct deviations from the plan.

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# Follow-on Activity

# Your Project's Tools and Techniques

**Purpose:** Use this follow-on activity to assess the tools and techniques you can use to direct and manage project execution in a project you manage.

**Instructions for use:** To use this tool, use the table to specify if your project requires you to refer to specific sources of expert judgment. Then write down who they are and what area of expertise they provide.

| **Sources of expert judgment** | | |
| --- | --- | --- |
| **Source of expert judgment** | **Yes/No** | **Details** |
| Consultants | Row 2 Column 2 | Row 2 Column 3 |
| Other units in the organization | Row 3 Column 2 | Row 3 Column 3 |
| Professional and technical associations | Row 4 Column 2 | Row 4 Column 3 |
| Project management team | Row 5 Column 2 | Row 5 Column 3 |
| Project manager | Row 6 Column 2 | Row 6 Column 3 |
| Stakeholders | Row 7 Column 2 | Row 7 Column 3 |

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| **Project management information systems** | | |
| --- | --- | --- |
| **Project management information system** | **Yes/No** | **Details** |
| Accounting program | Row 2 Column 2 | Row 2 Column 3 |
| Collaboration software | Row 3 Column 2 | Row 3 Column 3 |
| Configuration management system | Row 4 Column 2 | Row 4 Column 3 |
| Knowledge management software | Row 5 Column 2 | Row 5 Column 3 |
| Project management program | Row 6 Column 2 | Row 6 Column 3 |
| Other | Row 7 Column 2 | Row 7 Column 3 |

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# Follow-on Activity

# Products of Integrated Project Execution

**Purpose:** Use this follow-on activity to identify and describe the types of outputs your project produces during the Direct and Manage Project Execution process.

**Instructions for use:** To use this tool, use the table to write down the details of each output in your project.

| **Details of outputs in your project** | |
| --- | --- |
| **Output** | **Your project** |
| Deliverables | Row 2 Column 2 |
| Work performance information | Row 3 Column 2 |
| Change requests | Row 4 Column 2 |
| Project management plan updates | Row 5 Column 2 |
| Project document updates | Row 6 Column 2 |

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# Job Aid

# Direct and Manage Project Execution Activities

**Purpose:** Use this job aid as a reference to some of the key activities the project manager may perform during the Direct and Manage Project Execution process.

During the Direct and Manage Project Execution process, the project manager may perform the following activities:

* selecting, training, and managing the project team staff
* convening a kick-off meeting with stakeholders to inform them that the project is ready to be executed and to provide them with the baseline project plan
* meeting with the project team
* establishing and maintaining internal and external channels of communication
* acquiring and managing resources
* managing suppliers
* ensuring the planned methods and standards are used to create deliverables
* managing identified risks and implementing risk response activities
* creating the deliverables of the project
* executing tasks to fulfill project requirements
* producing costs, scheduling, status, and quality data
* issuing change requests and incorporating changes that are approved into the project scope and project management plan
* gathering information on lessons learned and taking steps to improve processes
* convening periodic meetings with the project team to gather information about the project status

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# Job Aid

# Key Concepts of Monitoring and Controlling

**Purpose:** Use this job aid to remind yourself of the inputs, performance types you need to measure, and actions for monitoring and controlling project work.

### Inputs

To monitor and control project work, you need the right set of inputs. You then use these to measure performance, by comparing actual to planned performance. Finally, you need to know what kind of action to take to correct any problems you find.

| **Monitoring and controlling inputs** | |
| --- | --- |
| **Input** | **Description** |
| Project management plan | A mapped out plan of the project, including cost, scope, quality, and time baselines. |
| Performance reports | Reports of activities, achievements, milestones, and problems. These include status reports. |
| Enterprise environmental factors | External or internal factors that can impact a project. These include government and industry standards, stakeholder risk tolerances, and project management information systems. |
| Organizational process assets | Processes used by the organization that can have an impact on the project. An example is financial control procedures, such as time reporting, accounting codes, and expenditure reviews. |

### Types of performance

To measure performance, you use expert judgment to assess and evaluate the inputs. You subtract actual performance from planned performance, and identify deviations that are significant. However, you first need to know the types of performance that you are looking for.

| **Types of performance** | |
| --- | --- |
| **Type of performance** | **How it's measured** |
| Cost performance | Inspect expenses to determine if they are in line with the budget |
| Quality performance | Identify defects in the product or service you're creating |
| Scope performance | Inspect deliverables to assess whether they meet scope requirements |
| Time performance | Inspect the schedule to determine if the work is being carried out on time |

### Project control activities

Once you've recognized that there is a deviation or problem that has to be attended to, you then determine what kind of action is most appropriate. There are three kinds of project control activities you can use:

* corrective action
* preventive action
* defect repair

Corrective action is used to repair a deviation that has already occurred, or to stop it from recurring.

Preventive action stops or reduces the chance of a potential deviation from happening.

Defect repair is the action of correcting product defects to bring the product back in line with requirements and specifications.

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# Job Aid

# Performance Standards

**Purpose:** Use this job aid to learn about the key standards of project control.

| **Key performance standards** | |
| --- | --- |
| **Performance standard** | **Description** |
| Cost estimates and budgets | Components of the work breakdown structure (WBS) that predict costs. |
| Development cycle time | The time it takes for the project to be developed, which is important for challenging competition. |
| Financial forecasts and funding plans | Cost calculations and a plan for how to finance the project. |
| Innovation | The creation of new ideas, which is measured by project impact. The impact can affect the cycle time to product delivery, prototype cycle reduction, and process milestone attainment. |
| Physical quantities of work | Units of work that can be quantified, such as lines of code or number of widgets. |
| Productivity | The ratio of output produced to resources consumed. |
| Project schedule | A schedule, usually made up of the master and supporting schedules, that documents the sequence of project activities according to time, resources, and other constraints. |
| Project specification | A particular requirement for the project that's found in the project management plan. |
| Project team satisfaction | The standard the project has to meet for team members to be satisfied. |
| Quality standards and product specifications | The standards that are set for the quality of the work, deliverables, and products, based on a description of the product and its required features. |
| Reliability | A quality metric that defines how reliable a project or product attributes should be. |
| Resource utilization | The way different resources are used in a project, usually according to their category or type. |
| Scope statement | A document that describes the project and what the project is intended to achieve. |
| Senior management satisfaction | The standard the project has to meet for management to be content. |
| Project requirements | Requirements that the finished product or products must meet. |
| Stakeholder satisfaction | The standard the project has to meet for all those who have an interest in it to be satisfied. |
| Strategic fit | A determination of whether project results fit in with other products and services in the market or industry. |
| Vendor or contract performance | A standard that determines the weight or value of contracts with third parties or suppliers. |
| WBS and WBS dictionary | The subdivision of a project into manageable deliverables. The WBS dictionary accompanies the WBS and provides the details of each component. |
| Work packages | Work breakdown structure components. |

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Integrated Project Change Control and Close

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# SkillBrief

# Configuration Management and Change Control

The Perform Integrated Change Control process is triggered when there's a change request generated as an output of project work processes or control processes. If members of the project team make even small changes without using the process, these could accumulate and badly affect the project scope, budget, and schedule. Every change, no matter how small, should go through the control process. This avoids scope creep. And it helps ensure only necessary changes are approved and that the project remains within budget and on schedule.

There are three key principles of the Perform Integrated Change Control process:

* develop a method to identify potential and actual changes to the project baseline
* address and manage changes promptly, so emergency procedures need to be in place to fast track the approval of change requests when necessary
* document the impact of changes in an issues log or change control log

When reviewing a change request, you need to determine who initiated the request and what type of change it asks for. You also need to understand the factors that have led to the request – these may be customer demands, changes in legislation, technical difficulties, and so on. You need to assess what impact the change could have on scope, quality, schedule, and cost. Finally, you need to decide whether the change should go ahead. To help you do this, you need to ask yourself whether the benefits of making the change increase or decrease the chances of successful project completion while still meeting the project objectives. You should then make a record of your decision.

To ensure only approved changes are made, you need to document change requests and the process for approving them. Where changes are not approved, you may need to address the factors that led to the change requests. Very few approved changes should affect the project's performance baseline. If a change of this kind is justified and doesn't threaten the project, ensure you gain your sponsor's approval. Though approved changes are incorporated in a new baseline, you should also keep a copy of the original baseline for comparison purposes. Changes that impact an existing or completed project management process require updates to that process. This could mean additional passes through the appropriate Planning and Executing processes.

Approved changes must be coordinated or integrated across the project. Also, updates to the product scope baseline typically result in changes to the budget and schedule. This means you need to assess the impact of a particular change right across the project. It's important to remember that project baselines should be changed only when absolutely necessary. Always look for an alternative solution to managing the change.

## Configuration management

Configuration management prevents version-related errors, such as delivering the wrong version of a product to the customer, testing the wrong version, or losing the correct version by mistakenly over-writing it with an out-of-date one. The larger a project is, the more complex the processes you follow, and the more people you have working on it. In these cases, mistakes are likely to happen. Using a configuration management system greatly reduces the risk of errors.

Besides ensuring version control, the configuration management system has another important role. It establishes a set of processes and checks for ensuring that only approved changes are made to the product and project documents. This is where the change control system comes into play. It's a subset of the configuration management system.

**Configuration identification** is when you select and record all the items related to the project, including the product and project management documents that require version control. These are known as configuration items and are documented in the configuration management plan. Part of this identification is providing an accurate and complete description of the characteristics of the product, service, or result. This description is used to verify when changes have been made.

**Configuration status accounting** simply means that you keep track of the status of the product or document at all times. This includes the status of any proposed changes to the document and the implementation of any approved changes. Most project managers use project management software or some type of log for tracking status and storing information about the product.

**Configuration verification** is when the product is reviewed to ensure it meets quality standards and stakeholder requirements. Guidelines for configuration verifications would be outlined in the quality management plan and scheduled during planning.

**Configuration audits** are simply ad hoc verifications that may be conducted by the project manager or another stakeholder. As part of the change control system, any changes resulting from the verifications or audits would be registered, assessed, approved, tracked, and correctly implemented.

The Perform Integrated Change Control process involves reviewing, approving, and managing changes to project deliverables, plans, and processes. This process helps ensure only necessary changes are approved and made, so a project remains within budget and on schedule. The configuration management system provides tools for implementing the Perform Integrated Change Control process. The change control system documents needed characteristics of a product or service, documents the change control process, and audits results to determine whether all specifications and requirements have been met.

**Course:** Integrated Project Change Control and Close  
**Topic:** Principles of Integrated Change Control

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# SkillBrief

# The Change Control Process

How you manage and control change during the life of a project will determine that project's success. The Perform Integrated Change Control process is designed to review change requests and manage approved changes to deliverables, organizational process assets, project documents, and the project plan.

## Inputs

The main input to the Perform Integrated Change Control process are change requests. Changes may include corrective actions, preventive actions, and defect repairs. Most change requests are recommendations or requests generated as the project progresses. Change requests vary according to the process associated with the change. The processes are the

* Direct or Manage Project Execution process
* Monitor and Control Project Work process
* Project Integration Management process

Another input, organizational process assets, influences the change control process. These assets include

* **the configuration management knowledge base** – It contains the versions and baselines of all official company standards, policies, and procedures. It also contains project documents and a lessons learned database. These resources can influence how a change in the current project will be handled.
* **change control procedures** – These specify how each change should be reviewed and assessed. They also state the process that project managers and the change control board should use to document rejected and approved change requests. Finally, they may specify which documents, such as the project plan, should be updated when a change is approved.
* **project files** – The files for the current project are useful for assessing possible changes, before and once change requests are sent to the change control board, and by the change control board. These files may include scope, cost, schedule, quality, and performance measurement baselines. Other documents that may be used include risk registers, risk response plans, project calendars, project schedules, and so on.

Other inputs to the Perform Integrated Change Control process are

* **the project management plan** – It contains the subsidiary plans and the baselines against which actual results are compared. The project plan must be updated when change requests are approved.
* **work performance information** – This reflects the actual results of a project, and is used when reviewing, approving, and managing change requests.
* **enterprise environmental factors** – These become inputs to the process when they are used to manage and apply changes across all affected components of a project in an organized and efficient way.

## Change control board

The change control board reviews change requests and approves or rejects each proposed change. The range of the project manager's responsibility in approving or rejecting minor change requests is clearly set out and must be approved by all key stakeholders. All change control board decisions are documented and communicated to stakeholders. The role of the change control board depends on the change control system set up for a project and the level of authority the project manager has been granted:

* **high authority** – In some projects, the project manager holds authority for much of the decision-making and brings changes to the change control board only when the requests are significant.
* **low authority** – In certain projects, very tight controls are put in place. The project manager and change control board have regular meetings to discuss and manage all project changes and related issues.

Members of the change control board can include stakeholders, managers, technical experts, and project team members, as well as others who might not have any connection to the project. Others may be called in for their expert judgment. These decision makers include customers, consultants, and members of industry groups, professional and technical associations, and the Project Management Office.

## Approving or rejecting changes

The control board uses the following criteria when assessing potential changes:

* **feasibility of change** – A change is considered "feasible" if the baselines can be adjusted to accommodate it and it won't affect the project's performance beyond tolerable levels. A change that is not feasible would place undue stress on the project, making it impossible for it to finish on time and on budget. If the board decides a change isn't feasible, it will reject the request for change or possibly send it back to the person who submitted it with a request for more information.
* **impact on scope** – The board has to determine whether a requested change will impact the project's scope. This means whether it will affect the project performance baselines. A change request is likely to be rejected if it does impact scope, unless the change is considered important enough.

The outputs of the Perform Integrated Change Control process are the

* **change request status** – Details on whether a requested change is approved, rejected, or given a pending status must be entered in the change request forms. The change request documents themselves should be stored in a single knowledge base for the project.
* **project management plan** – When a change affects the scope of a project, the project management plan must be updated. This includes updates to the performance baseline and component baselines.
* **subsidiary plans** – Updates to subsidiary plans must be made when a change is within the project scope, but impacts relevant plans. Subsidiary plans can include the quality management plan, human resources management plan, and risk management plan.
* **change control log** – Updates need to be made to any documents that are affected by the change control system. The change control log must always be updated, regardless of whether the change is approved or rejected. This log may take the form of a spreadsheet or automated change control system that tracks the status of change requests.
* **forecast documents** – Updates need to be made to any documents that are affected by the change control system. Forecast documents are updated only when a change affects project baselines. So changes in project scope must be documented in forecasts.

So to manage change effectively, you need to maintain accurate and reliable performance measurement baselines, coordinate all processes impacted by the change, and update the project baselines to reflect any changes in product scope.

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**Topic:** Using the Change Control Process

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# SkillBrief

# Inputs and Activities in Close Project

If you take time to think through what has happened and formally bring activities to a clear conclusion at the end of a project, you'll reap the following benefits:

* **it confirms project status** – Confirming the project status helps you to know for sure that the project or phase is really over. This frees you for other tasks. It also ensures that stakeholders will agree on the project's status too.
* **it clarifies successes and failures** – You need to debrief the project sponsor on the successes or failures of the project. The Close Project or Phase process helps to clarify what these are.
* **it releases resources** – By following the Close Project or Phase process, you are able to formally release resources so they can be used in the next project or phase.
* **it completes project documentation** – Project documentation and formal sign-offs can help you in the future, so you have to know how to find them quickly and know they are complete. The Close Project or Phase process helps ensure all documentation is complete and archived.

The close process can also be used to end a phase of a multiphase project. This helps ensure that resources are released and the deliverable is properly transferred to the next phase of the project. So the Close Project or Phase process ensures you transfer the completed deliverables as appropriate. It coordinates the activities needed to verify and document project deliverables, formalizing the acceptance of deliverables by the customer or sponsor. Finally, it is used to investigate and document the success or failure of a project or phase. If a project or phase is terminated before completion, it also identifies the reasons why.

The following aspects of the project plan serve as inputs to the Close Project or Phase process:

* **schedule** – You need to review the planned schedule and note whether products were delivered on time.
* **budget** – You need to determine whether the project expenses were within tolerated limits outlined in the cost baseline.
* **risks** – When comparing risks, you need to determine which project risks were actualized and whether the team's responses to these risks were effective. Documenting this can help you manage risks effectively in later projects or phases.

**Deliverables** are another input to the Close process. To be used as inputs to the Close Project or Phase process, deliverables need to progress through several phases and processes before they reach the accepted deliverable stage. Project managers use the Direct and Manage Project Execution process to oversee the creation of a product, component, or service. The product then passes through the Perform Quality Control process, where it is validated internally. Then during the Verify Scope process, the product is reviewed by an internal team to ensure it matches the project's scope statement. Stakeholders such as the customer or sponsor may also review and sign off on the product at this stage. Changes needed during the Verify Scope process are controlled through the Perform Integrated Change Control process. Finally, approval is obtained and the software becomes an "accepted deliverable" that's an input to the Close Project or Phase process.

**Organizational process assets** are the third and final input to the Close Project or Phase process. Some companies have phase and project closure guidelines, such as templates for performing project audits and evaluations. Company guidelines may also include processes for performing sub-product – or component – validations and completed product validations. There are also likely to be guidelines for standard acceptance criteria.

## Deliverables and administration

Ensuring the acceptance of deliverables involves consulting the project management plan to confirm that all acceptance criteria have been met. You may also need to confirm that the deliverable has been accepted by the customer, and that all product sign-offs have been filed. You need to ensure that products are transitioned either to the next phase or into operational use. You may be able to follow set corporate guidelines for performing product validations. You can also use corporate-level acceptance criteria to perform validations and to transition the product.

To carry out administrative closure, you need to ensure all the necessary paperwork is completed and properly archived. These documents include customer or sponsor sign-offs, finalized project files, and other project or phase records. You also gather lessons learned and archive project information for future use by the organization.

According to A Guide to the Project Management Body of Knowledge (PMBOK® Guide), expert judgment is the only tool used in the Close Project or Phase process. It is applied when performing administrative closure activities. Experts ensure the project or phase closure is performed to the appropriate standards.

## Assessing success

A project manager gathers assessment information by performing any required project audits or evaluations. And typically a group of stakeholders carry out the assessment using this information. This group reviews the project management plan and deliverables to determine the degree of the project's success. The following methods are used to assess success:

* **written survey** – A written survey is sent to all participants in the project. Each recipient answers questions about how the project progressed and returns their responses. This method is inexpensive but produces the least feedback. Subtleties of what occurred during the project are often lost.
* **closing meetings** – A series of brief closing meetings is held with stakeholders, the sponsor, clients, the project manager, and the project team. Sometimes, the meetings are led by an independent facilitator. In the meetings, everyone gives feedback about how the project progressed. This method is more expensive than using a survey, but produces richer information about the project.

By documenting what has occurred in a project and its reasons for termination, you provide helpful resources your company can use in the future.

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**Topic:** Overview of the Close Project or Phase Process

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# SkillBrief

# Close Project Outputs

How a project transitions depends on the situation and context for project or phase closure. Factors that impact how this transition should be handled include

* **end of phase** – When the product of one phase is used as an input for another phase, you need to transfer the product to those responsible for handling the next phase.
* **end of project** – When a project is completed, you may need to hand a deliverable over to a team that is responsible for its maintenance or for its mass production.
* **process improvement** – If the project is one that develops a process improvement, the required process and procedure documents, performance targets, and other deliverables are handed over to the company for ongoing monitoring and control.

You need to ensure that the product, service, or other result of a project or phase is formally accepted. This requires a **sign-off** from relevant stakeholders. Final product sign-offs generally include details of the product and an official sign-off form that has to be signed by key stakeholders. Forms often differ depending on whether they are

* **internal** – The formal sign-off document should include a signature from the project sponsor confirming approval of the phase or result. The signatures should be dated and the project name and working title should be on the document. The document should also include a summary of the phase of project completed.
* **external** – The sign-off document should include the project name, the author of the document, the version number of the product, and the date it was issued. The signatures of the sponsor, senior user, and project manager should be on the document. The document must also state the project outcome has been measured against its acceptance criteria and formally accepted. Any comments about the customer acceptance should be noted. Additionally, any recorded shortfalls of the outcome should be listed in the signoff document.

The result of a project that develops or improves a **business process** is the document outlining the improvement. This should include a signoff document naming the process and owner, who it was reviewed and approved by, and any follow-up actions required. Once a product or outcome has been formally signed off and transferred, the project manager is expected to notify relevant stakeholders of the transfer and that the product has been accepted. Updates to the following process assets are outputs of the Close Project or Phase process:

* **formal acceptance documentation** – This includes written confirmation that the customer or sponsor has officially accepted the project's deliverables as meeting all requirements.
* **project files** – These include all documentation resulting from the project's activities. Examples are the project management plan, scope, cost, schedule and quality baselines, project calendars, risk registers, planned risk response actions, and risk impact assessment.
* **closure documents** – Project or phase closure documents indicate a project or phase is complete and cover the transfer of its deliverables to others. If the project was terminated prior to completion, the formal documentation indicates why the project was terminated and formalizes the procedures for transferring finished and unfinished deliverables to others.
* **historical information** – You need to transfer historical information about the project and the lessons learned during the project to the knowledge base. This information can then be used during a later phase or later projects to help build on successes and minimize mistakes.

So outputs of the Close Project or Phase process include completed products or services, and updates to process assets that are handed over to a new project phase or organizational function. They also include completed signoff documents and archived project files and deliverables.

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# Follow-on Activity

# Integrating Change Control

**Purpose:** Use this follow-on activity to review your company's configuration management system and how it is used for integrated change control.

**Instructions for use:** To use this tool, answer the questions about your company's configuration management system.

When familiarizing yourself with the configuration identification process, ask yourself the following questions:

* Where are product, service, and process descriptions stored?
* Are these descriptions stored for project data?
* Are these descriptions used when assessing change requests?

To find out more about your company's configuration status accounting, ask yourself these questions:

* Are all change requests logged, whether or not they are approved?
* Where are records of the statuses of change requests kept?
* Where are lists of approved configuration identification stored?
* Where are the implementation statuses of approved changes recorded?

To familiarize yourself with the configuration verification and auditing activities, answer these questions:

* When and how are a project's configuration items assessed?
* How does the company assess whether changes are registered, assessed, approved, tracked, and correctly implemented?
* Is there a process in place to make sure a configuration audit takes place before a finalized product is delivered to the customer?

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# Follow-on Activity

# Close Project Activities

**Purpose:** Use this follow-on activity to review your closing procedures for projects and project phases.

**Instructions for use:** To use this tool, answer the questions to review how your company closes projects and project phases. If you can't answer any of the questions, interview one or two experienced project managers in your company and clarify how they close projects and phases.

Answer these questions to review how your company handles the acceptance of deliverables:

* What corporate guidelines are there for performing product validations and transitioning a deliverable to the next phase or into operational use?
* What guidelines exist for defining acceptance criteria?

Answer these questions to consider how your company tends to carry out project or phase post-mortems:

* Are surveys or meetings usually used?
* What project auditing procedures does the company follow?
* Are external facilitators used for closing meetings, where stakeholders assess project success?
* What guidelines exist for defining acceptance criteria?

Also consider how the company captures lessons learned and makes sure that all documentation is archived for future projects.

* Where are these documents stored?
* How are they classified for ease of access?

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# Job Aid

# Change Control Principles

**Purpose:** Use this job aid to review the list of principles that should be followed in the Perform Integrated Change Control process.

There are seven key principles that you should follow when implementing change control:

* a project manager needs to develop a method for identifying changes
* changes must be addressed in a timely manner
* reviewing, assessing, and deciding whether requested changes should go ahead are main activities of change control
* only approved changes should be implemented
* project baselines should be changed only when necessary
* approved changes must be coordinated across all the project management knowledge areas, such as cost, time, and scope management
* the impact of approved change requests must be documented

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# Job Aid

# Change Request Template

**Purpose:** Use this job aid as a template for developing your own change request form.

| **Structure of a change request form** | |
| --- | --- |
| **Field** | **Content** |
| Date of request | This field should be filled in by the person submitting the request. |
| Request number | The request number should follow an approved naming convention and should be completed by the project manager on receipt of the request. |
| Type of change | This may include issues such as noncompliance, a change in requirements, error correction, preventative action, functional change, regulatory change. |
| Priority | A system for specifying priority should be established. For example, top priority could entail crucial changes that need to be approved within a week of the requests and medium priority could be changes that need to go through the process within a month of the requests. |
| Requester | The name of the stakeholder making the request should be entered into this field. |
| Description of change | A detailed description of the envisioned change should be entered in this field. |
| Reason for change | The justification for the change should be entered in this field. |
| Work groups impacted by change | This field should be filled in by the reviewer of the change request and should include all groups that may be affected by the change – for example, code developers and testers. |
| Estimated impact | This field should be filled in by the reviewer and should include estimates of the change's impact on budget, schedule, and other areas of the project. |
| Status | This field should specify whether the request is approved, rejected, or pending a decision. |
| Reviewer | The name of the reviewer or reviewers should be entered in this field. |
| Approval signatures | The signatures of stakeholders confirming the approval of the change should be entered into this field. |
| Date | This field contains the date on which the stakeholders signed the change request form. |

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**Topic:** Using the Change Control Process

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# Job Aid

# Closing Activities Checklist

**Purpose:** Use this follow-on activity to review all the activities related to closing a project or phase.

The three main activities in the Close Project or Phase process are

1. ensuring acceptance of deliverables
2. carrying out administrative closure
3. assessing project success.

To ensure the **acceptance of deliverables**, you need to

* consult the project management plan to confirm that all acceptance criteria have been met
* confirm that the deliverables have been accepted by the customer, and that all product sign-offs have been filed
* use corporate guidelines and corporate-level acceptance criteria to perform product validations
* ensure that products have been transitioned either to the next project phase or into operational use

When carrying out **administrative closure**, you should

* complete and archive all the necessary paperwork, including customer or sponsor sign-offs, finalized project files, and other project or phase records
* enter knowledge or insights gained during the project or phase in the lessons learned database

To assess the **success of the project**, you can

* compare its actual results to the plans outlined in the project management plan
* use project audits and evaluations to gather assessment information
* use a project survey or a series of project closing meetings to gather assessments from the project team, sponsor, and key stakeholders

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Project Requirements and defining scope

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# SkillBrief

# Project Scope and Scope Creep

Everything you need to do to get from objectives to the results in a project is the project scope. If you change the project's scope, it's likely to have implications for the project's cost, time, and quality.

### Project and product scope

**Project scope** is all the work required to complete a project's deliverables, its services, or product. It forms a boundary around a project, with everything required to complete it on the inside, and everything else outside. The boundary must be clear, so that neither too little nor too much work is done.

**Product scope** is part of project scope. It is defined by all of the components, functions, and features the product must have to meet requirements, but not to exceed these.

### Scope creep

Scope creep is what happens when the scope of a project changes, without the change being managed. Often these changes can seem minor, but over time, unmanaged changes add up and can have a major impact on project costs, schedules, and quality. Specifically, scope creep usually causes cost and time overruns.

#### The causes of scope creep

The main causes of scope creep are

**unexpected scope-related issues** – These often arise during a project that can change the project's requirements, or raise its complexity.

**perfectionism** – This, when the people involved in a project try to improve the product without approval, can change the scope and lead to cost and time overruns.

**placating stakeholders** – Stakeholders may make requests that go beyond the original scope of a project, and giving in to these requests without following the correct procedures leads to scope creep.

**misunderstandings** – This can cause scope creep by affecting what work is done, how long it takes, and what it costs. They can cause the project team to misunderstand requirements, which can also lead to conflict. So, scope definitions must avoid ambiguity or unclear statements.

By learning to recognize these causes, you can mitigate the risks they pose to a project.

Project scope is all the work required to complete the deliverables a project is intended to produce. If either more or less work is put in, it's likely a project will suffer. Product scope identifies the required features and functions of a product, and may be one aspect of project scope.

Scope creep occurs when changes to scope aren't detected early enough or managed. Causes of scope creep in a project include unexpected issues, perfectionism, placating stakeholders, and misunderstandings.

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**Topic:** Understanding Project Scope

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# SkillBrief

# Project Scope Management Processes

The Project Scope Management knowledge area includes all the processes, which define and control what is and isn't involved in a project, through its life cycle. The methods that will be used in controlling scope throughout the project are described in the scope management plan. It is developed by the project team during the development of the project management plan and provides guidance on how project scope will be defined, documented, verified, managed, and controlled.

## Scope and the Planning process group

The Planning process group contains the scope management processes required early in a project to ensure that the project scope is planned correctly. There are three scope planning processes – Collect Requirements, Define Scope, and Create Work Breakdown Structure (WBS).

#### Collect Requirements

This process entails investigating, defining, and documenting stakeholders' needs and expectations about the project, and about a product's features and functions.

It results in detailed plans for managing stakeholders' requirements and expectations. You use these outputs in the Define Scope process to produce the scope statement, as well as during the WBS process.

#### Define Scope

The Define Scope process involves creating the project scope statement, which is a detailed description of the project work required and the product or service it must deliver. It elaborates on the deliverables, assumptions, and constraints for a project.

This process results in the project scope statement, which provides the starting point for the work breakdown structure. It also forms part of the scope baseline, which the Verify Scope and Control Scope processes use extensively. This document is used throughout the remainder of the project.

#### Create WBS

Using the Create WBS process, you divide the project scope – all the work required to complete the project – into smaller, manageable work packages.

The Create WBS process results in the WBS, the WBS dictionary, and the scope baseline. These documents provide the benchmark information that the Verify and Control Scope processes measure all work against. The WBS is a hierarchical overview of the entire project. The execution stage of the project relies heavily on this document.

## Scope and the Monitoring and Controlling process group

The Monitoring and Controlling process group contains the processes required later to that ensure the work and the deliverables are produced according to the scope requirements. There are two scope monitoring and controlling processes:

* **Control Scope** – This process involves monitoring the status of the project and product scope, and managing scope changes. It is integral to controlling change in all parts of the project, including the other knowledge areas.
* **Verify Scope** – This is the final Project Scope Management process. It's the process of confirming that the project has met its objectives, as defined in the scope statement.

The Verify Scope and Control Scope processes have implications throughout the project. They enable you to ensure that the project's deliverables meet the schedule, budget, product quality, and other stakeholder requirements.

The knowledge area Project Scope Management includes all the processes for defining and controlling the scope of a project. The Planning process group contains the scope management processes required early in a project, namely Collect Requirements, Define Scope, and Create WBS. The Monitoring and Controlling process group contains the processes required later in a project, namely Control Scope and Verify Scope.

**Course:** Project Requirements and Defining Scope  
**Topic:** Scope Management and Process Groups

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# SkillBrief

# Techniques for Collecting Requirements

Project requirements are the basis for defining a project's scope, and for planning and controlling project work, costs, time, and quality. Requirements are the necessary attributes of the deliverables – the product's functions and features, or the service the project provides. They depend on the client's needs and expectations.

The project charter contains the high-level project requirements. You document the more detailed low-level requirements by consulting the project's stakeholders. In doing so, you elaborate on stakeholders' general ideas of what they need, to arrive at a concise and specific list of requirements.

Stakeholder requirements must completely represent the customer's and other stakeholders' expectations. The complete list of requirements is necessary in order to

* generate the project's work breakdown structure (WBS)
* plan the budget, schedule, quality management plan, and other project baselines
* monitor and control the project

## Inputs used to collect requirements

There are two inputs to the Collect Requirements process:

* the **project charter**, which identifies high-level requirements, as well as the high-level description of the product or service a project must deliver
* the **stakeholder register**, which lists all the stakeholders for the project

## Tools and techniques used to collect requirements

Once you've analyzed information in the project charter and stakeholder register, you need to collect detailed project requirements from stakeholders. You can use several tools and techniques to do this.

#### Interviews

You can interview stakeholders, subject matter experts, and people who've worked on related projects to help you identify the features and functions a product or service should have. One-on-one interviews enable you to ask a set of prepared questions, and record the person's responses.

#### Focus groups

Focus groups are less formal way than interview. They involve a group of stakeholders and subject matter experts, and you guide an interactive discussion about the proposed product or service. Focus groups often comprise stakeholders with similar perspectives. This enables you to collect requirements that are focused on a specific aspect, such as the design of a product or the technical requirements it must meet.

#### Facilitated workshops

Facilitated workshops enable you to bring together cross-functional stakeholders who have different perspectives on what a project should deliver. The facilitator must help the group identify requirements and reach consensus.

#### Questionnaires and surveys

Questionnaires and surveys enable you to quickly gather responses to a set of written questions from a large number of people. You can then apply statistical analysis techniques to the information.

#### Group creativity techniques for generating ideas

Group creativity techniques are creative activities that can generate a list of potential requirements. They're useful to facilitate the creation and sharing of ideas. They include

* **mind mapping**, where you map stakeholders' ideas to look for similarities and differences between them and to inspire new ideas
* **brainstorming**, where you develop an unstructured list of possible requirements for a project or product
* **nominal group technique**, in which the group uses a process of ranking possible requirements in terms of their importance, and further developing the highest ranked requirements
* **Delphi technique**, in which a panel of experts refines potential project requirements, by answering questionnaires, and provides feedback on them
* **affinity diagrams**, where ideas are sorted into groups for review and analysis

#### Observation as a technique for collecting requirements

Using observation, you identify requirements by watching how a task or process is performed. Two methods of observation are

* **job shadowing** – Job shadowing involves watching a person or group of people as they perform their job. It is especially useful for complicated processes or when the requirements are difficult to identify using the other techniques.
* **participant observation** – In this technique, you try to perform the task or process yourself, and in doing so you identify the requirements for carrying out the task.

#### Prototypes as a tool for collecting requirements

A prototype is a working model of a product, which you create early in a project to enable stakeholders to test it and refine their requirements. This is a much more concrete way to collect requirements than simply asking stakeholders what they need. Prototypes are the most suitable for projects that deliver products that people use to complete tasks.

#### Group decision-making techniques

After stakeholders have generated possible requirements, you need to arrive at final decisions about which requirements to keep. Group decision-making techniques enable you to classify and prioritize requirements, and discard those that are not necessary. The decision-making techniques include unanimity, majority, plurality, and dictatorship.

In a unanimous decision, everyone in a group supports a single decision. In a majority, more than half the group agrees. A consensus is a majority where the remaining minority agrees to support the majority decision. Plurality is when the largest block of people gets to make the decision. In a dictatorship, one person makes the final decision.

Project requirements are the basis for defining a project's scope and for planning and controlling project work, costs, time, and quality. They will depend on the required attributes of a product and the needs of the client. High-level project requirements are outlined in the project charter. Using the stakeholder register, you need to consult stakeholders to collect more detailed requirements. This is the purpose of the Collect Requirements process.

Tools and techniques you can use to collect project requirements include interviews, focus groups, facilitated workshops, and questionnaires and surveys. They also include group creativity techniques, group decision-making techniques, observation, and prototypes.

**Course:** Project Requirements and Defining Scope  
**Topic:** General Techniques for Collecting Requirements

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# SkillBrief

# Approaches to Group Creativity

Collecting requirements is about getting as much feedback from stakeholders as possible about their needs and expectations. This goes a long way to ensuring that a project succeeds.

The group creativity techniques that you can use to generate potential requirements include mind mapping, brainstorming, the nominal group technique, and the Delphi technique. You can use these techniques in isolation, but it is preferable to combine them or use them in sequence.

### Mind mapping

A mind map brings together many ideas, grouping them visually to make it clear how they relate. At the center of the map is the problem to be solved. As you think of ideas, you build branches out from the center. Each branch groups related ideas. At the end of each branch, you get to specific ideas that develop from more general ones, and these should be the project requirements.

A group of stakeholders can create a mind map together, or work in smaller teams to create a few mind maps. Optimally, each person creates their own map. The facilitator then combines these into a single map. This main map then illustrates how everyone's ideas fit together.

### Brainstorming

Brainstorming is a great way to generate an unstructured list of possible project requirements, by encouraging everyone in a group to participate. One person's contribution often inspires people with new ideas.

Brainstorming has four rules:

* **be focused** – although brainstorming isn't very structured, it must still focus on clearly identifying the objective or the problem
* **document ideas** – record all the ideas stakeholders come up with so no good ideas are lost
* **don't criticize** – make sure nobody criticizes other people's ideas, as this can cause conflict and keep people from having a say openly
* **encourage ideas** – encourage everyone to build on other people's ideas

One especially effective strategy is to use brainstorming after you've already created a mind map. This way, everyone can focus on clarifying the early set of requirements. The purpose of the session will be clear, so it's more likely everyone will have productive ideas.

### Nominal group technique

The nominal group technique enables a group of stakeholders to identify which requirements are most important for a project. It can include brainstorming ideas and then ranking them. Or, it can rank existing ideas that you've already put together.

An advantage of the nominal group technique is that it lets each stakeholder in a group have a say about what's most important to them, without leading to conflict. The way people rank their requirements can even stay secret.

The way you use the nominal group technique will vary depending on what information you're trying to gather. If you're trying to refine a list of possible requirements you've already collected from stakeholders, the best way to use the technique is to follow these steps:

* have the full list of possible requirements you've already gathered in front of the group of stakeholders
* ask each person to rank their top five or so requirements
* have group members call out the requirements and their rankings, and write down these rankings – optionally, have members exchange cards before doing this so their choices stay anonymous
* tally the results for each requirement on the starting list, and identify the requirements with the highest scores

If you use a scoring system, each person must be consistent in assigning the highest score to the most important requirement.

### Delphi technique

The Delphi technique doesn't involve asking stakeholders to meet face to face. Instead, it uses a cycle of independent feedback from each person in a group of experts.

Each stakeholder answers written questions, gets a chance to revise the answers, and then sees a summary of everyone's responses as feedback. Each stakeholder then fills in a second questionnaire to rate ideas generated the first time round. You repeat the process of returning feedback and answering questions until it's clear everyone agrees or has reached a final position.

One of the best ways to use the Delphi technique is to have a group of experts and stakeholders start with the results of nominal group ranking and work to reach consensus. So you move from a list of possible requirements that a group has already ranked to a final list that can go ahead.

To use the Delphi technique to get consensus about ranked requirements, you need to follow these steps:

* **identify experts** – The experts you choose must be objective, without prior involvement in generating the project's requirements list. You would include experts and stakeholders with experience that is relevant to the type of project you're managing.
* **send out a questionnaire** – You should send out the questionnaire to each expert individually, so that they remain independent and are not swayed by what others say. The questionnaire may ask each expert to rank the listed requirements, defend his choices, point out considerations or risks, and add new requirements. Each person should return his responses independently.
* **collect and organize the responses** – Once you receive each person's responses to an initial questionnaire, you collect and organize the results, for example, by creating a summary that shows how the group ranked all the requirements, and including important feedback.
* **let participants revise their responses** – After summarizing the responses, participants revise their original responses. This enables each person to add further ideas, and it helps reach group consensus by sharing ideas and demonstrating that they'll be taken into account. If some requirements conflict but are still ranked high by different reviewers, another round of questionnaires and feedback might be necessary.
* **compile the final list of requirements** – The last step is to compile the final list of requirements, based on consensus among the reviewers' revised responses.

Group creativity techniques help you guide stakeholders in generating, refining, ranking, and approving the requirements for a project. These techniques include mind mapping, brainstorming, the nominal group technique, and the Delphi technique.

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**Topic:** Group Creativity Techniques

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# SkillBrief

# Using Stakeholder Requirements

For a project to meet agreed requirements, there must be a way to assess whether the requirements are being met. So each requirement has to be testable and traceable.

Methods to test a requirement include

* demonstrating that a product works as specified
* observing that product or service can be used as specified
* examining a product, to verify it has the agreed features

A requirement must also be forward and backward traceable. Backward tracking enables you to verify that it has been met. Forward tracking enables you to break it down into deliverables. The two items that make a requirement traceable are

* **unique identifiers** – Giving each requirement a unique identifier that won't change throughout a project ensures you can track it, even if circumstances change and it's canceled.
* **tracking systems** – You use a tracking system to document and monitor progress and changes to requirements. The system identifies each requirement, its source, priority, version, and current status – such as active, canceled, deferred, or approved. It might record attributes like stability of the requirement, complexity, or verification criteria.

### Outputs of the Collect Requirements process

The outputs of the Collect Requirements process are requirements documentation, the requirements management plan, and the requirements traceability matrix.

#### Requirements documentation

Requirements documentation results from collecting stakeholder requirements. It lists each agreed requirement and its attributes. This gives a baseline for monitoring and controlling a project throughout its life cycle.

This documentation should

* **organize requirements by stakeholder and priority** – Requirements should be grouped by the stakeholders or by the categories they come from, and by priority. This helps ensure easy tracking, and helps the project team prioritize the work.
* **describe what objectives requirements meet** – The documentation should contain the business need each requirement satisfies. This ensures stakeholders and the project team know what objectives a requirement is there to meet.
* **classify requirements by type** – A requirement or its components can be functional, nonfunctional, or quality-related. Identifying the broad type of each requirement helps you determine the aspects of project work that is needed to meet it.
* **identify assumptions and constraints** – It's important to document any assumptions and constraints on which a requirement is based.

It's important that all stakeholder requirements are consistent – meeting one requirement can't rule out meeting another.

#### Requirements management plan

The requirements management plan is another important output of the Collect Requirements process. It outlines how requirements must be managed throughout a project.

The requirements management plan must describe:

* how requirements will be tracked and reported throughout the project
* the methods used to prioritize the requirements, to ensure stakeholders and the project team have the same understanding of these
* configuration management activities, detailing how changes to requirements must be assessed, managed, and reported
* product metrics that will be used to measure whether a product meets requirements, and the rationale for their selection

Before you create a requirements management plan, you need to know what phases a project will have and how they relate to each other. This will affect how you manage requirements.

In a project with a **single phase** and a single result, all the requirements must be known and stable up front, and all resources must be available.

A project might have **incremental phases** and a single result, or **multiple phases** with separate results. If each phase must build on what a previous phase delivered to create a single result, it means you need to break requirements down as the project progresses.

A typical requirements management plan defines the methods, responsibilities, communication strategy, and tools for managing requirements. It explains how these must fit into each phase of a project. It includes sections for ensuring everyone has a common understanding, like a glossary of the terms in the plan.

#### Requirements traceability matrix

A third output of the Collect Requirements process is a requirements traceability matrix. This is a table that assigns each requirement a unique identifier, and lists its status. It lets you relate each requirement back to broader objectives and forward to the more detailed requirements phases must meet.

The requirements traceability matrix has three main purposes:

* it ensures each requirement adds value to the project by linking it back to the business need or objective it helps satisfy
* it tracks requirements, including their status, throughout the project
* it provides a structure for managing changes to the scope of a project so these changes don't result in requirements not being met

So the requirements traceability matrix lets you check how far a product or service has come in meeting each requirement, at any point in a project. It's also what you use to map user requirements to project scope and to product design, development, and testing.

The outputs of the Collect Requirements process are requirements documentation, the requirements management plan, and a requirements traceability matrix.

Requirements documentation identifies each requirement and its attributes. The plan determines how requirements must be managed, and the requirements traceability matrix is a tool you use to track requirements throughout a project.

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**Topic:** Managing Stakeholder Requirements

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# SkillBrief

# Defining Project Scope

The Define Scope process, early in the planning stages, occurs after you've developed the project charter and defined stakeholders' requirements, but before you create the project management plan.

Using **progressive elaboration**, you arrive at a documented agreement about exactly what a project will include. It involves documenting objectives, deliverables, and requirements in enough detail to guide the rest of the project.

## What is scope?

The Define Scope process involves defining two types of scope:

* **product scope** refers to all the required characteristics of the product, service, or result that a project must deliver. It's measured against the requirements stakeholders set out for a product. To define product scope you move from stakeholders' requirements to detailed descriptions of a project's deliverables.
* **project scope** refers to all the work required to meet the project deliverables. It's measured against the project management plan. You can define project scope only once the project deliverables and the product scope are defined.

Throughout a project, you monitor the work done against the project management plan, to ensure the work done meets the requirements set out in the product scope.

A fully defined project scope elaborates on conditions for a project's success. The factors that relate to these conditions are

* **assumptions** – An assumption is any idea held but not proven to be true. Defining scope involves identifying all assumptions and how they could affect a project.
* **constraints** – A constraint is anything that puts a limit on what can be achieved – like a limited budget, resources, or time.
* **risks** – A risk is any potential circumstance that could affect the success of a project. This ties in with assumptions and constraints.

## Inputs for defining scope

Before you can define scope, you need the project charter and requirements documentation, as well as any organizational process assets that can guide the process.

#### Project charter

The project charter provides a high-level description of a project and of the product, service, or result. It outlines basic requirements and expectations, assumptions, constraints, and risks. Defining scope involves elaborating on what's in the project charter.

#### Requirements documentation

Requirements documentation identifies requirements the project must meet to satisfy expectations, and their relative importance. Defining scope involves moving from these requirements to more detailed ones that can guide all steps of a project.

#### Organizational process assets

Organizational process assets make defining scope easier and more accurate. For example, project files and lessons learned from previous projects help identify important information about deliverables, risks, assumptions, and constraints that apply to your current project. Policies, procedures, and templates for a scope statement can also influence the define scope process.

## Tools and techniques for defining scope

Defining scope involves elaborating on what you know so far, to come up with a detailed description of what work a project will include and exactly what product, service, or result it must deliver.

The four main tools and techniques for defining scope are

* **expert judgment**, which is required to determine the implications of the project charter and requirements documentation for the rest of a project.
* **product analysis**, using methods like product breakdown, systems analsys, systems engineering, value engineering, value analysis, or requirements analysis, to discover the attributes and features that the deliverables require
* **alternatives identification**, which uses creative thinking to find alternative ways to meet requirements
* **facilitated workshops**, in which you bring together cross-functional stakeholders to think creatively about solutions and to reach consensus

The Define Scope process involves defining what specifications a product, service, or result must have and what work must be performed to deliver it. This should be defined in enough detail to guide the rest of the project.

Inputs for this process are the project charter, requirements documentation, and organizational process assets.

Tools and techniques you use to define scope include expert judgment, product analysis, alternatives identification, and facilitated workshops.

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**Topic:** Techniques for Defining Scope

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# SkillBrief

# The Project Scope Statement

The main output of the Define Scope process is the project scope statement, which is the stakeholders' consensus of what will and what won't be included in a project's deliverables.

## The purpose of the project scope statement

The project scope statement

* **defines the work** – The scope statement refines and expands on what the team already knows from the project charter and stakeholder requirements. It is used in creating a detailed work breakdown structure, where further progressive elaboration occurs.
* **guides the team** – The scope statement makes it clear to the project team what will and won't go into a project. It describes the deliverables that must be created and the work effort and methods required to do this.
* **sets the baseline** – The scope statement is one of the documents against which progress and change requests will be evaluated. It forms part of the scope baseline for a project.
* **sets stakeholder expectations** – The scope statement makes it clear to stakeholders what they can expect to receive, and what they can't, from a project. It's against these expectations that success will be measured.
* **defines exclusions** – Identifying important exclusions to include in the scope statement involves expert judgment. You should probe stakeholders and draw on the specialized knowledge of experts. The goal is to identify things that might reasonably be expected of deliverables but that don't actually fall within a project's scope.

## Components of the project scope statement

A project scope statement should have six main components. Together, these ensure everyone involved knows what falls within the project's scope. They also form a basis for determining how to manage all remaining activities in the project's life cycle.

The components of a project scope statement are the

* **product scope description** – The product scope description identifies the attributes a deliverable must have, it guides in creating the work breakdown structure, and guides in monitoring and controlling activities.
* **project deliverables** – The project deliverables are described clearly so that stakeholders know what they can expect from a project, right up to the close.
* **project exclusions –** These specify the scope exclusions – what the deliverables won't include, and they ensure that stakeholders agree on what the project won't deliver
* **product acceptance criteria** – The criteria are the detailed standards that the stakeholders and project team agree to use, to judge whether the project's deliverables have met requirements, during verification and acceptance processes at the end of a project or a phase.
* **project constraints** – The constraints include any factors that could limit the success of the project or pose possible risks. By describing constraints, you clarify why certain scope exclusions were made. This makes it more likely that stakeholders will understand and agree to the scope statement.
* **project assumptions** – Assumptions are accepted but unproven beliefs. By documenting them, you remind stakeholders and the project team about them. It also highlights the risk that the assumptions will be violated.

As well as the project scope statement, the Define Scope process results in **updates to project documents**. Documents you may update are the stakeholder register, requirements documentation, and the requirements traceability matrix.

The main output of the Define Scope process is the project scope statement. This statement progressively elaborates on the work of a project. It guides the work of the project team, sets the expectations of stakeholders, and provides a baseline for evaluating whether requested changes or additional work are within or outside the project's boundaries.

The project scope statement should include a product scope description, product acceptance criteria, and details of a project's deliverables, exclusions, constraints, and assumptions.

Another output from the Define Scope process is updates to project documents.

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**Topic:** Project Scope Statement

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# Follow-on Activity

# Group Creativity Exercises

**Purpose:** Use this follow-on activity to practice group creativity techniques.

**Instructions for use:** To use this tool, carefully read through the exercises on group creativity techniques. Then give each technique a try as per instructions.

## Mind mapping

### Exercise 1

Create a mind map about any subject, problem, or question of your choice, preferably related to an issue you are currently dealing with at work or in your personal life. For example, your mind map could address one of the following subjects:

* My life five years from now
* How do we build a stronger team?
* Managing my expenses
* Improving productivity
* Fixing up my house

### Exercise 2

Invite two or three coworkers to a mind-mapping session. Have blank paper and different colored pens or pencils available. Follow these steps for your session:

1. Tell the group that you are going to brainstorm about the requirements for a fictitious project that you are all going to do together. Make it something easy that anyone would be knowledgeable about, such as building a tree house or planning how to move house.
2. Explain the instructions for mind mapping and answer any questions the group members have about the process. Each person will create an individual mind map.
3. Allow everyone 5 to 10 minutes to complete their mind maps. When the maps are complete, consolidate them into a single map, discussing with the group how to resolve any conflicts between identified project requirements so that you reach a consensus. Look for relationships between the requirements and try to group them somehow.

## Brainstorming

Invite either the same group of coworkers who created mind maps or a new group to brainstorm ideas for a project or situation. A good example to use might be brainstorming ideas for an office party. Ensure you make the purpose of the session clear. Write down each person's ideas, try to prevent people in the group from criticizing each others' ideas, and encourage them to build on the ideas that are generated.

## The nominal group technique

Practice the nominal group technique with a group of people. You could have them prioritize the requirements identified during the mind-mapping exercise, or come up with a list of items for a completely different project or situation.

## The Delphi technique

Take a set of ranked ideas generated using another group creativity technique – or a set of ideas you come up with and rank yourself – and ask two coworkers to review these independently. The people you ask to participate in this exercise shouldn't be the same people who participated in the other exercises. Get their feedback and compile a new version of the ranked ideas that includes both your coworkers' responses. Return the summary to the coworkers and ask that they revise their responses. Then find out how the original ideas have changed, and if your coworkers have reached agreement.

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**Topic:** Group Creativity Techniques

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# Follow-on Activity

# Constraints, Assumptions, and Risks

**Purpose:** Use this follow-on activity to practice identifying project risks based on determined constraints and assumptions.

**Instructions for use:** To use this tool, write down the project risks that are based on specified constraints or assumptions. A list of example answers should help you do this.

You're managing a project to construct a large dam as part of a hydroelectric power program. The scope statement for the project details several assumptions and constraints.

For example, an assumption is that construction of the dam will be approved. Both federal and state building licenses must be obtained prior to any work at the site.

A constraint is that the full project must be completed within a two-year period because a critical subsequent project to build a hydroelectric power plant must begin at that time due to government regulations. This means each phase of the current project must follow a tightly planned schedule.

From this, you can see that one risk to the success of the project is failure to secure approval for construction in time for the first phase of project work to start on schedule.

| **Constraints, assumptions, and risks** | |
| --- | --- |
| **Constraint or assumption** | **Risk** |
| **Constraint 1** : Environmental assessments must be supplied to federal and state authorities a minimum of six months before project work is scheduled to start | Row 2 Column 2 |
| **Constraint 2** : Local authorities and residents have to agree to relocate, given authorized levels of compensation | Row 3 Column 2 |
| **Constraint 3** : Engineers have three months to complete initial plans for the dam | Row 4 Column 2 |
| **Assumption 1** : Earth-moving equipment will be supplied before the site leveling phase starts | Row 5 Column 2 |
| **Assumption 2** : Labor will be sourced locally as part of the project's mission to uplift and contribute to local communities | Row 6 Column 2 |
| **Assumption 3** : No unseasonably high levels of rainfall will occur through the summer months | Row 7 Column 2 |

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#### Example answers

**Constraint 1** makes it clear that failing to submit environmental assessments on time is a risk. This may delay the approval process, causing the project schedule to be thrown out.

**Constraint 2** identifies the risk that local authorities and residents may refuse to relocate. Protest or legal disputes involving these stakeholders could hamper the project.

**Constraint 3** should make you aware that if engineers run late in submitting initial plans, subsequent project activities may also run late.

**Assumption 1** relates to the supply of equipment needed to complete work during a project phase. If this equipment isn't supplied on time and in working order, the phase will run late.

**Assumption 2** relates to sourcing labor for the project. An associated risk is a shortage of skilled local labor.

**Assumption 3** relates to weather conditions. If unusually high rainfall occurs in the summer months, it may slow down work on constructing the dam. This could lead to delays, as well as budget problems because workers must continue to be employed during these times due to government labor regulations.

**Course:** Project Requirements and Defining Scope  
**Topic:** Project Scope Statement

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# Learning Aid

# Exhibition Brainstorming Session

**Purpose:** Use this learning aid to help you answer the question about which rules for effective brainstorming were broken.

Betty is currently conducting a brainstorming session to collect ideas of project requirements for the annual art exhibition. She has already asked several individuals to create mind maps, including the exhibition center manager, the manager and project team from her events management company, and some of the artists who'll be displaying their work. She now wants to use the session to encourage the group to refine and add to the ideas that came from the maps.

To begin, Betty places the full list of possible requirements in front of the group. She says the purpose of the session is to refine and expand on this list. She'll record the session using audio equipment so there's a record of all the ideas generated.

Follow part of the dialog in the session:

**Tim:** Let's look at the space requirements. We have a lot of work to display and some of the pieces will be pretty big. There has to be enough open space for people to appreciate the works.

**Anne:** I think we should focus on the diversity of the collection. We need to make sure each piece is unique. Why don't we draw up a list of criteria for selecting pieces?

**Juan:** Let's think about the lighting requirements we have. They'll be different for each category of work.

**Tim:** Yes, but back to the space we need. I think we're going to have to use some extra rooms in the center.

**Anne:** Why don't we look at the background of each artist, as well as the pieces? That should help us get a more representative collection together. These days, people really want to know where the pieces they buy come from.

**Course:** Project Requirements and Defining Scope   
**Topic:** Group Creativity Techniques

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# Learning Aid

# Trade Journal Brainstorming Session

**Purpose:** Use this learning aid to help you answer the question about which rules for effective brainstorming were broken.

You're managing a project to create a new quarterly trade journal for the textile industry. You're currently gathering ideas of project requirements from a group of stakeholders. Each person in the group has already created a mind map, and you have consolidated the maps into a single map. You're now leading the group in a brainstorming session.

You begin by placing the list of ideas stakeholders have had so far at the front of the room. You explain that the purpose of the session is to refine and add to this list. As the session proceeds, you listen to what each person has to say.

Follow part of the dialog in the session:

**Kate:** I think it's important for the journal to include a regular analysis of changes in world prices, like for cotton and other basic materials. That's something textile manufacturers have to keep a close eye on.

**Graham:** I don't agree. We have to keep the journal from being redundant. Most textile managers get information about things like that on a daily basis.

**Kate:** Well I think the journal could become a good resource for managers. It has to deal with financials and forecasts, not just with light stuff like new fashion trends.

**Graham:** Actually, I don't think fashion trends have to be covered as light stuff at all. There's a gap between the textile and clothing industries, and the journal should try to bridge that. It's difficult for textile manufacturers to get things right when fashion trends for each season aren't clear to them early enough.

**Lesley:** OK. We're going to have to get the general focus of the journal a lot more clear before we get down to nitty-gritty requirements.

**Course:** Project Requirements and Defining Scope   
**Topic:** Group Creativity Techniques

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# Learning Aid

# Document Tracking Brainstorming Session

**Purpose:** Use this learning aid to help you answer the question about which rules for effective brainstorming were broken.

You're leading a project to create a new document tracking and retrieval system. You and the project team are currently gathering ideas of project requirements from a representative group of stakeholders. The group has already generated a set of ideas in mind maps, and you have put these together in a single mind map. You now ask the group to take part in a brainstorming session.

You explain that the purpose of the session is to have some more good ideas about the project. As the session proceeds, you listen carefully to what each stakeholder has to say.

Follow part of the dialog in the session:

**Janet:** Let's talk some more about the basic system design. It has to be easy for users to track all document versions, so we'll have to think about a standard way to categorize documents.

**Greg:** Yes, that's a good idea. Who should be responsible for coming up with and approving a final category of document types?

**Ramon:** I think the design team can work on simplifying the categories the company has given us, and then managers at the company can have their say.

**Greg:** OK. And who will be responsible for testing if the categories we come up work in practice?

**Ramon:** We'll put together a prototype and have a focus group give us their feedback on it.

**Janet:** Should we get back to thinking about the system design?

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**Topic:** Group Creativity Techniques

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# Learning Aid

# Sample Requirements Traceability Matrix

**Purpose:** Use this learning aid to view an example of the structure of a requirements traceability matrix.

| **Sample requirements traceability matrix** | | | | | |
| --- | --- | --- | --- | --- | --- |
| **ID** | **Requirement** | **Backward traceability** | **Forward traceability** | **Status** | **Date** |
| e-001 | Training must use 3-D animations to explain the clinical pharmacology of the company's products |  | func-001, func-002 | Active | 12/02 |
| e-004 | Training must cover and test knowledge of the updated Food and Drug Administration regulations for information in packaging inserts |  | func-003 | Approved | 17/03 |
| func-001 | Training development platform must support 3-D animation | e-001 |  | Approved | 15/03 |
| func-002 | Training must include six approved animations illustrating clinical pharmacology | e-001 |  | Active | 18/03 |
| func-003 | Training must include four multiple-choice questions testing recall of updated Food and Drug Administration regulations | e-004 |  | Active | 16/02 |

**Course:** Project Requirements and Defining Scope   
**Topic:** Managing Stakeholder Requirements

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# Job Aid

# Questions for Refining Requirements

**Purpose:** Use this job aid to review a list of questions you can use in a written questionnaire or during interviews and focus groups to collect and refine project requirements.

Examples of questions you can use to help collect and refine requirements for a project:

* Are any requirements missing?
* Are the requirements clear, or is there room for misinterpreting them?
* Are the requirements feasible?
* Is it possible to meet the requirements consistently?
* Will it be difficult to implement the requirements? Are they complex?
* Have similar requirements been met before in a comparable project or product?
* Do the requirements accurately represent the client's intentions?
* Do the requirements fit together? Will they work in combination or are there conflicts?
* Is there a way to test if each requirement provides a solution?
* Will reliability, availability, and safety needs be met with the requirements?
* Do the requirements meet all the needs for making the product user-friendly?
* Is it possible the requirements will change? If so, when and to what extent?
* Are the requirements comprehensive enough to provide the basis for designing, testing, and implementation?

**Course:** Project Requirements and Defining Scope  
**Topic:** General Techniques for Collecting Requirements

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# Job Aid

# Sample Requirements Management Plan

**Purpose:** Use this job aid to view the layout and sections of a typical requirements management plan.

A requirements management plan generally opens with

* a cover page that clearly identifies the project it relates to, the fact that it's the final version of the plan, and its version number
* a signed page confirming approval of the plan
* a document change control sheet that lists versions of the plan and the dates they were created, up to the final version

After the opening pages, a typical requirements management plan for a project with multiple phases includes the following sections:

### 1.0 Introduction

The introduction outlines the purpose of the project and provides an overview of it. It should also include a glossary of terms and acronyms used in the plan, and references to standards and guidelines or Project Management Office (PMO) documents the plan draws on.

### 2.0 Requirements management organization and responsibilities

This section outlines the specific responsibilities of each party or board in terms of managing project requirements. Examples include the responsibilities of a

* configuration management specialist
* development contractor
* team of subject matter experts
* the project risk officer
* the quality management team
* the team responsible for testing
* the team that will provide product training

### 3.0 Requirements documentation

This section should reference requirements documention for the project.

### 4.0 Phased approach

This section should outline the phases the project will include, and how they relate to each other and the project deliverables.

#### 4.1 Concept exploration phase requirements management

This section should outline the process for developing and refining requirements for each phase, based on the final requirements the project must meet. It should cover concepts associated with operations development, development activities and cycles, and the iterations through which requirements for each phase must pass. It should also outline how requirements for each phase must be allocated and traced.

#### 4.2 Concept development phase requirements management

This section should outline the process for moving from baseline requirements to the final, approved requirements for development. It covers processes for moving from initial phase requirements to system design documents, and for reviewing requirements in relation to these to formulate new or updated baseline requirements.

#### 4.3 Initial production phase requirements management

This section outlines processes for managing incremental requirements during the production phase, including how requirements will be released to this phase from the phase before it, broken down into product specifications, and then passed on to subsequent phases. It should also cover methods for reporting on the status of the phase.

### 5.0 Change control

This section outlines how changes to requirements must be managed throughout the project.

### 6.0 Requirements management process reviews

This section outlines the process for reviewing how well the project is meeting requirements. Managers, the quality management team, and an independent testing team are examples of the people who may be involved in these reviews.

### 7.0 Requirements acceptance criteria

This section defines the criteria that will be used to confirm whether each requirement has been met.

### 8.0 Resources for requirements management

This section outlines documents and other information that will be used to manage requirements throughout the project.

### 9.0 Tools for requirements management

This section outlines tools that will be used to manage requirements throughout the project, such as a requirements traceability matrix.

### 10.0 Plan maintenance

This section outlines the processes for updating the requirements management plan when necessary.

**Course:** Project Requirements and Defining Scope  
**Topic:** Managing Stakeholder Requirements

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# Job Aid

# Project Phases and Requirements

**Purpose:** Use this job aid to review common phase structures and the implications they have for managing requirements.

| **Phase structures and implications** | |
| --- | --- |
| **Phase structure** | **Implications** |
| Single phase | All requirements must be known and finalized before the phase starts  All resources for meeting the requirements must be available during the phase  The phase deliverable must meet all project requirements |
| Incremental phases with a single delivery | Final requirements are broken down into detailed requirements for each phase  Together, the phases create a deliverable that must meet all project requirements |
| Incremental phases with incremental deliveries | All requirements for each phase and for the project as a whole must be known and finalized  The result of each phase must meet a full set of requirements  The integrated results of all the phases must meet all final project requirements |

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**Topic:** Managing Stakeholder Requirements

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# Job Aid

# Sample Assumptions and Constraints

**Purpose:** Use this job aid to review a sample assumptions and constraints segment of a project scope statement.

This is an excerpt from a sample project scope statement. It details an example of the assumptions and constraints segment of the project scope statement – in this case, for the New Employee Orientation and Training project.

## Project assumptions and constraints

The following assumptions and constraints underlie the proposed deliverables described elsewhere in this document. Requirements that are beyond the project scope identified in this document would be addressed under the change control process.

## Content

As of June 15 of this year, contents of "New Employee Kit" will be based on the kit currently in use.

Training on company policies, employee history, and marketplace position will be provided to the project manager no later than June 15 of this year. Any updates to content documents after that date will not be reflected in the training program without written approval of Gary Swenson, the project sponsor.

Approval of the "New Employee Orientation and Training" design document will determine program structure, objectives, and approach, and changes to structure or style after this point may alter the project scope, schedule, and budget.

## Reviews

The project will follow the company's standard development and review process.

Requests for additional reviews by project stakeholders may result in schedule delays and/or budget increases and will therefore by handled via the aforementioned change control process.

All reviews will comply with the company's configuration management procedures regarding document and product control.

## Assets

All training participants' computers will have required operating platforms installed prior to training launch.

All training materials to be used in classroom training will be created using applications within the required operating platforms to ensure compatibility across the platform and among project team members' systems.

All branded graphics such as company logo and generic graphics used in training materials will be approved by Antonia Sanchez in the Corporate Branding Department.

All images should be of the file types .jpg, .png, .psd, .eps, or .gif.

All videos should be in a usable format, which may include .mpeg, .avi, or .flv.

## Cost and time constraints

The budget for this project is $22,000. A more detailed budget is available in the project management plan.

Final deliverables must be ready for roll-out by October 31 of this year. A more detailed schedule is available in the project management plan.

**Course:** Project Requirements and Defining Scope  
**Topic:** Techniques for Defining Scope

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Create Work Breakdown Structure

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# SkillBrief

# The Work Breakdown Structure

In project management, the work breakdown structure (WBS) gives you control of a project by breaking work down into manageable units. To create a WBS, you use a process of decomposition.

During decomposition, you subdivide the elements of your project into progressively smaller components, starting with the project name and refining each level of decomposition until you are able to identify the smallest units of work that must be done.

The top level in any WBS is the project name, which represents the ultimate goal of the project. This is the starting point for the breakdown you'll create. It's at the second level that you have to decide how best to structure project work.

This means identifying the broadest divisions you can break it down into. There's no right or wrong method of structuring a WBS. It will depend on the size and nature of the project, and on company or personal preferences. For example, you can structure the WBS by

* **phases** – A project may be divided into sequential phases if it is complex or long.
* **major deliverables or sub-projects** – It's useful to structure a WBS by major deliverables or sub-projects if a project must deliver a tangible product that's made up of different components.
* **external sub-projects** – If external companies or teams will be contracted to complete different aspects of the project work, a WBS can be structured into separate, external sub-projects.

### Structuring the WBS

It's important that the WBS accurately represent all the work that must go into a project. So the second level must also include the work that goes into project management, which is central for any project.

Once you have decided on the upper structure for a WBS, you need to break it down further into tasks, sub-tasks, and work packages, until you get to reportable activities.

Typically, it makes sense to include from four to six levels of decomposition. This is to ensure the WBS is not overly complex and remains manageable.

### Outline

So far, the WBS has been represented as a diagram that uses a tree structure with boxes or nodes to represent each junction. But you can also choose to use an outline made up of an ordered list of the items in your decomposition. The benefit of the outline format is that it's easier to create. Often a hierarchical diagram requires specialized charting software or diagramming know-how.

### 100% rule

A good way to analyze the accuracy of a WBS is by using what's called the 100% rule. According to this, each level of decomposition must add up to 100% of the work required for the level above it. If you find this isn't applying, you need to re-evaluate the structure of the WBS.

### Identification

Coding minimizes confusion by giving you an idea of how each level of work relates to levels above it. The code for each work element is generally comprised of the number of coded work levels preceding it plus its own identifier. Coding also lets you track each element in the WBS so you can assign work and estimate and track costs and effort.

Most organizations that carry out project-based work use automated project management programs to generate digital WBS diagrams or layouts. These systems automatically assign a code to each component of the WBS.

### Reasons for decomposition

The WBS breaks down project deliverables into work packages, each of which is small enough to assign to particular project team members. This makes it possible to allocate clear responsibilities for each required unit of work.

If you have structured your WBS correctly, it should be invaluable in helping you achieve four distinct goals:

* defining project team members' responsibilities
* allowing better control of the project
* facilitating project scheduling
* facilitating accurate cost estimates
* The WBS breaks down project deliverables into work packages, each of which is small enough to assign to particular project team members. This makes it possible to allocate clear responsibilities for each required unit of work.

By breaking work down into manageable units, the WBS also facilitates accurate progress reports and can give stakeholders a context for interpreting reported progress.

The WBS also facilitates budget creation. The cost associated with each decomposed element of a WBS will be the sum of the costs of all the elements underneath it.

The WBS facilitates effective project scheduling by enabling you to create a schedule that includes all the work needed to complete a project. A good way to observe its effectiveness is to turn the WBS 45 degrees clockwise. You will notice that all the elements required to complete a project from the most basic activities to the final objective are laid out from left to right. This provides you with a start-to-finish work flow for your project.

One final point to bear in mind about the WBS is that it should identify work products or deliverables – the results of effort rather than the effort itself. Make sure you list all components as nouns instead of verbs. This is because the names in the WBS tell you what should be achieved, not how it should be achieved.

You use a work breakdown structure, or the WBS, to plan and monitor projects.

To create a WBS, you decompose a project into high-level categories like phases, deliverables, or sub-projects, based on the nature of a project. For instance, the structure you use may be based on whether it's necessary to complete work sequentially or concurrently. Once you have defined the upper levels of decomposition, you break these down into tasks, sub-tasks, and work packages, which are the smallest units of work.

Together, all the required work on one level should add up to all the work for the parent element on the level above it. The WBS has four main purposes. It enables you to assign responsibility to team members and control a project as it progresses. It also enables you to create an accurate project schedule and facilitates accurate cost estimates.

**Course:** Create Work Breakdown Structure  
**Topic:** The Work Breakdown Structure

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# SkillBrief

# Inputs to the WBS

To implement a well-designed work breakdown structure (WBS), you first need to analyze a range of inputs for the Create WBS process. These inputs were developed through the Initiating and Planning processes for a project. Remember, processes completed during a project build on each other.

So outputs from the Initiating and Planning processes become inputs for the Create WBS process. Take the Develop Project Charter process, for example:

* the Develop Project Charter process creates an output - the project charter - that broadly defines the project's goals and major deliverables
* once the project sponsor approves the charter, it becomes an input to the Define Scope process
* the Define Scope process involves elaborating on what's in the charter to create a project scope statement
* the project scope statement provides detailed requirements of what work must go into the project and what attributes its deliverables must have
* in turn, the project scope statement becomes an important input for the Create WBS process

In addition to the project scope statement, the Create WBS process has two other inputs derived from preceding processes. They are requirements documentation and organizational process assets.

### Project scope statement

A detailed project scope statement contains the following elements:

* the product scope description, which details all the features and functions a product must have, and what work must go into creating project deliverables, guiding the process of breaking down deliverables in the WBS
* the project deliverables, which details all the work that needs to be done to complete the project, and assists in identifying what tasks must be included in the WBS
* the product acceptance criteria, which outline the requirements the project must meet before stakeholders accept the final product or service, and indicate what tasks must be included in the WBS to achieve these goals
* project constraints, which specify the limitations and restrictions the project faces, such as imposed budgets or time limitations, and influence how you structure your WBS
* project assumptions, the factors that are considered to be true about a project, and which in turn lead to certain tasks being included and excluded from the WBS
* project exclusions, which clearly stipulate what is and is not included in the project

### Requirements documentation

The second input for the Create WBS process is requirements documentation. This input is important because all requirements must map to specific deliverables in the WBS. The more accurate the input is, the more accurate the WBS will be in ensuring all requirements are met.

Requirements documentation can also identify the priority of each requirement. This can affect how you structure the WBS. For example, it may determine the order in which work on deliverables should be carried out during project execution so that higher-priority deliverables are completed first.

You use requirements documentation to ensure that the WBS reflects stakeholder expectations for the project and its deliverables.

### Organizational process assets

Organizational process assets are the third input for the Create WBS process. These are some examples of organizational process assets that may be inputs for creating a WBS:

* existing policies and procedures, which often contain guidance for handling various aspects of projects
* existing WBS templates, which you may be able to use as is or with minor modifications
* project files and documents from previous projects such as time schedules, costing sheets, and process guides, which can often be reused or serve as guidelines, and may shed light on the actual complexity of activities for scheduling purposes
* lessons learned from previous similar projects, which can help project managers avoid mistakes, thereby saving time and money

The three inputs to the Create WBS process are the project scope statement, requirements documentation, and organizational process assets.

The project scope statement contains six main elements – the product scope description, project deliverables, product acceptance criteria, and project constraints, exclusions, and assumptions. Each of these elements helps guide the decomposition of a project into manageable components. Requirements documentation identifies what requirements the components of a WBS must meet, as well as the priority of each of these requirements. Examples of organizational process assets that can help you create a WBS are policies, procedures, WBS templates, and project files and lessons learned from previous projects.

**Course:** Create Work Breakdown Structure  
**Topic:** Gathering the WBS Inputs

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# SkillBrief

# Decomposition

The Create Work Breakdown Structure (WBS) process helps you break down deliverables into smaller, more manageable work components. The technique you use to do this is decomposition.

Decomposition is used to break down deliverables until they are defined at the lowest level of the WBS – the work package level. It involves creating increasingly detailed descriptions of small sections of work that are easier to plan, execute, monitor, and control.

So the benefits of using the decomposition technique are that it makes cost and schedule estimates more accurate and the work of the project easier to control and measure.

There are some pitfalls, however. It takes time to break down and detail small work components. If you break work packages and activities down too far, you may be wasting time and effort. So over-decomposition leads to inefficiency in terms of work performance and resource use. Another potential problem is that an overly detailed WBS can be overwhelming. This causes it to lose its effectiveness in communicating what needs to be done.

One of the purposes of the WBS is to give an "at-a-glance" look at the entire project scope.

There are four steps you follow when using the decomposition technique. The first is to identify and analyze the main deliverables. Next you need to decompose the deliverables into work packages. The third step is to develop and assign identification codes to each component. Finally, you verify the WBS, ensuring that the degree of decomposition is necessary and sufficient.

#### Identify deliverables

The first level of decomposition involves identifying key deliverables for the project. These items are generally placed at the second level of the WBS. You find information about these key deliverables from the project charter and project scope statement.

#### Decompose deliverables

The second step is to complete the decomposition of the identified deliverables. This involves organizing and defining work components. You then decompose the components to identify what work packages they contain. Each component should clearly describe a product, service, or result in verifiable terms, and the person or group responsible for its accuracy should be designated.

#### Assign identification codes

Once you have broken down deliverables into work packages, you need to assign a unique identifier code to each component. This ensures you can refer to and track each package. The identifiers are usually associated with the corporation's chart of accounts – so that accounting and management processes use the same identifiers.

#### Verify WBS

Associated Text 4 The final step of the technique is to verify the WBS. This involves ensuring that each bottom level item or work package is clearly identified and correct.

### WBS templates

You can simplify the decomposition process by using a WBS template. The template used should be based on the type of project you're managing.

Many organizations carry out projects that are similar in size and type. When this is the case, you can save a lot of time and effort by repurposing a WBS from a previous project. Work breakdown structures from the same department in the same organization are often useful templates for a new project.

Work breakdown structures from the same department in the same organization are often useful templates for a new project. Although each project is unique, projects in one department often have similar life cycle phases and other basic similarities.

If you don't have a template available, you can check with your Project Management Office, or PMO, for any templates it may have.

Decomposition helps you break down deliverables into smaller, more manageable work components. The four steps in this process are to identify the main deliverables, break them down into smaller work components and then work packages, assign a unique identifier code to each component, and verify the work breakdown structure, or WBS, is complete and correct.

To simplify the decomposition process, you can customize WBS templates from similar projects.

**Course:** Create Work Breakdown Structure  
**Topic:** Overview of Decomposition

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# SkillBrief

# Verifying the WBS

The first steps in developing a work breakdown structure (WBS) involve identifying deliverables and decomposing them into components and work packages. This topic deals with the final two steps of the process – assigning identification and verifying the WBS.

### Assigning identifiers

Once you've identified deliverables, components, and work packages, it's important to assign them with identification codes. The codes enable you to sum and track the costs, schedule, and resources associated with each element. For example, if you need to trace the cost of purchasing a resource, the same code is used in accounting and in the WBS. These codes are usually associated with the organization's chart of accounts, which tracks costs by category.

The type of identifier you use will depend on company standards and your own particular style. Identification codes can include the following:

* numbers with dashes, as in 1-4-2-1 for the first work package in the second component of the fourth deliverable
* numbers with dots, as in 1.4.2.1
* numbers with underscores, as in 1\_4\_2\_1
* alphanumeric combinations, as in A2A

You can use a code in the WBS to track a deliverable, component, or work package using the company's accounting or resource management system. This lets you identify deviations so you can correct them.

Most companies use some type of project management software to generate codes automatically for elements in a WBS. You can use this software to simplify the process and to integrate the WBS with project accounts and change management.

### Verifying the WBS

The final step in developing a WBS is verifying that the degree of decomposition you've used is sufficient. You have to determine if the lower-level elements are both necessary and sufficient for creating the higher-level deliverables.

The lowest level of decomposition is the work package. Each package should be a result or deliverable, rather than an activity. It should have a manageable duration and be measurable so you can determine when it's completed successfully.

When verifying work packages, you should check whether all the elements are clear and complete. You also check whether each component and work package listed is absolutely necessary to meet the requirements of the deliverable it relates to.

#### Clear and complete

When assessing whether the WBS is clear and complete, you need to question whether the descriptions of each element clearly state what work needs to be done. The name of each element should be easily understood and defined in the WBS dictionary.

To verify that the WBS is complete, you need to ensure that 100% of the work is represented at the second level. Then the sum of each child element should equal 100% of the parent element's work.

#### Necessary

When assessing whether the elements in a WBS are necessary, begin by analyzing the work packages. Ask yourself whether any of these elements are unnecessary given the project scope.

To help ensure necessary items have been included, you should always involve the project team, experts, and other key stakeholders.

#### Objectivity

Generally, someone other than the person who originally developed a WBS should verify it. This helps ensure objectivity. Someone with a fresh eye is more likely to spot areas that are unclear, incomplete, or unnecessary.

#### Preventing duplication

To prevent the duplication of project work, you should check that each deliverable is clearly defined. And you should ensure that each work package has a reasonable duration. You also should ensure that the identification code for each element is logical and can be integrated into accounting and management systems within the organization.

When checking deliverables and work packages, expert judgment is the tool used to verify the WBS.

Other areas you need to review when verifying the WBS include ensuring that project management elements are included, and that contractual work is entered correctly. A good rule of thumb is to check whether there is a project management element at the second level of the WBS – such as project plan. Most projects have a project management plan as a project deliverable.

For each component that involves contractual or outsourced work, you should use a single discrete element. And if any of the parent elements represent organizations, you should consider reworking them so they reflect deliverables.

Finally, when verifying the completed WBS, you need to assess whether it logically reflects how your particular organization does business. This may involve ensuring that the coding system used matches that of the organization's accounting system. It may also involve ensuring work package durations match with weekly reporting periods.

Once you have all your deliverables broken down, you may feel that the WBS is finished. However, projects change as they progress, and the WBS needs to reflect these changes. So you may need to come back to it as planning progresses. Further decomposition may then be needed to estimate costs and durations.

In the third step of developing a work breakdown structure, or WBS, you assign an identification code to each element. This ensures each element can be tracked, monitored, and controlled. It also enables you to connect specific project activities with an organization's accounting and management systems.

The fourth step is verifying the WBS. To do this, you need to ensure all the element descriptions are clear and complete, and that no unnecessary work is included.

**Course:** Create Work Breakdown Structure  
**Topic:** Verifying the Breakdown of Deliverables

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# SkillBrief

# Breaking Down Deliverables

The four steps in the decomposition technique are to

1. identify the main deliverables
2. decompose deliverables
3. assign identification to components
4. verify the work breakdown structure (WBS)

This topic deals with the first two steps of decomposition.

### Identifying the main deliverables

Before you begin work on a project, you have to know exactly what it must deliver. The decomposition technique is what you use to identify deliverables and break them down into manageable units of work. There is no right or wrong way to structure the work for a project.

During the first step of decomposition, the project team needs to focus on deliverables – the unique product or results the project must deliver. To do this, it should consider the nature of the product and the size of the project, and then organize the work logically.

Factors influencing how deliverables are identified and organized include the complexity of the project, whether phases are run concurrently, and whether the project has interim deliverables.

#### Complexity

A simple project requires less breakdown of deliverables than a complex one with many phases – deliverables for a complex manufacturing project could be divided according to project phases. In the project initiation phase, research documents are the deliverable.

#### Concurrent phases

The deliverables for a project with phases that take place concurrently can be divided according to these phases. In an IT project, the initial breakdown could show online service design, a developed user interface, a programmed application, a web site, and the integration of all the elements as deliverables.

#### Interim deliverables

A project that has interim deliverables that evolve to form the finished product could be organized by release or version. The publication of a book may be structured according to the book drafts or versions until it is ready to print.

### Decomposing the deliverables

After you identify key deliverables, you need to decompose them into components, and then into work packages. A work package is the smallest unit of work in a WBS. It should include an amount of work that can be realistically managed and completed within a specific time frame.

There are no hard rules for how many levels you should have in a WBS. The degree of decomposition depends on two main factors – the complexity of the project, and the experience of the project manager and team. A large and complex project is likely to have more levels than a small, simple one. A small, simple project like building a storage shed will need very little decomposition.

#### Level of experience

The experience of the project manager and team is the second factor to consider when deciding on the level of decomposition needed. The more familiar the team is with the required work, the more general the WBS can be. However, if the project type is unfamiliar or there are many unknowns, the project manager may want to break it down further to facilitate monitoring and controlling.

#### Familiar project

A computer gaming company regularly updates its top-selling games. These projects are familiar to the project team and have been managed without trouble many times before. Cost, duration, materials, and resource needs should be easy to estimate given the history of the company. So very little decomposition will be necessary.

#### Unfamiliar project

A company that designs interactive web sites decides to venture into developing computer games. In this scenario, the project is unfamiliar and the project manager will need a greater level of detail about the work packages. Planning and estimating costs, duration, and resources are difficult for the project manager and team, so a high level of decomposition will be necessary.

### Purpose of decomposition

The core purpose of decomposition is making sure the WBS contains all the deliverables and that work packages are manageable. For a work package to be manageable, you should be able to assign, monitor, and control it, and determine when it's complete.

#### Cost and time

If you look at a deliverable and say to yourself, "First I would have to know how long the research part of it would take," it's a sign that the deliverable should be further broken down.

#### Measurability

You need to be able to apply quality criteria to the deliverable. For instance, if a manuscript deliverable is broken down into edit manuscript. The editing criteria are vague. Is the content being edited? Or is the manuscript being proofread? So if the component is broken down further into edit content and flow, and proofread work packages, criteria such as "check sources" and "logical flow" can be applied to the edit content work package.

#### Duration

If work packages can't be completed between reporting periods, project managers may have difficulty in obtaining feedback control information and passing it on to the project team.

Whereas some experts feel that the durations of work packages should be based on reporting periods, others recommend the 8/80 rule. According to this rule, work package durations should be within defined limits, typically between 8 to 80 hours of work. If a work package will take less than 8 hours, you know you've broken the deliverable down too far. If it will take more than 80 hours, you should break it down further.

The first step in developing a work breakdown structure, or WBS, is identifying a project's deliverables. How this is organized depends on project size and complexity, and on logical ways in which the work can be broken down.

The second step is decomposing deliverables into components and then work packages. The degree of decomposition needed depends on the size and complexity of the project, and on the familiarity of the project manager and team with the required work.

Criteria you can use to determine if a work package has been sufficiently broken down include whether cost and duration can be estimated and whether the result can be verified or measured. You should also verify that its duration falls within reporting periods or meets the 8/80 rule – including between 8 and 80 hours of work.

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**Topic:** Breaking Down Deliverables

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# SkillBrief

# Create WBS Process Outputs

The Create Work Breakdown Structure (WBS) process generates the tools you need to evaluate work performance, and has four outputs:

* the finalized WBS
* the WBS dictionary
* the scope baseline
* updates to project documents

#### Finalized WBS

The WBS is a management overview document that outlines all the work required in a project. You finalize it by creating control accounts at strategic points to monitor performance.

#### WBS dictionary

The WBS dictionary is a key, or legend, that explains every component of the WBS. It contains information that doesn't fit into the WBS. It consists of a separate form for each WBS item, which describes its work and requirements in detail.

#### Scope baseline

The scope baseline is the complete description of the projections, requirements, assumptions, and constraints that you measure work performance against. It includes elements of all the Project Scope Management planning processes, as well as input from other knowledge areas.

#### Updates to project documents

As you create the WBS, you might discover that some projections in other project documents are not entirely realistic and need to be updated.

### Creating the scope baseline

You create the scope baseline using two other outputs from the Create WBS process. These are the finalized WBS and the WBS dictionary. You also use the project scope statement. Consider the relationships among these outputs in the creation of the scope baseline.

First the requirements documentation is created during the Collect Requirements process.

During the Define Scope process, you use requirements documentation to produce the project scope statement.

You then use the project scope statement and stakeholder requirements to produce the WBS. You finalize the WBS by adding control points.

Using the finalized WBS, you create the WBS dictionary.

From the finalized WBS, the WBS dictionary, and the project scope statement, you compile the scope baseline.

Finally, you update project documents with any approved changes that may have resulted from the Create WBS process.

The scope baseline is unusual in requiring three components - the scope statement, WBS, and WBS dictionary. Other baselines, like those for the budget and schedule, typically have only one component. Although all of the components describe the deliverables and the work required to create these, each one brings unique and important information to the scope baseline.

#### Project scope statement

The project scope statement provides a detailed and holistic description of the project and product scope, including the project's boundaries, exclusions, and constraints.

#### WBS

The WBS and WBS dictionary are both written for the project team. The WBS summarizes, organizes, and outlines the project's total scope. It arranges the required deliverables, phases, or processes in a hierarchy and splits them into components, and then into work packages. This enables you to assign each unit of work a unique identifier, also known as an account code, so you can track it.

#### WBS dictionary

The WBS dictionary describes the scope of each work package in more detail than the WBS. It contains details about the required work that the WBS cannot hold.

So by integrating these three scope planning elements, the scope baseline gives you an important set of tools to analyze work performance.

### The WBS dictionary

The WBS dictionary is an important element of the scope baseline because it contains information and details about the work that won't fit in the WBS itself. You can think of it as an expanded version of the finalized WBS. It consists of a set of forms with details about each element in the WBS.

In addition to the project's name, and the name and number of the WBS component, the dictionary form includes information about the following:

* the position of the work in the WBS, in terms of its parent and child components
* who's responsible for the work, including contract information
* the code for the stakeholder requirements, from the Requirement Traceability Matrix, to which the work is linked
* a description of the scope of the work
* the name of the person who prepared the form, and a signature and date of authorization

The scope of work description in a WBS dictionary form is a complete set of instructions for a work package.

#### Integrating cost, schedule, and quality baselines

In order for a WBS dictionary form to be useful, it should integrate the project's baselines into the details it provides about the work packages.

So schedule, budget, and quality baselines are integrated with each work package in the WBS dictionary.

You include the relevant schedule information about the work package, such as its expected duration and deadline. It may also be worth noting if the work contributes to an important milestone.

You cross-reference the work package back to its cost-account in the budget, and describe how the resources for the work will be spent.

You describe the quality and standard that's required for the work. This will enable you to judge the standard of the work and pick up quality issues before they become big problems.

By drawing information about each work package together in one easily accessible form, the WBS dictionary becomes a powerful management tool.

In a large project with a complex WBS, the WBS dictionary could contain many separate forms. When you're looking for a particular form, you need to be able to find it easily.

You always follow the WBS numbering system and arrange the forms in sequence. But within the WBS, some components are major deliverables or phases, and some are control accounts.

The Create WBS process has four outputs – the work breakdown structure, known as the WBS, the WBS dictionary, updates to project documents, and the scope baseline.

The scope baseline includes the WBS and WBS dictionary, as well as the project scope statement.

The WBS dictionary provides a detailed description of the scope of each work package. It identifies the team members responsible for each work package, and the requirements to which it relates. It also includes relevant schedule, cost, and quality information.

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**Topic:** Outputs from Create WBS

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# SkillBrief

# Finalizing the WBS

Once you've generated a work breakdown structure (WBS), using the Create WBS process, it's time to finalize that WBS. This means first identifying its components that need extra monitoring, and placing control points at them. This way, you establish the control you need over the work and the project's scope.

### Control points

Control points enable you to monitor and analyze work performance.

This process is known as earned value analysis (EVA). When you conduct an EVA, you detect scope creep by comparing work performance against the project's baselines.

You do this by comparing the work measurements against the project's baselines, particularly scope, quality, budget, and schedule. To analyze work performance, you first roll up, or collate, the performance data that's measured below a control point, to get a snapshot view of the project's overall performance, and compare this to the baseline performance.

#### Locating control points

Each WBS component already contains all the work required to complete it. So when you place a control point, it must be high enough to contain all the work you want to analyze, and low enough to exclude other work that you don't need to analyze.

Project management software has made creating the WBS, and in many cases, conducting EVA, easier. It can typically assign numbers to tasks or work packages, which can then be used to represent the WBS structure.

Some packages automatically integrate the WBS with other enterprise-wide automated systems – for example, cost, configuration and, resource management packages.

To conduct an EVA, you'd use the software to generate a report for a particular component in the WBS.

To establish control over a project, you finalize the work breakdown structure, or WBS, by adding control accounts at strategic management points. Control accounts enable project managers to perform earned value analysis, otherwise known as EVA, on work performance information, at each level of the WBS.

The larger and more complex a project, the more control accounts you need to create. Each control account can have a number of work packages, but a work package can belong to only one control account

**Course:** Create Work Breakdown Structure  
**Topic:** Finalizing the WBS

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# Follow-on Activity

# WBS Templates

**Purpose:** Use this follow-on activity to explore the WBS template that your company uses.

**Instructions for use:** To use this tool, locate a work breakdown structure (WBS) for a project your company has undertaken. If you are unsure where to look, ask an experienced project manager to assist you. Then, ask these questions.

What type of WBS template do you use at your company?

| **Your company's WBS template** | |
| --- | --- |
|  | **Input** |
| **Hierarchical** | Row 2 Column 3 |
| **Text-based** | Row 3 Column 3 |
| **Other** | Row 4 Column 3 |

****For online use, complete each row as described in the instructions. If you would like to work with the page as hard copy, simply print it out using the Print link at the top of this page.****

Review your WBS.

| **WBS review** | |
| --- | --- |
|  | **Input** |
| **Do you think you can use the WBS as a template?** | Row 2 Column 3 |
| **If not, how would you change it?** | Row 3 Column 3 |

****For online use, complete each row as described in the instructions. If you would like to work with the page as hard copy, simply print it out using the Print link at the top of this page.****

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**Topic:** Gathering the WBS Inputs

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# Follow-on Activity

# Verification Checklist

**Purpose:** Use this follow-on activity to assist you in verifying that a work breakdown structure (WBS) is complete, clear, and includes only necessary work.

**Instructions for use:** To use this tool, take a WBS that your organization has used. Then answer the questions to verify whether it is complete, clear, and includes only necessary work.

* Did you include key stakeholders, experts, and the project team in the development of the work breakdown structure?
* Does the work breakdown structure fit with how your organization conducts its business?
* Are all deliverables identified clearly in the work breakdown structure?
* Is the name of each element understandable in terms of what it represents or is a WBS dictionary required?
* Have you included a project management element at the second level of the work breakdown structure?
* Is each work package small enough to make it easy to estimate costs and duration, but large enough to avoid unnecessary administrative work?
* Do element descriptions clearly outline the work that needs to be completed?
* Can you apply criteria to deliverables, components, and work packages to ensure that each element is completed correctly?
* Do the deliverables outlined at level two of the work breakdown structure make up the complete project scope?
* Do the child elements in the work breakdown structure represent all the work required for their parent elements to be completed correctly?
* Do you need to include any integrative elements to connect separate work elements within the project?
* Is all the work that will be contracted out listed under a single, discrete element?
* Is each element coded correctly?
* Does the coding integrate with accounting and management systems within the organization?

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**Topic:** Verifying the Breakdown of Deliverables

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# Learning Aid

# Medical Products Company

**Purpose:** Use this learning aid to guide you through the first and second step of decomposition.

A multinational medical products company has purchased a company in the United Kingdom and intends to move some of its operations to a plant in Puerto Rico. The project involves moving a production line that manufactures adhesive bandages.

This is an in-house project, so it is not being performed under contract. The company standard for decomposition is the 8/80 rule.

The manufacturing facilities will need to be designed and built. The company can adapt existing designs and use these for the new facilities. It will hire contractors to make necessary adjustments to the designs, to construct the facilities, and to install shipped equipment.

The project will include packing and shipping machinery to the new location, where it will be converted for United States power supplies and commissioned. Additional equipment will be sourced, purchased, and installed.

Operating and quality procedures will need to be designed and validated. The team will then need to test and validate the new production line.

The project will also include translating documents on operating procedures from English into Spanish, training operators to work the production line, and training quality management staff to inspect, test, and validate the adhesive bandage products and the efficiency of the production line in the new location. Training material should be adapted and made available in both English and Spanish. After training is carried out, the training itself will have to be evaluated.

**Course:** Create Work Breakdown Structure  
**Topic:** Breaking Down Deliverables

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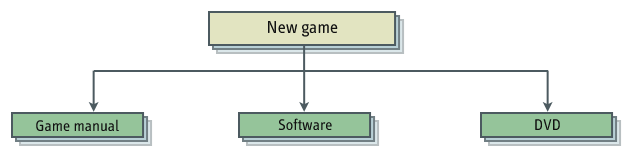
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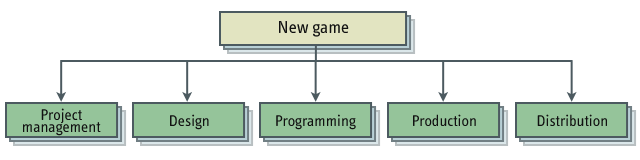
# Learning Aid

# Examples of Work Breakdown Structures

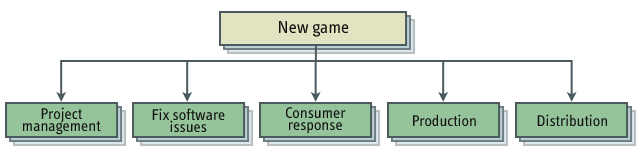
**Purpose:** Use this learning aid to answer the question about organizing a work breakdown structure.



WBS A



WBS B



WBS C

**Course:** Create Work Breakdown Structure   
**Topic:** The Work Breakdown Structure

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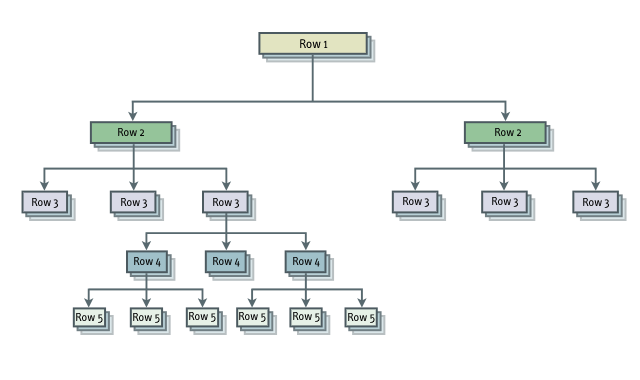
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# Learning Aid

# WBS Example

**Purpose:** Use this learning aid to answer the questions about the structure of a typical WBS diagram.



WBS structure

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**Topic:** The Work Breakdown Structure

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# Job Aid

# The Steps of Decomposition

**Purpose:** Use this job aid to help you remember the four steps of decomposition.

There are four steps that you need to take when decomposing a project.

### Identify deliverables

When you identify a project's deliverables, you need to consider these :

* nature of project's end result – Is a product a service or a tangible product?
* size of a project – Is a project large and complex, or a small and simple?
* the most logical way to organize the work – Does it make sense to organize work by phase or deliverable?

### Decompose deliverables

Once you've identified the key deliverables, you need to break them down – or decompose – into

1. components
2. work packages

When you do this, you need to consider

* the complexity of the project
* the experience of the project manager and team

You then need to establish if you have decomposed the work packages sufficiently by answering these questions:

* Can the cost and time required be reliably estimated at this level?
* Is the product, service, or result verifiable or measurable at this level?
* Does the duration of this work package exceed a reporting period?

### Assign identification to components

You now need to assign identification codes to a project's deliverables, components, and work packages. The codes help you to sum and track the costs, schedule, and resources.

There are various codes you can use:

* numbers with dashes, as in 1-4-2-1 for the first work package in the second component of the fourth deliverable
* numbers with dots, as in 1.4.2.1
* numbers with underscores, as in 1\_4\_2\_1

### Verify the work breakdown structure (WBS)

When you verify the WBS, you verify if you've decomposed a project sufficiently. You do this by checking if

* all the elements are clear and complete
* each component and work package listed is absolutely necessary
* deliverables are clearly defined
* identification codes are logical
* project management elements are included
* contractual work is represented as a single discrete element
* it reflects how your particular organization does business

**Course:** Create Work Breakdown Structure  
**Topic:** Verifying the Breakdown of Deliverables

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# Job Aid

# Example of a WBS Outline

**Purpose:** Use this job aid to review and examine a WBS in outline format.

## Water Supply Project

### 1. Design

#### 1.1 Site & Geotechnical survey

#### 1.2 Select Pipeline Route

#### 1.3 Design Water Main

1.3.1 Specify Trench Requirements

1.3.2 Specify Pipe Diameters

1.3.3 Specify Valve & Jointing

#### 1.4 Design Pumping Station

1.4.1 Building Architecture Design

1.4.2 Mechanical Pump Plant Design

1.4.3 Electrical Design

    1.4.3.1 Utility Electrical Supply

    1.4.3.2 Backup Generator Supply

#### 1.5 Design Elevated Storage Tank

1.5.1 Foundation Design

1.5.2 Tower Design

1.5.3 Tank Design

### 2. Construction

#### 2.1 Acquire Land

#### 2.2 Site Permit Applications

#### 2.3 Construction of Water Main

2.3.1 Lay 12-inch Main

2.3.2 Lay 10-inch Branch Mains

2.3.3 Lay 8-inch Branch Mains

2.3.4 Lay 6-inch Branch Mains

#### 2.4 Construction of Pumping Station

2.4.1 Construct Building

    2.4.1.1 Excavate Foundations

    2.4.1.2 Lay Foundations

    2.4.1.3 Build Walls

    2.4.1.4 Construct Roof

2.4.2 Install Pumps

2.4.3 Electrical Installation

2.4.3.1 Utility Electrical Supply

2.4.3.2 Backup Generator Installation

#### 2.5 Construction of Elevated Storage Tank

2.5.1 Lay Foundations

    2.5.1.1 Excavate

    2.5.1.2 Erect Steelwork

    2.5.1.3 Concrete Fill

2.5.2 Construct Tower

2.5.2.1 Erect Steelwork

    2.5.2.2 Construct Formwork

    2.5.2.3 Concrete Fill

2.5.3 Construct Tank

    2.5.3.1 Erect Steelwork

    2.5.3.2 Construct Formwork

    2.5.3.3 Concrete Fill

### 3. Commissioning

#### 3.1 Pressure & Leak Test

#### 3.2 Flush

#### 3.3 Disinfect

#### 3.4 Microbiological Test

**Course:** Create Work Breakdown Structure   
**Topic:** The Work Breakdown Structure

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Monitoring and controlling scope

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# SkillBrief

# The Verify Scope process

Project managers and stakeholders use this process to confirm that project deliverables meet requirements. A project is incomplete if this hasn't occurred. Before scope verification can take place, the project deliverables must be clearly identified. This is done during the planning stages of the project as a result of three scope-related planning processes:

* Collect Requirements
* Define Scope
* Create Work Breakdown Structure (WBS)

The outputs from these processes – the requirements documentation, project scope statement, and scope baseline – become part of the project management plan, which is used to manage and control scope throughout the execution of the project.

Verifying Scope is a Monitoring and Controlling process and is part of the Project Scope Management knowledge area.

The Verify Scope process is important during final delivery of a project because a project isn't complete until stakeholders accept the deliverables. They compare the deliverables with their requirements and the project management plan. When they're satisfied, they should confirm their acceptance in a formal, written statement.

### Verifying scope

Before scope can be verified, it's important to know what to compare project results against. So, what does the Verify Scope process use to determine if a project has met expectations?

Scope verification is essentially a process of inspection. During the scope planning process, the stakeholders identified and agreed to the project's requirements. As the work progresses and various deliverables are completed, stakeholders want to compare those completed deliverables against the project requirements and acceptance criteria.

The inspection of deliverables – also known as an audit, review, or walkthrough – can include these activities:

* measuring the deliverables against quantifiable standards
* examining deliverables to see if specific requirements have been met
* verifying that deliverables contain the required elements

#### Inputs

To carry out the precise inspections of the Verify Scope process, stakeholders need various inputs to compare to.

Validated project deliverables are the first input. They must be checked for correctness during the Perform Quality Control process and validated by means of an internal review.

The project's approved scope baseline is the second input. The baseline is a set of projected performance data developed at the start of a project. You measure performance by comparing actual work results against it. The project management plan contains the scope baseline. It outlines the project scope statement, the WBS, and the WBS dictionary. These set out exactly what is required of the project.

As well as the validated deliverables and the approved scope baseline, there are two more inputs to the Verify Scope process that describe approved project requirements:

* **requirements documentation**, which sets out project requirements, product requirements, technical requirements, and any other requirements that the project must meet
* **requirements traceability matrix**, which links each requirement to its origin – when project progress is reviewed or project scope is adjusted, the matrix is updated

#### Outputs

As stakeholders inspect project deliverables, they may find defects or areas that have been overlooked. A project manager should give stakeholders the opportunity to record problems with deliverables.

With products that are electronic in nature – like software programs or documents– stakeholders can record issues using something as simple as a spreadsheet. They may also opt for a more elaborate option, like an online bug-tracking system.

Where the product is a physical object, stakeholders can log problems in writing, using a checklist or some type of comments form, such as a survey.

#### Verify Scope or Perform Quality Control?

Although the Verify Scope and Perform Quality Control processes have much in common, they are not the same. The project manager needs to be clear about the differences between them.

The **Verify Scope** process aims to ensure that project deliverables meet requirements. The project manager and the stakeholders carry out this process, reviewing the deliverables against stakeholder requirements.

The **Perform Quality Control** process aims to ensure there are no defects in the deliverables. It also looks for ways to improve the product. The quality assurance team carries out this process by reviewing the deliverables against predefined quality standards.

The relationship between scope verification activities and quality control activities needs to be coordinated during initial project planning. The way the processes are coordinated depends on the nature of the project, the requirements of stakeholders, and the monitoring and control needs of the project manager.

These are the key differences between the Verify Scope and Perform Quality Control processes:

* what the purposes of the processes are
* who performs the processes
* what the deliverables are reviewed against

The Project Scope Management knowledge area includes the Verify Scope process, in which stakeholders inspect each project deliverable to ensure it meets their requirements.

This process is essentially an inspection. Stakeholders compare completed deliverables against the project requirements and acceptance criteria. Inputs to the process are the validated deliverables, scope baseline, requirements documentation, and the requirements traceability matrix.

Although both the Verify Scope and Perform Quality Control processes have similarities, they have different purposes, are performed by different parties, and occur at different times. Activities in both processes should be coordinated during initial project planning.

**Course:** Monitoring and Controlling Project Scope  
**Topic:** Inspecting Deliverables

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# SkillBrief

# The Outputs of the Verify Scope process

Verifying scope is not just about satisfying yourself that the deliverables of your project have been achieved. You need official approval from project stakeholders as well.

### Formal written acceptance

Formal written acceptance of deliverables is part of the Verify Scope process, in addition to stakeholder inspection of deliverables. This acceptance is the main output of the Verify Scope process. It's vital that you keep an official record of the acceptance of deliverables by major stakeholders. This protects you from later claims that the deliverable was not completed satisfactorily.

And once you have written acceptance of project deliverables, it's important to file the acceptance and to update any logs or project documents. This ties up any loose ends and ensures nothing is overlooked.

### Project document updates

Project document updates are the second output of the Verify Scope process. If the scope of a project has changed, you need to reflect this change in all documents that define the product or report the status on product completion. For example, you'd update the project scope statement if the inspection discovers that the project had the capacity to produce more deliverables within the same time that was initially planned.

### Change requests

That's where the final output of the Verify Scope process – change requests – come into play. As stakeholders inspect deliverables, they should use a log or another tool you supply to record any defects or problems they find.

The project manager reviews the results of the inspection. If any stakeholder feels a change is required, the manager then compiles this information into a change request.

Any change request triggers the integrated change control system that's in place for the project. The request is evaluated and either approved, deferred, or rejected. The decision is recorded, and only approved changes are implemented. Once this has happened, stakeholders inspect deliverables again to verify scope.

Whatever the reason for wanting a change, a stakeholder should always submit a change request form outlining the desired change and the reasons for it. The project manager should then assess the request and the impact the change will have and document the details of the request.

#### Change request forms

The first section of the change request form is completed by the stakeholder requesting the change – also known as the requestor. Here, the stakeholder describes the change that she wants to be made, the reasons for the request and the risks it will address, and the request's priority – or level of importance.

The section of the form completed by the project manager outlines what impact the requested change will have in terms of the work, resources, extra time, and extra costs required. It identifies dependencies, or factors that have to be in place before the change can be made. It also outlines any risks associated with making the change, and its likely total impact on the triple constraints of cost, duration, and quality.

Finally, the project manager includes a recommendation for either accepting or rejecting the request, and he signs and dates the form.

#### Changes must benefit the organization

Not all changes come about as the result of defects. Sometimes, new opportunities may lead to a change request. When it comes to managing change requests, the bottom line is that changes should represent a net benefit to the organization.

In fact, it's generally accepted that a change request coming from the Verify Scope process should be viewed with some suspicion. At this stage, you should only approve changes relating to defects in the product or representing gain for the project. You should avoid making changes for change's sake.

Once a change request has been approved, the project team must implement the change. The project manager must update baselines to ensure that future work aligns with the project management plan. Stakeholders will then inspect deliverables again and, if they're satisfied, sign off on the project.

The Verify Scope process has three main outputs - Accepted Deliverables, Change Requests, and Project Document Updates. It's important to obtain formal, written acceptance of deliverables from stakeholders before a project closes. You need to document the changes stakeholders ask for in change request forms and deal with them through a formal integrated change control system. Typically, changes should be approved only if they will have a definite business value.

**Course:** Monitoring and Controlling Project Scope  
**Topic:** Documenting Acceptance and Changes

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# SkillBrief

# The Inputs of the Control Scope process

The Control Scope process can help you manage changes to a project's scope and so keep it on target to meet requirements and objectives.

Control Scope is the last of the processes in the Project Scope Management knowledge area. It also falls in the Monitoring and Controlling process group.

#### Types of scope changes

You use the Control Scope process to manage two kinds of scope change – unmanaged change and managed change.

Unmanaged change occurs when a project deviates from its planned scope. It's also known as variance. It can negatively impact the budget and schedule, or cause a project to fail in meeting its objectives.

You use managed change to correct scope creep, or adjust the scope via a change request, which can arise during daily monitoring. Generally, project managers and sponsors reject all requests by default, unless the change has a proven benefit.

#### Integrating scope changes

Part of managing scope change is controlling the effect of changes on the rest of the project. To do this, the Control Scope process ensures that change requests that arise from monitoring the project go through the Perform Integrated Change Control process.

### Inputs for detecting scope creep

Scope creep is the difference between work performance information and the scope baseline, and both of these are inputs to the Control Scope process.

In the context of scope control, work performance information refers to the status of the work to complete the deliverables, or the functions and features of the product.

The scope baseline consists of the project scope statement, the WBS, and the WBS dictionary. You compare it against work performance information to detect any variance. It also helps you explain the causes and predict the impacts of a variance.

The work performance information that you use for scope control will relate to other knowledge areas, such as cost, duration, or quality performance.

### Inputs for managing scope change

In addition to detecting scope problems, the Control Scope process helps you manage scope issues and change requests. Some of the other inputs to the process can assist you in doing this.

These include the configuration management plan and the change management plan, both of which are part of the overall project management plan.

#### Configuration management plan

The configuration management plan defines the items, attributes, or project documents that must be controlled because they're integral to the project's success.

These items have been "configured" in a specific way that should not be changed without an approved change request. Configurable project items include

**product design documents** – These contain current information on how the product will perform and must be built.

**the product and its components** – The assembled product is configurable. It must conform to the design documents. All components of the product must be built according to the scope.

**all project files and the documentation** – The project's scope, budget, schedule, and all project guidelines and policies are configurable. The Control Scope process controls changes to them.

**the results of quality and stakeholder reviews** – The results contain vital information that assists in improving quality, and in ultimately producing the product to the scope requirements. Stakeholder reviews are critical when backing up claims for payment and when explaining decisions to the stakeholders.

#### Change management plan

Another input to the Control Scope process is the change management plan.

This plan is the roadmap the project manager follows when controlling changes. It provides details on the change control process to be used for the project. A change control process has three main stages: review the change request, decide what to do about it, and communicate the resolution.

Reviewing the change request is the first stage. The project manager and the relevant stakeholders review change requests. A request must thoroughly explain all costs involved and be clear about the reasons for change. It must also explain how the request will be carried out, including its constraints.

Then, the change control board usually decides what to do – approve or reject a change request? If the benefits outweigh the costs, it's likely that a change is accepted, or approved with modification. Alternatively, the decision can be deferred to a later date.

After a decision is made, the project manager communicates the resolution to the stakeholders and the project team – the people who must implement the change.

#### Other Control Scope inputs

Two other components of the project management plan serve as inputs to the Control Scope process:

* the scope management plan, which describes how to manage and control a project's scope, including the scope process, responsibilities of everyone involved, and the project scope statement
* the requirements management plan, which describes how to plan, track, and report changes to requirements, initiate them, analyze their impact, and approve them

The Control Scope process also uses two outputs of the Collect Requirements process – requirements documentation and the requirements traceability matrix. This information is included in the **requirements documentation** but not in the scope baseline:

* high-level information about the purpose of the product, service, or result the project must deliver
* the business objectives the project will fulfill
* potential impacts of changes in the requirements throughout the project
* compliance requirements, which describe how the product must comply with industry standards or regulations
* quality requirements
* the guiding principles of the organization running the project or of the client's organization

Another input to the Control Scope process is the **requirements traceability matrix**. This is a table that links project requirements to their origins, and to their progress throughout the project. The matrix helps manage change requests by identifying related requirements that might have more detail or be impacted by the change.

There are at least two examples of **organizational process assets** that are inputs to the Control Scope process.

A company's formal and informal scope control-related policies, procedures, and guidelines help project managers standardize the way they modify, approve, and validate changes to a project's scope. They may also provide useful information on how scope was controlled successfully on previous projects.

A company usually has set monitoring and reporting methods that need to be used for all of its projects. These help project managers monitor variances in scope and communicate these to all relevant stakeholders when they occur.

The purposes of the Control Scope process are to control scope creep and changes to scope that would have a detrimental effect on a project.

The process involves identifying and analyzing variance from project plans, taking steps to bring scope back in line when necessary, and managing the impact of changes made. It also involves ensuring that all requested changes are processed through the Perform Integrated Change Control process.

The project management plan is one of the key inputs to the Control Scope process. It contains the scope baseline, scope management plan, change management plan, configuration management plan, and requirements management plan. Other inputs include work performance information, requirements documentation, requirements traceability matrix, and organizational process assets.

**Course:** Monitoring and Controlling Project Scope  
**Topic:** Requirements for Scope Control

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# SkillBrief

# Approved Scope Changes

Project Scope Management includes all the processes required to ensure that changes to scope don't get out of control. But the scope control process is also linked with the overall change control process for a project.

#### Integrated change control

The change control process starts when you receive a request or complete one yourself. You assess the change and determine how it should be managed. You might then pass the request to the change control board, which can approve, defer, or reject the request.

During the assessment, the project manager determines how to manage the change while taking into account the change control process that was established for the project. For example, the project manager could reject a certain type of change and approve another that costs less than a given threshold amount – without approval from the change control board.

The project manager may decide to send the change request for review to the change control board. The board consists of a group of stakeholders, usually including the sponsor, that will approve, defer, or reject the request.

The change control board approves the change request. The project manager may approve a request if he has the authority to do so. The change is then recorded in the project's documentation during the Perform Integrated Change Control process.

The request may be deferred and sent back to the requestor for more information. Or it might be deferred because it depends on external factors revealing certain information at a future date.

When a change request is rejected, the project manager informs the requestor, marks the paperwork as rejected, and archives it.

### Control Scope outputs

The Control Scope process generates some important outputs following approved change requests. In addition to a change request itself and updates to the project management plan, these outputs are work performance measurements, project document updates, and updates to organizational process assets.

#### Change requests

An important part of managing scope is keeping good records of change requests and the review decisions made about them. The Perform Integrated Change Control process deals with approving change requests, but the Control Scope process, through the technique of replanning, ensures that the decisions themselves are properly recorded and archived.

#### Work performance measurements

Work performance measurements are the results of comparing actual performance data to planned performance in the project baselines, especially those for scope, cost, and time.

#### Project document updates

Some of the documents that need to be updated are the requirements documentation and the requirements traceability matrix. The requirements documentation describes how a project's requirements meet a business need. The matrix links the requirements to the need and helps trace its development throughout the project's life cycle. Ensuring that both documents are up to date helps manage changes to a project's scope.

#### Updates to organizational process assets

Organizational process assets are any information that can affect a project's success. In addition to policies, guidelines, and manuals, these assets also include all project documentation and records, and lessons learned from previous projects.

Changes to project scope impact costs, the schedule, or both, as well as most other areas of project management. To maintain control, it's important to process change requests that affect the scope according to guidelines in the change management plan, and using an integrated change control process. When changes are approved, replanning is required. This involves revising the scope baseline and other affected project documents.

As well as updated baselines, approved scope changes result in new work performance measurements, updated organizational process assets where relevant, and approved or rejected change requests.

**Course:** Monitoring and Controlling Project Scope  
**Topic:** Managing Approved Scope Changes

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# SkillBrief

# Conducting a Scope Variance Analysis

Imagine you're running a project to lay a pipeline for a water supply firm. During a weekly inspection, you find that the pipeline is about to cross a protected wetland. Conservation laws prevent you from building in the wetland at all, so you've got no option but to change the project's scope to go around the wetland. This will increase costs and take up resources and time.

The Control Scope process gives you the tools to manage situations like this. You use variance analysis to monitor scope during daily monitoring and inspections. And replanning enables you to manage approved change requests.

### Detect scope variance

Monitoring scope is about measuring work performance and product features against the scope baseline. This way you can detect when more or less work than necessary is being done. You may also discover that the wrong features have been added to a product. You use variance analysis to identify the variance, look for the cause, assess the impact of the variance, and choose the appropriate response.

Scope variance is more difficult to measure than variance in cost or time, which you can express in currency, hours, and days.

Scope variance can be quantitative and directly measurable – for instance, a table top is 15 inches too long. Or the variance may be qualitative, such as when the table is the wrong color or its features are not what the stakeholders specified.

### Find the cause of the variance

Being able to identify that a project is not staying within scope is not enough. You also need to identify the factors that are driving the project off course. Pinpointing the cause is an important step in solving the variance, and – where necessary – in creating the appropriate change request.

This involves some investigative work using the work breakdown structure (WBS) dictionary.

In particular, you look at resource assignments for the work most directly related to the variance. These might be described in the scope of work field. You also identify the work in which the variance occurs and the person responsible for it.

### Analyze the impact of the variance

A project manager must take all variances seriously – it indicates that something is wrong with the project or product development process, and needs to be addressed. So once you've found the cause of a variance from the scope baseline, you need to assess its impact on the project's objectives.

You should correct a variance if it's impacting the objectives significantly, if it will become significant because of inaction, or if it's relatively small and easy to fix. Sometimes a variance is large but in an area or product feature that doesn't affect the business objectives. In this case, you might not need to fix it. But when the objectives are seriously threatened, you definitely need to find an appropriate solution.

### Solutions to variance

Once you've identified a variance and explained it, you evaluate the impacts of the available solutions before you choose the appropriate response. This might mean a change in operational procedures to bring the project back in line with its planned scope.

Whatever solution you consider to correct scope variance, it will usually impact the budget, and possibly the schedule. In fact, these three elements form what project managers call the "triple constraint" model, in which a change in one element forces a change in one or both of the others.

This model enables you to evaluate the possible solutions to a variance. If you detect a scope variance that will create cost overruns to fix, you may need to consider reducing the scope. Alternatively, you will have to request more funding in the form of a change order on the budget.

The option of changing the schedule to fix a scope variance won't usually work – the schedule didn't create the mistake, and extending it will just increase costs.

When a project approaches its deadline and time for completing work runs out, scope variance can result. In this case, one option is to spend more to complete the work on time by expanding the budget.

You may experience a project in which you detect variance close to the "drop-dead date." And perhaps the budget's almost used up, and you can't afford to fix the variance. In this case, you might find resources within the project or organization that can come to the rescue. This is known as stacking resources.

### Changing the scope

Once the project manager has assessed and rejected possible ways to correct a variance, the only other option is to change a project's scope.

In a change request, you include the results and conclusions of your investigation into the variance and explain how you derived them. A change request is always subject to review, usually by the change control board, as described in the project's change control process. If it is approved, the change is implemented through the Perform Integrated Change Control process.

Variance analysis involves comparing actual performance information against the scope baseline. You also use variance analysis to discover the cause of a variance, the impact it has on the project, and the impact of any corrective action you might take.

The impact of a variance is determined by the triple constraints of scope, budget, and schedule. Solving scope variance usually involves some form of compromise, or tradeoff, between these constraints. When other solutions don't present themselves, you can consider shifting resources within the project, which is known as stacking resources.

If you're unable to resolve a significant variance in scope, or if the stakeholders and sponsor request a change that would improve project results, you need to create a change request that contains the details from the variance analysis.

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**Topic:** Scope Variance Analysis

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# Follow-on Activity

# Interview Response Form

**Purpose:** Use this follow-on activity to record the responses of experienced project managers to questions about dealing with scope changes.

**Instructions for use:** To use this tool, try to interview at least two experienced project managers about the kind of scope changes they have encountered as a result of the Verify Scope process, and the methods they have developed for dealing with them. Use the following form as a basis for the interview and to record the project managers' responses.

| **Interview response form** | |
| --- | --- |
| **Questions** | **Response** |
| How would you respond to customer requests for scope increase? | Row 2 Column 2 |
| How would you prevent team members from inadvertently changing the scope without approval? | Row 3 Column 2 |
| How do you deal with scope changes you notice when randomly inspecting the project? | Row 4 Column 2 |
| What would you say is the single most important factor to keep in mind when dealing with changes to project scope? | Row 5 Column 2 |
| If in doubt, what methods do you use to determine whether a scope change will be of net benefit to the project? | Row 6 Column 2 |
| Can you give an example of a past project where you feel you did not handle scope change as well as you could have? What would you do differently now? | Row 7 Column 2 |

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# Follow-on Activity

# Using Scope Variance Analysis

**Purpose:** Use this follow-on activity to apply your variance analysis knowledge and skills to a case of variance in one of your projects.

**Instructions for use:** To use this tool, consider a project you're working on or have worked on in the past, where you had experience in managing scope variance. If you have never worked on a project, you might go to an experienced manager to find out how they dealt with variance. Then answer the questions that follow to reinforce the learning.

| **Considering scope variance analysis** | |
| --- | --- |
| **Questions** | **Response** |
| Briefly describe a case of scope variance that you encountered in the project. | Row 2 Column 2 |
| What information did you use to identify and measure the variance? | Row 3 Column 2 |
| Was the variance qualitative or quantitative in nature? If it was qualitative, how did you measure it? | Row 4 Column 2 |
| What was the cause, and how did you ascertain this? | Row 5 Column 2 |
| Taking into account the "triple constraint" model that relates the budget, schedule, and scope, how did the variance impact the project? | Row 6 Column 2 |
| What were the solutions you considered? What factors resulted in you choosing the appropriate action? | Row 7 Column 2 |
| What was your choice of appropriate action? If it was a scope change, did you manage this change through the change control process? | Row 8 Column 2 |

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As you deal with variances that will inevitably arise in future projects, keep this activity at hand to remind yourself of the key aspects of the variance analysis process.

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# Learning Aid

# Hospital Staff Training Project

**Purpose:** Use this learning aid to answer the question about the role of the Control Scope process inputs to the hospital staff training project.

A project to train hospital staff in the proper use of a new workflow system has started. The project scope is to train 120 staff members, and then to ensure that each one passes a performance test. The scope calls for weekly workshops, which are to be held on Saturdays. Five months in all have been allowed for the training, and all the staff must pass the tests. The training has been running for two months, but only 15 people have passed the tests so far.

The teaching methods aren't reaching the remaining staff, so you request a scope change that will involve more frequent workshops with much smaller groups, on weekday evenings. The training protocol was designed on a tight budget because of an original request from the financial director to minimize costs. As a result, it requires strict change control. This change will increase costs significantly, and you've been instructed that all costly scope changes must go through the change control board.

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# Learning Aid

# Air Traffic Control System

**Purpose:** Use this learning aid to answer the question about the role of the Control Scope process inputs to the air traffic control system.

You have been employed to manage a project to upgrade the air traffic control systems at an international airport. The system must be able to control at least 500 flights a day. The airport normally handles about 250 flights, and a safety margin of 100% is required. To meet safety requirements, you'll test the system using simulated flight data after the approval of the aviation authority.

Towards the end of the project, you test the system and find that it's coping well with up to 600 simulated flights a day without error. Then airport management requests that you run an additional testing period of three months with real flight data. During this time, you need to employ extra flight controllers to pick up any errors in the system. So you submit a change request to the boards of the aviation authority, as well as the airport, asking for this additional testing period. A change to the system testing relates to an original requirement for testing using simulated flight data.

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# Learning Aid

# Emissions Control Project

**Purpose:** Use this learning aid to answer the question about the effects on the emissions control project when a change request is approved.

You're managing a project to ensure that emissions at an oil refinery comply with current air quality legislation. This requires monitoring and controlling emissions of five hazardous byproducts. The list of byproducts stated in the legislation is built into the project scope. Each product requires particular technology to monitor it, so the budget is very much tied to the project scope. For this reason, it's a requirement that the scope and budget be reviewed whenever the legislation is changed.

During the project, the legislation is updated to add a suite of 25 potentially hazardous products to the list. This requires a major revision of the project scope. You investigate the full impact of the new requirements, and submit a scope change request, which is approved by the stakeholders.

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# Learning Aid

# Baggage Handling Capacity Project

**Purpose:** Use this learning aid to answer the question about the effects on the baggage handling capacity project when a change request is approved.

As part of a large international airport upgrade, you're managing a project to increase baggage handling capacity.

Originally, the project was scoped to increase handling capacity from 5,000 to 8,000 pieces an hour. Half-way through the year, the client revises estimates based on the latest trends in tourism and decides to double the passenger capacity of the airport.

So instead of 8,000 pieces, it must now be able to handle 16,000 at peak times. You process a change request, and the change control board approves the change.

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# Learning Aid

# Employee Retention Project

**Purpose:** Use this learning aid to answer the question about the role of the Control Scope process inputs to the employee retention project.

In a project to improve employee retention, you're required to refine the strategy for retaining employees of the company. You need to develop a questionnaire, identify reasons for employee attrition, and develop strategies for retaining individuals.

The survey has shown that most of the employees are leaving for higher-paying jobs. The results also show that most of the employees are high performers. With this new information, managers request a change to the project's scope. They want to focus the employee retention strategy on high performers. This will have to complement the existing employee retention strategy.

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# Learning Aid

# System Enhancement Project

**Purpose:** Use this learning aid to answer the question about the role of the Control Scope process inputs to the system enhancement project.

You're working on a system enhancement project for a call center company. The company wants to add a feature that targets customers with marketing messages while they're on hold. The messages must be based on each the customer's historical data. This is to be an additional feature, and isn't meant to require changes to the existing system. During a project status meeting, you find a few outstanding action items that will impact the existing system.

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# Learning Aid

# Irrigation Project

**Purpose:** Use this learning aid to answer the question about the details that would go into the change request when the scope of the irrigation project changes.

The gardens have been developed by an expert landscaper, and it's critical that you get the irrigation right. The stakeholder requirements documentation states that it's essential for the system to cover the garden entirely. The water pressure of the new system is 20% below what is required and, as a result, parts of the garden are not receiving water.

It turns out that the municipality doesn't supply enough water pressure in the area for this irrigation system to work, although all the surrounding suburbs have higher pressure.

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# Learning Aid

# Platinum Hotel Project

**Purpose:** Use this learning aid to answer the question about the details that would go into the change request when the scope of the platinum hotel project changes.

The hotel will cater to both tourists and business travelers. It's mandated to be a platinum-rated hotel, and the hotel company will use it as its flagship hotel. The high-quality fixtures have been specified as part of the project scope. The project is on track to meet its deadline, which is three months away, and the budget is flexible.

A status meeting with a group of stakeholders reveals the need for a specific air purifying system through the hotel. Without it, the hotel will not receive the mandated platinum rating. The reason for this is a recent upgrade to the platinum rating system, in which the initially specified air purification system was removed from the list of approved air purifiers. The new air purification system costs twice as much as the old system, and it is available immediately.

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# Learning Aid

# Cabinet Manufacturing Project

**Purpose:** Use this learning aid to answer the question about the details that would go into the change request when the scope of the cabinet manufacturing project changes.

The scope of the work is to produce high-quality timber cabinets. The project must be completed within two weeks, in time for the arrival of important diplomatic corps guests. During the project, you find that some of the varnish was mixed incorrectly, and it has damaged the surface of about half the cabinets. The suppliers are out of stock of the original wood, and won't have more until after the project's deadline.

The project scope called for this particular timber to be used, as a key requirement stipulated by the interior designer. You have a warehouse some distance away, which contains enough of the same kind of timber that was left over from another project. You can use this timber, but transport costs will increase substantially.

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# Learning Aid

# High-speed Network Project

**Purpose:** Use this learning aid to answer the question about the details that would go into the change request when the scope of the high-speed network project changes.

You're managing a project to install a high-speed network at the research campus of an important international science center. The center has a reputation to uphold, based on its top computing facilities. The scope of the project is that the network must be installed and fully functional within one month. The high-speed network must operate at full specification to be able to handle complex parallel processing functions. The flexible budget is divided equally between the system's installation and its testing. The project employs five senior network technicians who work together through all areas of the project.

At two weeks into the project the network is already installed, one week ahead of schedule. However, you discover that the data transfer speeds are not satisfactory. You suspect the problem relates to a configuration error in one of the many servers. The work breakdown structure (WBS) dictionary contains the required speeds and the server configurations.

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# Learning Aid

# High-speed Network Change Request

**Purpose:** Use this learning aid to review an example of a change request form.

|  |  |
| --- | --- |
| **Section A – to be filled in by the requestor** | |
| **Date** | March 15 |
| **Project name** | High-speed network project |
| **Requestor** |  |
| **Project manager** |  |
| **Request description** | Replace the server operating system. |
| **Reason for request** | The current system is incapable of supporting the network transfer speed requirements. |
| **Risks, if not implemented** | The network speed will be short of what is required for parallel computing processes. |
| **Priority of request** | \_\_Low  \_\_Medium  \_\_High  \_\_**Critical** |
| **Section B – to be filled in by the project manager** | |
| **Work required** | Acquire and configure new operating system. |
| **Resources required** | Funds to purchase operating system. |
| **Expected duration** | Five days. |
| **Dependencies** | Routers will require reconfiguration. |
| **Additional cost** | $60,000 once-off purchase fee. |
| **Contracts affected** |  |
| **Risks, if followed through** | Computing and center's reputation will suffer. |
| **Triple constraints impacted** | Requires extra funding but the budget is flexible. Doesn't affect the schedule. |
| **Project manager's recommendation** | Proceed. |
| **Signature** |  |
| **Date** |  |

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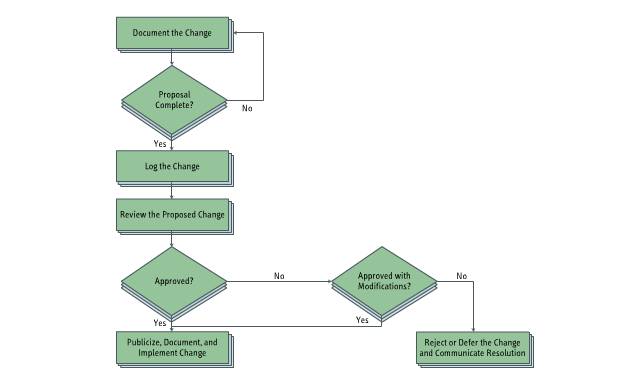
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# Job Aid

# Change Control Process

**Purpose:** Use this job aid to review the change control process.

The change control process involves documenting a proposed change, logging the change, and reviewing the proposal. If the change request is approved, it is publicized, documented, and implemented. The request may also be deferred, approved with modifications, or rejected. The resolution must then be communicated to the relevant people.



The change control process

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# Job Aid

# Sample Change Request Form

**Purpose:** Use this job aid to review an example of a change request form.

|  |  |
| --- | --- |
| **Section A – to be filled in by the requestor** | |
| **Date** | August 19 |
| **Project name** | Network upgrade |
| **Requestor** | Jill Thomas |
| **Project manager** | Tyrone Oswald |
| **Request description** | Although initial specifications called for security codes four characters in length, these codes must be at least seven characters in length for security reasons. |
| **Reason for request** | Current security settings are too easily cracked. |
| **Risks, if not implemented** | The information on our computer systems could be compromised if we do not tighten security. |
| **Priority of request** | \_\_Low  \_\_Medium  \_\_High  \_\_Critical |
| **Section B – to be filled in by the project manager** | |
| **Work required** | Startup and login process must be reprogrammed. |
| **Resources required** | Programming team – at least three programmers. |
| **Expected duration** | One month. |
| **Dependencies** | Availability of original programming team. |
| **Additional cost** | $10,000 |
| **Contracts affected** | Network upgrade contract. |
| **Risks, if followed through** | Some current data on system may be lost if user profiles are changed. |
| **Triple constraints impacted** | This will add to the duration and therefore the costs of the project. However, this is necessary to ensure the quality of the final product. |
| **Project manager's recommendation** | Proceed. |
| **Signature** | Row 9 Column 3 |
| **Date** | August 21 |

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# Job Aid

# Verify Scope versus Perform Quality Control

**Purpose:** Use this job aid to review the differences between the Verify Scope and Perform Quality Control processes.

| **Verify Scope versus Perform Quality Control** | | |
| --- | --- | --- |
| **Category** | **Verify Scope** | **Perform Quality Control** |
| **Purpose** | Ensure product meets requirements | Ensure there are no defects in the product  Find ways of improving the product |
| **Performed by** | Project manager and stakeholders | Quality assurance team |
| **Reviewed against** | Requirements documentation | Predefined quality standards |

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Defining and sequencing project activities

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# SkillBrief

# Processes of the Project Time Management Knowledge Area

### Schedule role

Time management processes can help you ensure that a project is finished on time. These processes enable you to estimate the duration of activities and identify the resources needed to carry out these activities within the project scope.

It all starts with the schedule management plan. This plan is part of the overall project management plan. It contains scheduling methodologies and tools that will be used throughout the duration of the project. This plan also sets the format and criteria for developing and controlling schedule management. How formal or detailed the plan needs to be depends on the organization and the project itself.

The scheduling methodology that you apply to a project generally depends on the process assets and tools that an organization typically uses. So different scheduling tools will be used for different types of projects and organizations. Tools and techniques that you can use to develop the schedule include schedule network analysis, critical path method, critical chain method, resource leveling, what-if scenario analysis, applying leads and lags, and schedule compression. The most common methods of schedule representation are PERT network diagrams, Gantt charts, and lists of milestones.

The backbone of project time management is the project schedule and any supporting schedules. Effective scheduling ensures a project is completed on time, and anticipates risks to the schedule. It also ensures that resources are scheduled appropriately.

The schedule fulfills two key roles:

* **lists project activities** – A project schedule is a list of activities and their expected time of implementation. The list is often developed in conjunction with the work breakdown structure. The project schedule establishes the time parameters of the project and helps you to coordinate and facilitate the efforts of the project team throughout the life of the project.
* **lists human resources** – A schedule lists the human resources that are scheduled to carry out the work. It identifies the person who has been assigned responsibility for each activity. The essence of a good schedule is that it plans and coordinates activities so that resources are used optimally over time.

### Schedule format

You can format schedules in different ways, depending on the software available to you and on your organization's process assets:

* an activity list
* a bar chart
* a network diagram
* a Gantt chart

### Project Time Management processes

There are six consecutive processes that are needed in the Project Time Management knowledge area:

* **Define Activities** – The Define Activities process involves identifying the specific actions to be performed in order to produce the project deliverables. These activities form the foundation of the schedule, so they need to be addressed first.
* **Sequence Activities** – Once you have identified and defined the activities of the project, you need to identify and document the relationships among activities. You do this during the Sequence Activities process.
* **Estimate Activity Resources** – Once the relationships between activities have been documented, the Estimate Activity Resources process begins. Here you estimate the type and quantities of material, people, equipment, and supplies needed for each scheduled activity.
* **Estimate Activity Durations** – After you have identified the resources needed or available for each activity, you work through the Estimate Activity Durations process. This entails estimating the number of work periods, or durations, needed to complete each activity with its estimated resources.
* **Develop Schedule** – During the Develop Schedule process, you need to analyze the information that the previous four processes generated. You analyze activity sequences, durations, resource requirements, and schedule constraints. From this information, you can create the project schedule.
* **Control Schedule** – The final process is Control Schedule. This requires that you monitor the status of the project and update its progress. Changes to the schedule are likely to occur as project activities are implemented. This process allows you to manage these changes.

Generally, you can use a work breakdown structure to help you define activities. This often results in a basic activity list. Then you need to map the relationships and sequences that the activities should take. Often Gantt charts or network diagrams begin to take shape during this process.

To flesh out the schedule, you add the necessary resources. Once you have linked the activities to their required resources, you estimate the duration for each activity. You then analyze the information you have, and develop the project schedule using that information. Once the project is underway, you update the schedule using the Control Schedule process.

The project schedule plays a vital role in project management. It lists all project activities and the timeframe in which they are to be carried out. It also highlights the resources responsible for completing the listed activities.

There are six consecutive processes that make up the Project Time Management knowledge area. The first is Define Activities, which is followed by Sequence Activities, and Estimate Activity Resources. Once these three processes are completed, you then carry out the final three processes: Estimate Activity Durations, Develop Schedule, and Control Schedule.

**Course:** Defining and Sequencing Project Activities  
**Topic:** Time Management Processes

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# Project Time Management and its Process Groups

### Scope and resources

Every project can be divided into five process groups. Only two of these groups overlap with Project Time Management processes. These are the Planning and the Monitoring & Controlling process groups.

The Planning process group is where all of your activities are defined, where your resources and timetables are estimated, and where the schedule is developed. The timeline for schedule planning has to fit in with these general planning processes.

The Project Time Management processes associated with this phase are Define Activities, Sequence Activities, Estimate Activity Resources, Estimate Activity Durations, and Develop Schedule.

These are some of the schedule planning activities:

* **develop scope documents** – Before you can begin planning the project schedule, you need to develop the scope documents, such as stakeholders requirements documentation and the work breakdown structure. These documents are used as inputs to identify project activities. An analysis of stakeholder requirements provides the basis for identifying deliverables. The deliverables are then decomposed into manageable work packages, and the schedule activities are drawn from this.
* **plan resources** – Once you have developed the project scope documents, you can begin planning resources. This involves planning what materials, equipment, human resources, and services you will need. Planning procurements must come before scheduling because some materials may be available only at certain times. And knowing what resources are available at these times will be essential for an accurate schedule. The Estimate Activity Resources process of planning the project schedule uses resource planning as an input.
* **plan the schedule** – The schedule planning processes can take place once you have created scope documents and a resource plan. These processes include Define Activities, Sequence Activities, Estimate Activity Resources, Estimate Activity Durations, and Develop Schedule.
* **plan costs** – The project schedule is a key input to estimating costs, so Project Time Management processes must precede activities that calculate a project's cost. The resources and durations of each activity listed in the schedule enable you to better estimate what each activity will cost. Schedule activity duration estimates also affect cost estimates because these may be time-sensitive costs, such as union labor, seasonal rates, late penalties, or overtime payments.

Although scheduling processes occur in sequence, there is an iterative relationship with the human resource plan. The Estimate Activity Resources process provides a preliminary list of requirements in terms of people and competencies the project will need.

Then the detailed HR plan is created, which documents the roles and responsibilities of individuals or groups for various project elements.

The finalized list of resources, along with the roles and responsibilities, is used to determine the actual resource assignments as the Develop Schedule process is completed.

### Schedule planning

Schedule development processes are ongoing. The schedule is updated and more detail is added as more information is gathered throughout the planning processes and during the development of the project management plan. As other baselines and plans are fleshed out, the schedule is refined.

The baseline schedule is also updated throughout the life of a project as changes and risks are managed.

The Control Schedule process is part of the Monitoring & Controlling process group. It involves tracking project schedule activities and their progress. Changes in status and in the schedule itself need to be documented, managed, and controlled. The Control Schedule process involves determining the current status of the project schedule, identifying factors that may create schedule changes, and managing the changes as they occur.

The triple constraint model shows the relationship between scope, cost, and schedule. This model is used in the Control Schedule process. You can't change one side of the triangle without the change affecting at least one of the other two sides. So changes to the scope or cost baselines will almost always impact the schedule.

The Planning process group is where all of your activities are defined, where your resources and timetables are estimated, and where the schedule is developed. Define Activities, Sequence Activities, Estimate Activity Resources, Estimate Activity Durations, and Develop Schedule are the processes that are associated with the Project Time Management knowledge area.

The Control Schedule process is part of the Monitoring and Controlling process group and involves adapting the schedule to meet changes to the project. The triple constraint model can be used to determine what changes need to be made.

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**Topic:** Time Management and the Process Groups

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# Project Activities

### Inputs to the Define Activities process

Define Activities is the first process of the Project Time Management knowledge area. It is part of the Planning process group. The Define Activities process is closely linked to the Create Work Breakdown Structure (WBS) process. It takes the work packages as they are defined in the WBS and breaks them down into activities. The WBS is part of the scope baseline, which is the first input to the Define Activities process. You use the WBS, as well as the WBS dictionary, and the project scope statement, to create this baseline.

The three components of the scope baseline that are important for defining activities are

* work packages and their activities
* dependencies and relationship between work packages
* project assumptions and constraints

The WBS identifies work packages and describes their dependencies. Work packages contain the products or services that make up the higher-level deliverables. The WBS dictionary is a supporting document. It consists of a collection of forms that describe a WBS component. This information helps you break down work packages into activities.

In addition to incorporating information on dependencies and on the work packages and activities that make up a project, the scope baseline includes the scope statement, which describes what the project must achieve. Written for the stakeholders, this statement outlines the high-level objectives, exclusions, assumptions, and constraints about the project.

There are two other inputs to the Define Activities process:

* **enterprise environmental factors** – Provide project managers with an infrastructure that can assist them to define activities. There may be items to resources - including human resources - available that the project can utilize.
* **organizational process assets** – Contain useful information on policies and procedures related to activity definition, as well as lessons learned from past projects.

### Define Activities techniques

There are four techniques that a project manager may use when defining activities:

* decomposition
* rolling-wave planning
* templates
* expert judgment

The objective of the Define Activities process is to arrive at a complete list of project activities, and the first technique to achieve this is decomposition. In the Create WBS process, you use decomposition to break phases and deliverables into work packages for scoping purposes.

Rolling-wave planning is used to decompose the WBS in stages, based on the amount of information that is needed or available at a time. You can save time with it when working on large projects. Here, work packages that need to be completed in the near term are broken into activities that can be sequenced and added to the schedule, while those that are to be performed in the future remain temporarily at the work package or milestone level.

Milestones are significant points in the WBS. The project manager often uses these to signify the start or end of a sub-deliverable, deliverable, or phase. As you progressively decompose the WBS during rolling-wave planning and more information becomes available, you update the activity list. The activity list is a summary of the activities that you've added to work packages using decomposition. It shows the activity ID, WBS ID, name, and description.

If an activity list template with predetermined fields for necessary information exists in your organization, use it. It could save you time and effort. The objective of the Define Activities process is to compile a complete list of all project activities. This list should contain information such as the activity identifier, WBS number, and activity description.

You can use expert judgment from external sources to assist you in identifying project activities. This is particularly important if you're managing a project that's outside your experience. Expert judgment can also come from internal sources.

### Classifying a project

To determine the effect that project size has on defining activities, it's convenient to divide projects into three broad categories:

* **small to medium** – few deliverables, minor unknowns, low risk, and a few dependencies between the deliverables
* **medium to large** – a more complex WBS, some dependencies between the deliverables, greater unknowns, and medium risk
* **large** – high degree of complexity, risk, unknowns, and dependencies

### Using the techniques

The way in which the tools and techniques of the Define Activities process are used depends on the project's needs and nature. On small projects, you might be able to define all the activities at the planning stage. But even on small projects, you still need to refine the activity list to control situations as they arise.

Medium projects are more complex, with greater dependencies, unknowns, and risks. This means that they require more time and effort to define the activities. But at this complexity level, it might still be possible to use an activity list template to define the activities. A medium project will usually require some degree of rolling-wave planning, and you might need to consult external experts when defining activities.

Large projects are complex because they have many dependencies between the deliverables, numerous unknowns, and significant risks. Because of all these factors, you use rolling-wave planning to decompose the WBS in numerous progressive stages. You may set many milestones because of the need for many decisions. You develop customized activity list templates. You also want to collaborate with a number of external area experts who would assist in defining activities.

The inputs to the Define Activity process are the scope baseline, organizational process assets, and enterprise environmental factors. The baseline is developed with information from the WBS, the WBS dictionary, and the project scope statement. Other information that is needed for the process are enterprise environmental factors and organization process assets.

The tools and techniques of the process are decomposition, rolling-wave planning, activity list templates, and expert judgment.

The nature and size of a project will determine what techniques are employed to define activities. When deciding on the most appropriate technique for your project, consider the project's size according to its complexity, risk, unknowns, and dependencies.

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**Topic:** Identifying Project Activities

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# Identifying the Outputs of Defining Activities

Defining activities enables you to create the schedule, assists the project team in doing the work, and enables you to control project work. To do these things, you need the outputs of the Define Activities process.

### Activity list

The activity list is a table that links an activity to the work package of the work breakdown structure, or WBS, and briefly describes the work required for this activity. The activity list includes an activity ID, a WBS ID, activity name, and description. Activities recorded in an activity list can vary widely, and their nature depends entirely on the project.

The first role of the activity list is to enable you to track activities in the schedule and project management information system, using the activity and WBS codes. The second role is to name and describe the activities. This enables the project team to carry them out.

### Attributes list

The second output of the Define Activities process is the activity attributes list. This list is similar to the activity list, because it also contains an activity ID, a WBS ID, name, and description. The difference is that the attribute list contains more attributes than just those in the activity list. The precise number depends on the type and size of the project, and on how detailed the project manager feels the description of the activities needs to be.

Activity attributes serve two functions – as inputs to the Sequence Activities process and to help team members carry out the activities. Those attributes used in sequencing activities are

* **predecessor activities** – Activities that happen directly before an activity.
* **successor activities** – Activities that happen directly after an activity.
* **logical relationships** – There are four types of logical relationships, or dependencies, between activities – finish to start, finish to finish, start to finish, and start to start. The most common is finish to start, where you start the next activity once its predecessor is complete. So you would first approve the design and then print the catalog.
* **leads and lags** – Leads allow successor activities to be accelerated by enabling them to be started and completed sooner. Lags are delays that could cause the activity to be started and finished later.
* **imposed dates** – Dates that the project manager can't control, often based on the availability of a resource, supply of material to the site, or the lags or leads on an activity.

Other activity attributes provide information that helps the project team carry out activities. These attributes include resource requirements, the location where work will be carried out, the level and nature of effort, constraints, and assumptions.

Resource requirements can refer to resources like human resources, materials, tools, warehouse space, or facilities.

The location of an activity is the actual physical place where the work will be undertaken.

The required level of effort can be

* **discrete** – Discrete effort is when the activity can be performed by one person or a defined project team, in a fixed amount of time.
* **apportioned** – Apportioned effort is required when the work can't easily be divided into separate, measurable parts.

Constraints on activities are factors that limit how the project team performs the work.

Assumptions are facts that the project manager regards as true, and on which the project depends.

### Milestone list

The last output of the Define Activities process is the milestone list, which becomes part of the project management plan. After defining activities, the project manager establishes milestones based on information in the requirements documentation. If an outcome is essential, you establish a mandatory milestone, but if it's just preferred, you make it optional.

Milestones are sometimes called "zero duration" events, because they are critical points in the project's schedule, not activities in themselves. They typically occur after a final activity in a phase or project. They can also be points where decisions are made about the future direction of the project. After defining the activities, creating the activity list, and deciding where you want milestones on the WBS, you record them in a milestone list. Here you give them a tracking number, and state the associated activity, the events they trigger, and the expected date.

Milestones are often used in project management to trigger events, such as:

* **monitoring and controlling processes**, for example performance and quality testing, and scope control
* **closing processes**, for example stakeholder inspection, verification of deliverables, and an activity for the next stage of a project
* **customer invoicing or payment milestones**, for example invoicing of work completed

The outputs of the Define Activities process are the activity list, activity attributes, and the milestone list. The activity list and activity attributes assist in sequencing the activities to create the schedule. By describing activities in detail, they also enable the project team to carry out the activities.

Milestones are critical events that the project manager has identified, and they usually occur after an activity at the end of a phase or project. They can be mandatory or optional, and may trigger the closing of a phase, monitoring and controlling activities, or customer invoicing.

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**Topic:** Outputs of the Define Activities Process

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# Inputs to a Schedule Network Diagram

**Purpose of sequencing activities**

The purpose of the Sequence Activities process is to identify the logical relationships between activities so you can develop a realistic schedule. Through the process, you arrange activities into an appropriate sequence, based on any dependencies.

Except for the very first and last activities a team performs in a project, every activity will have another activity before it and one after it. A predecessor is an activity that starts before another activity and a successor is an activity that begins after another activity.

However, this doesn't mean that every activity must happen one at a time, in sequence. Sometimes work on two or more activities can happen at the same time. One type of dependency exists when an activity can't start until another one is completed.

Project management software can help you identify dependencies and sequence activities. The size and complexity of a project determines if software will be useful, and which is best to use. No matter which software you use, you should remember to use good common sense when you determine dependencies. You should still make use of your project team's expertise and consult other stakeholders to help you determine dependencies and the best sequencing of activities for your project.

### Inputs used to sequence activities

To make the logical relationships between activities clear, you create a project schedule network diagram as the output of the Sequence Activities process. This is a graphical representation of the sequence of project activities, and of the dependencies and relationships between them. Using a schedule network diagram makes it easy for you and others to understand the logical dependencies between activities. This helps you identify which activities must run in sequence and which can run concurrently.

You derive a network diagram from these inputs to the Sequence Activities process:

* **the activity list** – lists all schedule activities that must be completed for a project
* **activity attributes** – describes each activity in the activity list
* **the milestone list** – identifies important or critical points in the project
* **the project scope statement** – details product and project scope
* **organizational process assets** – influence the way you schedule activities

The activity list was created during the Define Activities process and is now used as an input for the Sequence Activities process. It is a comprehensive list of all the schedule activities that need to be completed for a project to achieve its objectives.

Activity attributes are another input for the Sequence Activities process. They identify and describe each activity in more detail:

* **activity ID** – The activity identifier is a unique code you use to keep track of a schedule activity. These codes can be used in place of longer activity names and help differentiate similar sounding activities.
* **activity description** – The activity description is a clear, concise description of an activity. It assists in differentiating an activity from others in the schedule. All team members should be able to identify the activity from its description, no matter what their level of expertise.
* **constraints and assumptions** – Constraints refer to restrictions or barriers facing the project, such as budget limits or imposed deadlines. Assumptions are factors that are considered to be true or certain, without proof that this is the case. It's important to schedule activities to account for relevant constraints and assumptions.
* **predecessor and successor relations** – Information about the relationship of the activity to those that come before and after it is especially important when you're developing a schedule network diagram. This helps you determine when an activity must occur and what it's dependencies are.
* **resources** – Resource requirements can affect how you need to schedule an activity. For example, resources may become available only at a particular time. Another activity that must use the same resources might also have to end before the new activity can start.

The third input to the Sequence Activities process is the milestone list. A milestone is a significant event in the project schedule, such as the completion of a major deliverable. Milestones are useful for making sure that nothing falls behind schedule or gets forgotten. Inserting milestones into your network diagram will create a summary-level schedule that enables you to review all major milestones at a glance. You can choose to highlight milestone activities in the network diagram by color-coding them. Or you can use some other type of identifier, such as a zero time duration linked to the activity. Milestones can be mandatory or optional.

The fourth input to the Sequence Activities process is the project scope statement, which contains in-depth descriptions of the deliverables. The detailed nature of this document often sheds light on the best way to sequence activities.

The last input in the Sequence Activities process is organizational process assets. These are policies, guidelines, procedures, or information about previous projects that can prove helpful when planning.

Archived project files from similar, past projects should contain the old schedule network diagram from those projects. This information, along with the lessons learned from these projects, can prove very useful in helping create good quality diagrams for the current project. Other examples of helpful information from project files would be the description of the scheduling methodology used, as well as the rationale for how dependencies were determined.

You use the Sequence Activities process to identify the logical relationships between project activities so you can develop a realistic schedule. This involves identifying the appropriate sequence of activities and any dependencies among them.

To represent the sequence of activities and their dependencies, you create a project schedule network diagram. Inputs you use to do this include the activity list, activity attributes, the milestone list, the project scope statement, and organizational process assets.

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**Topic:** Introduction to Sequencing Activities

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# Creation of a Schedule Network Diagram

Planning a project has to include putting activities in a logical sequence. You do this using the Sequence Activities process. For this process to lead to an efficient project schedule, it's vital you account for any dependencies among activities. These determine which activities must start or end before others, and which activities you can choose to run at the same time.

There are four steps you follow when sequencing activities.

### Step 1 – Types of dependencies between activities

The first step in sequencing activities is always determining their types of dependencies on one another. There are three possible types of dependencies:

* **mandatory** – inherent to the work being done. They're based on hard logic and often involve physical limitations.
* **discretionary** – assigned based on preference rather than necessity. Discretionary dependencies are followed through only under ideal circumstances.
* **external** – occur between project activities and external activities.

### Step 2 – Using the precedence diagramming method

Once you've identified the types of dependencies among activities, you need to represent these dependencies in a schedule network diagram. To do this, you use the precedence diagramming method (PDM).

To use the precedence diagramming method, you start with the ordered list of activities in the activity list. To begin, you add a node to represent the first activity. Next you represent each activity that's dependent on the activity that comes before it. You continue adding activities until you have a logical pattern of sequenced dependent and nondependent activities. Last you should identify any external dependencies.

### Step 3 – Determining the leads and lags

Once you have the nodes of the network diagram laid out, you should identify where you can speed up the project and where delays are likely. This is known as assigning leads and lags.

A lead occurs when you gain time, often by scheduling work on more than one activity to happen in parallel. If necessary, you can then use the saved time to perform work on one or more other activities to mitigate possible delays in the future or to complete the project early. Nondependent activities can run at the same time as those above them in a schedule network diagram. Even when one activity depends on another, you can sometimes overlap the work in the activities to create a lead.

A lag occurs when there's a delay between activities, meaning that you lose time. If a task involves an unavoidable delay and no other progress can be made during this time, you should add the lag's duration to the schedule.

### Step 4 – Determining dependency relationships

Once you've laid out the nodes for activities in a schedule network diagram, you need to determine and represent the dependency relationships between each of them. In the diagram, you use arrows to indicate the types of relationships between nodes.

There are four types of dependency relationship:

* **start to start** – In a start-to-start relationship, one activity must start before another can begin.
* **start to finish** – In a start-to-finish relationship, one activity must start before another can finish.
* **finish to start** – In a finish-to-start relationship, one activity has to end before another can start. For example, you can't start configuring computer software until you've finished installing it.
* **finish to finish** – In a finish-to-finish relationship, one activity must finish before another activity can finish. For instance, editing can't finish until the writing of all articles for a magazine is completed.

To create a schedule network diagram, you identify required project activities and then determine the types of dependencies – mandatory, external, and discretionary – among them.

You then determine dependency relationships between activities using the precedence diagramming method.

Once you've done this, you determine where you need to note leads and lags. Leads occur when you can accelerate an activity, start an activity early, or start multiple activities at once. A lag occurs when a dependent activity is delayed.

Finally, you determine the dependency relationships between the activities and represent these in the diagram. The possible relationships are start to start, start to finish, finish to start, and finish to finish.

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**Topic:** Creating the Schedule Network Diagram

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# Follow-on Activity

# Defining Activities and their Attributes

**Purpose:** Use this follow-on activity to define attributes for some of the activities in a recent project you were involved in.

**Instructions for use:** To use this tool, think of a project you are currently involved in, or have been in the recent past. Using the table provided, write down all the activities for the project, or just a phase if it's a large project. Then write down some of the activity attributes – the predecessors, successors, leads, lags, and constraints for these activities.

| **Activity attributes** | | | | | |
| --- | --- | --- | --- | --- | --- |
| **Activity** | **Predecessor** | **Successor** | **Leads** | **Lags** | **Constraints** |
| Row 2 Column 1 | Row 2 Column 2 | Row 2 Column 3 | Row 2 Column 4 | Row 2 Column 5 | Row 2 Column 6 |
| Row 3 Column 1 | Row 3 Column 2 | Row 3 Column 3 | Row 3 Column 4 | Row 3 Column 5 | Row 3 Column 6 |
| Row 4 Column 1 | Row 4 Column 2 | Row 4 Column 3 | Row 4 Column 4 | Row 4 Column 5 | Row 4 Column 6 |
| Row 5 Column 1 | Row 5 Column 2 | Row 5 Column 3 | Row 5 Column 4 | Row 5 Column 5 | Row 5 Column 6 |
| Row 6 Column 1 | Row 6 Column 2 | Row 6 Column 3 | Row 6 Column 4 | Row 6 Column 5 | Row 6 Column 6 |
| Row 7 Column 1 | Row 7 Column 2 | Row 7 Column 3 | Row 7 Column 4 | Row 7 Column 5 | Row 7 Column 6 |
| Row 8 Column 1 | Row 8 Column 2 | Row 8 Column 3 | Row 8 Column 4 | Row 8 Column 5 | Row 8 Column 6 |
| Row 9 Column 1 | Row 9 Column 2 | Row 9 Column 3 | Row 9 Column 4 | Row 9 Column 5 | Row 9 Column 6 |
| Row 10 Column 1 | Row 10 Column 2 | Row 10 Column 3 | Row 10 Column 4 | Row 10 Column 5 | Row 10 Column 6 |
| Row 11 Column 1 | Row 11 Column 2 | Row 11 Column 3 | Row 11 Column 4 | Row 11 Column 5 | Row 11 Column 6 |
| Row 12 Column 1 | Row 12 Column 2 | Row 12 Column 3 | Row 12 Column 4 | Row 12 Column 5 | Row 12 Column 6 |
| Row 13 Column 1 | Row 13 Column 2 | Row 13 Column 3 | Row 13 Column 4 | Row 13 Column 5 | Row 13 Column 6 |
| Row 14 Column 1 | Row 14 Column 2 | Row 14 Column 3 | Row 14 Column 4 | Row 14 Column 5 | Row 14 Column 6 |
| Row 15 Column 1 | Row 15 Column 2 | Row 15 Column 3 | Row 15 Column 4 | Row 15 Column 5 | Row 15 Column 6 |
| Row 16 Column 1 | Row 16 Column 2 | Row 16 Column 3 | Row 16 Column 4 | Row 16 Column 5 | Row 16 Column 6 |

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# Follow-on Activity

# Examining a Schedule Network Diagram

**Purpose:** Use this follow-on activity to find out how your company creates a schedule network diagram.

**Instructions for use:** To use this tool, find a typical network schedule diagram in your organization. Then discuss these questions with an experienced project manager.

| **Questionnaire** | |
| --- | --- |
| **Question** | **Response** |
| Does the organization have a standard template for creating a schedule network diagram? | Row 2 Column 2 |
| Is a specific person or department responsible for creating the schedule network diagram for a project? | Row 3 Column 2 |
| Are past project schedule network diagrams retained by the organization? If so, where are they stored? | Row 4 Column 2 |
| If a template is used, who is responsible for updating the template as required? | Row 5 Column 2 |
| What criteria do you use to decide the dependency relationships among complex sets of activities? | Row 6 Column 2 |
| What sorts of activities have you assigned discretionary dependencies in past projects? | Row 7 Column 2 |
| What software packages would you recommend for creating a network diagram? | Row 8 Column 2 |
| How do you deal with external dependencies in a project schedule? | Row 9 Column 2 |

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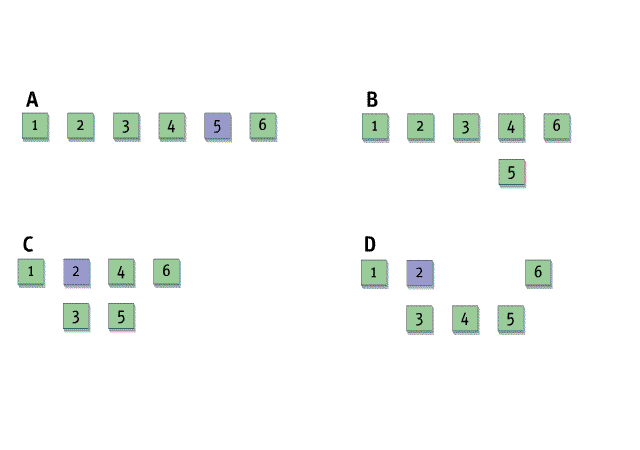
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# Learning Aid

# Sequencing a Construction Project

**Purpose:** Use this learning aid to answer questions about the sequencing of a construction project.

Six activities involved in completing a construction project have been sequenced in four different ways, use the graphic presented in this learning aid to help you choose the most appropriate sequence.



Activity list and four types of dependency relationships

An activity list identifies the following activities:

1. Map site
2. Excavate site
3. Procure materials for walls
4. Pour and set concrete
5. Create frames for walls
6. Attach walls to foundation

Four diagrams display.

In Diagram A, activities 1 to 6 appear on a single level, in a straight line, running from left to right. Activity 5 is highlighted in a different color from the rest of the activities.

In Diagram B, activities 1 to 4 are placed on the same level and run in order from left to right. Activity 5 lies below activity 4. Activity 6 is on the same level as activities 1, 2, 3, and 4, and is positioned to the right of activity 4.

Diagram C is sequenced so that activities 1, 2, 4, and 6 are on the same level, on a single path, running from left to right. Activity 3 lies beneath activity 2. Activity 2 is highlighted in a different color from the rest of the activities. Activity 5 lies beneath activity 4.

In Diagram D, activities 1, 2, and 6 are on the same level, in a single straight path, running from left to right. Activity 2 is highlighted in a different color from the rest of the activities. Activity 3 lies beneath activity 2 and is the start of a path containing activities 3, 4, and 5. This runs from left to right and is parallel with activities 1, 2, and 6.

**Course:** Defining and Sequencing Project Activities  
**Topic:** Creating the Schedule Network Diagram

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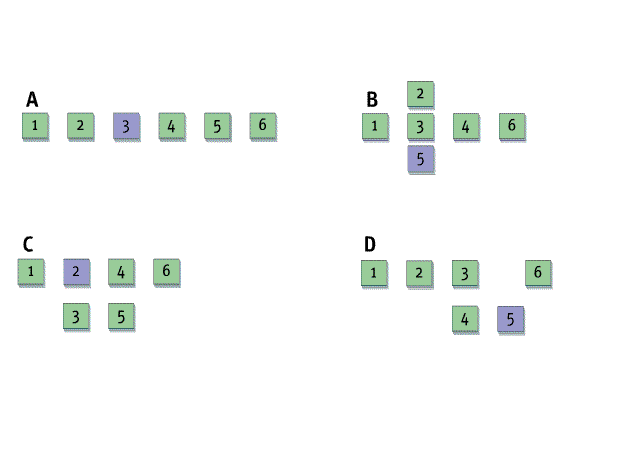
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# Learning Aid

# Sequencing an IT Project

**Purpose:** Use this learning aid to answer questions about the sequencing of an IT project.

Six activities involved in designing and assembling a new computer system have been sequenced in four different ways. Use the graphic presented in this learning aid to help you choose the most appropriate sequence for these activities.



Activity list and four types of dependency relationships

An activity list identifies the following activities:

1. Design system
2. Assemble hardware
3. Code software
4. Integrate hardware and software
5. Write manual
6. Systems test

Four schedule network diagrams, labeled A to D, display.

In Diagram A, activities 1 through 6 are sequenced in a single straight path, on the same level, running from left to right, and activity 3 is highlighted in a different color.

In Diagram B, activities 1, 3, 4, and 6 lie on the same level and run from left to right. Activity 3 lies beneath activity 2, and activity 5 lies beneath activity 3. Activity 5 is highlighted in a different color.

In Diagram C, activities 1, 2, 4, and 6 are positioned on the same level and run in order from left to right. Activity 2 is highlighted in a different color. Activity 3 is placed beneath activity 2, and activity 5 lies beneath activity 4.

In Diagram D, activities 1, 2, 3, and 6 lie on the same level, activity 4 is beneath activity 3, and activity 5 lies on the same level as activity, to the right of activity 3 and to the left of activity 6. Activity 5 is highlighted in a different color.

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**Topic:** Creating the Schedule Network Diagram

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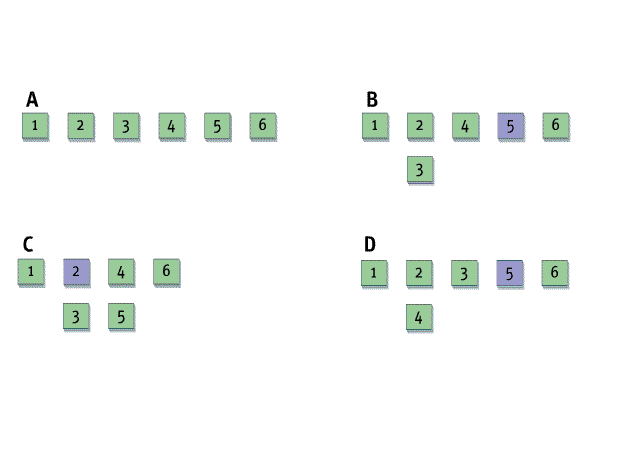
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# Learning Aid

# Sequencing a Market Research Project

**Purpose:** Use this learning aid to decide which diagram is most appropriate for sequencing the activities in a market research project.



Activity list and four types of dependency relationships

An activity list identifies the following activities:

1. Design the study
2. Conduct mail and telephone surveys
3. Observe customers using competitors' products
4. Analyze data from surveys and observations
5. Have reports printed and bound by printing company
6. Present reports and findings to customer representatives

In diagram A, activities 1, 2, 3, 4, 5 and 6, display from left to right on the same level, from left to right.

In diagram B, activities 1, 2, 4, 5 and 6 are positioned on the same level and run from left to right. Activity 5 is highlighted in a different color from the rest of the activities. Activity 3 lies beneath activity 2.

In diagram C, activities 1, 2, 4, and 6 lie on the same level and run from left to right. Activity 3 is positioned beneath activity 2, and activity 5 is positioned beneath activity 4. Activity 2 is highlighted in another color.

In diagram D, activities 1, 2, 3, 5, and 6 are postioned on the same level. Activity 5 is highlighted in another color. Activity 4 lies beneath activity 2.

**Course:** Defining and Sequencing Project Activities  
**Topic:** Creating the Schedule Network Diagram

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# Learning Aid

# Project Descriptions

**Purpose:** Use this learning aid to answer the question about classifying projects.

#### Rapid transit network project

The traffic in a major metropolitan area has reached unmanageable levels. In response, the city has commissioned a project to introduce a bus-based rapid transit network, which will be rolled out over ten years. The project is based on a prototype transport model that's been developed by a national research team. Key deliverables are upgrades to the road network infrastructure, a fleet of 600 specialized buses, a ticketing system based on smart card technology, bus station infrastructure, satellite tracking of all buses, and a new public Internet access system. The project will end when the system is fully established, which will take up to five years.

#### Nongovernmental (NGO) expansion project

An NGO operates twenty after-school care centers for youth in low-income communities. Each after-school center provides access to a library and multimedia center, as well as tutors to help with homework. Youth at the centers can participate in extracurricular activities like graphic design, arts and crafts, dance and martial arts, each of which is taught by volunteer specialists. The project involves expanding the NGO's activities to establish an additional five centers, using the existing expansion model, which includes activity list templates. The centers will be housed at existing community halls. You've worked on previous expansions, and you're confident that the project will run according to plan.

#### Flagship grocery store project

A leading region-wide grocery store is opening two flagship branches at prime locations. They've launched new branches before, but the flagship store concept is a new business initiative for them, and the project differs extensively from their previous ones. The concept is an individually tailored grocery shopping experience, relying heavily on good customer relations. The project involves establishing the new concept as a working model, finding the sites, and setting up the stores. You're also required to find suitable buyers to run them on a franchise basis, and provide staff training during the set-up phase, which will run for one year.

**Course:** Defining and Sequencing Project Activities  
**Topic:** Identifying Project Activities

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# Learning Aid

# IT Mitigation Project

**Purpose:** Use this learning aid to assist you in defining the activities of the IT mitigation project.

A multinational insurance firm has decided to replace its entire IT infrastructure with new hardware, a new network structure, and new data-management systems. This involves designing, installing, and testing the new system before migrating the data to it. Extensive funding is required to mitigate against the risk of losing clients' data. There's also the chance that some of the older data formats will conflict with the new system.

The changes will affect every system in the organization, across multiple locations. The company expects that this will result in significant operational expenditure savings.

**Course:** Defining and Sequencing Project Activities  
**Topic:** Identifying Project Activities

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# Job Aid

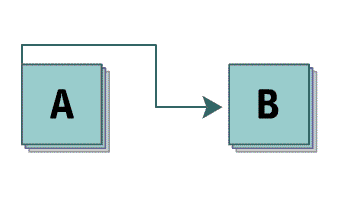
# Types of Dependency Relationships

**Purpose:** Use this job aid to help you identify different types of dependency relationships.

There are four types of dependency relationship.

**Start to start**

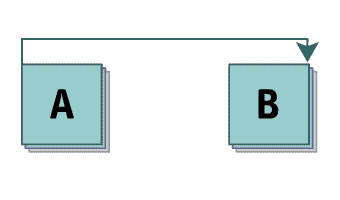
Activity A must start before activity B can start. For example, without having begun filming on a documentary (A), you would be unable to start the editing process (B).



Start-to-start dependency

**Start to finish**

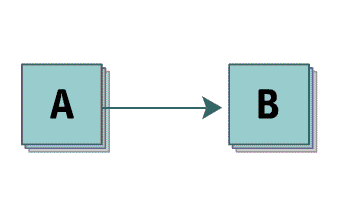
Activity A must start before activity B can finish. For example, you can't start running a new operating system on your computer (B) until you stop using your old system (A).



Start-to-finish dependency

**Finish to start**

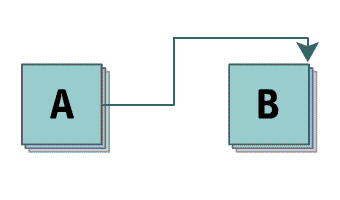
Activity A must finish before you can begin activity B. For example, you would have to put together computer hardware (A) before programming software (B).



Finish-to-start dependency

**Finish to finish**

Activity A must finish before activity B can be completed. For example, the activity of editing a manuscript can't be finished (B) until all the text has been written (A).



Finish-to-finish dependency

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**Topic:** Creating the Schedule Network Diagram

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# Job Aid

# A Project's Define Activities Techniques

**Purpose:** Use this job aid to help you select the appropriate tools and techniques to use when defining activities on a project.

| **Define Activities techniques** | | | |
| --- | --- | --- | --- |
|  | **Small to medium project** | **Medium to large project** | **Large project** |
| **Decomposition** | Decompose all work packages during planning stage. | Decompose known, low-risk work packages during planning stage. Leave unknown work packages and those with preceding dependencies to be decomposed later. | Decompose near term work. Leave later work at work package or milestone level until more information is available. |
| **Rolling-wave planning** | Not required on this type of project. | Use rolling-wave planning on later-occurring work packages. | Use rolling-wave planning on later-occurring work packages. |
| **Activity list templates** | Use standardized template based on similar projects. | Use standardized template based on similar projects. | Templates are of limited use, because of the numerous unknowns. |
| **Expert judgment** | No external subject matter experts required. Use project manager and team's own expertise. | Use judgment from external experts to understand unknowns, dependencies, unfamiliar aspects of the project. | Make extensive use of expert judgment to identify activities, dependencies, and risks. |

**Course:** Defining and Sequencing Project Activities  
**Topic:** Identifying Project Activities

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Estimating activity resources and duration

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# SkillBrief

# The Inputs of the Estimate Activity Resources Process

The Estimate Activity Resources process enables you to determine the resources or inputs needed to complete a project – in other words, the materials, people, equipment, and facilities you need for each project activity. Another purpose of the process is to gather information vital to creating a realistic schedule and, ultimately, formulating a budget.

To estimate required project resources, you need to consider the

* **types of resources required** – You need to identify the resources required for each project activity. This includes physical resources such as computers and human resources. Identified resources are the starting point for budgeting and scheduling.
* **quantity of each resource** – You must determine the quantity of each required resource. This data is important for scheduling and, later, for estimating costs.
* **required skill sets** – To identify appropriate human resources, you need to define the skill sets required to perform each activity. The skill level required will have a significant impact on your budget.
* **project team roles and availability** – You have to determine who will fill roles on the project team and if those identified will be available when needed. You need to take vacation times, leave schedules, other work obligations and other projects into consideration. This is critical for scheduling.

The Estimate Activity Resources process is important because resources – whether people, materials, or both – are typically the largest expense of any project.

Estimating the resources needed for project activities usually goes hand in hand with cost estimates. Knowing what resources you need enables you to get a more precise estimate of what the project will cost so you can develop a realistic budget.

Usually, a project begins with a rough breakdown of the overall estimated costs. For a more accurate estimate, you need to investigate further and determine not only what resources the project needs, but also how much you need of each resource.

You also need to ensure that the resources you identify are in line with what the project can afford. Most projects work with a limited budget for an ideal set of resources.

In addition to providing information vital to creating a realistic project budget, the Estimate Activity Resources process provides information vital to creating a realistic project schedule.

#### Inputs

To estimate the resources you need to complete project activities, you use

* the activity list, which identifies all the activities for completing a project
* the activity attributes, which describe what each activity involves
* enterprise environmental factors, which help determine what resources are available
* organizational process assets, which can affect what, when, and how you use your resources
* resource calendars, which tell you when particular resources will be available

**Activity lists and attributes**

You need to know what must be done before you can assess what's needed to support required activities. Important starting points for required resource estimates include

* **activity lists** – Activity lists include specific tasks such as getting approval for a media campaign, passing graphics, and writing copy for a direct mail letter.
* **activity attributes** – Activity attributes include consulting affected internal and external stakeholders for their peripheral or active participation in meeting specific activities' goals.

**Enterprise environmental factors and organizational process assets**

Both enterprise environmental factors and organizational process assets form inputs affecting your estimates of required resources and can determine which resources you may use for a project – as well as when and how.

* **enterprise environmental factors** – Enterprise environmental factors are circumstances surrounding a project that can affect its success. These include the availability of resources – internally and externally – and company infrastructure. A project manager needs to consider enterprise environmental factors, such as the availability of staff members and their skills for the period in which the campaign takes place. The manager also needs to determine if external suppliers will be available.
* **organizational process assets** – Organizational process assets include a company's policies, procedures, and guidelines, as well as historical information about previous projects. These may help determine how resources must be acquired and used. Company policy – an organizational process asset – may stipulate that only local suppliers can be used. Records from previous, similar projects might identify specific assets as key resources for such projects.

**The resource calendar**

The most important input for estimating activity resources is the resource calendar. This calendar provides details on the available human resources for the duration of the project.

It can also include information about the availability of material resources, such as equipment and space. For example, a project may require use of a printer and a specific conference room.

Having a resource calendar is critical in project management. However, there's no right or wrong way to create it. It's up to the project manager to decide the level of detail it should include.

A composite human resources calendar, a more detailed type of resource calendar, includes

* **scheduling information about human resources and equipment** – Using information in the human resources section, the project manager can see when staff members and equipment will be available to complete project activities.
* **the required human resource capabilities and skills** – Using the material resources section of the calendar, the project manager can see that a printer is required for the project only during the last two weeks of July and the first week of August.
* **skill resources** – The project manager can see when particular skill sets will be needed and map these to when relevant staff will be available.

The Estimate Activity Resources process involves estimating all the resources required to complete a project, and gathering information needed to create a realistic schedule and budget. The inputs necessary for this process include an activity list, activity attributes, enterprise environmental factors, organizational process assets, and resource calendars.

**Course:** Estimating Activity Resources and Durations  
**Topic:** Project Resources

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# SkillBrief

# Matching Activity Resource Process Tools and Techniques

Estimating required resources is important for two reasons. It helps you determine the resources needed to complete a project and it helps you create a realistic project schedule and budget.

Because it's not possible to predict the future, you can never be totally accurate in identifying the resources that you will need for project activities. But a wide range of tools and techniques enables you to make the most of the information at your disposal to come up with the best possible estimates.

Five tools or techniques that can help you determine the required resources for a project include

* **expert judgment** – Often, specialist knowledge of resource estimating or project planning is required. Project managers can use their own expert judgment when calculating what resources – and what quantity of these – will be needed. They may also call on experts in a relevant field to assist in the estimation process.
* **alternatives analysis** – Usually, there's more than one way to accomplish a task. Alternatives analysis is used to compare different ways of carrying out schedule activities. Using alternatives analysis, you can determine the best possible use of resources. For example, it may be possible to use staff members with different skills or expertise, other suppliers, or alternative equipment. Once you've selected the best alternative, you can quantify what resources are required.
* **published estimating data** – Using published estimating data can help you make accurate resource estimates for a current project. This data can give you a frame of reference to work from when you're quantifying the required resources.
* **bottom-up estimating** – Bottom-up estimating is when you break a project into its component pieces of work and then estimate the resources needed for each of the pieces. When this has been done for all the pieces, you add up all the estimates to get a total.
* **project management software** – You can use project management software to help plan, organize, and manage resources. Some sophisticated software programs have additional features that enable you to produce resource calendars and define resource availability and costs.

#### The bottom-up estimating technique

A project is made up of activities – some big, some small, and some more complex than others. To get an accurate estimate of the resources needed for the entire project, you need to know the resources required for each project activity.

How does an organization estimate resources for a complex project that it has never encountered before? And what if there is no reliable resource data available?

In such cases, it's best to use the bottom-up estimating technique. With this technique, you quantify the resources required for the smallest components of project activities, and work your way gradually to the top – to a total estimate of all the required resources.

When compared to other estimating techniques, the bottom-up estimating technique has pros and cons. It can be

* **more accurate** – Bottom-up estimation results are very detailed. The technique generally provides more accurate and definitive results, when compared to other estimating techniques.
* **slower to carry out** – Because bottom-up estimation considers all project activities – from the bottom to the top – it can be slower to carry out when compared to other estimation techniques.
* **more costly** – Because bottom-up estimation considers all project activities – from the bottom to the top – the process can take longer. As a result, it may be more costly than other estimation techniques.

It's critical to ensure that bottom-up estimating is based on realistic estimates. Small mistakes early in the estimation process can add up to a large mistake in the total estimate you reach.

#### Expert judgment

Expert judgment is sometimes needed to verify the accuracy of estimates. In many cases, the expert will be the project manager – but in other cases it may be another individual or team.

Expert judgment can help ensure you don't overlook anything and that estimates you make are as accurate as possible.

When estimating resources, it's also important to consider whether some project activities depend on others. These dependencies may affect how and when resources are used.

Dependencies should be recorded in the estimated requirements of the schedule activity.

Tools and techniques you can use to estimate the required resources for a project include expert judgment, alternatives analysis, published estimating data, project management software, and bottom-up estimating.

Bottom-up estimating is the most accurate way of calculating resource requirements. It's appropriate if reliable resource data is unavailable. Using this technique, you break project activities into smaller components of work, estimate resource requirements for each component, and then add the totals to get a final estimate.

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**Topic:** Establishing Resource Requirements

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# SkillBrief

# Activity Resource Estimate Assumptions and Breakdown Structures

In the Estimate Activity Resources process, the key output is activity resource requirements. These requirements describe the types and quantities of resources needed for each project activity.

Once you know what resources you need, you can begin to estimate the time each activity will take to complete. In this way, the **activity resource requirements list** generated by the Estimate Activity Resources process become inputs for the Estimate Activity Durations process.

#### Activity resource requirements list

The activity resource requirements list identifies, for tracking purposes, the activity's code in the work breakdown structure, as well as its name. Vital to generating the project schedule, it details the resources that you've estimated you need to complete the activity, and addresses

* **resource description** – The Resource description column lists each type of resource that is required for the activity. This includes human resources, materials, and facilities.
* **number required** – The Number required column identifies the quantity required of each resource. This value can be specified in any measurement unit, such as hours, days, or physical number of units required.
* **resource assumptions** – Resource assumptions are important factors to consider when devising the project schedule. Any relevant assumptions about the resource can be included, for example resource availability, skills, or quality.
* **resource availability** – The Resource availability column specifies when each resource can be used. This is vital information for putting together the project schedule.
* **resource dependencies** – The Resource dependencies column identifies factors that may affect the availability of resources. It's important to identify dependencies when devising the project schedule because any change in an activity that has a dependency can affect the project timeline.

The final row of the activity resource requirements list identifies the total resources needed for the activity. The resource totals are important in project scheduling as a base from which to calculate the duration of the activity.

#### Resource Assumptions

It's important to record resource assumptions, as they can help during different stages of a project. Select each project stage to find out how resource assumptions can help.

* **Monitoring** – Recorded assumptions can affect performance monitoring. For example, if a particular task seems to be taking too long, looking at the assumptions can help you identify the problem.
* **Controlling** – Recorded assumptions can also help you control performance. Having used the assumptions to identify a problem, you can now make performance adjustments so that the project can run more efficiently.
* **Closing** – Recorded assumptions can provide insights during post-project assessments at the closing stage. For example, if you had made incorrect assumptions about staff capabilities, looking at the assumptions helps you understand what went wrong. This can then be recorded in the lessons learned file for the project.

Failure to record assumptions can also have an impact during the Monitor and Control Project Work process.

#### Resource breakdown structures

Along with the activity resource requirements list, there's one more main output of the Estimate Activity Resources process – the resource breakdown structure.

The resource breakdown structure provides a hierarchical diagram of the resources required for a project. This structure

* is visually simple, showing resource information at a glance
* breaks resources into categories and resource types
* helps you to organize a project schedule and report on resource utilization information

Although they look similar, a resource breakdown structure is not the same as a work breakdown structure.

A work breakdown structure, or WBS, decomposes a project into manageable units of work. Elements in a WBS include project phases, tasks, sub-tasks, and work packages. These represent all the activities in a project.

#### Project document updates

The Estimate Activity Resources process concludes with project document updates – the final output of the process.

Initially, various project documents are used as inputs for the process. Now that resource estimation is complete, new information may have come to light. For this reason, you may need to update documents so they reflect the latest project information.

In the process of estimating resource requirements and creating the resource breakdown structure, it's often necessary to add or delete schedule activities that appear in the activity list.

The activity changes have a subsequent effect on activity attributes and resource calendars. Because project activities have changed, you need to document those changes by updating the descriptions of activities and the availability of relevant resources.

The first output of the Estimate Activity Resources process is an activity resource requirements list. It's important to record any assumptions you've made about resources in this list, for use in monitoring and controlling project work, and in post-project assessments.

A second output of the process is the resource breakdown structure. This is a hierarchical diagram that shows the resources required for the project in a visually simple way. It groups resources by category, and can be used for organizing and reporting on resources.

The final output of the process is updates to relevant project documents, such as the activity list, activity attributes, and resource calendars.

**Course:** Estimating Activity Resources and Durations  
**Topic:** Activity Resource Requirements and the RBS

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# SkillBrief

# Match Inputs with Their Uses to Estimate Activity Durations

#### Key inputs and their uses

An estimate is more than just a guess. You need to use carefully selected information to calculate an unknown result. When you begin building a project schedule, you need to estimate how long each activity in the project will take. Activity durations are calculated according to work periods. Most often these are calculated as hours.

To do this as accurately as possible, you need to gather information from a range of sources. These sources are the inputs for the Estimate Activity Duration process.

This process draws on information from

* **activity lists** – The project activity list identifies work tasks that you need to include in the project schedule. Only activities that are within the scope of the project should appear on this list. These are the activities for which durations will be estimated.
* **activity attributes** – Activity attributes describe the requirements or limitations on specific activities. They include assumptions and constraints about the timing and location of activities. They can also identify who will be responsible for each activity. These factors affect duration estimates.
* **activity resource requirements** – Activity resource requirements are an input of the Estimate Activity Resources process. This input identifies and describes the types and quantities of resources needed for each activity. Resource requirements affect activity durations. Similarly, the equipment choices you make affect activity durations.
* **the resource calendar** – The resource calendar shows the people, equipment, and materials that can be assigned to activities. Specific types of workers or equipment may be more efficient than others in completing an activity, and this affects duration estimates. It's not so much the availability or nonavailability of resources, but rather the resource capabilities or skills that make the difference in terms of duration estimates.
* **the project scope statement** – The project scope statement includes the deliverables, constraints, and assumptions that apply to the overall project. Specific milestones or limitations imposed by the project's customer – including project deadlines and length of reporting periods – are described in the statement and are used when estimating activity durations.
* **enterprise environmental factors** – Enterprise environmental factors reflect the external environment of an organization, which can affect resource availability. External factors that can influence duration are regulations imposed by government agencies, or the limitations of materials and equipment selected for the job. Information about the effect of environmental factors may be gathered from commercially available estimating databases or from the organization's own records.
* **organizational process assets** – An organization's rules, methods, and practices for conducting its work can affect how long project activities will take. For example, if quality checks must follow a particular process the duration for the activity will be affected by this process. Project organizations store and retrieve information about previous projects. And this historical data can help create accurate duration estimates.

As a project manager, you need to assess risks associated with assumptions. And you need to provide a duration buffer period to accommodate these risks.

As more information is gathered about the activities included in a project, the duration estimates can be refined.

The quality of information provided in the inputs to the Estimate Activity Duration process affects the accuracy of a project manager's duration estimates. Using a variety of inputs also increases the validity of the estimates.

When estimating activity duration for the project schedule, you need to gather information from key inputs such as the activity list, activity attributes, and activity resource requirements. These inputs outline which activities are required for the project and which resources need to be used for each activity.

Additional inputs that can improve the accuracy of activity duration estimates include resource calendars, the project scope statement, enterprise environmental factors, and organizational process assets.

**Course:** Estimating Activity Resources and Durations  
**Topic:** Sources of Activity Duration Information

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# SkillBrief

# Using Parametric and Three-point Estimating Techniques

#### Parametric estimating

Parametric estimating requires that you use this equation to calculate duration estimates for activities. So you need to know the quantity of work required and the work productivity rate. Often, the number of resources that will be used is also included in the calculation.

It is important to understand the difference between duration and effort when calculating duration estimates. Effort is the amount of labor - or total number of billable hours - invested in an activity because of the resources involved. It is used when calculating costs. Duration is how long an activity is expected to take with the labor available.

* **duration** – Unloading a freight truck may take ten hours with one person carrying out the activity, and only five hours if two people are assigned to the activity. If the effort is increased by adding more labor, or people in this case, then the duration of the activity is decreased. However, some activities are not affected by the amount of labor assigned to them.
* **effort** – Unloading a freight truck has a duration of five hours if two people are used as the resource. The effort in this case is ten hours, or the total number of billable hours.

Sometimes stacking resources on an activity won't help you decrease duration. You need to understand the nature of the activities you are estimating.

#### Three-point estimates

Three-point estimates can improve the accuracy of the activity duration by taking into account the amount of risk in the original estimate. It does this by using best case, worst case, and most likely durations for an activity. Finding a weighted average from these estimates is a fairly complex process.

Because the three-point duration estimate reflects best and worst case scenarios, it incorporates two types of risk: threats and opportunities that can affect an activity's duration.

To create three-point estimates, you begin by performing three steps. First you record an optimistic estimate that reflects the estimated duration if conditions are very favorable. Next you record a most likely estimate based on typical conditions and historical information. The third step is to record a pessimistic estimate based on how foreseeable negative conditions might delay an activity.

Select each step for an example of each estimate for the testing activity in a coding project.

* **Record an optimistic estimate** – Using expert judgment and analogous estimating, you determine how long the coding activity will take if conditions are favorable. If no errors are found in the coding and there are no glitches on the test computers, the testing process is likely to take seven hours to complete.
* **Record a most likely estimate** – Historical data shows that if an average of two problems occur during testing, these problems generally take one hour each to resolve. In this case, if the optimistic estimate is seven hours, the most likely duration is nine hours.
* **Record a pessimistic estimate** – If a tester is off sick and a code that is being tested has more than the average two errors, the testing process is likely to take 15 hours.

Once you have completed the estimate process, you are ready to begin steps four to seven. In step four, you assign weights to each estimate. In step five, you multiply each estimate by the assigned weight. Next you total the weighted durations. The final step is to divide the sum of the weighted durations by the sum of the weights.

A three-point estimate demands that you

* **assign weights to estimates** – You need to assign weights that reflect the probability that each estimate will turn out to be accurate. It's common to assign a weight of 4 to the most likely estimate and weights of 1 to the other estimates. A weight of 4 means it's 4 times as likely to happen as an estimate with a weight of 1.
* **multiply each estimate by weight** – The next step is to multiply each of the estimates by their respective weights to get the weighted durations.
* **total the weighted durations** – In the sixth step of the process, you total the weighted duration of each estimate.
* **divide sum of weighted durations by sum of weights** – In the final step of the process, you divide the sum of the weighted durations by the sum of the weights. The result is the three-point duration estimate.

When using parametric estimating, you divide the product of the work quantity and productivity by the number of resources you will use. You use expert judgment and analogous estimating to estimate productivity rates and the number of resources comes from the activity resource requirements list.

When determining a three-point estimate, you use expert judgment and analogous estimating to determine the optimistic, most likely, and pessimistic durations for an activity. You then assign weights to the durations and divide the total weighted durations by the sum of the weights assigned.

**Course:** Estimating Activity Resources and Durations  
**Topic:** Using Parametric and Three-point Estimating

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# SkillBrief

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# SkillBrief

# The Estimating Activity Durations Process

#### Primary tools

The estimating tools and techniques that you use will depend on the project. These tools help determine how many work periods, or units of time, will be required to complete each project activity.

All projects are different with regard to some element, be it the type of industry, product, size, or complexity. Typically, the more complex a project, the more complex the method of estimating activity durations will be.

When estimating durations it's best to start with what you already have: the skills and experience of those around you, and information from previous and similar projects. You use these two project elements to apply

* **expert judgment** – There are two key sources of expert judgment for estimating durations: other project managers who have led similar projects and project team members who have worked on similar projects. These individuals can provide information about how long a given task typically takes and how quickly certain people perform their work.
* **analogous estimating** – Analogous estimating combines expert judgment and historical information from similar, completed projects. The past project forms the "analogy" to your new project. This technique is also known as "top-down" estimating. It is particularly useful in the early stages of planning because it can provide a ballpark figure to work with. Its reliability depends on how similar the projects are, how much experience the sources of expert judgment have, and whether the team members have similar levels of experience as those in the previous project.

By assessing the previous activity durations against the current activities and the available resources, you use analogous estimating to provide a basic projection for the project's activities. This is more accurate than using just expert judgment because here opinions are supported by historical data.

#### Further tools and techniques

In addition to using expert judgment and analogous estimating, project managers can use parametric estimating, three-point estimating, and reserve analysis.

**Parametric estimating**

Parametric estimating uses a mathematical formula that accounts for various factors affecting duration. These include the quantity of work to be performed, the number of resources assigned to the task, and the productivity rate of the assigned resources.

Consider the basic formula for parametric estimating. When a single human resource is carrying out the activity, you multiply the quantity of work by the productivity rate. If more than one resource is applied to an activity, you multiply the quantity of work by the productivity rate and then divide the result by the number of resources.

**Three-point estimating**

You can build on the information gained through parametric estimating using the three-point estimating technique.

Work in a project doesn't always proceed at a constant rate. Unforeseen delays may cause an activity to take longer than planned or a lucky break may allow an activity to be completed more quickly than expected.

The three-point estimate takes different outcomes like this into account. It considers the amount of risk in the original estimate. It does this by adjusting the original duration estimate to reflect the probability of both positive and negative events.

The three-point estimate, then, is a weighted average of an

* **optimistic duration estimate** – An optimistic duration estimate is how long an activity will take if positive conditions advance its completion date of the activity. This estimate reflects how long the activity takes if conditions are more favorable than usual for similar activities.
* **likely duration estimate** – The most likely duration is the probable length of time for an activity. It is the calculated duration of an activity, excluding the effects of extraordinary positive or negative influences.
* **pessimistic duration estimate** – A pessimistic duration estimate is the length of time needed for an activity if foreseeable negative conditions delay an activity. An example of a foreseeable negative condition is the unavailability of workers or materials.

**Reserve analysis**

Another method used to factor in risks or delays to activity duration is reserve analysis. This technique incorporates additional time – called contingency reserves, time reserves, or buffers – into the overall project duration. This creates a buffer in the schedule for activities where delays are very likely.

Project managers frequently add reserve time by increasing their initial duration estimates by a fixed percentage. Reserve time buffers can be added to the total project time. Alternatively, they can be added as a chunk of extra time for specific activities.

The use of reserve times should be documented and saved as lessons learned. In this way, the information becomes historical data that can be used for future activity duration estimating.

There are a variety of project risks that may point to the need for adding contingencies or buffers to time estimates. For example, you might want to allow buffer time in these situations:

* your project needs a resource that is currently being used in another project
* there is the possibility of bad weather on a construction site
* you are likely to have sick days because work will be done during winter months

#### Outputs

The duration estimates you calculate using estimating tools are the primary output of the Estimate Activity Durations process. Another output is updates to project documents.

When the project schedule is constructed, the estimates help determine the time needed to complete the entire project. Each estimate represents a quantitative assessment of the likely time required to complete a project activity, drawing on the best available data.

As noted, updates to project documents need to be made after the Estimate Activity Durations process is complete. This is because the process of estimating durations may change the attributes of specific activities or may affect assumptions made in developing the activity duration estimate.

Tools used to estimate activity durations for a project include expert judgment, analogous estimating, parametric estimating, three-point estimates, and reserve analysis.

The outputs for the Estimating Activity Durations process include the duration estimates and changes to activity attributes, such as assumptions about the activities that are added to the project schedule.

**Course:** Estimating Activity Resources and Durations  
**Topic:** Overview of the Estimating Activity Durations process

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# Follow-on Activity

# Estimating Activity Durations

**Purpose:** Use this follow-on activity to guide you in using parametric estimating and three-point estimates to determine a duration estimate for a project activity.

**Instructions for use:** To use this tool, select any project's activity. Then perform the steps and answer the questions to estimate its duration.

## Parametric estimating

Determine the amount of work output that must be produced during a work activity. How many units of output must be created by the activity?

Estimate the rate at which the output will be produced by a single worker or piece of equipment. State the rate in number of units produced in a given amount of time, such as an hour, a day, or the entire duration of the activity.

Determine the number of workers or pieces of equipment that are available for the work activity.

Multiply the number of available workers or pieces of equipment by the estimated rate for each one to determine the total rate of output. Divide the total units of output the activity must produce by the total rate of output. The result is a quantitatively based duration estimate.

## Three-point estimate

Determine the most likely duration for the work activity using parametric estimating, analogous estimating, or expert judgment.

Refer to the project's risk register or use your own judgment to determine what events may delay the completion of the work activity. If foreseeable negative events occur, how will the duration of the work activity change? Determine a pessimistic estimate for the duration of the work activity.

What events could occur that would allow the work activity to finish in less time than expected? Determine an optimistic duration estimate for the work activity.

#### Three estimates

Use the table provided to enter the

1. estimated duration for the activity under foreseeable positive circumstances
2. most likely duration for the activity
3. estimated duration for the activity under foreseeable negative circumstances

#### Weight

Assign a weight to each estimate that reflects its probability. Commonly, a weight of 4 is assigned to the most likely estimate and a weight of 1 is assigned to the optimistic and pessimistic estimates. However, you may change these values to reflect different probabilities for each outcome. Then total the three values in the Weight column.

#### Weighted duration

Calculate a weighted average of the three estimates, by multiplying each estimate by the weight assigned to it. Total the three values in the Weighted Duration column.

#### Duration estimate

Take the total from the Weighted Duration column and divide it by the total from the Weight column. The result is a duration estimate that reflects the risks and opportunities that may affect the completion of the work activity.

| **Three estimates** | | | |
| --- | --- | --- | --- |
| **Estimate category** | **Estimate** | **Weight** | **Weighted duration (Estimate × weight)** |
| Optimistic | Row 2 Column 2 | Row 2 Column 3 | Row 2 Column 4 |
| Most likely | Row 3 Column 2 | Row 3 Column 3 | Row 3 Column 4 |
| Pessimistic | Row 4 Column 2 | Row 4 Column 3 | Row 4 Column 4 |
| Total | Row 5 Column 2 | Row 5 Column 3 | Row 5 Column 4 |

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You can also use a formula to estimate the duration of the activity:

Expected time = (Optimistic + Pessimistic + 4 × Most Likely) /Sum of the weights (6)

|  |  |
| --- | --- |
| **Three-point estimate** | |
| **Total weight** | Row 0 Column 3 |
| **Total weighted duration** | Row 1 Column 3 |
| **Three-point estimate** | Row 2 Column 3 |

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**Topic:** Using Parametric and Three-point Estimating

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# Follow-on Activity

# Human Resource Calendars in Your Workplace

**Purpose:** Use this follow-on activity to learn more about the human resource calendar system used in your organization.

**Instructions for use:** To use this tool, answer the questions in your own time. If you are unsure of the answers, find an example of a resource calendar that was recently used on a project. If there are no examples, then ask a project manager how the organization normally determines resource availability.

What types of resource calendars does your company work with?

Does your organization's e-mail application contain a feature that shows when employees are on scheduled leave?

Does your organization have an automated time tracking and scheduling application?

If yes, which application?

Who inputs the availability data (managers, supervisors, or employees)?

How is the data retrieved?

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**Topic:** Project Resources

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# Follow-on Activity

# Estimating Activity Resources

**Purpose:** Use this follow-on activity as an exercise for learning how activity resources are estimated in the real world.

**Instructions for use:** To use this tool, interview a couple of experienced project managers to find out how they have recorded resource needs.

### Selection of possible interview questions

By learning from real-life examples, you can build a comprehensive set of knowledge that will help you excel in project management.

#### Resource requirements

What kind of resource information do you collect?

What sources did you use to get this information?

How do you record this information? Do you use a resource requirements list or another format?

What are the advantages and disadvantages of the recording method you use?

How do you use this resource information in the project?

Do you include assumptions in this recording? If so, how has this helped in past projects? If not, has this caused problems in past projects?

#### Resource breakdown structure

Do you illustrate resource requirements in a diagram format, such as a resource breakdown structure?

If so, what are the advantages and disadvantages of the format you use?

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# Job Aid

# Activity Resource Requirements List Template

**Purpose:** Use this job aid as a template for creating an activity resource requirements list.

|  |  |
| --- | --- |
| **Activity code and name** | |
| **Activity code** | Row 0 Column 3 |
| **Activity name** | Row 1 Column 3 |

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| **Activity resource requirements list** | | | | |
| --- | --- | --- | --- | --- |
| **Resource description** | **Number required** | **Resource assumptions** | **Resource availability** | **Resource dependencies** |
| Row 2 Column 1 | Row 2 Column 2 | Row 2 Column 3 | Row 2 Column 4 | Row 2 Column 5 |
| Row 3 Column 1 | Row 3 Column 2 | Row 3 Column 3 | Row 3 Column 4 | Row 3 Column 5 |
| Row 4 Column 1 | Row 4 Column 2 | Row 4 Column 3 | Row 4 Column 4 | Row 4 Column 5 |
| Row 5 Column 1 | Row 5 Column 2 | Row 5 Column 3 | Row 5 Column 4 | Row 5 Column 5 |
| Row 6 Column 1 | Row 6 Column 2 | Row 6 Column 3 | Row 6 Column 4 | Row 6 Column 5 |

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| **Total task resource requirements** | |
| --- | --- |
| **Number** | **Requirement** |
| 1 | Row 2 Column 2 |
| 2 | Row 3 Column 2 |
| 3 | Row 4 Column 2 |
| 4 | Row 5 Column 2 |
| 5 | Row 6 Column 2 |

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# Job Aid

# Techniques for Estimating Duration

**Purpose:** Use this job aid to review tools for estimating activity duration.

## Three-point estimating

You use three-point estimating to get a duration estimate that reflects the risks and opportunities that may affect the completion of the work activity.

To calculate the three-point estimate, you

1. add the weights assigned to each estimate. Typically the total is 6, since the most likely estimate gets a weight of 4 plus a weight of 1 for the optimistic and for the pessimistic estimates.
2. add each weighted duration for the total and divide the total weighted duration by the total weight.

The sum of an optimistic estimate, a most likely estimate multiplied by a weight of four, and a pessimistic estimate is divided by 6. This equals the duration of an activity.

Three-point estimating formula

## Parametic estimating

Parametric estimating requires that you use this equation to calculate duration estimates for activities:

Quantity of work × Productivity rate

If more than one resource is used, you first divide the productivity rate by the number of resources and then multiply the result by the quantity of work.

## Expert judgment and analogous estimating

Expert judgment simply involves asking experienced people to estimate how long specific activities will take.

Analogous estimating uses a combination of expert judgment and historic data from previous similar projects to provide you with a base estimate for how long activities will take.

## Reserve analysis

Reserve analysis is used to accommodate risks and possible delays. This technique incorporates additional time – called contingency reserves, time reserves, or buffers – into the overall project duration.

Project managers frequently add reserve time by increasing their initial duration estimates by a fixed percentage. Reserve time buffers can be added to the total project time. Alternatively, they can be added as a chunk of extra time for specific activities.

**Course:** Estimating Activity Resources and Durations  
**Topic:** Using Parametric and Three-point Estimating

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Developing and controlling the project schedule

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# SkillBrief

# Inputs to the Develop Schedule process

#### The Develop Schedule process

The project schedule is an output of the Develop Schedule process. It identifies what activities the team needs to perform to complete a project, who is going to perform these activities, and when they are going to take place.

The project schedule is important for several reasons:

* it coordinates the activities of team members, so that the right activities occur at the right time and in the right sequence
* it helps optimize the use of resources, by making it clear exactly when particular resources are needed
* it provides a baseline for monitoring performance and tracking actual progress
* it aids communication with the project team and stakeholders, by providing a baseline against which progress can be reported

The Develop Schedule process fits in the Planning process group – it involves planning exactly how project time will be used.

It also falls in the Project Time Management knowledge area, where it follows on from four other processes. These are Define Activities, Sequence Activities, Estimate Activity Resources, and Estimate Activity Durations.

The project schedule is usually highly detailed. It can take various forms but typically includes columns for recording activity descriptions, activity identifiers, resources, calendar units, and the project schedule time frame.

These are some of the features of a project schedule that is completed with the help of project management software:

* **activity identifier** – This is a code, consisting of numbers, letters, or both, that uniquely identifies an activity. Each identifier is recorded in the activity list.
* **activity description** – Each activity is described using the name assigned to it in the activity list.
* **resources** – The schedule identifies both the equipment and the human resources assigned to each activity.
* **calendar units** – These are the units of time used to schedule activities and monitor their durations. Depending on the type of project, weeks or hours may be used.
* **project schedule time frame** – It summarizes the project planning with respect to scheduling of activities, durations, project milestones, and deliverables. Important features are the duration bars, data date line, and precedence arrows.

In the project schedule time frame the horizontal duration bars represent the duration of each activity, running from its planned start date to its planned finish date.

Each **duration bar** is positioned in relation to the periods listed across the top of the time frame pane, which together represent the total project duration.

The shaded area of the bar represents the percentage of the task that has been completed thus far.

The **data date line** is a vertical line that appears in the time frame pane. It reflects either the current date or a future data date that was entered into the software for forecasting purposes.

**Precedence arrows** identify the relationships between the activities represented as duration bars. These tell you the sequence in which the activities must occur, where this sequence is important.

#### Develop Schedule inputs

The inputs of the Develop Schedule process include the key outputs of the other processes in the Project Time Management knowledge area.

The nine inputs of the Develop Schedule process are

* **the activity list** – lists all the activities or tasks that must be performed to complete a project. The activities are included in a project schedule.
* **activity attributes** – detail how and when activities must be performed. They are used to categorize activities into phases and to plan the schedule accordingly.
* **activity resource requirements** – describe the types and quantities of resources needed to complete each activity, and are used to schedule the required materials and human resources for activities.
* **the project scope statement** – lists the constraints and assumptions for the project, which affect cost and time.
* **resource calendars** – show when team members are committed to other projects, are on vacation, or are otherwise unavailable to a project. They identify the time when specific team members or pieces of equipment are required. This can help determine when particular activities that require the resources must be scheduled.
* **project schedule network diagrams** – highlight the relationships among activities, while taking into account the time and resources needed for each activity. For example, a diagram will indicate whether one activity must be completed before another can begin.
* **activity duration estimates** – inform project managers of how long each activity will take to be completed and used to create the overall project timeline.
* **enterprise environmental factors –** identify aspects of the external or internal environment that affect a project and the scheduling process.
* **organizational process assets** – are the project calendar and the organization's scheduling methodology.

Once the project schedule has been developed, it will guide all project work and provide a baseline against which progress can be measured. It will also be updated when necessary.

Inputs for the Develop Schedule process include the activity list, activity attributes, activity resource requirements, activity duration estimates, and the project scope statement. They also include resource calendars, project schedule network diagrams, organizational process assets, and enterprise environmental factors. Each of the inputs provides specific information used in the development of a project schedule, or influences this process.

**Course:** Developing and Controlling the Project Schedule  
**Topic:** Introduction to Project Scheduling

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# SkillBrief

# Critical Path Method

#### Introduction

Once you have the network diagrams for the activities, as well as the activity duration estimates, you can begin scheduling the project. The critical path method (CPM) is one of the key techniques for developing a project schedule.

In a schedule network diagram, the critical path is the longest full path linking activities that must be performed in sequence. It's important to identify this path, because if one of its activities is delayed, the end date of your project is delayed too.

CPM provides a way to calculate four time boundaries:

* the early start date, which is the earliest possible start date for each activity to begin
* the early finish date, which is the earliest date each activity can end
* the latest start date, which is the latest possible time for each activity to begin
* the latest finish date, which is the latest date each activity can end

CPM involves completing three steps:

1. performing a forward pass through the network diagram
2. performing a backward pass to check your initial results
3. calculating the float for each activity to determine the critical path

#### The forward pass

The first step in CPM is performing a forward pass through the schedule network diagram so you can establish the early start and finish dates for each activity. This is done so that resources, such as project team members and equipment, can be allocated as soon as possible. Allocating resources assists in determining project expenditure and therefore establishing the project budget.

When performing a forward pass, you begin with the first activity in the network diagram and move forward. You

1. record the earliest date the first activity can start
2. add the duration of this activity to the early start date
3. subtract one day from the result

Some project managers find it useful to record activities' start and finish times in the network diagram. The early start is usually filled in on the top left corner of each activity block, with the early finish date shown in the right corner.

#### The backward pass

The second step in determining the critical path for a project is to perform a backward pass through the schedule network diagram.

You perform the backward pass to establish the latest start and finish dates for the project to remain on schedule.

In a backward pass, you start at the end of the project and work back, subtracting the estimated duration of each preceding activity.

To begin the backward pass, the late finish date will either be a hard date that's been set or the early finish date of the last activity in the project. An example of a hard date may be a deadline that determines the project's end date.

To calculate the late start date, you

1. subtract the duration of the last activity from its late finish date
2. add one day because the last day of the project is included as a working day

As you work backward through the schedule network diagram, the late finish date will fall on the working day preceding the late start date of the last activity.

When activities occur in parallel, the smaller of the late start values of the activities is used to calculate the late finish date for the preceding activity.

The late start date should usually be the same as the early start date for the first activity in a schedule network diagram. Any other result may indicate that you've made an error, unless there is a hard end date and you're starting the project in advance to give yourself an extra buffer.

#### Calculating the float

When there's a difference between the early finish date of an activity and the early start date of an activity that immediately follows it, the difference is called slack time, or float. It's the amount of time that an earlier activity can be delayed without affecting the completion time of the project.

The final step in the CPM is to find the activities that lie on the project's critical path by calculating their float. The critical path is sometimes defined as the longest path through the network diagram and contains no float.

The easiest way to find the critical path is to find the activities where the early start date is the same as the late start date. If the two dates are the same, there's no float available for that activity, and it must lie on the critical path.

You can also calculate the float for each activity by subtracting the early start date from the late start date, or by subtracting the early finish date from the late finish date.

If any of the activities on the critical path aren't completed on time, all of the activities that follow it will run late too. So it's important to prevent this, for example by ensuring enough resources are allocated for completing critical activities.

The critical path is one of the techniques for developing a project schedule. It identifies the shortest period of time in which the project can be completed. The critical path method involves completing three steps. You perform a forward pass through the network diagram, perform a backward pass to check your initial results, and then calculate the float for each activity to determine the critical path.

**Course:** Developing and Controlling the Project Schedule  
**Topic:** Critical Path Method

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# SkillBrief

# Develop Schedule Outputs

## Project schedule

The completed project schedule outlines exactly how time in a project will be used, to coordinate all aspects of achieving project objectives.

The schedule may be considered preliminary until resources have been assigned to activities, start and finish dates are established, and all other planning processes are complete. It's then finalized and added to the project management plan.

The project schedule is usually presented graphically using different formats.

#### Milestone charts

In a milestone chart, each milestone has zero duration and is sometimes called a milestone activity. It may mark an event such as the completion of a major deliverable.

A milestone chart, which you can create using project management software, may contain detailed information about each milestone Or it may take the form of a simple table that lists milestones, and their scheduled and actual dates.

#### Bar chart

A bar chart is a schedule format in which each activity is represented by a duration bar. It contains schedule information that's rolled up to the level of the main deliverables in the work breakdown structure (WBS). It's useful for reporting summary schedule information.

Each activity is represented by a horizontal bar plotted on a project timeline to show when it's scheduled to start and finish. The length of the bar corresponds to an activity's estimated duration. Shading on the bars shows how much of each activity has been completed.

A data date line in the timeline marks the time up to which actual schedule information has been recorded. So it identifies the "as of" date for the progress reported in the chart. It's typically represented as a vertical dotted line that marks the current date in the timeline.

In a bar chart, you can also choose to represent a project's critical path. This is a stepped line, running from left to right, and down, to cover the duration bar for each critical activity.

Bar charts can be used to update stakeholders as to schedule performance as outlined in the communications plan.

#### Project schedule network

A schedule network diagram provides a graphical view of the flow of activities in a project, and of their logical dependencies.

It typically indicates the critical path by way of a red highlighted path through the diagram. If activities on this path finish later than planned, the project will finish later than planned.

The audience for a schedule in this format is primarily the project team, including members who are carrying out the work and managers who need detailed scheduling and resource information.

Project schedule network diagrams can have one of two formats:

* **activity-on-node format** – used for activity sequencing and calculating a project's critical path. It often includes the start and finish dates for each activity. The critical path between critical activities is highlighted in red.
* **logic bar chart format** – represents each activity as a bar on a timeline and uses precedence relationship arrows to identify activity dependencies. The diagram also identifies milestones and their positions on the timeline.

## Schedule baseline

The schedule baseline is the current, approved version of the project schedule. It's developed through schedule network analysis, and then reviewed and accepted by the project management team. It contains the start and finish dates for activities. It may include resource assignments, but they are not necessary.

The schedule baseline guides what work is completed during the executing processes, and in what order. And in the monitoring and controlling processes for a project, you'll use it to compare what you planned to do against what has actually been done.

The schedule baseline is frequently updated based on how a project unfolds progresses. When schedule changes are approved, the altered schedule becomes the new schedule baseline. Old versions are archived according to the project's configuration management system.

## Schedule data

Schedule data includes all the information used as inputs to develop the schedule, as well as information you gather during the process.

The amount and type of data varies according to the nature of a project, and it's up to the project manager to judge what's relevant. But generally, it's safer to have too much documentation than too little.

Examples of information used to develop the schedule are milestones, activities, activity attributes, assumptions, and constraints.

Resource histograms are an example of data you generate during the process of creating a schedule. A resource histogram is essentially a bar chart that indicates how many staff hours are required for each time period. It may also show how many hours a particular resource is required.

Alternative schedules may be included in schedule data to provide information about best-case and worst-case scenarios.

Additional types of schedule data include the following:

* the contingency reserves incorporated in the schedule, to account for likely delays to activities
* cash-flow projections, aligned with the time periods represented in the schedule
* order and delivery schedules, which are based on information from the procurement management plan and used as communication tools for the project team

## Project document updates

Updates to activity resource requirements are a common. Resource leveling can have a significant effect on initial estimates and, as a result, the types, quantities, or timing of the required resources may have to be adjusted.

As you develop the schedule, you may also realize that changes must be made to planned activities. These amendments are listed as changes to the activity attributes and must be recorded and communicated to the project team responsible for performing the activities.

Project calendars show the days and hours during which project activities can be performed.

Updates may need to be made to the project risk register, which records any opportunities or threats to the project, based on scheduling assumptions.

The Develop Schedule process has four outputs – the project schedule, schedule baseline, schedule data, and project document updates.

**Course:** Developing and Controlling the Project Schedule  
**Topic:** Completed Project Schedule

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# SkillBrief

# Tools and Techniques of the Develop Schedule process

## Schedule network analysis

Schedule network analysis is a technique that assists in generating the project management schedule. This method is used to research data in order to manage project funds and time efficiently.

The Develop Schedule process includes four schedule network analysis techniques:

* critical path method
* critical chain method
* resource leveling
* what-if scenario analysis

These four techniques build on one another. You will need to use all of them to arrive at the dates you finally include in the schedule.

#### Critical path method

In a schedule network diagram, the longest full path linking activities that must be performed in sequence is known as the critical path. Together, the estimated durations of the activities on this path represent the shortest time in which a project can be completed.

Changes to the estimated duration of critical path activities will affect a project's end date.

You use the critical path method to determine the critical path in the network diagram. This is then used to calculate the minimum total project duration, based on estimates of how long critical activities will take to complete.

Once you know this, you add the duration of the activities on the critical path to the project's start date to determine its theoretical end date.

Based on these dates, you can also calculate different estimates of the dates at which each critical activity must start and finish.

The theoretical dates for all activities are determined without regard for any resource limitations.

#### Critical chain method

The critical chain method uses estimates that are based on limited resource availability to determine a more realistic critical path. You enter resource availability into the schedule and add duration buffers to the network diagram.

Each buffer is represented as a non-work activity, and is a reserve period in which work on any activities that are running late can be completed.

The goal is to manage a project so that it can complete when planned, despite unavoidable delays and uncertainties.

#### Resource leveling

Resource leveling involves adjusting the resources allocated to activities to optimize both resource use and the schedule.

The aim of resource leveling is to ensure that demand doesn't exceed availability. So you use this technique when resources have been over-allocated, are only available at specific times, or are limited in numbers.

Before you use resource leveling, you must have already identified a project's critical path. Moving resources from noncritical to critical activities can help reduce a project's total planned duration.

The resource leveling technique can also involve increasing the estimated duration of an activity because of a resource constraint – for example, based on the earliest date when required equipment can be delivered.

#### What-if scenario analysis

Another useful technique is what-if scenario analysis, in which the project manager tests the feasibility of the draft schedule by assessing a series of worst-case scenarios, based on the activity assumptions.

The results of this technique are used to prepare appropriate contingency and response plans, outlining how the project can finish on time despite possible delays.

## Applying leads and lags

Another technique for developing a reliable schedule is applying leads and lags.

A lead occurs when an activity can begin before a predecessor activity completes. A lag, on the other hand, delays a successor activity.

The technique of applying leads and lags to the schedule is essentially a three-step process.

First you consider possible leads and lags in the schedule during the Sequence Activities process. This is when you're creating the schedule network diagram and plotting activity dependencies and relationships.

You apply specific leads and lags in terms of dates to the schedule, once you've identified the project's critical path and estimated its start and finish dates.

Finally, once you've applied all the other scheduling techniques and a draft schedule is complete, you adjust leads and lags by going back over them and changing them as necessary to ensure the schedule is viable.

## Schedule compression

Schedule compression involves reducing a project's duration – for example, so the project can end by an agreed date – without changing its scope. There are two ways you can do this.

#### Crashing

Crashing involves speeding up activities, often by assigning more resources to them.

Crashing involves making tradeoffs between costs and the schedule. If more resources are allocated, an activity can often be completed faster – but this means spending more on resources. Crashing usually involves considering various alternatives, and choosing the one that represents the best compromise between keeping costs in line and getting project duration down.

Crashing can also involve identifying which activities are really necessary and removing "nice-to-have" activities.

Sometimes this can make it necessary to resequence the activities that are left, and may mean changing a project's critical path.

#### Fast tracking

Fast tracking involves scheduling two or more activities to be performed in parallel, instead of one at a time. This helps speed up a project.

A down side to fast tracking is that it may increase project risk. Fast tracking can only be used if activities can be safely overlapped.

## Scheduling tool

The scheduling tool helps you create a schedule that is based on the inputs of the activities you've identified, network diagrams you've drawn up, resources you've assigned, and durations you've estimated for a project.

You use the scheduling tool in conjunction with either project management software or manual scheduling techniques

Many project scheduling tools are available and can help make scheduling easier, faster, and more accurate. These automated tools generate start and finish dates based on various inputs, such as activities, network diagrams, resources, and activity durations. These are the real keys to planning a successful project schedule.

Tools and techniques for the Develop Schedule process include the scheduling tool you use to create the schedule and four schedule network analysis techniques – the critical path method, critical chain method, resource leveling, and what-if scenario analysis. They also include applying leads and lags, and techniques for schedule compression.

**Course:** Developing and Controlling the Project Schedule  
**Topic:** Overview of Scheduling Tools and Techniques

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# SkillBrief

# Tools, Techniques, and Outputs of the Control Schedule process

## Tools and techniques

The tools and techniques you use during the Control Schedule process can be grouped into three categories – tools for monitoring performance, those for controlling variance, and organizational tools for controlling the schedule.

#### Monitoring performance

Control Schedule tools you use to monitor schedule performance include

* **performance reviews** – You measure and analyze schedule performance information, such as the percent complete for unfinished work. Using schedule network diagrams to assess performance allows you to determine whether delays affect activities on the critical path.
* **variance analysis** – You use schedule variance (SV) and schedule performance index (SPI) when performing variance analysis. They allow you to assess the magnitude of variation from the original schedule baseline. Variance analysis also involves determining the cause of the variance and deciding whether corrective or preventive action is required.

#### Controlling variance

Once you have identified schedule variances, you need to access a new set of tools to control them.

Control activities typically involve adjusting the baseline plan to reflect current project realities.

You often need to re-plan activity durations, so you use many of the same techniques you used during the initial Develop Schedule process.

The techniques for controlling schedule variance include

* **resource leveling** – distributes work evenly among resources. You apply the technique to a schedule you have analyzed using the critical path method. Typically, it involves reallocating resources from noncritical to critical activities.
* **what-if scenario analysis** – evaluates the possible outcomes of various methods for bringing the schedule back into alignment with the plan.
* **adjusting leads and lags** – ensures that the schedule is both realistic and viable if variance analysis determines that leads and lags applied to the schedule during planning have contributed to schedule variance.
* **schedule compression** – involves crashing or fast tracking to bring activities back on schedule without changing the project scope. Crashing involves analyzing cost and schedule tradeoffs to determine how the greatest amount of compression for the least cost can be achieved. Fast tracking is where activities normally performed in sequence are performed in parallel.

#### Organizational tools

The scheduling tool is part of the project management software you use for the project. This tool facilitates reporting, measuring variances, and forecasting the effects of control efforts. The automatic functions of the tool simplify the process of what-if scenario analysis and the testing of various schedule compression approaches. The data is automatically updated within the schedule.

Project management software allows you to track planned and actual dates, and to forecast the effects of project schedule changes. The scheduling tool, supporting schedule data, and other software tools are used in combination when performing schedule network analyses. They can also be used to generate updated project schedules.

## Outputs

Project managers can tell if they're controlling the schedule effectively by reviewing the outputs of the Control Schedule process.

#### Work performance measurements

Schedule control activities, such as monitoring and measuring performance, may result in requests to update the schedule baseline or other aspects of the project management plan. To estimate the degree to which a change will impact the schedule and the severity of that impact, you need to calculate work performance measurements such as the SPI.

These measurements also need to be documented and communicated to stakeholders.

#### Change requests

A review of variance analysis, progress reports, and performance measures can result in requests for changes to the schedule baseline. Change requests are then reviewed using the Perform Integrated Change Control process.

Types of change requests that the Control Schedule process generates include changes to start dates, finish dates, activity durations, or project milestones.

#### Updates to project management plan components

Once change requests have been approved, you may need to update the schedule baseline, the schedule management plan, and the cost baseline. The cost baseline is often updated to reflect changes due to schedule compression techniques.

#### Updates to project documents

Project documents you may need to update as a result of the Control Schedule process are schedule data documents and the project schedule. New network diagrams are developed to display approved remaining durations and the updated work plan. In extreme cases, a new target schedule with revised target start and finish dates is needed.

#### Updates to organizational process assets

You update lessons learned documentation as necessary following schedule control activities. This information will include causes of variance, corrective actions, and the rationale behind any corrective actions taken.

Like all other control processes, the Control Schedule process feeds change requests into the Perform Integrated Change Control process. Updated change requests, which have been approved or denied, are outputs of the Perform Integrated Change Control process.

Project schedule control tools used to monitor schedule performance include performance reviews and variance analysis.

Once performance issues have been identified, you can use resource leveling, what-if scenario analysis, adjustment of leads and lags, and schedule compression to control the variance between scheduled and actual dates and durations.

Project management software is an organizational tool that facilitates schedule monitoring and control.

Outputs of the Control Schedule process include work performance measurements, change requests, and updates to project management plan components, project documents, and organizational process assets.

**Course:** Developing and Controlling the Project Schedule  
**Topic:** Monitoring and Measuring Schedule Performance

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# Tools, Techniques, and Outputs of the Control Schedule process

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* **variance analysis** – You use schedule variance (SV) and schedule performance index (SPI) when performing variance analysis. They allow you to assess the magnitude of variation from the original schedule baseline. Variance analysis also involves determining the cause of the variance and deciding whether corrective or preventive action is required.

#### Controlling variance

Once you have identified schedule variances, you need to access a new set of tools to control them.

Control activities typically involve adjusting the baseline plan to reflect current project realities.

You often need to re-plan activity durations, so you use many of the same techniques you used during the initial Develop Schedule process.

The techniques for controlling schedule variance include

* **resource leveling** – distributes work evenly among resources. You apply the technique to a schedule you have analyzed using the critical path method. Typically, it involves reallocating resources from noncritical to critical activities.
* **what-if scenario analysis** – evaluates the possible outcomes of various methods for bringing the schedule back into alignment with the plan.
* **adjusting leads and lags** – ensures that the schedule is both realistic and viable if variance analysis determines that leads and lags applied to the schedule during planning have contributed to schedule variance.
* **schedule compression** – involves crashing or fast tracking to bring activities back on schedule without changing the project scope. Crashing involves analyzing cost and schedule tradeoffs to determine how the greatest amount of compression for the least cost can be achieved. Fast tracking is where activities normally performed in sequence are performed in parallel.

#### Organizational tools

The scheduling tool is part of the project management software you use for the project. This tool facilitates reporting, measuring variances, and forecasting the effects of control efforts. The automatic functions of the tool simplify the process of what-if scenario analysis and the testing of various schedule compression approaches. The data is automatically updated within the schedule.

Project management software allows you to track planned and actual dates, and to forecast the effects of project schedule changes. The scheduling tool, supporting schedule data, and other software tools are used in combination when performing schedule network analyses. They can also be used to generate updated project schedules.

## Outputs

Project managers can tell if they're controlling the schedule effectively by reviewing the outputs of the Control Schedule process.

#### Work performance measurements

Schedule control activities, such as monitoring and measuring performance, may result in requests to update the schedule baseline or other aspects of the project management plan. To estimate the degree to which a change will impact the schedule and the severity of that impact, you need to calculate work performance measurements such as the SPI.

These measurements also need to be documented and communicated to stakeholders.

#### Change requests

A review of variance analysis, progress reports, and performance measures can result in requests for changes to the schedule baseline. Change requests are then reviewed using the Perform Integrated Change Control process.

Types of change requests that the Control Schedule process generates include changes to start dates, finish dates, activity durations, or project milestones.

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Once change requests have been approved, you may need to update the schedule baseline, the schedule management plan, and the cost baseline. The cost baseline is often updated to reflect changes due to schedule compression techniques.

#### Updates to project documents

Project documents you may need to update as a result of the Control Schedule process are schedule data documents and the project schedule. New network diagrams are developed to display approved remaining durations and the updated work plan. In extreme cases, a new target schedule with revised target start and finish dates is needed.

#### Updates to organizational process assets

You update lessons learned documentation as necessary following schedule control activities. This information will include causes of variance, corrective actions, and the rationale behind any corrective actions taken.

Like all other control processes, the Control Schedule process feeds change requests into the Perform Integrated Change Control process. Updated change requests, which have been approved or denied, are outputs of the Perform Integrated Change Control process.

Project schedule control tools used to monitor schedule performance include performance reviews and variance analysis.

Once performance issues have been identified, you can use resource leveling, what-if scenario analysis, adjustment of leads and lags, and schedule compression to control the variance between scheduled and actual dates and durations.

Project management software is an organizational tool that facilitates schedule monitoring and control.

Outputs of the Control Schedule process include work performance measurements, change requests, and updates to project management plan components, project documents, and organizational process assets.

**Course:** Developing and Controlling the Project Schedule  
**Topic:** Monitoring and Measuring Schedule Performance

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# SkillBrief

# Inputs to the Control Schedule process

The Control Schedule process provides you with clear methods of receiving information that keeps your project on track and within schedule.

Unlike other processes in the Project Time Management knowledge area, the Control Schedule process is not part of the Planning process group. It forms part of the Monitoring and Controlling process group.

The Control Schedule process includes these four aspects of schedule management:

* ensuring there's a way to check on the current status of the project schedule at all times
* influencing the factors that could cause schedule changes – in other words, being proactive and using preventive measures to avoid schedule slippage
* having a monitoring system that alerts the project manager whenever there is a change that threatens the schedule
* managing changes as they occur by putting them through the project's change control system

The Perform Integrated Change Control process contains specific procedures for controlling changes in general. The Control Schedule process is a component of this group. As with all change control, you need to ensure that the management of the project schedule is integrated with budget, scope, quality, and risk management for a project.

Although the types of schedule changes and delays differ from project to project, they can be handled using similar processes. And they must all be checked in terms of how they affect the scope and the budget of a project.

## Inputs

To control the project schedule effectively, you need information. The sources of this information are the inputs to the Control Schedule process.

#### Project management plan

Two areas of the project management plan are inputs – the schedule baseline and the schedule management plan. The schedule baseline is an approved version of the project schedule and contains baseline start and finish dates. This document provides the basis for measuring and reporting schedule performance. The schedule management plan describes the circumstances in which schedule changes are allowed and how these changes should be made. After schedule change requests have been approved, they become another input for controlling the schedule.

#### Project schedule

The most recent version of the project schedule includes notations to reflect updates and to show which activities have been started or completed. You need to revise the schedule whenever necessary, so it reflects approved changes in project deadlines and milestones.

#### Work performance information

This information tracks how much work has been performed by work groups or individuals. It provides the actual dates and durations of work activities. You use this information to compare work performed against the original plan for the project.

#### Organizational process assets

Schedule control tools; policies, procedures, and guidelines for controlling the schedule; and monitoring and reporting methods are examples of organizational process assets that are inputs to the Control Schedule process.

The Control Schedule process involves four main aspects of schedule management. These are ensuring that you can check the current status of the project schedule at all times, influencing the factors that could cause schedule changes, using a monitoring system to detect changes that may threaten the schedule, and managing changes as they occur using the project's change control system.

Inputs into this process include the project management plan, the project schedule, work performance information, and various organizational process assets.

**Course:** Developing and Controlling the Project Schedule  
**Topic:** Control Schedule Inputs

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# SkillBrief

# Measures of Variance Analysis

The Control Schedule process is in place to help you determine the current status of the project schedule, determine the size and impact of any changes, and manage changes when they occur.

Variance analysis involves comparing actual project performance against the schedule. Project managers use two measures of variance analysis – schedule variance (SV) and the schedule performance index (SPI).

Calculating both SV and the SPI involves using financial values to determine if a project is on schedule – and if not, by how far the project is off schedule. This doesn't mean they measure actual project costs. Instead, they measure the financial value of the work performed up to a given date, relative to the value of the work scheduled to have been completed by this date.

## Calculating SV

SV is the difference between earned value and planned value at any chosen point in the project. So you calculate it using the formula earned value (EV) minus planned value (PV), or SV = EV - PV.

The variables of this formula are

* **EV** – You calculate the earned value for each activity by multiplying its approved cost estimate by the percentage of work actually completed on the activity up to a chosen date. If an activity is 100% complete, its earned value is its full budgeted value. You then add the earned value for each activity to get a total.
* **PV** – Planned value is the budgeted cost of all the work scheduled to be completed by a chosen date. If work on an activity isn't scheduled to have been fully completed by the given date, you multiply the percentage of work that was scheduled to be completed by the activity's budgeted cost. So if an activity with a budgeted cost of $1,000 is due to be 50% complete at the specified time, its planned value will be $500.

SV quantifies how far the project is ahead of or behind schedule. If the value for SV is

* equal to zero, the project is exactly on schedule
* a positive value, the project is ahead of schedule
* a negative value, the project is behind schedule

## Calculating SPI

By itself, the monetary value of SV doesn't tell a complete story. It describes how much work is ahead of schedule or behind schedule, but it doesn't put the variance in the context of the whole project.

The formula for calculating SPI is EV divided by PV, or SPI = EV ÷ PV.

If the SPI value is

* equal to 1, then the earned and planned values are equal, and the project is on schedule. So one dollar's worth of work is performed for every dollar spent.
* less than 1, the project is behind schedule.
* greater than 1, the project is ahead of schedule.

It's useful to calculate both SV and SPI to control a project schedule. This work performance information is useful in determining the size and the impact of schedule changes. In turn, this allows for informed decisions to be made when approving or denying the changes.

To determine the size and impact of a change in schedule, you can calculate the schedule variance (SV) and the schedule performance index (SPI) at particular dates in the schedule.

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**Topic:** Schedule Variance and Schedule Performance Index

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# Follow-on Activity

# Measuring Schedule Performance

**Purpose:** Use this follow-on activity to guide you in finding out how schedule performance is measured in your organization.

**Instructions for use:** To use this tool, contact an experienced project manager at your company to find out how schedule performance is measured.

These are some example questions you can ask the project manager about measuring schedule performance:

* What measures are used?
* Why are those measures used?
* Does the project management software that the company uses have a feature that calculates earned value and schedule performance index (SPI) automatically?

If project management software does calculate these values automatically, ask the project manager to provide a demonstration.

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**Topic:** Schedule Variance and Schedule Performance Index

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# Follow-on Activity

# Scheduling Techniques

**Purpose:** Use this follow-on activity as a checklist of the scheduling tools and techniques.

**Instructions for use:** To use this tool, interview an experienced project manager in your company. Use the checklist – by deleting either "yes" or "no" depending on your answer – to help you determine your company's scheduling techniques and how you would determine a project's critical path activities.

| **Scheduling tools and techniques** | | | |
| --- | --- | --- | --- |
| **Checkbox** | **Schedule tools and techniques** | **Description** | **Method used to determine critical path activities** |
| Row 2 Column 1 | Applying leads and lags | Involves modifying the schedule to include advances and delays on activities | Row 2 Column 4 |
| Row 3 Column 1 | Critical chain method | Manages uncertainty in the schedule by adding in non-work buffers | Row 3 Column 4 |
| Row 4 Column 1 | Critical path method | Determines theoretical project start and finish dates using estimates of how long critical activities will take to complete | Row 4 Column 4 |
| Row 5 Column 1 | Resource leveling | Reallocates people and equipment where necessary to optimize both resource use and the schedule | Row 5 Column 4 |
| Row 6 Column 1 | Schedule compression | Involves reducing activity durations by allocating more resources or resequencing activities | Row 6 Column 4 |
| Row 7 Column 1 | What-if scenario analysis | Measures the effects of possible delays on the project schedule | Row 7 Column 4 |

****For online use, complete each row as described in the instructions. If you would like to work with the page as hard copy, simply print it out using the Print link at the top of this page.****

**Course:** Developing and Controlling the Project Schedule   
**Topic:** Overview of Scheduling Tools and Techniques

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# Learning Aid

# Paving Company

**Purpose:** Use this learning aid to help you answer the test questions on calculating schedule variance.

| **Project data** | | | | | |
| --- | --- | --- | --- | --- | --- |
| **Activity** | **Planned start** | **Planned finish** | **Budgeted cost** | **Planned completion as of day 18** | **Percent complete as of day 18** |
| Demolition | Day 1 | Day 5 | $35,000 | 100% | 100% |
| Storm drain installation | Day 5 | Day 8 | $12,000 | 100% | 100% |
| Curb framing | Day 8 | Day 10 | $8,000 | 100% | 100% |
| Concrete pouring | Day 10 | Day 14 | $80,000 | 100% | 100% |
| City inspection | Day 15 | Day 18 | $5,000 | 100% | 100% |
| Asphalt surfacing | Day 18 | Day 25 | $200,000 | 0% | 20% |
| Cleanup | Day 25 | Day 26 | $4,000 | 0% | 0% |
| Striping | Day 27 | Day 28 | $6,000 | 0% | 0% |

**Course:** Developing and Controlling the Project Schedule  
**Topic:** Schedule Variance and Schedule Performance Index

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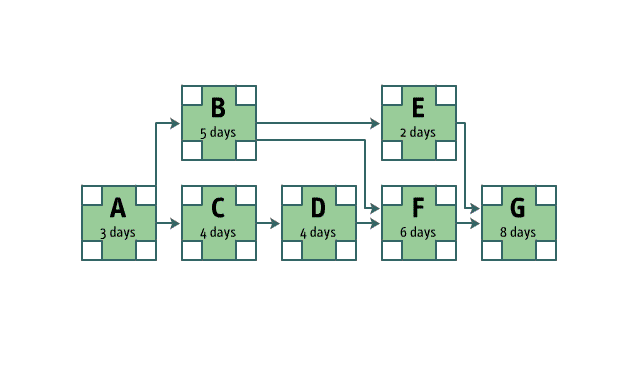
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# Learning Aid

# Recruitment Process

**Purpose:** Use this learning aid to answer the test questions on applying the critical path method.

| **Activity list** | | |
| --- | --- | --- |
| **Activity ID** | **Activity name** | **Duration** |
| A | Compile selection criteria | 3 days |
| B | Identify external candidates | 5 days |
| C | Identify internal candidates | 4 days |
| D | Review personnel files for internal candidates | 4 days |
| E | Request background check on external candidates | 2 days |
| F | Conduct interviews with top three candidates | 6 days |
| G | Deliberate and make final decision | 8 days |



Schedule network diagram

The schedule network diagram begins with activity A which has an estimated duration of three days. It is succeeded by both activities B and C which take place in parallel. Activity B has an estimated duration of five days and is succeeded by activity E, which has an estimated duration of two days, and activity F which take place in parallel. Activity C has an estimated duration of four days and is succeeded by activity D which has an estimated duration of four days. Activity F, which has an estimated duration of six days, then succeeds both activities B and D. Finally, activity G which has an estimated duration of eight days succeeds activity E and activity F.

**Course:** Developing and Controlling the Project Schedule  
**Topic:** Critical Path Method

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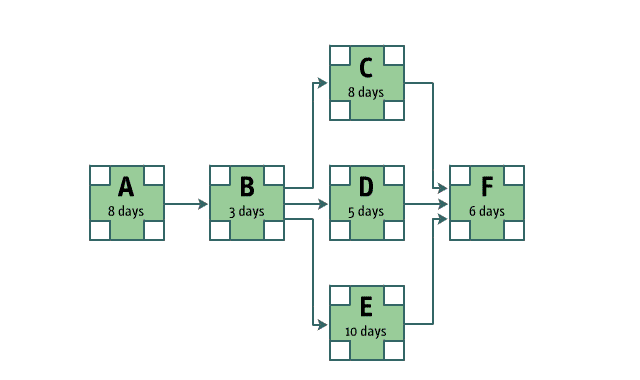
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# Learning Aid

# The Annual Flower Show

**Purpose:** Use this learning aid to answer the test questions on applying the critical path method.

| **Activity list** | | |
| --- | --- | --- |
| **Activity ID** | **Activity name** | **Duration** |
| A | Hire venue | 8 days |
| B | Advertise show | 3 days |
| C | Record entrants | 8 days |
| D | Commission judges | 5 days |
| E | Purchase prizes | 10 days |
| F | Create program | 6 days |



Schedule network diagram

The schedule network diagram for the annual flower show begins with activity A, which has an estimated duration of eight days and is then succeeded by activity B, which has an estimated duration of three days. Activity B is then succeeded by activities C, D, and E which all take place in parallel. Activity C has an estimated duration of eight days, activity D has an estimated duration of five days, and activity E has an estimated duration of ten days. These activities are all succeeded by activity F which has an estimated duration of six days.

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**Topic:** Critical Path Method

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# Learning Aid

# Direct Mail Project

**Purpose:** Use this learning aid to help you answer the test questions on calculating schedule variance.

| **Project data** | | | | | |
| --- | --- | --- | --- | --- | --- |
| **Activity** | **Planned start** | **Planned finish** | **Budgeted cost** | **Planned completion as of Day 14** | **Percent complete as of day 14** |
| Flyer design | Day 1 | Day 5 | $8,000 | 100% | 100% |
| Written copy | Day 2 | Day 6 | $5,000 | 100% | 100% |
| Edited copy | Day 6 | Day 8 | $3,000 | 100% | 100% |
| Photos and art | Day 8 | Day 11 | $7,000 | 100% | 100% |
| Printing | Day 11 | Day 14 | $21,000 | 100% | 100% |
| Mailing list | Day 1 | Day 14 | $10,000 | 100% | 70% |
| Address and mail | Day 15 | Day 21 | $44,000 | 0% | 0% |
| Monitor customer response | Day 22 | Day 30 | $10,000 | 0% | 0% |

**Course:** Developing and Controlling the Project Schedule  
**Topic:** Schedule Variance and Schedule Performance Index

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# Learning Aid

# Book Publishing

**Purpose:** Use this aid to answer the practice questions on calculating schedule variance.

| **Project data** | | | |
| --- | --- | --- | --- |
| **Activity** | **Budgeted cost** | **Planned completion by day 30** | **Actual percent complete** |
| Research | $10,000 | 100% | 100% |
| Product design | $5,000 | 100% | 100% |
| Outline | $9,000 | 100% | 100% |
| First section written | $24,000 | 50% | 10% |

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# Learning Aid

# Book Publisher

**Purpose:** Use this aid to answer the practice questions on calculating schedule variance.

| **Project data** | | | |
| --- | --- | --- | --- |
| **Activity** | **Budgeted cost** | **Planned completion by day 30** | **Percentage complete** |
| Research | $15,000 | 100% | 100% |
| Product design | $10,000 | 100% | 100% |
| Outline | $10,000 | 100% | 100% |
| First section written | $30,000 | 100% | 50% |

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**Topic:** Schedule Variance and Schedule Performance Index

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# Job Aid

# Calculating Schedule Variance and SPI

**Purpose:** Use this job aid to help you calculate schedule variance and the schedule performance index (SPI).

When calculating schedule performance data, you need to first calculate the planned and the earned value for the work on a specified date.

To calculate **planned value**, you

1. multiply each activity's approved cost estimate by the percentage of work planned to be completed on that activity by the measurement date
2. sum the planned values of each activity to get the total planned value

For example, if the first two activities are meant to be 100% completed and the third activity is meant to be 40% complete at the day of the calculation, you add 100% of the cost estimates for the first two activities and 40% of the cost estimate for the third activity to calculate the planned value.

To calculate **earned value**, you

1. multiple each activity's approved cost estimate by the percentage of work actually completed on the activity up to the given date
2. sum the earned values of each activity to get the total earned value

For example, if the first activity is 100% complete, the second activity is 90% complete, and the third activity is 25% complete, you add the full cost estimate for the first activity, 90% of the cost estimate for the second activity, and 25% of the cost estimate for the third activity to calculate the earned value.

To calculate **schedule variance**, you subtract the planned value from the earned value. So the formula for this is SV = EV - PV.

To calculate **SPI**, you divide the earned value by the planned value. The formula for this is SPI = EV/PV.

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**Topic:** Schedule Variance and Schedule Performance Index

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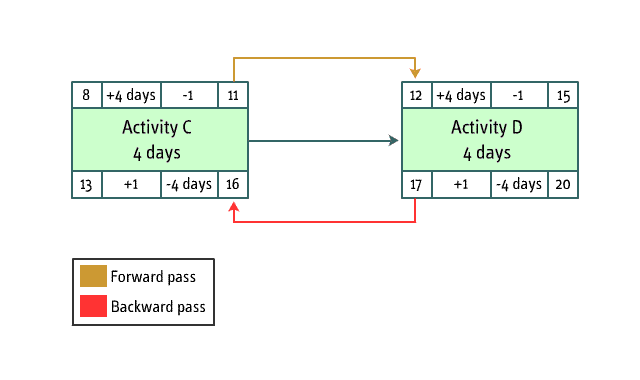
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# Job Aid

# Critical Path Calculations

**Purpose:** Use this job aid as a reference to the calculations used in the critical path method.

### One-to-one dependency between tasks



One-to-one dependency between tasks

#### Forward pass

Early start date + Duration - 1 = Early finish date

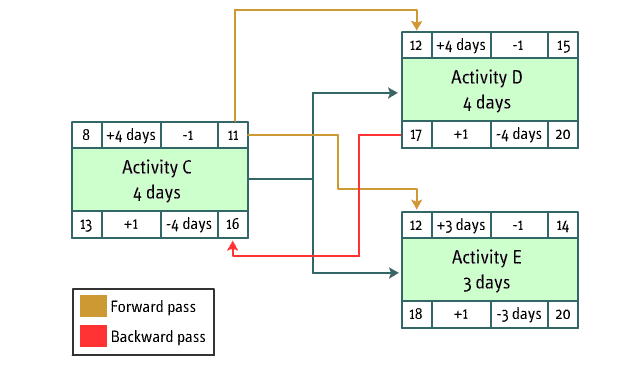
The early start date of an activity should fall on the next working day after the early finish date of the previous activity.

#### Backward pass

Late finish date - Duration + 1 = Late start date

The late finish date of an activity should fall on the working day before the late start date of the following activity.

### One-to-many dependency between tasks



One-to-many dependency between tasks

#### Forward pass

Early start date + Duration - 1 = Early finish date

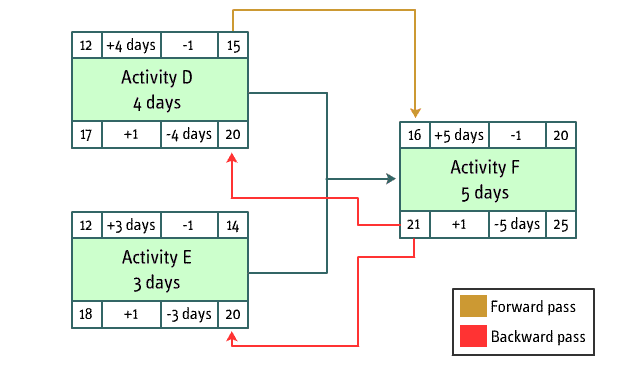
The early start date of the dependent activities should fall on the next working day after the early finish date of the previous activity.

#### Backward pass

Late finish date - Duration + 1 = Late start date

The late finish date of the previous activity should fall on the working day before the smaller late start date of the succeeding activity – that is, the working day before the late start date of the critical path activity.

### Many-to-one dependency between tasks



Many-to-one dependency between tasks

#### Forward pass

Early start date + Duration - 1 = Early finish date

The early start date of the dependent activity will be the working day after the larger early finish date of the previous activities.

#### Backward pass

Late finish date - Duration + 1 = Late start date

The late finish date of the preceding activities will be the working day before the late start date of the dependent activity.

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**Topic:** Critical Path Method

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Estimating and budgeting project costs

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# SkillBrief

# Project Cost Management

A project can run over budget if you don't plan and manage costs carefully. Project Cost Management is the knowledge use for managing costs. Processes in this area help you ensure a project is completed within the approved budget.

An important aspect of Project Cost Management is arriving at accurate forecasts of what project activities will cost. If you don't do this carefully, you won't arrive at a realistic idea of what funding the project needs to go ahead. It's also important that the project managers monitor and control costs once project work is in progress.

Project Cost Management is about more than just calculating and tracking costs. It involves recognizing how project decisions can affect costs. It might also reduce the number of product defects later in the project. And it is far more expensive to repair defects further down the line than to find them during quality control inspections. Most project decisions affect costs somehow, directly or indirectly.

There are three Cost Management processes:

* **Estimate Costs** – the process of forecasting what each project activity will cost, based on the resources required to complete it. This includes human resources and physical resources, like material or equipment.
* **Determine Budget** – the process of adding up the estimated costs for each activity or work package to get to an estimated budget for the entire project. This provides you with a cost baseline against which you can monitor actual costs.
* **Control Costs** – the process of keeping actual costs and the planned budget in line. It involves influencing the factors that cause cost variances and, when necessary, managing changes to the budget. Keeping an eye on cost trends and anticipating the cost of work that still needs to be done are important aspects of this.

Each of these processes supports the others in creating a stable cost management structure. Each of the Project Cost Management processes has particular inputs, tools and techniques, and outputs. The outputs from one process become inputs for the next process.

In the Estimate Costs process, the inputs are sources of information about what activities a project must include and what these are likely to cost. Techniques for analyzing and estimating costs let you convert this information into a cost estimate for each activity. Once you've got this output, you should document the reasoning behind the estimates and make relevant updates to project documents.

For the Determine Budget process, the inputs include the cost estimates you calculated and other project information that could affect total resource expenditure. The tools and techniques are what you use to arrive at a realistic total budget that stays within fixed funding constraints.

The Control Costs process makes use of inputs that list how much the project is going to cost, what has already been spent, and what policies and procedures must be used to monitor costs. The tools and techniques are then used to assess the performance and progress of the project.

So the cost estimates you arrive at through the Estimate Costs process are what enable you to determine a total budget. The budget provides a baseline against which you can measure actual project costs. During the Control Costs process, you use these measurements as the basis for keeping actual costs and the planned budget in line.

As part of the Develop Project Management Plan process, a cost management plan is produced. The cost management plan guides all three of the Project Cost Management processes. The cost management plan sets out to establish the

* required level of accuracy in activity cost estimates
* defined units of measurement for resource costs
* organizational procedure links
* control thresholds, which indicate an agreed amount of variance that can occur before action must be taken
* rules of performance measurement, including the use of earned value management
* reporting formats and frequency
* process descriptions for cost management

The Project Cost Management knowledge area includes three processes – Estimate Costs, Determine Budget, and Control Costs. Cost estimates for each of the activities in a project are needed to determine a budget. The budget is then used as a baseline against which actual project costs can be monitored. Costs are controlled – through changes to the baseline or some other corrective action – to ensure that actual costs stay in line with the budget.

**Course:** Estimating and Budgeting Project Costs  
**Topic:** Cost Management Processes

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# SkillBrief

# Cost Management Process Groups

As a project manager, it's important to understand how cost management fits into the overall management of a project. Managing costs includes three processes:

* you use the Estimate Costs process to work out how much each activity is likely to cost
* you total these costs in the Determine Budget to arrive at a cost performance baseline
* you take action to keep actual costs and the baseline costs in line in the Control Costs process

The Guide to the Project Management Body of Knowledge (PMBOK® Guide) organizes all the processes for managing a project into process groups. The PMBOK® Guide defines a process group as "a set of interrelated actions and activities that are performed to achieve a pre–specified set of products, results, or services."

There are five process groups:

* **Initiating process group** – consists of processes that facilitate the formal authorization to start a new project or to begin a new project phase.
* **Planning process group** – consists of processes that develop the project management plan. Additionally, they define and mature the project scope, and identify and schedule project activities.
* **Executing process group** – consists of processes performed to complete the work defined in the project management plan so as to achieve a project's objectives.
* **Monitoring and Controlling process group** – consists of processes used to track, review, and control project performance and progress. These processes enable you to identify potential problems and correct them, or recommend preventive action when necessary.
* **Closing process group** – consists of processes that are performed to formally end a project or a project phase. These processes include transferal or approval of the final deliverables or closing a project that has been canceled.

The Estimate Costs process is used to develop an approximation of the costs of each activity. This helps the project manager and stakeholders plan the resources and budget accordingly. So Estimate Costs falls within the Planning process group.

The Determine Budget process also fits under the Planning process group. In this process, an estimated budget for the entire project is planned. This provides the project manager with a cost performance baseline against which actual spending can be measured.

The Control Costs process involves monitoring the status of a project and regulating actual costs to stay in line with the planned budget. As such, it falls in the Monitoring and Controlling process group.

In practice, the process groups are interrelated. Each group depends on outputs from groups that come before it. In the case of managing costs, the cost estimates you arrive at are what enable you to develop a budget. The planned budget then becomes the yardstick against which you monitor and control costs.

The process groups are also iterative – they repeat throughout a project. As you monitor and control costs, you may need to return to the Planning process group or revise the budget you planned.

The outputs of estimating costs become the inputs of determining the budget. Similarly, outputs of Determine Budget become inputs of Control Costs. Cost estimates are used to calculate reserve amounts for the activities. The costs and contingency reserves are then added together so as to determine the budget for the project. The Estimate Costs and Determine Budget processes are Planning process group processes, while Control Costs is a Monitoring and Controlling Process group process.

After the cost baseline and budget are in place, the project manager knows what the approximate costs and expenditure should look like. Fluctuations in prices and added expenses are then managed to keep planned and actual costs in line. This is part of the Monitoring and Controlling process group.

The processes for managing a project can be categorized into five process groups – Initiating, Planning, Executing, Monitoring and Controlling, and Closing. The Estimate Costs and Determine Budget processes fall in the Planning process group, and the Control Costs process falls under Monitoring and Controlling.

Outputs from the planning processes become inputs for controlling costs. Information that emerges from monitoring and controlling costs may also make it necessary to update cost estimates and the budget.

**Course:** Estimating and Budgeting Project Costs  
**Topic:** Project Cost Management and the Process Groups

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# SkillBrief

# Estimate Costs Process Inputs

Estimating costs is a critical step in turning a project's vision into reality. Estimating costs forces you to be realistic and it helps you stick to the budget when the project is under way.

One of the challenges for any project manager is to budget enough up front for an entire project. Once you've done this, the success of a project depends on managing the available funds well. The first step, both in knowing how much to budget and in controlling costs once work starts, is to estimate a project's costs.

The Estimate Costs process is the first of three processes in the Project Cost Management knowledge area. It's also part of the Planning process group because it forms an important aspect of project planning.

Cost estimates are usually defined in terms of currency. Cost estimates are projections of the monetary resources that a project needs to meet its objectives. Arriving at these estimates involves determining all the material and staff resources required to complete each activity, and the costs of the needed resources. It also involves identifying cost alternatives and basing estimates on the best choices, in terms of cost and risk.

### Benefits of estimating costs

Cost estimation is a progressive process. You continue refining cost estimates as more information becomes available. As you gain more information you adjust the earlier estimate and its margin for error continues to shrink.

Cost estimation provides project managers with two main benefits:

* **it identifies funding requirements** – The project sponsor needs to identify the funding requirements for a project before deciding to grant funding.
* **it establishes a cost baseline** – By estimating costs, you establish a cost baseline, which enables you to monitor and control costs as the work progresses. This baseline contains the estimated costs of the resources the project will use.

### Inputs for estimating costs

To estimate the costs for a project, you need the information contained in six inputs.

#### Scope baseline

The scope baseline, which describes the work required to complete the project, consists of the

* **work breakdown structure (WBS)** – The WBS is a hierarchical breakdown of the project's scope, including all components of the work that must be done. It shows the relationships between the deliverables and work packages. Each work package provides the basis for cost estimation. You develop the WBS progressively using rolling-wave planning and, as a result, a project's cost estimate baseline is often also refined progressively.
* **WBS dictionary** – This document describes every component of the WBS is described in detail. Each component's form or page contains the work descriptions, milestones, and other information you need to estimate costs.
* **project scope statement** – This is a broad written description of the project aimed at stakeholders. It helps you keep in mind the project's business objectives, total project and product scope, strategies, constraints, and assumptions while estimating costs.

#### Project schedule

Another input to the Estimate Costs process is the project schedule. It contains the planned dates for performing schedule activities and information about what resources are needed, when, and for how long. The schedule enables you to estimate resource costs for staff, materials, equipment, and location resources. Some activity costs are time-sensitive. Using the project schedule can help you estimate these costs accurately.

#### Human resource plan

The human resource plan describes the staff requirements for a project and is another important input for estimated costs. Knowing staff information enables you to estimate costs based on defined staff roles, staff numbers, and their rates or salaries.

#### Risk register

The risk register is another input to the Estimate Costs process. It is the section of the project management plan that documents the risks associated with the project. Risks can pose a threat to a project because if realized, they usually cause an increase in the duration and cost of an activity. The risk register identifies each risk, its cause, and the impact it will have on the project. The risk response is an important section of the register because it suggests what actions to take in case the risk materializes.

#### Enterprise environmental factors

These are external factors that can influence a project. Information about these factors is another input for estimating costs.

#### Organizational process assets

These are sources of knowledge within your organization that can be useful to a project. Examples of organizational process assets that help estimate costs are the

* **historical information from past projects** – When you estimate costs, you can draw on historical information from previous projects. Closed project files or contracts can help you determine more accurate cost estimates and avoid cost estimating mistakes that were made in the past.
* **lessons learned** – This is the knowledge gained from previous projects. This knowledge should be recorded in a knowledge base, so that you can familiarize yourself with it before you start with your current project. A possible lesson learned is a information on who is, and who is not, a reliable supplier.
* **cost estimating policies** – Documents from previous projects often include cost estimating policies that standardize the way you need to perform certain activities.
* **cost estimating templates** – These templates save you time and effort when estimating costs for a current project, because you can input data without first having to develop a spreadsheet for your project.

The Estimate Costs process is part of the Project Cost Management knowledge area and the Planning process group. You use cost estimation to develop funding requirements and to establish the cost estimate baseline. Inputs to the Estimate Costs process are the scope baseline, the human resource plan, the project schedule, the risk register, enterprise environmental factors, and organizational process assets.

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**Topic:** Inputs for Estimating Costs

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# Estimate Costs Tools and Techniques

With projects, how you estimate costs often determines their success or failure. There are several cost estimating tools and techniques that can help you figure out how much your project will cost. Each tool and technique is useful at some point in the project, offering a unique approach to cost estimation, and helping you to produce accurate and realistic estimates.

#### Analogous estimating

You use the costs of a past project to forecast the costs of a current project. It's most reliable when the projects you compare are very similar.

Analogous estimating uses expert judgment to adjust past costs according to the scope, duration, and budget of the current project. This technique is most effective when used in conjunction with other estimating techniques. It is useful whether you're estimating costs for the total project or for a particular phase or part of the required work. Analogous estimating requires solid industry experience.

#### Parametric estimating

Parametric estimating is a powerful technique for forecasting costs using parameters related to the scope of the project and product, as well as resource cost information. Parameters, which are attributes of an activity, can include its scope, cost, budget, and duration. The accuracy of the parameters you include will determine how accurate an estimate is.

Using parametric estimating to approximate the cost of materials to build a townhouse, you use the average cost per square yard of building materials and the size of the house in square yards as parameters. This is a very rough estimate. Then when you get the actual costs and quantities of the required bricks and cement, you can use the parameters to create a more accurate estimate.

#### Bottom-up estimating

Bottom-up estimating involves making separate estimates of the cost for each work package in the work breakdown structure (WBS). To determine the estimate for a work package, you break the work package down into its detailed activities, estimate costs for each activity, then roll those costs up to the work package level.

Bottom-up estimating is straightforward, but it does require great attention to detail.

#### Reserve analysis

This is a technique that enables you to establish a cost, or contingency, reserve, for the project. Contingency reserves provide a buffer for activities that may go over budget.

Reserve analysis calculates contingency reserves based on a percentage of the estimated cost, a fixed number, or through quantitative analysis methods. As the project progresses and information becomes available, reserves may be used, reduced, or eliminated.

#### Cost of quality

Cost of quality describes all the costs associated with conforming to a project's quality requirements. It also includes the costs of failing to meet the requirements and of having to rework a product until you achieve the required quality.

#### Project management estimating software

The software includes spreadsheets, cost simulation models, and other computerized statistical tools for rapidly estimating costs. Some of these tools enable you to forecast how the budget will look for the entire project, based on your current parameters and cost estimates.

#### Vendor bid analysis

Once qualified vendors have submitted their bids or quotations for work on a project, you compare the various quoted costs in order to arrive at a market-related cost estimate.

#### Three-point estimates

The three-point estimates technique aims to improve the accuracy of the activity cost by taking into account the amount of risk in the original estimate. It does this by calculating best case, worst case, and most likely durations for an activity.

When determining a three-point estimate, you first assign weights to the costs and calculate the denominator. A three-point estimate typically assigns a weight of one to the optimistic and pessimistic estimates and a four to the most likely estimate. The denominator of 6 is the sum of the weightings. You then use expert judgment and analogous estimating to determine the cost estimates. The result is the expected cost of an activity as a dollar value.

The tools and techniques you use to estimate costs are expert judgment, analogous estimating, parametric estimating, bottom-up estimating, three-point estimates, reserve analysis, cost of quality, project management estimating software, and vendor bid analysis. Each of these provides unique information and helps ensure the final estimates you arrive at are as accurate as possible.

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# Estimate Costs Outputs

The results of the Estimate Costs process, which you use to estimate what each component of project work will cost, are critically important to a project. They're what let you determine the project's funding requirements and control actual costs as work proceeds.

It's important that when you estimate costs, every estimate is supported by good judgment and sound thinking. No detail that might affect costs should be overlooked and the possible effects of activity changes to the estimates should be recorded. A good cost estimate is about being precise, anticipating possible changes, and clarifying the reasons for your decisions to others. You should keep these principles in mind as you examine the outputs of the Estimate Costs process.

This process has three outputs:

* **activity cost estimates** – These are quantitative valuations of how much the resources necessary for carrying out project activities will cost. These estimates depend on such factors as costs for materials and equipment, labor, services, and facilities, as well as any imposed funding requirements – such as an inflation allowance or a cost contingency reserve. Activity cost estimates may be presented in detail or summarized and presented as costing totals.
* **basis of these estimates** – These provide a detailed explanation of the factors on which each activity cost estimate is based. It's important to record the factors, as well as any assumptions or constraints, on which estimates are based. This will help you adjust cost estimates accurately if any of the factors – like the resources required for an activity – change. You should also indicate how confident you are about the estimates by specifying the range of anticipated variance – for example, ±10%.
* **project document updates** – Once you have estimated project costs, you need to update any project documents affected by these costs or information you gained during the process. This will often require changes to the risk register but changes can include any project-related documents that require updates after costs are estimated.

Both activity cost estimates and the basis for those estimates will be inputs in the Determine Budget process. So any weakness in the Estimate Costs process will affect the budget you use to control project spending.

Remember, when estimating costs, you need to keep track of why costs were necessary, what assumptions have been made, the constraints that might affect your costs, the range of possible variation in estimates, and your level of confidence in the estimates you have produced.

Though activity cost estimates can affect various project documents, they generally have most impact on the risk register. One of the main factors in cost risk is the validity of the assumptions upon which estimates are based and the number of budget-related constraints a project has. There is a strong relationship between the risks listed in the risk register and the items in the "basis of estimates" document, such as assumptions, constraints, and level of confidence in the final estimate.

The three outputs of the Estimate Costs process are activity cost estimates, the basis of these estimates, and project document updates. Activity costs should be estimated using the best information possible and this information should be recorded as the basis for the estimates. Once cost estimates are established, project documents should be updated to reflect the impacts of the estimates on the project.

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# SkillBrief

# Bottom-up Estimating

Bottom-up estimating of project costs is a valuable technique because, as its name implies, it involves determining costs at the lowest levels and in the most detail, before aggregating them up to higher levels in the work breakdown structure (WBS). This technique has both advantages and disadvantages:

An advantage of bottom-up estimating is that it takes all costs incurred by the smallest units of work in the WBS into account. It also enables easy reporting and tracking of costs up through remaining levels in the WBS. Another major advantage is that bottom-up estimating often relies on input from people who'll be performing the relevant tasks. This can increase their commitment to completing the tasks within the budget that's developed based on the estimates.

Although it provides the most accurate results, a disadvantage of bottom-up estimating is that it takes a lot of effort to implement. In addition, too little information may be available at the beginning of a project to allow for accurate estimates of what work packages will cost. For this reason, bottom-up estimating is often more reliable once an initial project phase has completed, for estimating the costs of remaining phases.

#### Step 1

The first step in the bottom-up estimation technique is to estimate the costs for all the decomposed activities that make up the bottom row of the WBS.

You estimate the cost of each activity by adding the costs of the labor and materials it requires. To the result, you then add the established contingency reserve – or the cost of risk for the activity – and the cost of quality, to get a total activity cost estimate. Note that not all projects will use the same method when determining contingency and quality costs, which may be estimated at the activity level or at a summary level. The method chosen has implications on how the costs are rolled up.

#### Step 2

Once you have analyzed each activity's costs, the second step is to add these costs. This lets you roll up the estimated costs to the next highest level in the WBS. You continue aggregating costs and rolling them up until you've determined a total cost estimate for each of the project's main deliverables or phases.

When reviewing a bottom-up cost estimation, there are four fundamental questions you need to ask:

* **Was each task cost estimated?** – If any task has been missed, this will result in an inaccurate estimation because the costs will be rolled up without taking the omitted costs into account. Be sure to check that all of the work packages at the lowest level of your project's WBS have been given a cost estimate. Bear in mind that the cost estimates for work packages will be derived by adding the costs for labor and materials for each component task in the work package and adding contingency and quality costs.
* **Was each task estimate correct?** – Poor estimation of costs for the elements that comprise your project will mean that all the rolled up costs for higher levels of the project are incorrect. Ensure that estimates for work packages are as accurate as possible. To correctly calculate the cost of each component task that will make up the total cost of the work package, add the labor and material costs for each.
* **Were all estimates included in the subtotal?** – No costs should be left out of the figures being rolled up from the lower level of your project's decomposition. When working out the costs for work packages, double-check that every component task has been included in the calculations used to derive the subtotal before adding the contingency reserve and quality costs.
* **Was the total for activity costs calculated correctly?** – Even if you are sure that you have included the costs of all components in your calculations, it is good practice to check that they have all been added up correctly. When calculating the costs for work packages, the contingency reserve and the quality costs should be added to the subtotal of all the component tasks in order to give you a total estimate for the work package.

Bottom-up estimating is the most accurate, but also the most demanding, cost estimation technique. It involves estimating the costs of all activities at the lowest level in a project's WBS, accounting for contingency reserves and quality costs. When reviewing a bottom-up estimate, you should ask yourself four questions: Was each task cost estimated? Is each task estimate correct? Were all estimates included in activity cost subtotals? Was the total for activity costs calculated correctly?

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# SkillBrief

# Budget Determination

### Inputs

Project Cost Management includes the processes involved in estimating, budgeting, and controlling costs so that a project can be completed within the approved budget.

In the Determine Budget process, you take the estimated costs of each project activity and convert them into a realistic cost performance baseline. This becomes the yardstick against which you can measure and control actual costs.

The Determine Budget process is in the Planning process group. Through careful planning of a project's costs, you determine what funds will be needed, and when, to complete each aspect of a project. This gives you a cost performance baseline against which you can monitor and control actual spending as work proceeds. A project budget usually includes contingency reserves to cover anticipated but unknown costs. It's important you determine a realistic amount to cover unanticipated costs, which are also included in the cost baseline.

Like the Estimate Costs process, the Determine Budget process has inputs, tools and techniques, and outputs. To determine a budget, you need several sources of information. The inputs you use include

* **activity cost estimates** – These are estimates of how much each schedule activity will cost to complete. This includes all resource costs, like the costs of staff, materials, and equipment.
* **basis of estimates** – This is a documented record of how you arrived at activity cost estimates. This is important because it identifies any assumptions. For example, the cost of a required resource could be based on the availability of the resource at a particular time. If an assumption proves false, it can alert you that an activity cost estimate – and therefore the budget – must change.
* **scope baseline** – A project's scope baseline includes a scope statement, the work breakdown structure (WBS) and the WBS dictionary. The scope statement is an important input because it identifies budget limitations. The WBS shows the relationships among all the project deliverables and their various components. And the WBS dictionary lists the work that needs to occur in each component to create the deliverables. When you know what activities need to be performed and how they interrelate, you can estimate the budget more accurately.
* **project schedule** – This provides the expected start and finish dates for project activities and milestones. When determining the budget, you use this information to aggregate costs to the calendar periods that they are scheduled for.
* **resource calendars** – A resource calendar provides information about which resources are assigned to the project and when they are available. In the Determine Budget process, you use this information to ensure that funds are available when resource costs are due to be incurred.
* **contracts** – Project contracts provide cost information about the resources, like materials or services, due to be purchased for the project. You include these costs when determining a budget.
* **organizational process assets** – These include policies, procedures, and guidelines related to cost budgeting, as well as cost budgeting tools and reporting methods. All of these assets can guide or assist in the process of developing a budget.

### Tools and techniques

You need to know in advance what a project should cost so you can ensure it stays within the agreed limits. You apply these to information you get from the inputs for the Determine Budget process to arrive at an accurate budget.

The tools and techniques you use when determining a budget are

* **cost aggregation** – Cost aggregation means adding together the activity cost estimates for each component in the WBS. You first aggregate the costs of activities in the work packages. From there, you aggregate work package costs to arrive at the costs of components above them in the WBS. By aggregating the cost estimates all the way up the WBS, you establish a cost estimate for the project as a whole. This ensures you can budget for and track costs for each component of the project work.
* **reserve analysis** – Reserve analysis is the technique you use to determine realistic reserves. These consist of contingency reserves and management contingency reserves. Contingency reserves are to account for unplanned changes related to risk events that occur during the project. Contingency reserves are part of the cost performance baseline and the total budget. Management contingency reserves are for unplanned changes to scope and cost. They are not included in the cost performance baseline but are included in the total budget. The project manager may need to seek approval before accessing the management contingency reserve.
* **expert judgment** – The expert judgment of people with specialized knowledge about particular project activities and about associated costs can help you develop a more accurate budget.
* **historical relationships** – Historical relationships between specific activities and their costs can help you determine more accurate estimates of what activities in the current project will cost. Project managers can use parametric estimates to develop mathematical models for predicting total project costs, based on historical relationships. But these models depend on quantifiable parameters being available and on the accuracy of the information used to develop them.
* **funding limit reconciliation** – This is all about regulating cash flow over the life of the project. It involves arranging the time-phased budget so that planned expenditures never exceed planned funds-on-hand. Sometimes work must be rescheduled to level out cash flow projections.

Inputs for the Determine Budget process are activity cost estimates, the basis of these estimates, the scope baseline, the project schedule, resource calendars, contracts, and organizational process assets. Tools and techniques you use to determine a realistic project budget are cost aggregation, reserve analysis, expert judgment, historical relationships, and funding limit reconciliation.

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# SkillBrief

# Determining a Cost Baseline

### Key elements

Developing the cost baseline is a vital part of the Determine Budget process. It's this baseline that you'll compare actual costs against throughout a project's duration. The cost baseline has five key elements. These are work package costs, subproject costs, total costs, contingency reserves, and due dates.

Of all the tools and techniques for determining a project budget, cost aggregation is the one you typically use first when establishing a cost baseline. This is because cost aggregation is what enables you to determine the costs of each component in the work breakdown structure (WBS).

To aggregate costs correctly, it's important you start by assigning cost estimates at the lowest level of your project's WBS. In other words, you begin by estimating the cost of each project activity, as accurately as possible.

Next you total the costs of activities to work out the aggregated cost of each work package. You add the estimated costs of all the work packages, which include the determined contingency reserves, to arrive at the planned cost of each subproject. As well as reflecting the costs of each work component, it's essential that the cost baseline is time phased. It must show you not only how much project activities will cost, but when these costs will be incurred.

You get the time-related information for the cost baseline from the project schedule. Using the schedule, you need to identify when, and for how long, each activity is planned. You then align the aggregated costs you've calculated with the time durations in which they fall.

The key elements of any cost baseline are the work package, subproject, and total costs you aggregate, as well as their due dates and contingency reserves.

### Checking a cost baseline

If the cost baseline isn't accurately established, you won't be able to monitor and control actual project costs accurately either. So it's important you carefully check the cost baseline you develop. To check whether you have established your cost baseline correctly, you can ask yourself the following questions:

* Were the costs correctly aggregated at the work package, subproject, and project levels?
* Were the contingency reserves included?
* Were the correct dates assigned to each cost estimate based on the project schedule?

By checking each key element of the cost baseline, the project manager helps ensure that no errors made at this stage will result in cost control problems once the project is underway.

The key elements that should be present in any cost baseline are work package costs, subproject costs, a total project cost, as well as their due dates and contingency reserves. Once you've developed a cost baseline, it's important to check its accuracy. This involves verifying that you've aggregated costs correctly for work packages, subprojects, and the project as a whole. It also involves checking that contingency reserves are accurate and included in the cost baseline, and that the correct dates are assigned to each cost estimate.

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# SkillBrief

# Determining Budget Process Outputs

Even if a project finishes ahead of schedule and meets or surpasses everyone's requirements, it still won't be regarded as a success if it didn't stay within acceptable cost parameters. That's what makes the Determine Budget process so important. Without a clear budget, you have no way to control costs as work proceeds. In severe cases, this could mean running out of money and having a project collapse because work can't be completed. Ultimately, it also means you won't have a way to confirm the project's success, even if it does complete on time and meet other requirements.

It's through the outputs of the Determine Budget process that you can control project costs and ensure they stay in line with agreed limits.

#### Cost performance baseline

You measure, monitor, and control actual project costs against the cost performance baseline. It identifies the expected costs of all work, as well as the dates when the costs apply. For projects with several phases, it can be useful to create a separate cost performance baseline for each phase, as well as a total project baseline.

As an output of the Determine Budget process, the cost performance baseline is an input to the Control Costs process, which takes place in the Monitoring and Controlling process group. You use the Control Costs process to identify and manage variances between estimated and actual costs.

The cost performance baseline is commonly represented as a graph, where the X-axis represents time and the Y-axis represents cost. It is also called the performance measurement baseline because it combines three baselines into one graph: the budget, schedule, and scope.

You plot a point for each work package. Once you've finished adding points, you connect them to create a cost baseline curve. This makes it easy to see the accumulated planned costs per time period over the course of the project. A cost baseline curve usually has an "S" shape. This is because costs will generally be low at the start of a project and then increase as time goes by. As the project nears an end, costs taper off.

It's one thing to estimate a budget and another to try to keep to one. Prices can increase unexpectedly and new costs may emerge as work proceeds. Contingency reserves are included in the baseline to cover expected but unknown costs. In addition, most project budgets include a management contingency reserve that's separate from the baseline. The management reserve is usually set as a percentage of the total baseline cost and is included to deal with entirely unanticipated costs. Together, the costs in the baseline and the management contingency reserve determine a project's funding requirements.

#### Project funding requirements

A project's funding requirements are established in conjunction with your organization's Finance Department. During normal operations, companies typically have a finite amount of funds on hand to cover expenses. In looking at the cost performance baseline, you will be able to tell what funds your project will need at each stage of work. Funding requirements must be approved according to organizational policies and expected cash flow so that you are able to expense your project as required.

It's useful to plot project funding requirements on a budget graph. This lets you track the management contingency reserve added to the baseline, which is the upper spending limit planned over time for your project. Funding is typically given in installments, so funding requirements are often shown as steps.

#### Project document update

In the process of determining a budget, you may gain new information about likely project costs. You might also make budgetary decisions that affect other aspects of a project, like its schedule. You then need to update relevant project documents.

In the process of establishing the cost baseline and project funding requirements, new information about likely costs and their impact on the rest of a project often comes to light. This leads to the last output of the Determine Budget process – project document updates. Among the documents you might update are the

* **risk register** – This records risks or opportunities that might arise during a project. As you determine a budget, you should update the risk register with information regarding how any change in the budget might represent a risk to quality or the project schedule.
* **cost estimates** – As you determine the budget, new information or insights may emerge about what project activities will cost. You then need to update the relevant cost estimates.
* **project schedule** – This documents the duration and sequence of all project activities. Budgetary constraints may require a change in scheduling. For instance, it may be necessary to reduce the duration of an activity. The schedule must then be updated.

The outputs of the Determine Budget process are the cost performance baseline, project funding requirements, and project document updates. You can represent the baseline and the requirements graphically. Examples of documents you may need to update are the risk register, cost estimates, and the project schedule.

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**Topic:** Tools and Techniques for Estimating Costs

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# Follow-on Activity

# Illustrating the Budget

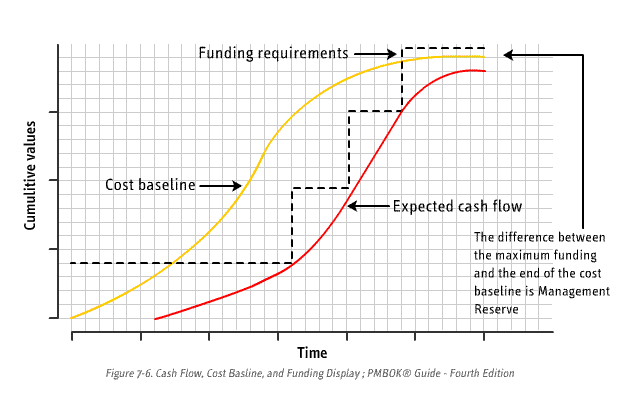
**Purpose:** Use this follow-on activity to practice graphically expressing the outputs of the Determine Budget process.

**Instructions for use:** Use the sample graph and definitions of the outputs of the determine budget process to help you sketch a graph for the budget of the last project you worked on or for a project you will be working on in the near future.

**The cost performance baseline** represents the combined, estimated costs for each project activity, including a contingency reserve to account for expected but unknown costs, represented over time. Generally a project's highest levels of expenditure occur during the middle of its life cycle, so a cost performance baseline commonly forms an S-curve when plotted on a graph.

**Project funding requirements** represent the total costs for a project. You determine them by adding the project's total baseline cost and the management contingency reserve you establish. Because funding for a project is usually incremental, the funding requirements are displayed as steps in a graph.

**Cash flow** represents the amount of money that is expected to come into the project over time. Like the cost performance baseline, it often forms an S-curve when plotted on a graph.



Sample graph of project budget

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**Topic:** Outputs from Determining Budget

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# Follow-on Activity

# Reviewing the Cost Estimates for a Recent Project

**Purpose:** Use this follow-on-activity to help you analyze how costs were estimated in a recent project.

**Instructions for use:** To use this tool, obtain a report that was used to estimate costs for a recent project and use it to answer the questions.

| **Questions on cost estimation** | |
| --- | --- |
| **Question** | **Answer** |
| How were the costs estimated? | Row 2 Column 2 |
| Was a bottom-up approach used? | Row 3 Column 2 |
| Was each task cost estimated? | Row 4 Column 2 |
| Was each task cost estimated correctly? | Row 5 Column 2 |
| Were all estimates included in the subtotal? | Row 6 Column 2 |
| Was the total for the activity cost estimate calculated correctly? | Row 7 Column 2 |
| Was the overall project estimate calculated correctly? | Row 8 Column 2 |

****For online use, complete each row as described in the instructions. If you would like to work with the page as hard copy, simply print it out using the Print link at the top of this page.****

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**Topic:** Reviewing Bottom-up Estimates

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# Job Aid

# Cost Baseline Document Template

**Purpose:** Use this job aid to review an example of a cost baseline template.

| **Cost baseline document template** | | | | |
| --- | --- | --- | --- | --- |
| **Work package** | **Due date** | **Cost** | **Contingency reserves** | **Total** |
| Row 2 Column 1 | Row 2 Column 2 | Row 2 Column 3 | Row 2 Column 4 | Row 2 Column 5 |
| Row 3 Column 1 | Row 3 Column 2 | Row 3 Column 3 | Row 3 Column 4 | Row 3 Column 5 |
| Row 4 Column 1 | Row 4 Column 2 | Row 4 Column 3 | Row 4 Column 4 | Row 4 Column 5 |
| **Subproject** | Row 5 Column 2 | Row 5 Column 3 | Row 5 Column 4 | Row 5 Column 5 |
| Row 6 Column 1 | Row 6 Column 2 | Row 6 Column 3 | Row 6 Column 4 | Row 6 Column 5 |
| Row 7 Column 1 | Row 7 Column 2 | Row 7 Column 3 | Row 7 Column 4 | Row 7 Column 5 |
| Row 8 Column 1 | Row 8 Column 2 | Row 8 Column 3 | Row 8 Column 4 | Row 8 Column 5 |
| **Subproject** | Row 9 Column 2 | Row 9 Column 3 | Row 9 Column 4 | Row 9 Column 5 |
| **Total budget** |  | Row 10 Column 3 | Row 10 Column 4 | Row 10 Column 5 |

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# Job Aid

# Project Cost Management Processes

**Purpose:** Use this job aid to review the three Project Cost Management processes.

| **Project Cost Management processes** | | | | |
| --- | --- | --- | --- | --- |
| **Project Cost Management** | | **Definition** | | |
| Estimate Costs | | The process of estimating the resource costs of completing each project activity. These include the costs of required human resources and of physical resources like raw materials and equipment. | | |
| Determine Budget | | The process of adding the estimated costs of individual activities or work packages to establish a cost performance baseline. | | |
| Control Costs | | The process of controlling costs by taking corrective action to alter cost performance and, where necessary, revising the cost performance baseline. | | |
| **Process inputs, tools and techniques, and outputs** | | | | |
|  | **Estimate Costs** | | **Determine Budget** | **Control Costs** |
| **Inputs** | Scope baseline  Project schedule  Human resource plan  Risk register  Enterprise environmental factors  Organizational process assets | | Activity cost estimates  Basis of estimates  Scope baseline  Project schedule  Resource calendars  Contracts  Organizational process assets | Project management plan  Project funding requirements  Work performance information  Organizational process assets |
| **Tools and techniques** | Analogous estimating  Parametric estimating  Bottom-up estimating  Reserve analysis  Cost of quality  Project management estimating software  Vendor bid analysis  Expert judgment  Three-point estimates | | Cost aggregation  Reserve analysis  Expert judgment  Historical relationships  Funding limit reconciliations | Earned value management  Forecasting  To-complete performance index (TCPI)  Performance reviews  Variance analysis  Project management software |
| **Outputs** | Activity cost estimates  Basis of estimates  Project document updates | | Cost performance baseline  Project funding requirements  Project document updates | Work performance measurements  Budget forecasts  Organizational process assets updates  Change requests  Project management plan updates  Project document updates |

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# Learning Aid

# Office Refurbishing Cost Baseline

**Purpose:** Use this learning aid to answer the test question on cost baselines.

The CEO of an accounting firm would like to refurbish the firm's offices to make them more comfortable and appealing for visiting clients. The project will involve redecorating the offices and rewiring the lighting. The project manager has developed a cost baseline and has set contingency reserves at 5%.

| **Office refurbishing cost baseline** | | | | |
| --- | --- | --- | --- | --- |
| **Work package** | **Due date** | **Cost** | **Reserves** | **Total** |
| Repaint the office walls | Oct 8 | $1,000 | $50 | $1,050 |
| Purchase office furniture | Oct 10 | $2,500 | $125 | $2,625 |
| **Interior decorating complete** | **Oct 12** | **$3,000** | **$150** | **$3,150** |
| Purchase new lighting fixtures | Oct 10 | $3,000 | $150 | $3,150 |
| Install new lighting | Oct 15 | $1,500 | $75 | $1,575 |
| **Light rewiring complete** | **Oct 25** | **$4,000** | **$200** | **$4,200** |
| **Total cost** |  | **$7,000** | **$350** | **$7,350** |

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**Topic:** Establishing a Cost Baseline

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# Learning Aid

# Hospital Management System Cost Baseline

**Purpose:** Use this learning aid to answer the test question on a cost baseline.

The hospital management system project will include an analysis of requirements, system design, and implementation. The project manager has set contingency reserves at 5%.

| **Hospital management system cost baseline** | | | |
| --- | --- | --- | --- |
| **Work package** | **Cost** | **Reserves** | **Total** |
| Ideation document | $3,000 | $150 | $3,150 |
| Functional requirements document | $3,000 | $150 | $3,150 |
| Technical specifications document | $3,000 | $150 | $3,150 |
| **Documentation complete** | **$9,000** | **$450** | **$9,450** |
| Quality assurance test plans | $3,000 | $150 | $3,150 |
| Development | $250,000 | $12,500 | $262,500 |
| Quality assurance runs test plans | $18,000 | $900 | $18,900 |
| **Development and testing of software complete** | **$271,000** | **$13,550** | **$284,550** |
| **Deployment and maintenance complete** | **$188,000** | **$9,400** | **$197,400** |
| **Total cost** | **$468,000** | **$23,400** | **$491,400** |

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# Learning Aid

# Forge Installation Cost Baseline

**Purpose:** Use this learning aid to get an example of a correctly established cost baseline.

A metalworks company is installing a new hydraulic drop forge. The project has a total budget of $108,000, and the project manager has set contingency reserves at 5%.

| **Forge installation cost baseline** | | | | |
| --- | --- | --- | --- | --- |
| **Work package** | **Due date** | **Cost** | **Contingency reserves** | **Total** |
| Request bids from contractors | Jan 7 | $8,000 | $400 | $8,400 |
| Complete contract | Jan 10 | $5,000 | $250 | $5,250 |
| **Contract complete** | **Jan 10** | **$13,000** | **$650** | **$13,650** |
| Design architectural modifications | Jan 12 | $3,000 | $150 | $3,150 |
| Modify building | Jan 17 | $7,000 | $350 | $7,350 |
| **Building modifications complete** | **Jan 17** | **$10,000** | **$500** | **$10,500** |
| Provide electrical source | Jan 20 | $21,000 | $1,050 | $22,050 |
| Increase compressor capacity | Jan 20 | $10,000 | $500 | $10,500 |
| Install new pressure controller | Jan 27 | $44,000 | $2,200 | $46,200 |
| Install forge | Feb 7 | $10,000 | $500 | $10,500 |
| **Equipment complete** | **Feb 7** | **$85,000** | **$4,250** | **$89,250** |
| **Total cost** |  | **$108,000** | **$5,400** | **$113,400** |

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# Learning Aid

# Medical Products Company Relocation Cost Baseline

**Purpose:** Use this learning aid to answer the practice question about the cost baseline.

The project involves moving a production line that manufactures adhesive bandages. The project manager has drawn up a cost baseline for the project, and has set contingency reserves at 5%.

| **Medical products company relocation cost baseline** | | | | |
| --- | --- | --- | --- | --- |
| **Work package** | **Due date** | **Cost** | **Contingency reserves** | **Total** |
| Packing the machinery | Jan 10 | $210,000 | $10,500 | $220,500 |
| Shipping and receiving machinery | Feb 15 | $78,000 | $3,900 | $81,900 |
| Setting up machinery and equipment | Jul 6 | $112,000 | $5,600 | $117,600 |
| Installing enterprise software | Aug 16 | $43,200 | $2,160 | $45,360 |
| Testing machinery and equipment | Sept 1 | $27,040 | $1,352 | $28,392 |
| **Machinery and facility complete** | **Sept 1** | **$470,240** | **$23,512** | **$493,752** |
| Translating operating procedures | Sept 6 | $24,600 | $1,230 | $25,830 |
| Training staff | Oct 1 | $92,810 | $4,640.50 | $97,450.50 |
| **Translation and training complete** | **Oct 1** | **$92,810** | **$5,870.50** | **$123,280.50** |
| **Total cost** |  |  |  |  |

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# Learning Aid

# Cosmetics Company Cost Baseline

**Purpose:** Use this learning aid to answer the practice question about an example of a cost baseline.

The remote access project will involve purchasing 200 laptops, setting up Internet service provider accounts for each of the agents, installing a virtual private network (VPN) server at the company's headquarters, and training the sales agents to use the new system. The project manager has drawn up a cost baseline for the project, and has set contingency reserves at 5%.

| **Cosmetics company cost baseline** | | | | |
| --- | --- | --- | --- | --- |
| **Work package** | **Due date** | **Cost** | **Contingency reserves** | **Total** |
| Laptop acquisition | Feb 25 | $450,000 | $22,500 | $472,500 |
| Laptop configuration | Feb 25 | $67,000 | $3,350 | $70,350 |
| **Complete** | **Feb 25** |  |  |  |
| Redesigning internal software | Jan 20 | $48,000 | $2,400 | $50,400 |
| Acquisitions and infrastructure upgrades | Jan 20 | $134,000 | $6,700 | $140,700 |
| Installing and configuring VPN server | Jan 20 | $35,000 | $1,750 | $36,750 |
| **Complete** | **Jan 20** |  |  |  |
| Testing laptops, servers, and connections | Apr 1 | $10,000 | $500 | $10,500 |
| **Complete** | **Apr 1** |  |  |  |
| Training program | May 15 | $25,000 | $1,250 | $26,250 |
| **Complete** | **May 15** |  |  |  |

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# Learning Aid

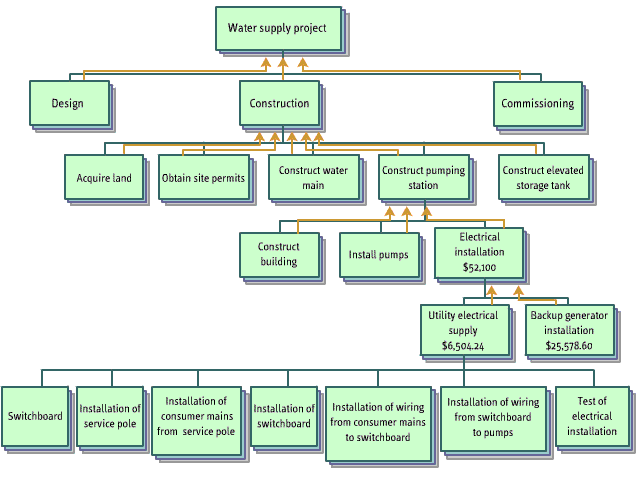
# Estimates for a Water Supply Construction Project

**Purpose:** Use this learning aid to answer the test questions about bottom-up estimates.

The WBS for the water supply project has been subdivided into three phases – design, construction, and commissioning.

The construction phase has been further decomposed into five deliverables: acquire land for $250,000; obtain site permits, which will cost $28,000; construct the water main for $3,727,600; construct a pumping station for $402,500; and construct an elevated storage tank for $8,600,000.

The construct a pumping station deliverable will include constructing a building for $230,000, installing the pumps for $120,400, and installing electricals for $52,100. The electrical installation is further divided into the two sub-tasks of setting up the utility electrical supply and installing the backup generator, which are listed as costing $6,504.24 and $25,578.60 respectively.



WBS

The table summarizes the bottom-up cost estimates for each component in the WBS.

| **Activity costs for the Utility electrical supply work package** | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Resource** | **Duration** | **Total hours** | **Cost/ hour** | **Total labor** | **Material** | **Task cost estimate** |
| **Manufacture, supply, and delivery of switch board** | no resources |  |  |  |  | $1,200.00 | $1,200.00 |
| **Installation of service pole** | 2 electricians | 1 day | 16 | $12.80 | $204.80 | $460.00 | $664.80 |
| **Installation of consumer mains from service pole** | 2 electricians | 1 day | 16 | $12.80 | $204.80 | $620.00 | $824.80 |
| **Installation of switchboard** | 2 electricians | 2 days | 32 | $12.80 | $409.60 | $60.00 | $469.60 |
| **Installation of wiring from consumer mains to switchboard** | 2 electricians | 1 day | 16 | $12.80 | $204.80 | $620.00 | $824.80 |
| **Installation of wiring from switch board to pumps** | 2 electricians | 2 days | 32 | $12.80 | $409.60 | $1,260.00 | $1,669.60 |
| **Test of electrical installation** | 2 electricians | 1 day | 16 | $12.80 | $204.80 |  | $204.80 |
| **Subtotals** |  |  |  |  | **$1,638.40** | **$4,220.00** | **$5,858.40** |
| **Contingency reserve** |  |  |  |  |  |  | $585.84 |
| **Quality** |  |  |  |  |  |  | $60.00 |
|  |  |  |  |  |  |  |  |
| **Total** |  |  |  |  |  |  | **$6,504.24** |

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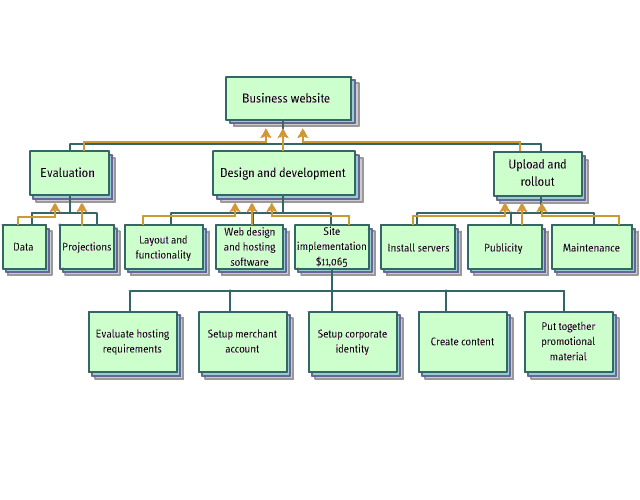
# Learning Aid

# Estimates for a Business Web Site Project

**Purpose:** Use this learning aid to answer the test questions about bottom-up estimates.

The WBS for the business web site has been divided into the three phases: evaluation of market, design and development, and upload and rollout.

The evaluation of the market will be decomposed into two deliverables data and projections derived from collected data. These deliverables are going to cost $3,500 and $1,380, respectively. Design and development for the web site will mean achieving three deliverables. The first deliverable is creating the layout and functionality for the web site, which will cost $4,050. Web design and hosting software will need to be purchased, and this will cost $11,000. Once the layout has been developed and the software has been purchased, the last deliverable, site implementation, must be finished and will cost $11,065. The upload and rollout phase will consist of installing the servers to host the site, which will cost $8,000; a publicity campaign for the site costing $35,200; and maintenance of the site, which is estimated to cost $10,000 for the next year.



WBS

The table summarizes the bottom-up cost estimates for each of the components in the WBS.

| **Activity costs for the Site implementation work package** | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Resource** | **Duration** | **Total hours** | **Cost/ hour** | **Total labor** | **Material** | **Task cost estimate** |
| **Evaluate hosting requirements** | 1 web designer | 1 day | 5 | $85 | $425 | $0 | $425 |
| **Setup merchant account** | 1 web designer | 1 day | 9 | $85 | $765 | $0 | $765 |
| **Setup corporate identity** | 1 senior web designer | 1 day | 9 | $90 | $810 | $0 | $810 |
| **Create content** | 2 web designers | 3 days | 48 | $85 | $4,080 | $0 | $4,080 |
| **Put together promotional material** | 2 web designers | 3 day | 45 | $85 | $3,825 | $500 | $3,825 |
| **Subtotals** |  |  |  |  | **$9,905** | **$0** | **$9,905** |
| **Contingency reserve** |  |  |  |  |  |  | $1,000 |
| **Quality** |  |  |  |  |  |  | $160 |
|  |  |  |  |  |  |  |  |
| **Total** |  |  |  |  |  |  | **$11,065** |

**Course:** Estimating and Budgeting Project Costs  
**Topic:** Reviewing Bottom-up Estimates

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Controlling Costs

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# SkillBrief

# Using the Earned Value Management Technique

Establishing the budget for a project is a vital process in project management, but it means nothing if the budget is not adhered to. Controlling costs is a critical part of any project. It can mean the difference between project success and failure. Controlling project costs effectively takes more than just tracking actual costs. It also involves knowing what the project has earned so far in terms of scheduled work that has been completed, and what it should have earned.

Earned value management (EVM) is a useful technique for measuring a project's performance in terms of its cost and schedule. It involves using formulas to combine objective measurements of project performance into one integrated system. You can use this system to monitor and control performance for the duration of a project.

To understand EVM and how it fits into controlling project costs, it's worth remembering that costs and the schedule are closely related.

Project costs are essentially the costs of completing scheduled activities. So work that's completed or that still has to be done can be viewed in terms of its monetary value. As a result, EVM involves looking at

* **schedule performance** – refers to how well a project is sticking to the planned schedule.
* **cost performance –** refers to how efficiently funds are being used to complete the work outlined in the project schedule. It's measured against the project's cost performance baseline.

The principles of EVM aren't exclusive to specific types of projects. They can be applied to any project, in any industry. You can use EVM to monitor and control performance at any point in a project – not just at its completion. You can also use EVM to make estimations about future performance, based on how a project has performed so far.

### Cost and value formulas

EVM involves measuring and monitoring three key performance dimensions for each work package and control account. These key dimensions are

* **planned value (PV) –** the amount of the budget allocated to work you planned to be complete by a specific date. Another way of saying this is that it's the total budget for the project – known as the budget at completion (BAC) – multiplied by the quotient of schedule time spent so far and the total time in the project schedule, or BAC × (time passed ÷ total schedule time).
* **earned value (EV)** – the actual value of work completed so far, based on the budgeted funds assigned to that work. You can think of it as the total budget at completion multiplied by the ratio between actual work completed and the total work required, or BAC × (work completed ÷ total work required).
* **actual cost (AC)** – the total cost actually incurred up to a specific time.

### Variance and performance indicators

Once you've calculated the planned value, earned value, and actual costs for a project, you can determine exactly where the project stands in relation to its cost baseline and planned schedule. Any departure from these is known as variance.

There are two measures of variance:

* **schedule variance (SV)** – the difference between what a project has actually earned by a specified date and what the planned schedule and budget say it should have earned, or EV - PV. A positive SV value tells you that a project is ahead of schedule. A negative value shows the project has earned less than planned, and so is behind schedule.
* **cost variance (CV)** – the difference between what a project has earned to date and what it has cost, or EV - AC. This tells you how well the project is performing in terms of costs. A negative CV shows that the project has earned less than has been spent. A positive value means the project's cost performance is better than expected – for each dollar of value earned, less than a dollar was spent.

You can convert SV and CV values into performance indicators. These are measures of performance, which can sometimes be more meaningful than specific dollar values. You can compare them against the indicators for other projects, or compare them at different project stages.

### Measuring project performance

There are two indexes that are used to measure a project's performance:

* **schedule performance index (SPI)** – the quotient of earned value and planned value, or EV ÷ PV. In other words, it indicates how the value of performed work compares to the value of planned work. An SPI value greater than one tells you that a project is ahead of its planned schedule. A value less than one indicates poor performance.
* **cost performance index (CPI)** – the quotient of the EV and the AC, or EV ÷ AC. This is a critical EVM metric because it tells you how a project is really performing in terms of costs. A CPI value higher than one indicates that a project is earning more than is being spent. A value lower than one indicates a cost overrun.

Bear in mind that performing behind schedule on a project doesn't necessarily mean that the project is performing poorly in terms of costs as well. A project might run behind schedule, but actual costs for the completed work might still be at or below those planned. Likewise, a project can be on or even ahead of schedule but still be over budget.

The three key dimensions you determine for each work package and control account to calculate earned value management (EVM) are planned value(PV), earned value(EV), and actual cost (AC).

You use these values to calculate both schedule variance and cost variance from the approved baseline.

The schedule and cost variance values can be converted into performance indicators that reflect project cost and schedule performance. These indicators are the schedule performance (SPI) and the cost performance index (CPI).

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**Topic:** Earned Value Management

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# SkillBrief

# Forecasting Performance

Not only can projects be monitored as time progresses, you can control costs by making estimations about your project's future performance. So projects rely on forecasting as a technique for controlling costs.

Forecasting enables you to estimate what the total cost of completing a project will be, based on its performance so far. This value is known as the project's estimate at completion (EAC). So forecasting helps project managers calculate more accurate estimates of costs for activities that have not yet been completed, based on current work performance and cost information.

In any project, the budget at completion (BAC) will typically differ from the EAC.

The BAC is the total planned cost for the project. In other words, it's the total approved budget for completing all scheduled activities. The project manager should develop a forecasted EAC, if the BAC changes during the execution of the project.

The EAC is an estimate of how much it will cost to complete a project, revised based on the project's performance to date. Typically, the EAC includes the actual costs incurred for work completed, plus an estimate to complete (ETC) for the remaining work. The ETC is an informed estimation about what the remaining work on a project will cost to complete.

It's important to determine a project's EAC because this gives you a more realistic idea of future project performance than the BAC. The EAC can help you identify areas where tighter cost control might be necessary, based on how you know a project is likely to perform instead of on how you planned it should perform at the outset.

## Calculating EAC

There are a number of ways you can calculate the EAC.

#### Using bottom-up EAC

The most common and detailed EAC forecasting approach is the bottom-up EAC. This involves a manual bottom-up summation of estimated costs by the project manager.

To calculate a bottom-up EAC, you start by recording the actual costs incurred so far for work packages in the work breakdown structure. Based on what you know about costs, you then estimate the costs of work packages still to be completed. Finally, you aggregate the known and estimated costs at each higher level, up to a total for the project.

So the bottom-up EAC for a project is the sum of actual costs incurred so far, plus the project manager's bottom-up ETC – the estimated costs of the work packages still to be completed.

A bottom-up EAC is useful because it gives you a way to track and report likely costs for each level in the work breakdown structure, rather than only for the project as a whole.

A disadvantage of the bottom-up EAC method is that project work has to stop temporarily for you to calculate it – or the values you're working with will continue to change. Because it's time-consuming, this method can also be expensive.

There are three ways to calculate the EAC that don't depend on bottom-up estimates. These involve estimating the costs of future work, or the ETC, based on the budgeted value of this work, on the project's cost performance index (CPI) to date, or on both its CPI and schedule performance index (SPI).

#### Using budgeted value

To calculate the EAC, you can choose to assume that costs for remaining work will stay exactly as they were planned. This is appropriate if you know cost variance is unlikely for the remainder of a project.

In this case, you add the AC incurred so far to the BAC, and then subtract the EV, or AC + BAC - EV. This has the effect of canceling out any costs for which the project has already earned back an equivalent value. If the project has earned one dollar for each dollar spent, for example, this will leave only the BAC.

#### Using the CPI

If you expect a project to continue having the same cost performance as it has shown to date, you can calculate the EAC based on its cumulative CPI – the average of the project's CPI values to date. To do this, you divide the project's BAC by its cumulative CPI, or BAC ÷ cumulative CPI.

If project costs so far were exactly in line with the cost baseline, the CPI would be a value of 1 – so the EAC is the same as the project's BAC.

#### Using the CPI and SPI

You can calculate an EAC based on a project's cumulative cost and schedule performance. This method is most useful when the project schedule is a factor likely to impact the ETC. To calculate this type of EAC, you first subtract the EV from the BAC. You divide this value by the product of the project's cumulative CPI and its cumulative SPI. The cumulative SPI value is the average of the project SPIs to date. Finally, you add the result to the AC incurred so far.

The formula is AC + [(BAC – EV) ÷ (cumulative CPI × cumulative SPI)].

Depending on what information is available and what the project team wants to explore, any of these EAC methods can be used to provide the team with early warning signals that costs may exceed acceptable tolerances.

It can also be useful to compare each of the three EAC values, each of which accounts for a different risk scenario, to a project's bottom-up EAC.

Project managers rely on forecasting techniques so they can control costs by making estimations about their projects' future performance.

The most detailed and commonly used forecasting method is the bottom-up estimate at completion (EAC). This is the forecasted total cost of a project, based on costs so far and on individual estimates to complete (ETC) for remaining work packages.

You can also calculate an EAC based on the assumption that future work will cost exactly the amount budgeted for this work, that the project's cost performance to date will remain the same, or that both its schedule and cost performance will remain unchanged.

**Course:** Controlling Costs  
**Topic:** Forecasting

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# SkillBrief

# TCPI and Performance Reviews

In addition to earned value management and forecasting, there are three other tools you can use to monitor and control cost performance. These are the to-complete performance index (TCPI), performance reviews, and project management software.

### TCPI

The TCPI indicates what cost performance has to be achieved on remaining work if a project is to meet a financial goal.

So whereas the cost performance index (CPI) represents performance on work already done, the TCPI represents the performance that's needed on work still coming. If the TCPI is greater than the CPI, it means an improvement in cost performance is required.

The TCPI for a project is calculated in relation to one of two financial goals. These are the budget at completion (BAC) or the estimate at completion (EAC).

#### BAC

The BAC is the original, authorized project budget. It's the first prerogative of any project to stay within this budget. So especially early on in a project, it's this value on which you base the TCPI. In other words, the TCPI will show what cost performance must be achieved for a project to complete within the planned BAC.

#### EAC

As work proceeds, it may become clear that a project can't achieve the goal of staying within the authorized BAC. The project manager then provides a new forecast of the funds required to complete the project, known as the EAC. Once it's authorized, the EAC becomes the new measure against which cost performance is tracked. You then calculate the TCPI as performance required for the project to finish within the EAC amount.

Remember that you calculate CPI as earned value divided by the actual cost of project work so far – or EV ÷ AC. The formula for calculating TCPI also uses EV divided by AC, except it subtracts each of these values from either the BAC or the EAC.

TCPI = (BAC - EV) ÷ (BAC - AC)

To calculate the cost performance needed for a project to finish within the BAC, you first subtract the EV from the BAC. Then you divide this value by the BAC minus the AC incurred for work done so far.

TCPI = (BAC - EV) ÷ (EAC - AC)

A result greater than one indicates that future cost performance needs to be greater than planned, whereas a figure less than one indicates that it may be less than planned.

To base the TCPI on the EAC, you use a similar formula to the one for basing it on the BAC. However, you subtract the AC incurred for work done so far from the EAC, instead of from the BAC.

### Project management software

You can use project management software to help you control costs. Project managers use this specifically designed software to monitor earned value management (EVM) analyze trends graphically, and forecast a range of possible project results.

### Performance reviews

Another important tool used to monitor and control cost performance is performance reviews.

During performance reviews, project managers analyze work performance information in order to evaluate the overall cost performance of their projects. Performance reviews look at various indicators of project performance, including cost performance over time, scheduled activities that are running over or under budget, and estimated funds needed to complete work in progress.

Reviews produce information about

* **variance analysis** – as used in EVM – involves comparing actual project performance to planned performance. The most frequently analyzed variances are cost and schedule variances. However, variance analysis does not integrate the two as you're simply comparing their values. Also, the cause of the variance must be ascertained, as well as its impact, and any subsequent possible solutions. Solutions are chosen depending on the impact. Remember that variance analysis can be used as a stand-alone tool as well.
* **trend analysis** – involves examining project performance over time to determine whether performance is improving or deteriorating. Graphical analysis techniques are valuable for understanding performance to date and for comparison to future performance goals.
* **EVM** – incorporates project scope, cost, and schedule measures to help the project management team objectively measure project performance and progress. It involves comparing actual schedule and cost performance to the actual project baseline plans.

In addition to earned value management (EVM) and forecasting, three other tools are used in the Control Costs process – the to-complete performance index (TCPI), performance reviews, and project management software.

The TCPI identifies the cost performance a project must have for it to be completed within either the planned budget at completion (BAC) or an estimate at completion (EAC).

Performance reviews provide information to assess project cost and schedule performance. They provide information about variance analysis, trend analysis, and earned value performance.

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**Topic:** TCPI and Performance Reviews

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# SkillBrief

# Control Costs Process Inputs

### Overview

Throughout a project, you need to be aware of how much money is being spent. You also have to know whether spending aligns to the project budget and cost baseline. Projects, like life, can be unpredictable. Things can change fast – like materials, resources, or scope. Each change can affect project costs. When you don't know about a change, you can't control the effects it will have on costs. That can mean major problems, such as schedule changes, compromises on quality, and cost overruns.

To stay on top of these risks, you need to keep tight control over project costs. You do this using the Control Costs process.

This process is the third and final aspect of Project Cost Management, and covers two major areas:

* managing the actual costs of a project
* managing changes to the cost performance baseline

The Control Costs process isn't just a statistical exercise. It accounts for the value of the actual work done to date in a project, and analyzes spending from that perspective.

These are some of the tasks in the Cost Control process:

* monitoring actual work performed against its cost
* analyzing discrepancies between cost performance and the approved cost baseline
* managing change requests and implementing approved changes
* influencing factors that affect actual costs to bring costs back in line with the approved cost baseline
* communicating approved changes and cost implications to the relevant stakeholders
* keeping project spending within the authorized limits, both within defined periods and for the project as a whole

### Inputs

There are four inputs to the Control Costs process.

#### Project management plan

The project management plan contains two sections that help control costs. The cost performance baseline is a time-phased estimate of all project costs. It identifies the costs of all activities and when these costs are scheduled to be incurred over a project's life. The cost performance baseline includes contingency reserves, which allow for actual costs to exceed estimated costs by specified margins, to account for unanticipated expenses.

The cost management plan describes how the project costs will be managed and controlled.

#### Project funding requirements

Project funding requirements are the total estimated project costs, as established in the cost baseline, as well as established management contingency reserves. Management contingency reserves are the difference between the maximum funding and the end of the cost baseline.

The project funding requirements are the total funds required for the project at each phase.

#### Work performance information

Work performance information describes the status and costs of current and completed project activities. It includes the costs of finished and unfinished deliverables, estimates of when schedule activities will complete, and analyses of work progress. Common formats for this information include bar charts, S-curves, histograms, tables, and project schedule network diagrams.

#### Organizational process assets

Organizational process assets are policies, guidelines, and procedures of the organization. Types of these assets that can affect the Control Costs process include the organization's monitoring and reporting methods, policies related to cost control, and cost control tools.

Examples of organizational process assets the project manager will need to use during the Control Costs process include

* the sponsor organization's policies in relation to cost control
* the organization's established format for project cost performance reports
* the organization's cost control tools

You use the cost performance baseline as a basis for comparison. As project work is completed, actual cost performance is measured against the performance planned in the baseline.

Using the cost performance baseline allows the project manager to determine when actions may be needed to bring actual and planned costs back in line.

Project funding requirements are another input against which the project manager compares and controls costs. They are funds that the project manager needs to have available at different times throughout the project in order to finance the work.

Work performance information provides the basic information needed to give substance to the conclusions that are drawn from statistics. By telling you what work has been completed for the amount spent to date, it helps you see the value of the work done so far.

The Control Costs process involves monitoring and managing actual project costs to keep them in line with planned costs and funding limits. Where necessary, it also involves managing changes to the cost performance baseline.

Inputs to the Control Costs process include the project management plan, project funding requirements, work performance information, and organizational process assets.

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**Topic:** Inputs to the Control Costs Process

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# SkillBrief

# Tools and Techniques of the Control Costs Process

Keeping project costs under control isn't an easy task. That's where the tools and techniques for the Control Costs process come in. They're what let you convert basic project data into meaningful information about how a project is performing, so you can take appropriate action when necessary.

#### Earned value management (EVM)

EVM is a technique for determining how a project is performing, in terms of project scope, costs, and schedule. As well as comparing actual to planned costs and dates, it involves comparing what a project has earned so far – based on the work completed – to what it should have earned.

Say you know exactly what has been spent so far on a project, as well as the total funds available for completing it. This still doesn't tell you enough about how the project is doing. To make sense of costs, you also have to know what the project has achieved in return for what was spent, and if it's on track in terms of the schedule.

EVM is a technique for measuring performance that takes all these things into consideration. These are the factors earned value management takes into account:

* the value of work scheduled to have been completed so far
* the value of work actually completed so far
* actual project costs up to the present
* the variances between planned and actual costs, and between planned and actual schedule dates

If a project is behind or ahead of schedule, it means less or more work than planned has been done. This affects how much of the planned budget should have been spent so far.

#### Variance analysis

This involves identifying differences between actual and budgeted cost performance. It also focuses on identifying the causes of these variances. You can use variance analysis to assess performance in terms of the planned scope and project schedule, as well as costs.

Variance analysis is carried out after work has been done, and can be performed at any stage of the project – such as after each project phase.

The methods used in variance analysis can differ between projects and industries, but certain tasks are common to most projects.

To control costs, it's also essential to know how much funding is available to complete a project – and how much funding the project has used. While early estimates do give an idea of how much a project will cost, it's only once a project is underway that more accurate estimates can be ascertained. This is where the forecasting technique comes in.

#### Forecasting

Forecasting involves estimating future project costs, based on what you know so far. An important aspect of this is determining the EAC. This is an estimate of the total cost to complete the project, based on what it has cost so far and on a forecast of what remaining work will cost.

The EAC is updated and reissued as the project progresses.

#### To-complete performance index (TCPI)

Another useful tool for assessing and controlling costs is the TCPI. This is a measure you calculate based on what you've forecast a project will cost.

TCPI is the calculated cost performance that must be achieved on remaining work if the project is to meet a financial goal set by management, such as the initial budget at completion (BAC) or a subsequent estimate at completion (EAC).

Management can use the TCPI to decide whether to revise the estimate at completion so that the project can be completed.

#### Performance reviews

During performance reviews, the project team reports on the project status and progress. Performance is assessed in terms of costs, schedule, technical performance, and risks.

These reviews give you the raw information about performance that you use in techniques like trend analysis, earned value management, and variance analysis.

#### Project management software

The software includes applications specifically designed to help in planning, monitoring, and controlling project performance, including cost performance.

You can use project management software in tasks such as cost estimating, scheduling, communications, and collaboration. It can also be used for configuration management, document control, records management, and risk analysis.

This kind of software is very useful in identifying performance trends and can be used in estimation techniques such as the EVM.

Using project management software, the project manager can input a number of basic variables, and the software will automatically monitor EVM dimensions, and display graphical trends and forecasts based on those inputs.

Although project management software is very useful, it can only be effective if the data you put into it is accurate. If there is faulty data entered to begin with, the information will not be accurate and you'll have no other point of reference to help you identify this inaccuracy.

Tools and techniques for the Control Costs process include earned value management (EVM), forecasting, the to-complete performance index (TCPI), performance reviews, variance analysis, and project management software.

These enable you to convert data about project costs and the schedule into meaningful information about its cost performance, and to take corrective action where necessary.

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**Topic:** Tools and Techniques Used to Control Project Costs

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# Outputs of the Control Costs process

Once you've determined how a project is performing in terms of costs, you need to act on this information. This is where the outputs of the Control Costs process come in.

The Control Costs process has six main outputs.

### Work performance measurements

Work performance measurements include your calculations of cost and schedule performance for each of the work packages and control accounts in the work breakdown structure. These calculations show how project activities are actually progressing in relation to the planned budget and schedule.

Examples of work performance measurements are cost variance, schedule variance, the cost performance index, and the schedule performance index.

#### Cost variance

A negative cost variance value means costs are higher than budgeted. This may indicate a need for corrective action.

A positive cost variance means costs are lower than budgeted. This may enable you to absorb higher than anticipated costs for later project activities, or it may mean a project will finish below budget.

#### Schedule variance

A negative schedule variance means project work is behind schedule, whereas a positive value means the project is ahead of schedule.

#### Cost performance index (CPI)

A cost performance index with a value of less than 1.0 indicates a cost overrun for work completed.

A value greater than 1.0 indicates that the project is performing better than anticipated in terms of costs. In other words, it's costing less than a dollar to complete every dollar's worth of work.

#### Schedule performance index (SPI)

A schedule performance index of less than 1.0 means that less work than planned has been completed. So corrective action may be necessary.

A value greater than 1.0 means the project is ahead of schedule.

Stakeholders need to know if project work is proceeding according to plan. So work performance measurements feed into the Report Performance process, which you use to ensure stakeholders are kept informed.

### Budget forecasts

It's also important to share details of the estimate at completion with stakeholders, so they know where a project is headed in terms of costs. This is known as the project's budget forecasts. Like work performance measurements, budget forecasts are an input to the Report Performance process.

If the budget forecast for a project is substantially higher than its approved budget at completion, it will alert you – and stakeholders – to a potential problem.

### Change requests

Changes to the cost performance baseline or other components of the project management plan should be processed through the project's integrated change control system. So the change requests become an input to the Perform Integrated Change Control process, through which they'll be approved or denied.

An additional three outputs of the Control Costs process involve updates to organizational process assets, the project management plan, and project documents.

### Organizational process assets updates

You need to update the organizational process assets because the knowledge you gain through the Control Costs process should be added to the lessons learned database. For example, you should document the root causes of significant variances, what corrective action was taken to address them, and the outcomes. This is useful information to feed back into the organization for future projects. If cost control measures result in changes to policies, procedures, or guidelines, these organizational process assets must also be updated.

### Project management plan updates

The project management plan includes the cost performance baseline and a cost management plan. These must be updated if approved changes are made to the budget or the procedures for managing costs. In addition, these changes could impact other areas of the project, like its schedule or the required resources. Updates to other affected parts of the plan are then needed. A dramatic change to the costs of a project could result – or be caused by – a change in the project's scope. This is unusual but could make it necessary to draft a completely revised cost baseline.

### Project documents updates

As you continue monitoring and controlling costs, new information about costs is likely to emerge. This can enable you to make more accurate estimates of how much remaining work will cost. So examples of project documents you may need to update are cost estimates and the basis for these estimates. In projects with several phases, it's sometimes useful to plan for systematic revisions of cost estimates to happen after each phase ends.

The Control Costs process has six main outputs. These are work performance measurements, budget forecasts, change requests, and updates to organizational process assets, the project management plan, and other project documents.

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# SkillBrief

# Revising the Cost Performance Baseline

Sometimes, the Control Costs process will reveal cost variances so severe that a revised cost baseline is required. If actual costs have departed too far from the original baseline, it's no longer useful or realistic to compare costs against it.

This means an update to the project management plan. And it means the project manager must consider strategies to deal with the impact of the change on project objectives.

Changing the cost performance baseline isn't something you do lightly. It's like moving the yardstick for project costs. This has a ripple effect on other areas of the project. For example, it affects what the project can be expected to achieve, given a finite amount of funding. It can also mean having to change the sequence of project activities and the resources that the project will use.

Before you decide to revise the cost performance baseline, it's important to exhaust possible corrective actions for bringing costs back in line with the original baseline. If a change is still necessary, you need to do whatever can be done to minimize the extent of the change.

So when revising a cost baseline, you should consider three factors to help minimize the changes as much as possible:

* project priorities
* the sequencing of project activities
* the use of resources for the project

Dramatic cost variances may make it important to revisit project priorities. If costs are running too high, you need to check the project's scope and determine which activities are absolutely essential so you can prioritize these. It's possible other activities can be left out or deferred to other projects to save costs. In turn, this will reduce the extent of changes you have to make to the cost performance baseline.

It may be possible to reduce costs by changing the planned sequence of activities for a project. This could involve running two or more activities at the same time. This kind of fast-tracking could lower costs.

Another consideration related to changing the cost baseline is how project resources are used. Using less expensive or more efficient resources to get work done could lower costs.

The cost performance baseline for a software development project needs to be revised. Consider examples of how the project manager might use the different factors to minimize changes.

#### Project priorities

After consulting the project scope statement, the project manager chooses to prioritize fixing only bugs that will prevent basic functioning of the software. Fixing other bugs is deferred to a new project to release a second version of the software, later in the year. The manager also determines that a change to the cost performance baseline will enable the scheduling of extra hours for the testing team to work on resolving the bugs that must be addressed.

#### Sequencing of activities

To save time and money on the final software testing, the project manager schedules testing to start on completed modules of the program, before the full program is developed. The manager places milestone checkpoints at different points in the development and testing components of the work breakdown structure to allow this.

#### Use of resources

The project manager chooses to replace three less experienced programmers with one highly qualified programmer. This means the manager will have to allocate more hours for programming, but this will still result in lower costs. It could also reduce the time and money it will take to fix bugs as part of the testing and quality control activities that follow.

Because altering the cost performance baseline can have a major impact on a project, it's vital you communicate with stakeholders about this. They need to know what cost and other implications the changes will have. You should also make it clear exactly why changes to costs are necessary. You need to secure all stakeholders' agreement on the new cost performance baseline you've drafted before you finalize the changes.

If cost variances are severe, it may be necessary to revise the project's cost performance baseline. Before doing this, however, it's important to take all possible steps to minimize the required extent of changes. This involves considering and possibly adjusting project priorities, the sequencing of activities, and the use of resources.

**Course:** Controlling Costs  
**Topic:** Revised Cost Performance Baseline

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# Follow-on Activity

# Calculating EAC Forecast Values

**Purpose:** Use this follow-on activity to calculate estimate at completion (EAC) values for the project that you're currently working on.

**Instructions for use:** To use this tool, and given the data that is available to you, calculate any of the four EAC forecast values. Enter your answer in the designated field.

| **EAC forecasting formulas** | | |
| --- | --- | --- |
| **Name** | **Calculation** | **Answer** |
| Project manager's bottom-up EAC | AC + bottom-up ETC = | Row 2 Column 3 |
| EAC for ETC work performed at the budgeted rate | AC + BAC – EV = | Row 3 Column 3 |
| EAC for ETC work performed at the present CPI | BAC ÷ cumulative CPI = | Row 4 Column 3 |
| EAC for ETC work considering both SPI and CPI factors | AC + [(BAC – EV) ÷ (cumulative CPI × cumulative SPI)] = | Row 5 Column 3 |

****For online use, complete each row as described in the instructions. If you would like to work with the page as hard copy, simply print it out using the Print link at the top of this page.****

actual cost (AC)

budget at completion (BAC)

cost performance index (CPI)

estimate at completion (EAC)

estimate to complete (ETC)

earned value (EV)

schedule performance index (SPI)

Which estimate do you think is the most accurate given the project's past performance and reliability of the estimates to complete outstanding work?

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**Topic:** Forecasting

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# Follow-on Activity

# Tracking Cost Control Outputs

**Purpose:** Use this follow-on activity to identify outputs of the Cost Control process for a project you are working on.

**Instructions for use:** To use this tool, write your project's Cost Control outputs in the text box provided.

| **Control Costs outputs** | |
| --- | --- |
| **Outputs** | **Details** |
| Work performance measurements | Row 2 Column 2 |
| Budget forecasts | Row 3 Column 2 |
| Change requests | Row 4 Column 2 |
| Updates to organizational process assets | Row 5 Column 2 |
| Updates to the project management plan | Row 6 Column 2 |
| Updates to project documents | Row 7 Column 2 |

****For online use, complete each row as described in the instructions. If you would like to work with the page as hard copy, simply print it out using the Print link at the top of this page.****

**Course:** Controlling Costs  
**Topic:** Outputs of Controlling Costs

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# Job Aid

# EVM Values, Formulas, and Definitions

**Purpose:** Use this job aid as a reminder of the values and formulas used during the earned value management (EVM) technique.

| **EVM values, formulas, and definitions** | | |
| --- | --- | --- |
| **Value** | **Formula** | **Definition** |
| Budget at completion (BAC) | None | The total authorized budget for the project. |
| Planned value (PV) | BAC × (time passed ÷ total schedule time) | The budgeted amounts assigned to work scheduled to have been completed. |
| Earned value (EV) | BAC × (work completed ÷ total work required) | The value of completed work, expressed in terms of the budget assigned to that work. |
| Schedule variance (SV) | SV = EV – PV | The difference between the budgeted value a project has earned through completed work and the planned value of this work. This value indicates whether project work is proceeding as planned in the schedule. |
| Cost variance (CV) | CV = EV – AC | The difference between earned value and actual costs, which indicates cost performance. |
| Schedule performance index (SPI) | SPI = EV ÷ PV | The ratio between earned value and planned value, which represents schedule performance. An SPI of one indicates the project is on schedule. A value greater than one indicates it is ahead of schedule, and a value less than one indicates it is behind schedule. |
| Cost performance index (CPI) | CPI = EV ÷ AC | The ratio between earned value and actual costs, which represents cost performance. A CPI value greater than one indicates better performance than expected, whereas a value less than one indicates poor performance. |

**Course:** Controlling Costs   
**Topic:** Earned Value Management

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# Job Aid

# Formulas Used During Forecasting

**Purpose:** Use this job aid as a reminder of the formulas, and when they are used, during the forecasting technique.

| **Forecasting formulas** | |
| --- | --- |
| **Formula** | **When it is used** |
| EAC = AC + bottom-up ETC | When you want to forecast EAC based on the project manager's bottom-up ETC |
| EAC = AC + BAC - EV | When variances are not expected to occur for the remainder of the project, so the costs of future work are estimated to be the same as the budgeted costs |
| EAC = BAC ÷ cumulative CPI | When you want to take the cost performance of a project into account, and assume its current cost performance level won't change for the remainder of the project |
| EAC = AC + [(BAC – EV) ÷ (cumulative CPI × cumulative SPI)] | When you want to take both the schedule and cost performance of the project into account, and the project schedule is a factor likely to impact the ETC. |

actual cost (AC)

budget at completion (BAC)

cost performance index (CPI)

estimate at completion (EAC)

estimate to complete (ETC)

earned value (EV)

schedule performance index (SPI)

**Course:** Controlling Costs   
**Topic:** Forecasting

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Quality assurance and quality control

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# SkillBrief

# Inputs to Perform Quality Assurance

Perform Quality Assurance is one of three processes in the Project Quality Management knowledge area. It's the means by which you go about auditing the quality requirements established during the Plan Quality process and the results from quality control measurements made during the Perform Quality Control process.

The goal of Perform Quality Assurance is to ensure that the performing organization uses appropriate policies and work methods to fulfill the project customers' needs. The Perform Quality Assurance process is often handled by a separate Quality Assurance Department within a company. Even if an entire department isn't required, it's best that the quality assurance team is not actively involved in the work of the project being assessed. This helps ensure the team will be objective.

There are four inputs to the Perform Quality Assurance process.

#### Project management plan

The project management plan contains two subsidiary plans that are used to perform quality assurance. One is the quality management plan which contains a description of how the project management team will implement both quality assurance and quality control for a project. The process improvement plan is the second subsidiary plan. It lays out the criteria for analyzing processes, with a view to enhancing their value to the project.

#### Quality metrics

Quality metrics define how the quality of project attributes and processes will be measured. One example is to express team outputs in terms of percentages. The team performing the quality control process will use these metrics to gauge the degree of success or failure of a process.

#### Work performance information

Work performance information is collected from the project while it is in progress. This – in conjunction with the agreed quality metrics – will be the basis for quantifying actual project performance in terms of quality.

#### Quality control measurements

Quality control measurements are the results obtained from performing quality control activities. During the Perform Quality Assurance process, these results will be used to assess the success of the quality control methods that have been instituted.

The goal of the Perform Quality Assurance process is to ensure that an organization uses appropriate policies and work methods during a project to meet customers' needs. The inputs to the process are the project management plan, quality metrics, work performance information, and quality control measurements.

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**Topic:** Quality Assurance Inputs

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# SkillBrief

# The Outputs of Perform Quality Assurance

The Perform Quality Assurance process ensures that an organization is doing all it should to meet project quality requirements. To this end, it uses the quality management plan – which forms part of the project management plan – to ensure all required quality management activities are performed adequately.

The outputs of the Perform Quality Assurance process document the results of these activities carried out in line with the quality management plan. They also trigger corrective action where necessary.

**Change requests**

Change requests that result from quality assurance activities propose alterations to policies, processes, or procedures. These aim to increase the effectiveness and efficiency of quality-related activities in a project.

Each change request must be submitted using a formal written document, such as a proposal or request form. Change requests are then sent through the project change review process, which is known as the Perform Integrated Change Control process. Changes are not implemented until they are formally approved.

Approved change requests usually prompt either corrective or preventive action. Corrective actions that emerge from the Perform Quality Assurance process are usually recommended as a result of a quality audit or process analysis. They aim to remedy existing problems or inefficiencies in processes, policies, or procedures. Preventive actions are taken to prevent anticipated problems with processes or to counter negative risks associated with a project.

#### Organizational process assets updates

Organizational process assets, such as company policies, processes, and procedures, often need to be revised during the course of the project. For example, a project manager may implement additional or new procedures to increase product quality. This will make it necessary to update the company's procedure manual.

Quality assurance activities often generate revisions to quality standards, which are an important component of organizational process assets.

#### Project management plan updates

As an organization carries out a quality management plan, it sometimes discovers that the plan needs to be modified. This results in changes to the project management plan.

Elements of the project management plan also require updates based on the outcomes of the Perform Quality Assurance process. These include, but are not limited to, updates to

* the quality management plan, when there are changes to the methodology used to attain and maintain required levels of quality
* the schedule management plan, when the previous schedule needs to be modified to accommodate late activities or new activity timing
* the cost management plan, when changes need to be made to cost estimates, expenditure, and cash on hand estimates

#### Project document updates

Project managers often realize that changes need to be made along the way as part of quality assurance. This leads to numerous project document updates.

Quality audits often trigger corrective actions, and quality audit reports must be updated to identify these actions and their effects. Training plans may be updated if project staff require new or altered training because of changes to processes. Similarly, changes to processes themselves must be recorded through updates to the corresponding process documentation, which details what the processes include.

The Perform Quality Assurance process has four outputs – change requests, organizational process assets updates, project management plan updates, and project document updates.

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**Topic:** Quality Assurance Outputs

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# SkillBrief

# Perform Quality Assurance Tools

The Perform Quality Assurance process is part of the Executing process group and the Project Quality Management knowledge area. It makes use of many of the same tools and techniques that are used during the Plan Quality and Perform Quality Control processes.

The Perform Quality Assurance and Plan Quality processes share many tools and techniques. Both examine production-related and project management processes so as to anticipate where quality issues may arise and where processes can be improved. For example, both processes use techniques such as cost of quality, cost-benefit analysis, and design of experiments (DOE). However, these tools and techniques are used to measure project performance rather than to plan quality activities when performing quality assurance.

Perform Quality Assurance and Perform Quality Control processes use some of the same tools and techniques because both are concerned with checking project results and deliverables against quality standards. For example, both processes use control charts to monitor outputs that are variable to compare actual and planned project process to other similar projects. However, the Perform Quality Assurance process uses these tools and techniques to monitor project processes, whereas the Perform Quality Control process uses them to assess project outputs.

#### The audit quality system

All quality assurance activities should be designed to identify missing, ineffective, or inefficient policies, processes, and procedures used in the project. Quality audits are used to address this requirement. These tools are unique to the Perform Quality Assurance process. Quality audits enable project managers to evaluate current project activities to make sure they comply with policies and procedures set out for the project and for the organization as a whole.

Performing quality audits involves three main functions:

* **inspecting work results –** An effective quality assurance system should reduce the cost of creating high-quality project deliverables by continually streamlining and improving processes. Quality audits aim to uncover any policies and procedures that aren't efficient or aren't yielding the results they should. This involves inspecting work results. Audits should also identify any further policies and procedures that are required.
* **checking approved change requests –** Quality audits ensure that approved change requests have been correctly implemented. This involves checking that corrective and preventive actions have been carried out properly. Ultimately, this will result in increased customer satisfaction.
* **ensuring compliance with documentation –** Quality audits compare the project's documentation for processes, procedures, and work instructions with actual evidence of how the project work is being carried out. This documentation may include, for example, sign-off forms, defect logs, and progress reports. Compliance with project documentation ensures that project deliverables are on target and will meet the customer's requirements.

A team of auditors that's independent of the project can be more impartial. Small companies would benefit from bringing in external auditors, whereas large organizations may have their own internal quality assurance teams. There's no right or wrong quality management system or audit process, provided these satisfy quality requirements.

#### Process analysis

Another tool specific to the Perform Quality Assurance process is process analysis. Process analysis aims to identify where improvements can be made to project processes. It uses the steps outlined in the process improvement plan to assess processes and determine strategies for improvement. Using process analysis helps to streamline a project's processes, and produce high-quality deliverables.

A process might need analysis for different reasons:

* the project manager, the project team, or other stakeholders experience problems as they carry out the process
* the process introduces constraints on what the project team can achieve
* the process includes inefficiencies or activities that don't add value to the project

#### Root cause analysis

An important element of process analysis is performing a root cause analysis of any problems that are identified.

Root cause analysis is a technique you use to find the source of a problem and to determine why underlying issues exist. Once you've got to the root of the problem, you can find a solution to deal with it.

Root cause analysis is important because it helps you determine where workflow is constricted and where inefficiencies are present. It should be performed regularly because it helps to fine-tune project processes. In turn, this decreases cycle times and increases the quality of project deliverables.

Root cause analysis involves performing six steps:

1. define the problem
2. gather data to describe the problem
3. determine possible causes
4. select the root cause
5. develop a solution strategy
6. test and evaluate the solution

These are some of the types of causes that a root cause analysis may uncover as being the source of a problem:

* faulty equipment
* lack of training
* redundant or missing procedures
* communications breakdowns
* unrealistic budgets or schedules

The Perform Quality Assurance process uses various tools and techniques, including those used in the Plan Quality and Perform Quality Control processes. Quality audits are unique to the Perform Quality Assurance process. These tools evaluate current project activities to ensure they comply with policies and procedures set out for the project and of the organization as a whole.

Another tool used in Perform Quality Assurance is process analysis, which identifies where improvements can be made to project processes.

One element of process analysis is root cause analysis, which is used to identify the source of a problem and determine why underlying issues exist. A solution for these underlying issues can then be found.

**Course:** Quality Assurance and Quality Control  
**Topic:** Quality Assurance Audits and Analysis

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# SkillBrief

# Perform Quality Control Inputs

In a project, the Perform Quality Control process depends on a variety of inputs. You can categorize the inputs as belonging to one of three groups.

Each input provides information needed to conduct quality reviews, contains the baseline quality standards, or represents actual work results.

### Quality review information

There are four main inputs to determine how quality reviews must be conducted.

#### Quality management plan

The quality management plan, which is contained in the project management plan, describes how quality control activities should be carried out. Typically, a quality management plan makes it clear what quality reviews must occur and what attributes will be checked during these reviews. It also specifies how quality problems must be recorded and may identify deadlines for quality reviews.

#### Quality checklists

Quality checklists guide you through the quality reviews step by step. They help ensure reviewers take a standard approach and don't leave out important steps in the checks they perform.

#### Work performance measurements

Work performance measurements create the performance metrics you'll use when measuring quality. Work performance metrics enable you to evaluate actual project progress in relation to planned progress. They include, but are not limited to, comparisons of planned and actual technical, schedule, and cost performance values.

#### Organizational process assets

Organizational process assets provide you with essential background information, such as company guidelines on how to perform quality reviews. Standard work guidelines, issue and defect reporting procedures, and communication policies are all examples of organizational process assets that can influence the way quality reviews are conducted.

### Baseline quality information

Baseline quality standards are the criteria against which actual work results are measured during quality reviews. In addition, approved change requests can identify new or modified criteria against which quality must be compared.

The inputs that contain the baseline quality standards are

* **quality metrics** – the criteria that will be measured to determine whether project work meets quality standards
* **approved change requests** – approved change requests can lead to new or revised quality criteria for a project

### Work results

Deliverables themselves are an input for the Perform Quality Control process. They represent actual work results, which are measured against quality requirements throughout a project as part of the process.

The input in this category is the project deliverables – the completed products or services the project customer will receive. During the Perform Quality Control process, it's deliverables that represent actual work results. Ultimately, it's the quality of completed products or services that counts. Using all the other inputs for the process, this is what you need to measure and control throughout a project.

The Perform Quality Control process consists of seven inputs, which you can categorize into three groups based on the information they provide.

Inputs that determine how quality reviews must be conducted are the project management plan, quality checklists, work performance measurements, and organizational process assets.

The inputs that provide baseline quality standards are quality metrics and approved change requests.

The final input is project deliverables, which represent actual work results.

**Course:** Quality Assurance and Quality Control  
**Topic:** Information Required for Quality Control

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# SkillBrief

# Perform Quality Control Tools and Techniques

You use specific tools and techniques during the Perform Quality Control process to measure a project's quality performance.

You group these tools and techniques based on the purposes for which they're used, namely data collection, data analysis, and cause and identification analysis.

### Data collection tools

The tools used to collect information required for performing quality control are:

* **inspection** – involves physically observing, measuring, or testing results to verify whether they conform to the required quality standards. It involves gathering data about the output of a single work activity or about a finished product. An inspection is also known as a review, audit, or walkthrough, and is an appropriate technique for any type of project.
* **statistical sampling** – involves using mathematical rules to select a random sample, which represents all the units of a project's output. Data is then collected from the sample. Samples are selected and tested as defined in the project's quality management plan. The sample frequency and sizes must therefore be determined during the Plan Quality process. Statistical sampling is appropriate when the project output includes a batch or lot, and when it's not feasible or won't be effective to examine every instance of the output.
* **approved change requests review –** involves gathering information about approved changes to verify that specified defect repairs, or corrective or preventive actions, were implemented as approved.

### Data analysis tools

Tools used to analyze data during the Perform Quality Control process include the control chart, run chart, and scatter diagram.

#### Control charts

Control charts measure the results of project processes over time and against established control limits. They also indicate whether variances from a known baseline are staying within acceptable limits, known as control limits. If more than a certain number of items continuously fall above or below the middle limit, it could be an indicator that something is wrong. When the results of a process remain randomly distributed within control limits over time, the process is said to be "in control" and does not need to be adjusted.

#### Run charts

Run charts are line graphs that show data points plotted in the order in which they occur. Events, shown on the Y-axis, are graphed against a time period on the X-axis. This information is then used to predict future performance based on past results. Run charts are therefore visual displays of data that enable a project manager to monitor a process by determining whether there is a systematic change in that process over time. Because they can be used to analyze patterns of variation in a process, run charts are used to perform trend analysis. The results of trend analysis can also be used to recommend preventive actions.

#### Scatter diagrams

Scatter diagrams are also a graphical illustration of data. However, scatter diagrams display information about the relationship, or correlation, between two variables in a process. Any correlation is determined by the relationship between independent and dependent variables. The dependent variable is the observed change. The independent variable is always the manipulated variable that invokes a change in the dependent variable.

In a scatter diagram, the independent variable is plotted on the X-axis. The dependant variable is plotted on the Y-axis. The correlation between the two variables is represented by the data points on the graph. This can result in

* **a strong correlation** – exists if the values of an independent variable have a clear and substantial effect on the values of the dependent variable. In a scatter diagram, the closer the plotted points to a diagonal line – running either up from where the axes intersect or down from a high value – the stronger the relationship between the two variables.
* **a weak correlation** – exists where the independent variable has a minor effect on the values of the dependent variable. In a scatter diagram, data points that follow an upward, diagonal line but that aren't close to the line indicate a weak correlation.
* **no correlation** – exists when randomly scattered points on a scatter diagram indicate that there is either no correlation or an insignificant one between the independent and dependent variables.

### Cause identification and analysis tools

In the Perform Quality Control process, these are the four tools and techniques you can use to identify and analyze causes of quality problems:

* **flowcharting** – illustrates the logical sequence of steps, decision points, and handoffs of responsibility in a process. In the Perform Quality Control process, they're used to determine whether any process steps are failing, and where improvements should be made.
* **cause and effect diagrams** – show the relationships between the effects of problems and their causes. They may also illustrate the effect that each proposed solution will have on a problem. Once the possible causes for each factor are identified, the diagram is analyzed by narrowing down the most likely causes and investigating them further.
* **histograms** – are vertical bar charts. You use them in the Perform Quality Control process to help identify and rate the causes of defects. The Y-axis displays the frequency of defects and the X-axis displays the identified causes of the defects. Each column represents an attribute of a problem or situation. The relative frequency of each attribute is represented by the height of each column.
* **Pareto charts** – take the histogram one step further by analyzing potential causes of defects. The causes are arranged by frequency so that you can easily see which causes are creating the greatest numbers of defects. This helps the project team establish priorities in terms of implementing corrective action, so causes resulting in the most defects are addressed first. Cumulative percentages are included on the chart.

The tools and techniques for the Perform Quality Control process can be grouped according to their uses. Inspection, statistical sampling, and approved change requests review are used for data collection. The control chart, run chart, and scatter diagram are used to analyze data. The flowchart, cause and effect diagram, histogram, and Pareto chart are used to identify and analyze causes of defects.

**Course:** Quality Assurance and Quality Control  
**Topic:** Conducting Quality Control Activities

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# SkillBrief

# Perform Quality Control Outputs

The outputs from the Perform Quality Control process document the findings of quality control activities and provide the basis for improvements in work processes. There are outputs resulting from quality inspections and outputs involving document updates.

### Outputs resulting from quality inspections

During quality inspections, actual work results – or deliverables – are checked against baseline quality standards.

Deliverables, quality checklists, and quality metrics are inputs you use to gather data about project quality. Through techniques like inspection and statistical sampling, these inputs are converted into outputs.

#### Quality control measurements

Quality control measurements are the documented measures of how actual project work or deliverables compare to the required quality standards specified during quality planning.

#### Validated changes

Validated changes are created through the careful maintenance and scrutiny of the project management plan, scope statement, and other deliverables. In this way, changes are continuously managed and are either rejected or approved. Validated changes are the result if the processes or deliverables pass inspection – meaning that with the changes, they satisfy quality requirements. Reworking of rejected items that don't pass inspection may be required until results meet project standards.

#### Validated deliverables

Validated deliverables are project results that meet the required quality standards.

#### Change requests

To address quality problems or defects, change requests may recommend alterations to project or product scope. These types of changes can impact the project management plan, project documents, and requirements for deliverables.

Changes to a project may include, but are not limited to

* **corrective actions** – the actions required to bring future performance into conformance with the project management plan
* **preventive actions** – the actions required to reduce the probability of negative consequences associated with project risks
* **defect repair** – the actions required to bring defective deliverables into conformance with requirements

### Outputs involving document updates

The remaining outputs of the Perform Quality Control process involve documentation updates.

#### Completed checklists

During quality inspections, reviewers complete quality checklists to verify that all required steps are performed. The completed checklists become an organizational process asset that is filed for future reference.

#### Lessons learned documentation

The reasoning behind the corrective action chosen, causes of variances, and other types of lessons learned from quality control should be documented so they become part of the historical database for both the project and the performing organization. Lessons learned may be documented throughout the project life cycle. At least, they should be recorded during project closure.

#### Project management plan updates

The quality management plan describes how the project management team will implement the performing organization's quality policy. If during control activities for the sofa manufacturing project, it is discovered that a better quality thread is needed, then the quality management plan needs to be updated.

The process improvement plan details the steps for analyzing processes to identify activities which enhance their value.

#### Project document updates

Examples of project documents that may be updated because of quality control activities include quality standards, quality metrics, quality checklists, and work performance measurements.

Outputs of the Perform Quality Control process that result from quality inspections are quality control measurements, validated changes, validated deliverables, and change requests. The outputs that involve documentation updates are organizational process assets updates, project management plan updates, and project document updates.

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**Topic:** Quality Control Results

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# SkillBrief

# Creating a Pareto Chart

One of the primary objectives of the Perform Quality Control process is to identify the causes of unsatisfactory project results and to propose ways to remove these causes. The tools and techniques for the process assist in identifying and addressing causes of error.

Pareto charts are useful because they isolate the causes responsible for the vast majority of unsatisfactory project results. In other words, they rank causes based on the frequency of the defects they result in.

#### Creating a Pareto chart

Pareto charts are based on an axiom applied by many quality control experts, asserting that most of the problems in a project are created by just a few vital causes. This axiom is referred to as the Pareto principle.

A Pareto chart ranks errors based on the frequency of defects they cause. This ensures the project team can optimize its efforts by addressing the causes responsible for the most defects before focusing on less significant sources of quality problems.

When creating a Pareto chart, you perform the following six steps:

1. develop a list of causes or error types to be compared
2. record the frequencies at which each error type has occurred
3. rank the top six or seven causes in descending order, according to the frequency of errors they result in
4. find the cumulative percentages of the total number of errors for which each of the causes is responsible
5. create a histogram – or bar chart – that displays the data
6. draw a line graph that plots the cumulative percentage for each cause

#### Analyzing a Pareto chart

The final step in using the Pareto chart as a quality control tool is to analyze the chart to determine which of the causes account for 80% of the defects.

In most cases, two or three causes – or categories of causes – will tower above the others. So you must look for a break point in the cumulative percentage line. This point occurs where the slope of the line begins to flatten out. The causes under the steepest part of the curve are the most important because it's these that account for the bulk of the problems. They are the high-impact causes on which you need to focus.

If you can't immediately tell which causes account for the majority of defects, you should begin by drawing a horizontal line marking the cumulative percentage value of 80%.

Next you drop the line you've added down to the X-axis. This defines a square or rectangular shape on the chart. Any causes that fall to the left of your vertical line are responsible for 80% of the recorded errors or problems.

As well as identifying the most significant causes of error, Pareto charts can help identify project and process improvements. Here are three suggestions on how to use them:

* to create before and after charts to track improvements and target new project processes to improve
* to create charts that further analyze the top causes
* to analyze other types of data, such as how long it takes to complete an activity, how many resources it uses, or how much it costs

One of the limitations of Pareto charts is that sometimes the frequency of defects is not as important as the overall impact particular types of defects may have on a project.

A Pareto chart is useful for identifying the main causes of unsatisfactory project results, defects, or errors. To create a Pareto chart, you first develop a list of causes or error types. You then record how frequently each item occurred, and rank the causes in descending order. You determine the percentage and the cumulative percentage of the total errors for which each cause is responsible. You then create a histogram and, finally, draw a line graph that plots the cumulative percentages for each cause on the histogram.

Analyzing a Pareto chart involves determining which of the causes account for 80% of the errors or defects.

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**Topic:** Pareto charts

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# Follow-on Activity

# Root Cause Analysis in Practice

**Purpose:** Use this follow-on activity to find out how experienced project managers use root cause analysis.

**Instructions for use:** To use this tool, print this sheet and ask one or more experienced project managers in your company to discuss how they've dealt with a particular quality problem.

#### Questions

Have you ever performed a root cause analysis on a quality issue in one of your projects?

If the answer is **yes**, ask the respondent to discuss the corrective action that was taken to deal with the problem, and take notes of their responses.

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**Topic:** Quality Assurance Audits and Analysis

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# Follow-on Activity

# Pareto Chart Activity

**Purpose:** Use this follow-on activity to learn more about the Pareto charts used in your organization.

**Instructions for use:** To use this tool, find an example of a Pareto chart that your company has used in a past project. Then print this sheet and answer the questions. If you are unsure of any of the questions, consult with your company's quality manager or an experienced project manager who has been involved in quality control activities.

#### Questions

1. Are Pareto charts used as a way to investigate quality problems in your company?
2. If Pareto charts are used, perform an analysis on your example.

* Does the chart reveal an example of the 80/20 principle? In other words, are 80% of the problems due to 20% of the causes?
* At the time it was created, how did the project or the project manager use the findings of the chart to control project quality?

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**Topic:** Pareto Charts

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# Learning Aid

# Tools for Identifying and Analyzing Causes of Defects

**Purpose:** Use this learning aid to answer the question on different types of tools used in quality control.

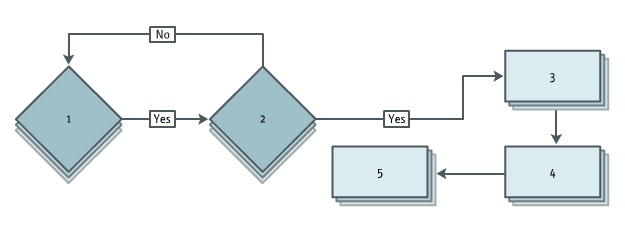


Diagram 1

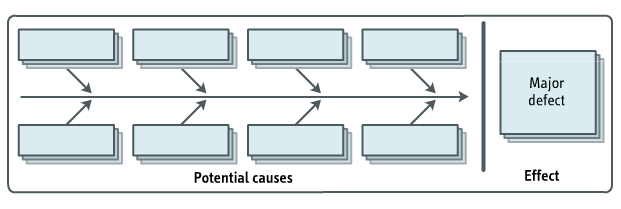


Diagram 2

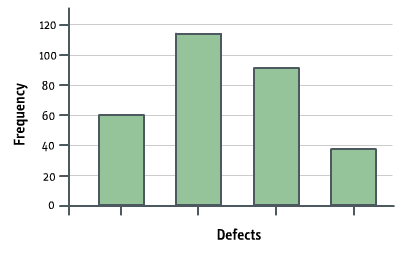


Diagram 3

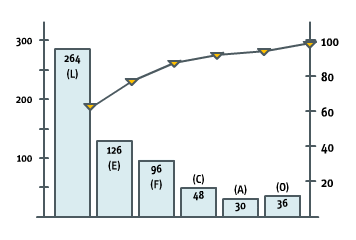


Diagram 4

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**Topic:** Conducting Quality Control Activities

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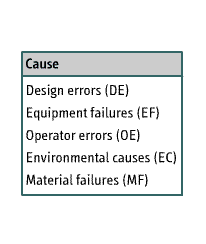
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# Job Aid

# Creating a Pareto Chart

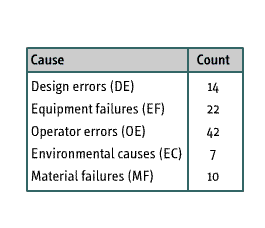
**Purpose:** Use this job aid to review the steps you take when creating a Pareto chart.

The first step includes developing a list of causes or error types.



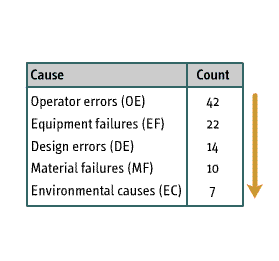
Step 1

The second step is to count the number of defects that can be attributed to each cause.



Step 2

The third step is to rank the causes in descending order, according to the frequency of errors they result in.

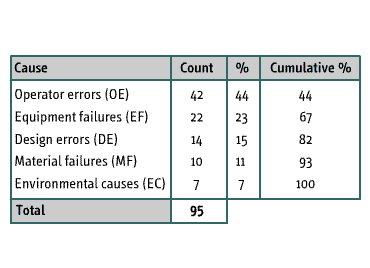


Step 3

The fourth step is to find the cumulative percentage of the total number of errors for each cause.

To do this, you

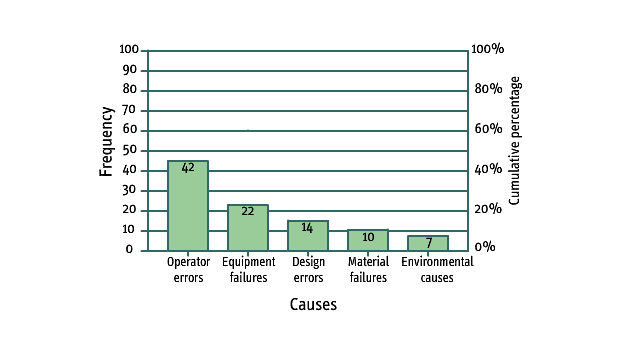
1. add the frequency numbers to determine the total errors
2. find the percentage for each cause by dividing the percentage of errors for which it's responsible by the total number of errors, then multiplying the result by 100
3. for each cause, add the percentage of errors it's responsible for to the sum of the percentages for causes ranked above it



Step 4

As the fifth step, you create a histogram that displays the data.

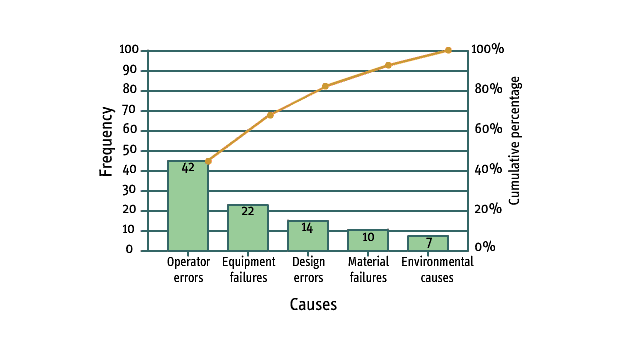
Frequency rates must be on the left vertical axis and bars representing the number of errors associated with each cause are plotted, in descending order, on the horizontal axis.



Step 5

As the final step, you draw a line graph that plots the cumulative percentages for each cause.

The first point on the line graph should line up with the top of the first bar.



Step 6

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**Topic:** Pareto Charts

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# Job Aid

# Plan Quality and Perform Quality Control Tools and Techniques

**Purpose:** Use this job aid as a summary of the tools and techniques used in the Plan Quality and Perform Quality Control processes.

| **Tools and techniques** | | |
| --- | --- | --- |
| **Tool or technique** | **Plan Quality process** | **Perform Quality Control process** |
| Approved change request review |  | X |
| Benchmarking | X |  |
| Cause and effect diagrams |  | X |
| Control charts | X | X |
| Cost of quality | X |  |
| Cost-benefit analysis | X |  |
| Design of experiments (DOE) | X |  |
| Flowcharting | X | X |
| Histogram |  | X |
| Inspection |  | X |
| Pareto charts |  | X |
| Proprietary quality management methodologies | X |  |
| Run charts |  | X |
| Scatter diagrams |  | X |
| Statistical sampling | X | X |

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**Topic:** Quality Assurance Audits and Analysis

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Project quality planning

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# SkillBrief

# An Introduction to Quality Management

The PMBOK® Guide defines quality as the degree to which a set of characteristics fulfill requirements. This definition relates particularly to product quality. A product must meet customer requirements once it's completed.

Project quality has several elements:

* **defining quality policies** – Project managers need to define quality policies for the project – which state how, when, and by whom quality checks will be carried out – and ensure the project team applies them. This forms part of quality planning.
* **setting quality objectives** – When planning project quality, you need to ensure that each project has clearly defined quality objectives, such as the end product's level of quality and its target defect rate.
* **assigning roles and responsibilities for quality** – You need to specify who will perform product quality reviews at various stages of production. And you need to specify who will perform quality reviews on behalf of the customer.
* **implementing a quality management system** – Quality management can be about the quality of the project management process, the primary focus is the quality of the processes producing the end product. As a project manager, you need to implement a quality management system throughout a project's life cycle.
* **monitoring and improving process effectiveness** – To ensure project quality, you need to monitor the effectiveness of all project management processes, particularly those used to produce the end product. You also need to administer continuous process improvement efforts.

So quality refers to how well a set of characteristics of project deliverables and objectives fulfills project requirements.

### Quality versus grade

Product quality management techniques depend on the specific product being produced, whereas project quality management applies to all projects no matter what product or service is being developed. To ensure better overall quality, you need to know the processes and terms associated with project quality.

Quality is defined as the degree to which characteristics meet requirements. Grade is a category assigned to products that have similar functional uses but different technical characteristics. So grade covers the number of features present in the product or service.

Whereas a quality level that fails to meet quality requirements is always a problem, a low grade may be acceptable. The art of quality management is knowing how to find the right balance between grade and quality.

Typically, the overall budget along with stakeholder requirements will be your guide.

### Precision versus accuracy

There are two quality concepts you need to be aware of:

* **precision** – ensures that repeated measurements are clustered closely together. Precise measurements are all similar or repeatable, but don't have to be close to the target value. Precision is the size of the cluster of measurements one would expect if the same procedures were repeated many times under the same conditions. So a precise process is one where there is a small deviation from the norm.
* **accuracy** – requires the measured value to be very close to the true value. A precise measurement is not necessarily accurate. The closer a system's measurements are to the accepted value, the more accurate the system is.

### Quality management systems

The PMBOK® Guide's approach to quality management is consistent with modern quality management systems. Examples of these quality systems include

* **ISO 9000 series** – a set of international guidelines and quality management standards used to establish quality management systems and global, industry-wide standardization
* **Six Sigma** – a disciplined quality process that strives to develop and deliver near-perfect products and services by measuring how many defects are in a process and then systematically figuring out how to eliminate them
* **continuous improvement** – an ongoing effort to improve customer satisfaction through continuous improvements to products, services, or processes
* **Total Quality Management** – a common approach for implementing a quality improvement program within an organization
* **failure mode and effect analysis** – an analytical procedure in which each potential failure mode in every component of a product is analyzed to determine its effect on the reliability of a component
* **design review** – a management technique used to evaluate proposed designs to ensure that they can be produced and maintained, can perform successfully, and meet customer requirements
* **voice of the customer** – a planning technique used to translate customer requirements into appropriate technical requirements for each phase of product development to ensure that products, services, and results truly reflect customer requirements
* **cost of quality** – involves determining prevention and appraisal costs – which include quality planning, quality control, and quality assurance – to ensure compliance with requirements

All quality management systems have four concepts at their core.

#### Customer satisfaction

Customer satisfaction requires you to define, evaluate, and manage customer expectations so the project meets customer requirements. To ensure customer satisfaction, you need to ensure that the product conforms to requirements and that it satisfies real needs of the customer.

#### Prevention over inspection

The cost of preventing mistakes is generally lower than the cost of correcting them. To prevent errors, you need to plan quality and ensure that quality processes are built into the project. Inspecting products for defects should play only a small role in quality management.

#### Management responsibility

Both quality and project management recognize the importance of managers taking responsibility for the conduct and development of their teams. While all team members are required to participate in meeting the organization's objectives, management must provide the resources needed to succeed.

#### Continuous improvement

The plan-do-check-act cycle is the basis for continuous quality improvement. Improvement initiatives should strive to improve both the quality of the project's management and the quality of the product or service.

Quality is the degree to which project deliverable characteristics and objectives fulfill the project requirements. It is the sum of project and product quality.

When planning quality, you need to consider trade-offs between quality and grade, and between precision and accuracy.

The quality management system that you use to ensure product and project quality will depend on organizational preferences. However, all quality management systems emphasize customer satisfaction, prevention over inspection, management responsibility, and continuous improvement for the product and for project processes.

**Course:** Project Quality Planning  
**Topic:** Quality Management Concepts

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# SkillBrief

# Project Quality Management and its Process Groups

### Quality processes

Project Quality Management includes the activities an organization uses to determine quality policies, objectives, and responsibilities, and to implement continuous improvement.

The three processes associated with Project Quality Management are

* **Plan Quality** – helps you identify which quality requirements and standards are relevant to the project and product. It also helps you to determine how to satisfy those standards and to document the quality control processes to be used.
* **Perform Quality Assurance** – involves executing quality process activities and auditing quality control measures. This is to ensure that the team uses the correct standards and operational definitions – that it carries out what it planned to do.
* **Perform Quality Control** – is the measurement, evaluation, and documentation of project results to determine whether the results meet project quality standards. This process helps you to determine when changes are necessary.

Each quality process is carried out by specific groups or resources. Depending on the organization, quality planning may be performed by a quality manager, the project manager, or both jointly.

The quality assurance function is typically performed by a quality group in the organization that is not part of the project team. Or it's performed by an external quality expert brought in to analyze quality procedures.

The quality control team may be made up of internal resources such as the project team, members of the Quality Control Department, or a blend of the two. Alternatively, Quality Control may be handled by a third party or external resource.

The Project Quality Management processes work with each other and with other project management processes to ensure the continuous improvement of product and project quality. These processes interact with each other and with the processes in the other knowledge areas. Each process occurs at least once in every project and occurs in one or more project phases. The processes often overlap and interact.

For example, the Plan Quality process outlines the details related to how Quality Control activities would be carried out. The quality management plan may specify what tools would be used, as well as when and by whom. The plan also describes the Quality Assurance function, such as when audits will take place and how process improvements will be recommended.

The Perform Quality Assurance process includes periodic checks of the results of quality control reviews to see whether the standards or quality processes need to be improved.

If change requests resulting from these reviews are accepted, the quality management plan may be altered. And this in turn may alter how quality control is conducted

### Quality and process groups

The quality management processes fit in the context of other project management processes, which fall into the five process groups:

* **Plan Quality belongs to the Planning process group** – During the Plan Quality process, activities that impact project and product quality are identified. Plans for how and when quality assurance and quality control activities will be carried out are also made.
* **Perform Quality Assurance belongs to the Executing process group** – The Perform Quality Assurance process is typically performed by an external team or expert. They carry out planned quality activities and conduct quality audits to ensure that the project processes are being correctly applied.
* **Perform Quality Control belongs to the Monitoring and Controlling process group** – The Perform Quality Control process is used to monitor and control changes that occur during project execution, identify potential problems, and either correct problems or recommend preventive action for them.

### Process interactions

Project managers often use the same project management processes for all projects. The output of Plan Quality – the quality management plan – is an input to the Develop Project Management Plan process. The Perform Quality Assurance process interacts with all other processes. In Perform Quality Control, identified changes are managed under the Perform Integrated Change Control process.

There are many other subsidiary plans and baselines created during the Develop Project Management Plan process. The quality management plan is developed after deliverables and requirements for the project are identified and detailed. It is created after the project scope has been planned to the work breakdown structure (WBS) level.

One of the purposes of the Perform Quality Assurance process is to identify flaws in processes and provide recommendations for process improvements.

As problems are identified during the Perform Quality Assurance process, recommended changes are implemented via the Monitoring and Controlling process group, namely the Perform Integrated Change Control process. The project processes continue to be audited as the Executing process group processes take place throughout the rest of the project.

Change requests can also be an output of the Perform Quality Control process. Any changes identified during quality control are managed under the project's change control system. So, they are managed using the Perform Integrated Change Control process. When requested changes are approved, the project manager updates the quality management plan and anyone may update other aspects of the project management plan.

There are three quality processes: Plan Quality, Perform Quality Assurance, and Perform Quality Control.

The Plan Quality process includes identifying and planning Quality Control and Quality Assurance activities. The Plan Quality process is part of the Planning process group and occurs in the context of the Develop Project Management Plan process.

The Perform Quality Assurance process interacts closely with other processes in the Planning process group, Executing Process group, and Monitoring & Controlling process group.

Perform Quality Control involves checking project results and is part of the Monitoring and Controlling process group. This process helps to ensure that identified changes are managed under the Perform Integrated Change Control process.

**Course:** Project Quality Planning  
**Topic:** Quality Management and the Process Groups

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# SkillBrief

# Inputs to the Plan Quality Process

Carried out in the project's planning stages, the Plan Quality process identifies the standards and quality requirements that must be applied to the project and product. This process also documents the plan of how the project will meet these requirements.

Planning for quality at the start of a project results in important benefits:

* **it increases chance of project success** – define a project's needs, standards, and necessary processes
* **it establishes commitment to improve quality** – commit to improving quality by conducting quality control throughout a project
* **it helps decrease costs** – decrease the costs associated with poor quality by preventing them at the beginning

### Plan Quality process inputs

Information required for quality management can be found in the five inputs to the Plan Quality process.

#### Scope baseline

The scope baseline is used to determine quality metrics. A key element in this is the project scope statement. This provides a description of the project's major deliverables and acceptance criteria. It contains details of technical issues that might affect quality planning, such as the definition of acceptance criteria.

The scope baseline consists of the

* **project scope statement** – Project managers use the project scope statement to plan project activities so that the project deliverables meet the desired level of quality. It includes the acceptance criteria for project deliverables. Sometimes this includes the quality attributes that are needed. The acceptance criteria – which determine if the customer's needs have been met – are key to determining the cost of the project's quality-related tasks.
* **work breakdown structure (WBS)** – The WBS identifies the deliverables, the work packages, and the control accounts used to measure project performance.
* **WBS dictionary** – The WBS dictionary assists in reading the WBS and in defining technical information for WBS elements.

#### Risk register

The risk register, also known as the risk log, is a detailed document that identifies threatening factors that may have an impact on the project's quality. Risks can be either threats or opportunities. When risks become reality, project costs and schedule are affected. The risk register is initiated during the Identify Risks process and is updated as the project advances.

The risk register is important for the Plan Quality process because it identifies risks and opportunities that can impact quality or product testing. You should include this information in the quality management plan, along with a description of what strategies you'd implement to counter the risk, should it occur.

#### Stakeholder register

The stakeholder register is a list of relevant stakeholders for the project. It's an important input to the Plan Quality process because it helps to identify which stakeholders have a particular interest in quality.

#### Enterprise environmental factors

The PMBOK® Guide defines enterprise environmental factors as "any or all external environmental factors and internal organizational environmental factors that surround or influence a project's success." Project quality needs to comply with these factors.

Some external factors that could affect quality planning are government agency regulations; industry and product standards; and operating conditions under which the project or product must perform. Internally, the company's organizational culture, staff structure, and resources could also affect the quality management plan.

#### Organizational process assets

Organizational process assets are rules of the organization – for example, policies, procedures, and guidelines. This category also includes information from lessons learned on previous projects and from historical databases that contain quality-related information.

In addition, you use these organizational process assets when planning quality:

* **standards** – are guidelines or characteristics that should be followed. These can include best practices for various tasks. They are not mandatory, and can be set internally by the organization or by external bodies, like the International Organization for Standardization (ISO).
* **regulations** – are mandatory. They are most often imposed by governments or regulatory institutions, but can also be imposed by the organization itself. Failure to comply with regulations can result in penalties, such as fines and jail time in some cases.

The organization's quality policy is an especially important document because it guides the quality-related aspects of the organization's projects, products, and services.

If the organization does not have a formal quality policy, or if the project involves multiple organizations, such as in a joint venture, the project team needs to create a specific quality policy for the project. The project team ensures that the stakeholders are fully aware of the policy used for the project by distributing this policy as appropriate.

### Plan Quality impact

Quality planning is performed in parallel with other project planning processes – such as scope, budget and schedule planning. This is because quality-related activities can have an impact on the project's overall cost and schedule.

Important factors when planning any quality-related activities are the

* **cost baseline** – is a time-phased budget used to monitor and control total project cost performance
* **schedule baseline** – resides in the project management plan and shows the accepted schedule performance measures for the project

To meet customer expectations of quality, you need to test your product or service. But because these tests take time and cost money, you need to know how much time and money is available for quality testing.

The project's cost and schedule baselines may influence the tests you're able to perform and what metrics you use as a measurement of quality. So the cost and schedule baselines play a role in the Plan Quality process because you must consider the time and money available to carry out quality-related activities.

Inputs to the Plan Quality process include the scope baseline, risk register, stakeholder register, enterprise environmental factors, and organizational process assets.

Quality-related activities can impact the project's overall cost and schedule, so you need to check two more inputs – the cost and schedule baselines – to make sure you are working within them.

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**Topic:** Information for Planning Quality

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# SkillBrief

# Cost of Quality and Cost-Benefit Analysis

When you use the proper quality planning tools and techniques, you are better able to meet your project's quality requirements. Benefits include

* less rework
* higher productivity
* lower costs
* increased stakeholder satisfaction

The two techniques that are used for the Plan Quality process are cost of quality and cost-benefit analysis. Both techniques deal directly with weighing the benefits of quality against the costs of quality.

### Cost of quality

The PMBOK® Guide defines cost of quality as "the total cost of all efforts related to quality throughout the product life cycle." In short, any quality-related task that incurs a cost can be included in the cost of quality. These tasks can be either planned or unplanned. Project managers need to bear these tasks in mind when planning schedules, and consider their costs when devising budgets.

Cost of quality considerations can be classified in two main groups: cost of conformance and cost of nonconformance. Cost of conformance consists of all costs incurred to ensure the project conforms to the required level of quality. And cost of nonconformance consists of all costs incurred when the project fails to meet the required level of quality.

The cost of conformance contains two categories of costs:

* **prevention costs** – are incurred to prevent the customer from receiving a poor quality or defective product or service. Examples include spending money on staff training, on making sure you document processes clearly and accurately, and using good equipment for project work.
* **appraisal costs** – are incurred to find quality problems and to check that the product or work processes are meeting project requirements. Simply put, any kind of testing and inspection falls into this category – for example product testing.

The cost of nonconformance includes failure costs, otherwise known as the cost of poor quality. These costs are incurred when things go wrong – like having to fix manufacturing errors and dealing with customer complaints.

There are two categories for such costs:

* **internal failure costs** – are incurred before the product or service is released to the customer. This can include costs to rework elements of the product, fix faulty areas of the product, postpone product release, and even scrap the product where necessary. Wastage-related costs are also included in this category, such as time wasted due to internal errors and unnecessary advertising.
* **external failure costs** – are incurred only once the product or service has been released, and the customers are not satisfied that their requirements have been met. This can include liability and penalty costs, warranty work, the cost of developing and distributing a product fix, and any customer service costs – such as technical support calls or visits. Damage control costs are also included in this category, such as giving discounts to resellers so that they'll keep selling the product, and public relations efforts to minimize the damage of bad product reviews.

The total cost of quality can be seen as the sum of prevention, appraisal, internal failure, and external failure costs.

### Performing the cost-benefit analysis

After determining the cost of quality, you perform the cost-benefit analysis to weigh the benefits of quality versus the costs of quality. Cost-benefit analysis helps project managers determine the cost-benefit trade-offs for making a potential change.

When it comes to planning for quality, cost-benefit analysis helps project managers determine whether it's cost-effective to make a quality-related change. It ensures that time and money are invested only in quality activities and process changes that are worth the effort. It also ensures that there is balance between the cost of quality and the benefits of quality. In other words, a cost-benefit analysis helps project managers answer the question, "Is it economically viable to make a change?"

There are three steps to take when performing cost-benefit analysis.

#### Step 1: List and calculate the costs

The first step is to list and calculate the potential direct and indirect costs of consumed resources.

Direct costs are the estimated financial costs associated with the project's tangible inputs and are part of ordinary budget-making and planning. They can include expenses from equipment, operators, personnel, training, materials, utilities, contractual services, and facility construction.

Indirect costs are usually based on estimating or prorating shared resources, such as a portion of infrastructure maintenance and depreciation, or overall administration expenses. Additional indirect costs include worker safety and environmental factors.

#### Step 2: List and calculate the benefits

The second step is to list and calculate all the potential financial benefits – tangible and intangible.

Examples of tangible benefits include quality, time, labor, risk, production, maintenance, and the ability to draw upon pre-existing resources.

Intangible benefits are the gains attributable to improving your project. These gains do not have to be reported for formal accounting purposes.

These are some other examples of intangible benefits:

* increased customer satisfaction
* new customer opportunities
* higher workplace morale because of accolades received from customers and management
* boosted company reputation
* improved market position compared to rivals

Some benefits are quantifiable – meaning you can put a monetary value on them, others are not. When dealing with unquantifiable benefits, the key is to find the quantifiable elements. Then you compare those to the actual costs of implementing the quality activity.

#### Step 3: Compare the results

The third step is to compare the results and determine whether the total financial benefit is worth making the change. In other words, you verify whether the benefits outweigh the costs. Then you can make a recommendation based on the results.

To achieve quality, project managers need to use tools and techniques to plan quality into a project. One of these techniques is cost-benefit analysis, which weighs the benefits of quality against the costs of quality.

To perform a cost-benefit analysis, you first calculate the total cost of quality – which includes the costs of all efforts related to quality throughout the product life cycle. After this, you calculate the potential financial benefits of quality. Finally, you compare the two to determine whether the benefits outweigh the costs.

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**Topic:** Cost of Quality and Cost-Benefit Analysis

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# SkillBrief

# A Selection of Quality Planning Tools and Techniques

To be successful, the inputs, processes, and final deliverables of projects should all reflect an attention to quality. This can be achieved by employing various tools and techniques throughout the project.

The tools and techniques of the Plan Quality process can be put into three categories.

### Quality planning tools

#### Control charts

Control charts are used to monitor performance of a process, showing its performance in relation to a set of predefined baselines.

Although a control chart is most often used to track repetitive manufacturing activities, it's a versatile tool that can also be used to monitor management indicators, such as costs, schedule, volume, and frequency of scope changes.

A control chart contains six elements:

* **goal line** – represents the target performance for the activity – a planned or goal value for performance at each phase
* **actual line** – displays the real performance for the activity
* **upper specification limit** – reflects the maximum values allowed for performance which the project team may not exceed without facing penalties
* **upper control limit** – should an activity's actual performance reach this limit, corrective action must be taken to prevent it from reaching and exceeding the upper specification limit
* **lower control limit** – should an activity's actual performance reach this limit, corrective action must be taken to prevent it from reaching and dropping below it.
* **lower specification limit** – reflects the minimum values allowed for performance, below which the project team may not drop

Cost control charts can affect decisions made in the Plan Quality process. By looking at the upper control and specification limits, a project manager can determine whether to make adjustments to certain tasks. This allows them to ensure that the activity remains close to the targeted performance and within acceptable limits.

### Quality planning techniques

#### Benchmarking

Benchmarking is the process of identifying, understanding, and adapting outstanding practices from other organizations or industries. It is used to provide a basis by which to measure performance in different areas, including business, the media, politics, travel, and sport.

In the context of project management, benchmarking entails using quality criteria from another project as a reference point for the current project's quality criteria. This indicator can tell you whether you need to change your quality-related activities, so that you are up to the level of quality required.

#### Flowchart

The flowchart is a graphical representation of a process. It allows a project team to create a map of the events in a process. By examining flowcharts carefully, project managers can often identify gaps in workflow that could cause problems and errors.

Flowcharting can also identify inefficiencies in the quality process.

### Statistical techniques

#### Design of experiments (DOE)

The outcome of a process is the result of a number of factors, such as its inputs and tasks. The DOE technique delves into these factors, and tries to give you the best results for your processes.

DOE is a statistical method for determining the relationship between factors affecting a process and the end results of that process. Using DOE helps identify the key variables that can be altered to change and optimize processes. DOE is especially useful in the early stages of product or process design, such as planning quality.

In the manufacturing industry, DOE is typically used to plan two aspects of quality:

* **testing** – DOE is used to determine the numbers and types of tests that the product should undergo. It reflects the impact of these tests on the cost of quality.
* **process optimization** – DOE allows you to test whether the chosen methods, designs, materials, or other factors are truly the best for a given situation. In doing so, the technique can illustrate the conditions you need to put in place so that the process performs optimally.

In a non-manufacturing context, DOE can also be used for process optimization.

#### Statistical sampling

As the name implies, statistical sampling takes a sample of a particular item – for instance, a random collection of bottles in a bottling plant – and inspects it for quality. Conclusions are drawn about the quality of the entire set of items, based on the statistics from this inspection.

These inspections need to be designed during the Plan Quality process. Planning requires you to determine how often inspections will be done and what size the samples will be. The information is used when calculating the cost of quality, since there are costs associated with carrying out the inspections.

### Other tools and techniques

There are a number of proprietary quality management methodologies, including Total Quality Management (TQM) and Six Sigma. TQM sees quality improvement as a continuous and integral part of how a business works, whereas Six Sigma is a measurement-based system that aims to eliminate defects.

There are other tools to help project and quality managers plan effective quality management activities:

* **matrix diagrams** – used to compare the efficiency and effectiveness of alternatives based on the relationship between two criteria, for example project cost and performance
* **brainstorming** – used to generate ideas about specific quality issues and ideas on how to plan effective quality management activities
* **nominal group techniques** – are structured procedures that identify and rank major problems or key issues that need to be addressed
* **force field analysis** – is a useful technique for examining all the forces for and against a decision relating to quality
* **affinity diagrams** – are used to organize large amounts of data or to generate a large number of related ideas that are the results of a quality brainstorming session
* **prioritization matrices** – are used to rank the importance of different quality aspects of a project generated by a brainstorming session

A good way to achieve quality in your project is to employ quality planning tools and techniques. Cost control charts, benchmarking, flowcharting, design of experiments (DOE), and statistical sampling are some of the techniques used in the Plan Quality process. Other tools include matrix diagrams and force field analysis, as well as proprietary methodologies like Total Quality Management, also known as TQM, and Six Sigma.

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**Topic:** Control Charts and Other Quality Planning Techniques

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# SkillBrief

# Outputs of the Plan Quality Process

The Plan Quality process generates the outputs that enable you to manage, control, and improve quality.

#### Quality management plan

The quality management plan is a subsidiary of the project management plan. Its style and level of detail depends on the kind of project.

There are four types of plan that fit the different kinds of projects:

* **informal plan** – typically used for an internal project that's part of ongoing work, where the team is familiar with all the requirements.
* **formal plan** – necessary when the customer is formal, such as a large corporation or government agency. For projects that have legal and compliance ramifications, the quality management plan should reflect the serious nature of the project.
* **broadly based plan** – suitable for service-oriented projects, and in projects where the product is either non-tactile, or not required to meet strict quantifiable specifications.
* **detailed plan** – necessary in projects with exact specifications, such as in manufacturing, construction, and technical projects.

A tip for creating the quality management plan is to consult the work breakdown structure (WBS). The WBS summarizes project scope visually. The WBS makes it easy to identify work packages that will require particular quality control or assurance activities.

The quality management plan must establish the guidelines for quality control and assurance. Quality control provides guidelines for inspecting compliance of deliverables to the project standards. Quality assurance describes guidelines for evaluating overall performance, focusing on review and auditing of project processes. The quality management plan also contains high-level approaches to continuous process improvement.

The quality management plan includes this quality control information:

* **the major deliverables to be tested** – are those that have the most strictly defined specifications and on which the project's success relies most heavily
* **standards and criteria of the product** – are clearly defined
* **monitoring and controlling activities** – are used to manage quality, including what will be tested and how to perform the tests
* **the quality control schedule** – includes information for the quality control activities, including their timing and location, and who will perform them

The other section of the quality management plan – that on quality assurance – describes the processes subject to quality assurance. It sets out the standards and stakeholder expectations for each process. Quality assurance activities – such as the necessary audits and reviews – are outlined, as is the quality assurance schedule for these activities.

Another function of the quality management plan is to provide the high-level approaches to continuous process improvement. At this level, you identify approaches to expand and develop later in the Plan Quality process. Of the many possible approaches, benchmarking, process mapping, and work flow analysis represent a sample. A commonly used high-level approach to process improvement is Total Quality Management (TQM).

#### Process improvement plan

Along with the quality management plan, the process improvement plan contributes to the project management plan. The process improvement plan outlines strategies for analyzing and improving the project management and production processes. Where quality control and assurance reveal problems, the process improvement plan details the steps for bringing quality back in line with the required standards.

The process improvement plan also contains guidance around performing ad hoc process audits throughout the project to identify activities that would bring added value. The kinds of processes you would target are those most closely tied to your organization's strategic goals.

The process improvement plan should contain this information:

* **process boundaries** – describe the purpose, start, and end of a process, as well as its inputs, requirements, process owner, and stakeholders.
* **process configurations** – describe the design of a process, typically using a flow diagram to indicate how the process operates. When a process is configured, its design and flow is set or fixed. This enables you to benchmark the process and control changes to it.
* **process metrics** – are what you use to measure the performance of a process.
* **targets for improved performance** –are metrics that the project manager or stakeholders define for improving the performance of a process.

#### Quality metrics

Quality metrics help you evaluate quality performance and ensure that deliverables and work processes meet quality standards. They are often defined in terms of rates of performance, production, or error.

The type of quality metric you define depends on the kind of project. A manufacturing project has different quality metrics to a service-oriented project:

#### Quality checklists

Quality checklists are structured lists that you use to ensure the required steps in a process have been performed. Your organization, or professional organizations, may provide standardized checklists for frequent quality control tasks. Checklists can be simple or complex, depending on the application.

#### Project document updates

Because the quality planning process is iterative, as with most project planning processes, it often results in changes to other project documents. So project document updates make up another output of the Plan Quality process. Quality planning can easily lead to updates to requirements documentation. Another document that commonly requires updating is the roles and responsibilities matrix.

The Plan Quality process generates several outputs that help in ensuring that the project and its deliverables comply to the required quality standards. The quality management plan describes the guidelines and activities for quality assurance and quality control, and describes high-level approaches to continuous process improvement.

The process improvement plan outlines strategies for analyzing and improving processes. The remaining outputs are quality metrics, quality checklists, and project document updates.

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**Topic:** Quality Planning Outputs

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# Follow-on Activity

# Cost-Benefit Analyses

**Purpose:** Use this follow-on activity as an exercise for learning how cost-benefit analyses are used in the real world.

**Instructions for use:** To use this tool, contact a more experienced project manager to find out about cost-benefit analyses that are used at your company to plan quality activities for projects.

Here are some initial questions for you to consider:

* How are the analyses carried out?
* What tools are used?
* How successful have the analyses been?

Now examine the documents in which an analysis was worked out to identify the different types of quality, costs, and benefits.

During your examination of the documents, try and answer these questions:

* What kinds of costs are listed?
* What kinds of benefits are listed?
* How are these costs and benefits quantified?
* How does the project manager record this information?

Some additional questions you could ask the project manager are

* Where is the source information on costs and benefits acquired from?
* In cases where the benefits outweighed the costs and the project went ahead, did the estimated figures turn out to be accurate?
* Is the cost-benefit analysis a reliable decision-making tool?

By learning from real-life examples, you can build a comprehensive set of knowledge that should help you excel in project management for years to come.

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**Topic:** Cost of Quality and Cost-Benefit Analysis

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# Follow-on Activity

# Quality Planning Tools and Techniques

**Purpose:** Use this follow-on activity as an exercise for learning how quality planning tools and techniques are used in the real world.

**Instructions for use:** To use this tool, contact a more experienced project manager to find out how your company usually plans quality into a project. Use the table provided to comment on some of your findings.

Ask the project manager what tools and techniques are used. Also ask how successful the tools and techniques have been under particular circumstances.

In addition, find out the advantages and disadvantages of the tools and techniques they use.

| **Quality planning tools and techniques** | | |
| --- | --- | --- |
| **Category** | **Tool or technique** | **Comments** |
| Proprietary quality management methodologies | Six Sigma  Total Quality Management (TQM) | Row 2 Column 3 |
| Quality planning techniques | Benchmarking  Flowcharting | Row 3 Column 3 |
| Quality planning tools | Cost control charts | Row 4 Column 3 |
| Statistical techniques | Design of experiments (DOE)  Statistical sampling | Row 5 Column 3 |
| Other quality planning tools | Affinity diagrams  Force field analysis  Matrix diagrams  Nominal group techniques  Prioritization matrixes | Row 6 Column 3 |

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# Learning Aid

# Cosmetics Company Project: Cost-Benefit Analysis

**Purpose:** Use this learning aid to perform a cost-benefit analysis for the cosmetics company project.

## Scenario information

A cosmetics company wants to provide its field sales force with laptops to allow them to have an Internet connection to send electronic orders to the corporate ordering system. The company has hired you to determine the cost effectiveness of the proposed option over a four-year period.

### The current process

* There are 200 members of the sales team.
* The sales force works by printing customer information summaries: paper order forms are returned in person, by mail, or by fax to the corporate ordering system.
* It takes seven staff members to keep up with processing the orders once they're received.
* Each staff member earns $40,000 a year.
* The costs for printing and distributing paper forms are $300,000 each year.
* Fax, mail, and shipping fees for the forms run $100,000 each year.
* Additionally, order processing inaccuracies and material returns cost the company $150,000 a year.

**Costs of the proposed solution**

* If the proposed system is to be implemented, there are various initial costs:
* The company would need to purchase 200 laptops at $2,000 each.
* The server, programming, and infrastructure upgrades would cost $100,000.
* Training and materials would run $500 for each salesperson.
* Possible loss of staff productivity during training and while getting used to the new system would cost an estimated $200,000.
* Possible staff attrition because of confusion or inability to adapt to the new system would cost an estimated $300,000.
* After these initial setup costs, the company would be paying for an Internet access account for each salesperson. Each Internet access account would cost $14 per month.

### Benefits of the proposed system

You anticipate the proposed system would reap the following benefits:

* the company would be able to reduce the order-processing staff from seven people to two people
* the costs for printing and distributing paper forms would be reduced by 75%, i.e. $300,000
* fax, mail, and shipping fees for the forms would be eliminated completely
* Order processing inaccuracies and material returns would be reduced by 60%, i.e. $150,000

Use the template to perform a cost-benefit analysis for this scenario over a four-year period.

## Cost-benefit analysis template

Record the estimated costs for the proposed system over four years.

| **Estimated costs** | | |
| --- | --- | --- |
| ***Item*** | **Calculations** | **Total ($)** |
| **Purchase of 200 laptops** | Row 2 Column 3 | Row 2 Column 4 |
| **Server, programming, and infrastructure upgrades** | Row 3 Column 3 | Row 3 Column 4 |
| **Training and materials for salespeople** | Row 4 Column 3 | Row 4 Column 4 |
| **Possible loss of staff productivity** | Row 5 Column 3 | Row 5 Column 4 |
| **Possible staff attrition** | Row 6 Column 3 | Row 6 Column 4 |
| **Internet access accounts for salespeople** | Row 7 Column 3 | Row 7 Column 4 |
| **Total estimated costs:** |  | Row 12 Column 4 |

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### Step 2: List and calculate the benefits

Record the estimated benefits for the proposed system over four years.

| **Estimated benefits** | | |
| --- | --- | --- |
| ***Item*** | **Calculations** | **Total ($)** |
| **Fewer order processing staff** | Row 2 Column 3 | Row 2 Column 4 |
| **Lower costs for printing and distribution of paper forms** | Row 3 Column 3 | Row 3 Column 4 |
| **Lower fax, mail, and shipping fees** | Row 4 Column 3 | Row 4 Column 4 |
| **Fewer order processing inaccuracies and material returns** | Row 5 Column 3 | Row 5 Column 4 |
| **Total estimated benefits:** |  | Row 6 Column 4 |

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### Step 3: Compare the results

Record your comparison of the results and make a final recommendation.

| **Final recommendation** | |
| --- | --- |
|  | **Comments** |
| **Difference between benefits and costs of the proposed system:** | Row 2 Column 3 |
| **Final recommendation:** | Row 3 Column 3 |

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# Learning Aid

# Medical Products Company Project: Cost-Benefit Analysis

**Purpose:** Use this learning aid to perform a cost-benefit analysis for the medical products company project.

## Scenario information

A multinational medical products company has purchased a company in the United Kingdom. The company is considering moving a production line that manufactures adhesive bandages to a plant in Puerto Rico. The company hopes this proposed move will enable it to keep its cost management performance in line with corporate quality policies. You have been hired to determine the cost-effectiveness of making the move.

For ease of calculation and comparison, all figures in this scenario have been converted to American dollars.

### The current process

Under the current arrangement, the costs of the adhesive bandages production line are:

* $255,000 per year in operating expenses
* $130,000 per year in corporate taxes
* $84,000 per year for shipping
* $780,000 in employee salaries per year

### Costs of the proposed solution

If the production line were to be moved to Puerto Rico, these costs are estimated:

* the actual relocation would cost $2,880,000
* setting up and testing the equipment would cost $1,827,300
* training for the new employees would cost $106,750 (new employees in Puerto Rico would replace the existing UK employees)
* productivity loss while employees reach optimal performance capability would cost the company an estimated $600,000
* $428,000 in employee salaries for per year

**Benefits of the proposed system**

You anticipate these benefits, if the production line were to move, for the company:

* savings of $352,000 in salaries per year
* savings of $124,000 a year in operating expenses
* savings of $68,000 a year in corporate taxes
* savings of $44,000 per year in shipping costs

Use the template below to perform a cost-benefit analysis for this scenario over a five-year period.

## Cost-benefit analysis template

### Step 1: List and calculate the costs

Record the estimated costs for the proposed system over five years

| **Estimated costs** | | |
| --- | --- | --- |
| ***Item*** | **Calculations** | **Total ($)** |
| **Actual relocation** | Row 2 Column 3 | Row 2 Column 4 |
| **Setting up and testing equipment** | Row 3 Column 3 | Row 3 Column 4 |
| **Training new employees** | Row 4 Column 3 | Row 4 Column 4 |
| **Initial productivity loss** | Row 5 Column 3 | Row 5 Column 4 |
| **Employee salaries** | Row 6 Column 3 | Row 6 Column 4 |
| **Total estimated costs:** |  | Row 7 Column 4 |

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### Step 2: List and calculate the benefits

Record the estimated benefits for the proposed system

| **Estimated benefits** | | |
| --- | --- | --- |
| ***Item*** | **Calculations** | **Total ($)** |
| **Employee salaries savings** | Row 2 Column 3 | Row 2 Column 4 |
| **Operating expense savings** | Row 3 Column 3 | Row 3 Column 4 |
| **Corporate tax savings** | Row 4 Column 3 | Row 4 Column 4 |
| **Shipping cost savings** | Row 5 Column 3 | Row 5 Column 4 |
| **Total estimated benefits:** |  | Row 6 Column 4 |

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### Step 3: Compare the results

Record your comparison of the results and make a final recommendation.

| **Final recommendation** | |
| --- | --- |
|  | **Comments** |
| **Difference between benefits and costs of the proposed system:** | Row 2 Column 3 |
| **Final recommendation:** | Row 3 Column 3 |

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**Topic:** Cost of Quality and Cost-Benefit Analysis

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# Learning Aid

# Sales Management System: Cost-Benefit Analysis

**Purpose:** Use this learning aid to perform a cost-benefit analysis for the sales management system.

## Scenario information

You are the project manager for a growing company. The sales manager is considering implementing a new computer-based contact management and sales processing system. Your boss has asked you to determine whether the request is feasible from a financial aspect. You need to do a cost-benefit analysis for the first year.

### The current process

The Sales Department is not computerized.

* There are ten members of the sales team.
* Each salesperson creates their own non-computerized customer database by writing the contact information for prospective and current customers on large index cards and organizing them in a centrally located filing cabinet.
* Each time a customer or prospect is contacted, a salesperson updates that contact's index card.
* At $20 an hour, it takes a salesperson 30 minutes to create and file an index card for a new prospect; and it takes 15 minutes to locate, update, and refile an index card for a follow-up phone call with a current customer or prospect for whom an index card already exists.
* In one day, a salesperson typically contacts six new prospects and follows up with ten current customers or prospects already in the database.
* Each salesperson works 236 days a year.

### Costs of the proposed solution

The sales manager wants each member of her sales team to have a desktop computer.

* Each new computer will cost $1,225.
* The cost includes the necessary supporting software, but the company will still have to pay a software license fee each year. This annual fee, which covers all computers, is $1,200.
* Additionally, the sales manager wants to purchase three subscriptions to online lead databases: the first one costs $55 per month, the second one costs $40 per month, and the third one costs $60 per month. The subscriptions will be managed centrally, and every sales person will be able to use them.
* Because the sales manager wants all of the computers to be networked, the Sales Department also needs its own server, including the cabling and installation. After researching these needs as project manager, you learn that the server will cost $1,750 to buy and approximately $200 per month to maintain. The cabling and installation will run $2,300.
* The sales manager proposes that the Sales Department lease a heavy-duty printer that everyone will share. The lease for the printer and the necessary printing supplies will cost approximately $300 a month.
* All the salespeople will need to be trained to use the new system; the training will cost $200 per person.
* In spite of the training the salespeople will receive, the sales manager anticipates that the company will lose money due to user error: approximately $10,000 in sales and $10,000 in time during the first month of operation.

### Benefits of the proposed system

The sales manager anticipates these benefits:

* The new computer-based contact management and sales processing system will reduce the time for adding new prospects to the database down to 15 minutes, and the time for updating the database after a follow-up phone call to seven and one-half minutes.
* Estimated sales will increase by at least $50,000 a year because customers and prospects will be contacted in a more timely manner.

Use the template to perform a cost-benefit analysis for this scenario for its first year.

## Cost-benefit analysis template

### Step 1: List and calculate the costs

Record the estimated costs for the proposed system for the first year.

| **Estimated costs** | | |
| --- | --- | --- |
| ***Item*** | **Calculations** | **Total ($)** |
| **Networked computers with supporting software** | Row 2 Column 3 | Row 2 Column 4 |
| **Software license fee** | Row 3 Column 3 | Row 3 Column 4 |
| **Online subscriptions** | Row 4 Column 3 | Row 4 Column 4 |
| **Server** | Row 5 Column 3 | Row 5 Column 4 |
| **Cabling and installation** | Row 6 Column 3 | Row 6 Column 4 |
| **Lease of printer and purchasing printing supplies** | Row 7 Column 3 | Row 7 Column 4 |
| **Training** | Row 8 Column 3 | Row 8 Column 4 |
| **Lost sales in first month of operation** | Row 9 Column 3 | Row 9 Column 4 |
| **Lost time in first month of operation** | Row 10 Column 3 | Row 10 Column 4 |
| **Total estimated costs:** |  | Row 11 Column 4 |

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### Step 2: List and calculate the benefits

Record the estimated benefits for the proposed system for the first year.

| **Estimated benefits** | | |
| --- | --- | --- |
| ***Item*** | **Calculations** | **Total ($)** |
| **Increased sales** | Row 2 Column 3 | Row 2 Column 4 |
| **Reduction in time for adding new prospects to the database** | Row 3 Column 3 | Row 3 Column 4 |
| **Reduction in time for updating the database after a follow-up phone call** | Row 4 Column 3 | Row 4 Column 4 |
| **Total estimated benefits:** |  | Row 5 Column 4 |

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### Step 3: Compare the results

Record your comparison of the results and make a final recommendation.

| **Final recommendation** | |
| --- | --- |
|  | **Comments** |
| **Difference between benefits and costs of the proposed system:** | Row 2 Column 3 |
| **Final recommendation:** | Row 3 Column 3 |

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# Learning Aid

# Sales Management System: Completed Cost-Benefit Analysis

**Purpose:** Use this learning aid to find out how the cost-benefit analysis for the sales management system should be carried out.

## Completed cost-benefit analysis for the first year

### Step 1: List and calculate the costs

Record the estimated costs for the proposed system for the first year.

| **Estimated costs** | | |
| --- | --- | --- |
| ***Item*** | **Calculations** | **Total ($)** |
| **Networked computers with supporting software** | 10 × $1,225 | 12,250 |
| **Software license fee** | $1,200 | 1,200 |
| **Online subscriptions** | ($55 + $40 + $60) ×12 | 1,860 |
| **Server** | $1,750 + (12 × $200) | 4,150 |
| **Cabling and installation** | $2,300 | 2,300 |
| **Lease of printer and purchasing printing supplies** | $300 × 12 | 3,600 |
| **Training** | 10 × $200 | 2,000 |
| **Lost sales in first month of operation** | $10,000 | 10,000 |
| **Lost time in first month of operation** | $10,000 | 10,000 |
| **Total estimated costs:** |  | **47,360** |

### Step 2: List and calculate the benefits

Record the estimated benefits for the proposed system for the first year.

| **Estimated benefits** | | |
| --- | --- | --- |
| ***Item*** | **Calculations** | **Total ($)** |
| **Increased sales** | $50,000 | $50,000 |
| **Reduction in time for adding new prospects to the database** | 10 × ($5 x 6) × 236 | $70,800 |
| **Reduction in time for updating the database after a follow-up phone call** | 10 × ($2.5 x 10) × 236 | $59,000 |
| **Total estimated benefits:** |  | **$179,800** |

### Step 3: Compare the results

Record your comparison of the results and make a final recommendation.

| **Final recommendation** | |
| --- | --- |
|  | **Comments** |
| **Difference between benefits and costs of the proposed system:** | Costs = $47,360  Benefits = $179,800 |
| **Final recommendation:** | Implement the new system |

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# Job Aid

# Quality Management Systems

**Purpose:** Use this job aid to review popular quality management systems.

There are several key figures associated with quality management systems:

* Philip B. Crosby
* Joseph M. Juran
* Walter Shewhart
* W. Edwards Deming

**Crosby** devised the zero defects practice. This emphasizes quality planning and prevention of defects. If you prevent the defect from occurring, costs are lower and requirements are easier to meet.

**Juran** developed the fitness for use premise, which emphasizes that customer and stakeholder expectations should be met or exceeded. Fitness for use focuses on the customers' view of quality in terms of meeting quality expectations, satisfying real needs, and being both reliable and safe. Juran also brought in the concept of quality and grades.

**Shewhart** is often called the grandfather of total quality management (TQM). He developed statistical tools to determine when a corrective action must be applied to a process. He invented control chart techniques and the Plan-Do-Check-Act cycle.

**Deming** proposed that quality is a management problem, suggesting that as much as 85% of the cost of quality is a management related. He popularized and further developed the TQM system. Deming also proposed that employees need to be shown what quality level is acceptable and that they need to understand that quality and continuous improvement are necessary elements of a project.

These theories resulted in several quality management systems.

## Kaizen approach

The Kaizen approach was created in Japan and focuses on continuous improvement. This approach requires that you first improve the quality of the people, so that the quality of the products or service will then improve automatically. With this technique, everyone involved in a project should be looking for ways to improve quality at every stage of the process. This involves taking measurements, reducing variations in performance and production, reducing defects, improving cycle times, and improving processes by ensuring that they are waste free. TQM and Six Sigma are examples of continuous improvement systems that use Kaizen philosophy.

## TQM

TQM emphasizes that processes rather than people generate quality problems. TQM requires that quality be managed and that quality improvement should be a continuous and an integral part of how a business works.

## Six Sigma

Six Sigma is a measurement-based system that focuses on process improvement and variation reduction. Six Sigma aims to eliminate defects and requires that no more than 3.4 defects per million are produced. There are two Six Sigma methodologies used for this purpose:

* **DMADV** (Define, Measure, Analyze, Design, and Verify), which is used to develop new processes or products
* **DMAIC** (Define, Measure, Analyze, Improve, and Control), which is used to improve existing processes or products

## Design of experiments (DOE)

DOE provides a statistical framework that enables you to change project variables simultaneously, instead of changing one variable at a time. This technique identifies the elements – or variables – that have the greatest effect on project outcomes and focuses on changing these elements. It is generally used for product quality, but can also be applied for project quality when weighing up quality trade-offs.

DOE uses a limited number of sample cases to find the ideal solution for a problem. By doing this, it helps you to analyze multiple variables and determine which combination will produce the best result.

## Cost of quality

The cost of quality is the total cost to produce the product or service of the project according to the quality standards. These costs include all planned and unplanned work needed to meet the product requirements. It also includes the costs of work performed because of nonconforming quality requirements. Three costs associated with the cost of quality are

* **prevention costs**, which are associated with satisfying customer requirements by producing a product without defects. They cover aspects such as quality planning, training, design review, and supplier costs.
* **appraisal costs**, which are the costs of checking the product or process against its requirements. This includes testing and inspection costs.
* **failure costs**, which are estimates of price when things don't go according to plan or the cost of poor quality. These costs may be internal – such as corrective action, rework, and downtime – or external, for example when a customer returns a faulty product or when the organization needs to inspect or repair the product at the customer's site.

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**Topic:** Quality Management Concepts

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# Job Aid

# Quality Management Plan Template

**Purpose:** Use this job aid to create the quality management plan for your projects.

## Overall quality requirements

First write a short paragraph describing the overall quality requirements of the project from the stakeholders' perspective. Then complete sections A and B.

### Section A: Quality control

Use section A to describe the deliverables to be tested for satisfactory quality level, the quality standards and criteria, quality control activities, and the quality control schedule for the project.

| **Deliverables to be tested** | | |
| --- | --- | --- |
| **WBS ID** | **Name** | **Purpose or function within the overall product** |
| Row 2 Column 1 | Row 2 Column 2 | Row 2 Column 3 |
| Row 3 Column 1 | Row 3 Column 2 | Row 3 Column 3 |
| Row 4 Column 1 | Row 4 Column 2 | Row 4 Column 3 |
| Row 5 Column 1 | Row 5 Column 2 | Row 5 Column 3 |
| Row 6 Column 1 | Row 6 Column 2 | Row 6 Column 3 |

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| **Quality standards and criteria** | |
| --- | --- |
| **WBS ID** | **Quality standards and criteria** |
| Row 2 Column 1 | Row 2 Column 2 |
| Row 3 Column 1 | Row 3 Column 2 |
| Row 4 Column 1 | Row 4 Column 2 |
| Row 5 Column 1 | Row 5 Column 2 |
| Row 6 Column 1 | Row 6 Column 2 |

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| **Monitoring and controlling activities** | | |
| --- | --- | --- |
| **Activity ID** | **WBS ID** | **Description of activity** |
| Row 2 Column 1 | Row 2 Column 2 | Row 2 Column 3 |
| Row 3 Column 1 | Row 3 Column 2 | Row 3 Column 3 |
| Row 4 Column 1 | Row 4 Column 2 | Row 4 Column 3 |
| Row 5 Column 1 | Row 5 Column 2 | Row 5 Column 3 |
| Row 6 Column 1 | Row 6 Column 2 | Row 6 Column 3 |

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| **Quality control schedule** | | | |
| --- | --- | --- | --- |
| **Activity ID** | **Person responsible** | **Location** | **Date** |
| Row 2 Column 1 | Row 2 Column 2 | Row 2 Column 3 | Row 2 Column 4 |
| Row 3 Column 1 | Row 3 Column 2 | Row 3 Column 3 | Row 3 Column 4 |
| Row 4 Column 1 | Row 4 Column 2 | Row 4 Column 3 | Row 4 Column 4 |
| Row 5 Column 1 | Row 5 Column 2 | Row 5 Column 3 | Row 5 Column 4 |
| Row 6 Column 1 | Row 6 Column 2 | Row 6 Column 3 | Row 6 Column 4 |

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### Section B: Quality assurance

Use section B to describe the processes subject to quality assurance, the quality standards and stakeholder expectations for each deliverable, quality assurance activities such as audits or reviews, and the quality assurance schedule for the project.

| **Processes subject to quality assurance** | |
| --- | --- |
| **Process** | **Description** |
| Row 2 Column 1 | Row 2 Column 2 |
| Row 3 Column 1 | Row 3 Column 2 |
| Row 4 Column 1 | Row 4 Column 2 |
| Row 5 Column 1 | Row 5 Column 2 |
| Row 6 Column 1 | Row 6 Column 2 |

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| **Standards and stakeholder expectations** | |
| --- | --- |
| **Process** | **Standards and stakeholder expectations** |
| Row 2 Column 1 | Row 2 Column 2 |
| Row 3 Column 1 | Row 3 Column 2 |
| Row 4 Column 1 | Row 4 Column 2 |
| Row 5 Column 1 | Row 5 Column 2 |
| Row 6 Column 1 | Row 6 Column 2 |

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| **Quality assurance activities** | | |
| --- | --- | --- |
| **Activity** | **Process** | **Description of activity** |
| Row 2 Column 1 | Row 2 Column 2 | Row 2 Column 3 |
| Row 3 Column 1 | Row 3 Column 2 | Row 3 Column 3 |
| Row 4 Column 1 | Row 4 Column 2 | Row 4 Column 3 |
| Row 5 Column 1 | Row 5 Column 2 | Row 5 Column 3 |
| Row 6 Column 1 | Row 6 Column 2 | Row 6 Column 3 |

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| **Quality assurance schedule** | | |
| --- | --- | --- |
| **Activity ID** | **Person responsible** | **Location** |
| Row 2 Column 1 | Row 2 Column 2 | Row 2 Column 3 |
| Row 3 Column 1 | Row 3 Column 2 | Row 3 Column 3 |
| Row 4 Column 1 | Row 4 Column 2 | Row 4 Column 3 |
| Row 5 Column 1 | Row 5 Column 2 | Row 5 Column 3 |
| Row 6 Column 1 | Row 6 Column 2 | Row 6 Column 3 |

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**Topic:** Quality Planning Outputs

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Planning project human resources

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# SkillBrief

# Human Resource Responsibilities

A project team consists of all the people in an organization who are involved in a project. Each member of the project team is assigned particular roles and responsibilities for completing the project. Together, the people in the project team carry out all the planning and work required to complete a project.

#### Responsibilities of the project management team

The project management team is a subset of the project team. This team is also sometimes called the core, executive, or leadership team. It includes all the people responsible for project management and leadership. A project management team can include several people for larger projects, or fewer people for smaller projects. The project manager, though, is always a member of this team.

There are two kinds of projects that explain how the project management team may be composed:

* **larger projects** – For a large project, the project sponsor is at the top in terms of authority. The project management team, which can include a large number of members in addition to the project manager, is one level below. The project staff, which includes the people who'll carry out project work, fall under the project management team.
* **smaller projects** – For a small project, the sponsor is at the top, and the project management team may include only two or three members – or even consist of just the project manager.

The project sponsor works with the project management team, typically assisting with matters such as project funding, clarifying scope, monitoring progress, and influencing others in order to benefit the project.

Other functions that are part of the sponsor's role in a project include

* approving the project plan, schedule, and budget
* verifying the project's progress
* chairing the project's steering committee
* approving the final project deliverables
* communicating with external stakeholders about the project

One of the main responsibilities of the project management team in terms of human resources is providing leadership and project management. This is required during all the stages of a project. Another responsibility of the management team is influencing the project team. This involves using influence, power, and politics to ensure the project team and other stakeholders meet project objectives, on time and within the approved budget. Other factors the project management team may influence include the team environment and culture, communications among stakeholders, and other similar "people" factors.

The project management team is also responsible for modeling professional and ethical behavior, and ensuring all team members know what's expected in terms of their behavior.

#### Responsibilities of the project manager

Although all members of the project management team share responsibilities for managing human resources, it's the project manager who's expected to play the greatest role. The first of the two primary human resource responsibilities of the project manager is managing the project team.

Managing the project team has three key aspects:

* acquiring the right team members during the planning stage
* developing the members of the project team and ensuring the team performs at the best possible level
* managing changes to the make-up of the project team throughout the life of the project

One of the challenges related to managing a project team is that project teams are usually dynamic. In other words, individuals are brought onto the team as a project progresses to meet specific requirements, and moved off the team once their particular work is completed.

A dynamic project team enables more efficient use of resources, and keeps human resource costs to a minimum. This is because people join the team only when there is work for them to do. Also, once particular human resources aren't needed any longer for a project, they can be reassigned to other projects or ongoing work.

The second primary responsibility of the project manager in terms of human resources is to integrate all human resources decisions with decisions in the other project management knowledge areas. This means assessing how any changes to human resources – during planning or execution – impact other areas of the project, and the project overall.

Similarly, the project manager has to consider how changes in other areas – such as time, cost, scope, risk, procurement, and communication management – will impact human resources.

It's very important that project management be an integrated process. This means that management activities must be unified and coordinated across all the knowledge areas and processes. In particular, human resources management has to integrate with time, cost, scope, risk, procurement, and communication management.

The project management team includes everyone involved in managing a project. Its responsibilities in terms of managing project human resources include providing leadership and project management throughout a project, influencing the project team, and modeling professional and ethical behavior.

The project manager, who is a member of the management team, is responsible for acquiring and developing the project team, and for managing changes to the team. The project manager is also responsible for ensuring that all human resource decisions are integrated with the other project management knowledge areas.

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# SkillBrief

# Human Resource Management Processes

Dividing all the aspects of Human Resource Management into specific processes can help ensure each of the aspects is handled correctly, and that none are overlooked.

The Project Human Resources Management knowledge area includes four processes.

#### Develop Human Resource Plan

The Develop Human Resource Plan process helps identify and document project roles, responsibilities, required skills, and reporting relationships. It also involves developing a staffing management plan for the project. The inputs for the Develop Human Resource Plan process – activity resource requirements, enterprise environmental factors, and organizational process assets – all affect how a project manager plans a project's use of human resources.

#### Acquire Project Team

This is the process of confirming the availability of human resources, and then assembling the team necessary to complete the project work. During the process, project managers recruit, hire, and orient project team members. Project managers use the project management plan, as well as enterprise environmental factors and organizational process assets, as inputs for the Acquire Project Team process. This information is then used to develop the outputs of project staff assignments, resource calendars, and project management plan updates.

#### Develop Project Team

This is the process of improving team members' competencies, team interaction, and the overall team environment to enhance project performance. As inputs for the Develop Project Team process, project managers use the project management plan, as well as staff assignments and resource calendars, which are outputs from the Acquire Project Team process. The process outputs are team performance assessment and updates to enterprise environmental factors

#### Manage Project Team

The Manage Project Team process helps keep track of team members' performance and helps manage it by providing feedback and resolving issues. It also involves managing changes to the project team. The Manage Project Team process involves using several inputs to guide the work of the project team. Outputs of the process include change requests for resolving issues and updates to the project management plan. They also include updates to enterprise environmental factors, and updates to organizational performance assets like appraisal systems and lessons learned databases.

Each of the Human Resource Management processes interacts with the project management process groups in a specific way. The project management process groups include:

* **Initiating process group** – includes the processes necessary for formally authorizing the beginning of a new project.
* **Planning process group** – the project management plan is developed through this process group. Information is gathered to develop the project schedule, and the project's scope and cost is identified, defined, and detailed.
* **Executing process group** – consists of processes for coordinating people and project resources. It is primarily involved with integrating and performing project activities. Also, if need be, the project's scope is addressed, and where necessary the approved changes are implemented.
* **Monitoring and Controlling process group** – processes are used to evaluate work performance data, identify potential problems, and control the subsequent changes.
* **Closing process group** – performed to officially end a project or a project phase. They include handing off the completed deliverables or closing a project that has been canceled.

The Develop Human Resource Plan process fits in the Planning process group because it involves developing the human resource plan – a subsidiary plan of the overall project management plan. The remaining three Human Resource Management processes – namely, Acquire Project Team, Develop Project Team, and Manage Project Team – all fall in the Executing process group. This is because they all involve carrying out – or executing – the human resource plan.

The four processes that make up the Project Human Resources Management knowledge area are Develop Human Resource Plan, Acquire Project Team, Develop Project Team, and Manage Project Team.

The Develop Human Resource Plan process belongs in the Planning process group because this is when the human resource plan is developed. The remaining processes fall under the Executing process group because they all involve carrying out – or executing – the human resource plan.

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**Topic:** Human Resources Management and the Process Groups

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# SkillBrief

# Influences of Human Resources

#### Human resource planning

During the Develop Human Resource Plan process, you identify and document human resources with the skills needed for a project.

Your human resource plan should contain a description of:

* **the different roles and responsibilities of the project team** – The roles and responsibilities of each project team member are identified and documented. Additionally, the positions, skills, and competencies required are documented and linked to individuals and groups who will work on the project. The reporting relationships between team members are also set out.
* **a staffing management plan** – The staffing management plan details how staff will be acquired, managed, trained, and – once their tasks are completed – released. It outlines the time periods for which each project team member will be required and identifies training needs for individuals and groups working on the project. It may also include team-building strategies, plans for recognition and rewards programs, compliance considerations, safety issues, and details of the impact of the staffing management plan on the organization.

An important part of human resource planning is working within constraints imposed when there's a limited supply of skilled resources. Even if it seems enough qualified people are available on paper, there's often competition for these resources among different projects or for use in ongoing work.

It's vital to determine any constraints on the availability of resources, both internally and in terms of third-party organizations or contractors. These constraints can significantly affect project costs, risks, quality, and the project schedule. To minimize the impact of the human resource constraints, you need to plan for these issues and develop ways to accommodate them.

#### Inputs for the human resource plan

The key inputs to the Develop Human Resource Plan process are the

* **activity resource requirements** – Activity resource requirements outline the resources, including types and quantities, that are required to complete the schedule activities in each work package. The initial human resource and competency requirements are progressively elaborated throughout the human resource planning process.
* **enterprise environmental factors** – A wide range of factors within the enterprise environment may affect the availability and use of human resources for a project. Examples are an organization's existing human resources and personnel administration policies, marketplace conditions, and organizational culture and structure.
* **organizational process assets** – Organizational processes and policies, lessons learned, and tools developed in past projects are stored as organizational process assets. These may guide or assist you in human resource planning. Historical information on successful organizational structures can be useful in the human resource planning process. Templates for creating organizational charts and roles and responsibilities documents may also be available. Categories of enterprise environmental factors that act as inputs to human resource planning include organizational culture and structure, existing human resources, personnel administration policies, and marketplace conditions. Organizational process assets that are used as inputs in human resource planning include templates and checklists. Templates used in this process include project organization charts, position descriptions, performance appraisals, and a standard conflict management approach. Checklists used pertain to roles and responsibilities, team ground rules, competencies, training programs, and safety and compliance issues.

The Develop Human Resource Plan process involves identifying and documenting human resources with the skills needed for a project, and creating a human resource plan. This plan contains a description of all the roles and responsibilities of the project team, and a staffing management plan. It should take into account potential constraints on the availability of resources.

The inputs to this process include activity resource requirements, enterprise environmental factors, and organizational process assets.

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# Roles and Responsibilities of the Project Team

#### Recording roles and responsibilities

Organizational charts and position descriptions are what you use to identify project roles and responsibilities. This information can be formatted in

* **hierarchical-type organizational charts** – which display information graphically in a top-down format. An example of this type of chart is an organization breakdown structure, which identifies the position of each department or work team in an organizational hierarchy.
* **matrix-based responsibility charts** – which graphically display the links between work that must be performed and the project team members responsible for the work. An example is a responsibility assignment matrix (RAM).
* **a text-oriented format** – which presents detailed descriptions of team member roles, responsibilities, and authority levels. Often a document known as the role-responsibility-authority form, or as a position document, is used for this purpose.

#### Organizational breakdown structure

You can use the organizational breakdown structure, responsibility assignment matrix, and text-based position descriptions as part of developing a human resource plan. Each of these tools has strengths and weaknesses, and so is used for different purposes.

An organizational breakdown structure shows the positions and reporting relationships for the entire project team at a glance, in a graphic, top-down view. The advantage of this tool is the speed at which it enables team members to find information.

#### Responsibility assignment matrix

Matrix charts make it easy for team members to check all the project activities for which a particular person is responsible, or all the people associated with one deliverable.

The responsibility assignment matrix links work packages from the project's work breakdown structure to the resources listed in the organizational breakdown structure. A low-level or detailed matrix includes the bottom-level work packages from the work breakdown structure. So it contains a column for each work package. A high-level responsibility assignment matrix may show key project phases or deliverables only, and list departments rather than individuals.

#### RACI charts

The most common type of responsibility assignment matrix is the RACI chart. This lists work packages from the work breakdown structure down one side, and the names of resources from the organizational breakdown structure across the top. One of four letters identifies each person's roles and responsibilities. These are:

* **R for Responsible** – The letter "R" identifies the person who owns an activity or is responsible for performing the work it includes.
* **A for Accountable** – The letter "A" identifies who must sign off or approve work before it is effective – in other words, the person who is accountable for successful completion of a deliverable or work package.
* **C for Consult** – The letter "C" identifies who has information or the capability needed to complete a deliverable or work package. It shows who should be approached to provide input to the work or to decisions that need to be made during an activity.
* **I for Inform** – The letter "I" identifies who must be informed of the progress or results of an activity, or of decisions associated with it. This person doesn't necessarily need to be consulted before work on the activity starts.

#### Text formats

Documents that outline project roles and responsibilities using a text-oriented format contain much of the same information as charts or matrixes.

But because you aren't confined in terms of space, you can fit more detail into these sections:

**position titles section** – helps identify roles

**competencies section** – includes the skills and knowledge required for particular positions

**qualifications section** – identifies technical diplomas, degrees, and years of experience, or other qualification sets, that are required for specific roles or positions

**specific responsibilities section** – specifies the work that each project team member is expected to perform toward completing the project's activities

**authority section** – specifies who has the right to apply project resources, make decisions, and sign approvals

#### Networking and organizational theory

Interacting informally with others is a valuable way of gaining insight into the political and interpersonal dynamics that will influence staffing effectiveness. Networking is a useful technique at the beginning of a project. It is also effective in enhancing project management during the project, and after the project ends.

The PMBOK® Guide lists several examples of networking that can assist in human resource planning. These are proactive correspondence, luncheon meetings, and informal conversations – including those at meetings and events, trade conferences, and symposia.

Organizational theory provides information about how individuals and teams behave. This knowledge can be applied to the creation of roles and responsibilities within a project. A key factor in influencing team and individual behavior is organizational structure.

The structures that affect how project teams and their members perform are

* **functional** – In a functional organization, the focus is on functional departments and project team members are often "borrowed" from these departments.
* **projectized** – In a projectized organization, the focus is on project teams. Employees may work full-time on projects. They may also work on more than one project at a time.
* **matrix structures** – In matrix organizations, team members often work on the same team and the reporting structures are typically unambiguous. This generally improves productivity and team dynamics.

Tools and techniques for the Develop Human Resource Plan process include organizational charts and position descriptions, networking, and organizational theory.

Organizational charts and position descriptions identify the roles and responsibilities of project team members in terms of project activities. They include hierarchical charts, matrix tables, and text-based position documents. The most common matrix table is the RACI table, which links tasks and resources with roles and responsibilities.

Networking helps project managers learn more about prospective staff members' capabilities and availability from those who work with them.

Organizational theory sheds light on how different organizational structures affect team performance and interpersonal dynamics. This knowledge can be used to provide insight into the factors that will influence staffing effectiveness.

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**Topic:** Assigning Project Team Roles and Responsibilities

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# Information Included in a Human Resource Plan

The Develop Human Resource Plan process results in one output - a plan that documents how human resources will be used in the project. This plan becomes part of the overall project management plan, providing guidance on how human resources should be defined, managed, controlled, and eventually released.

There are three key sections to any human resource plan.

### Roles and responsibilities section

The roles and responsibilities section of the human resources plan should contain four key areas of information:

* **roles** – A role is a defined function – such as testing, inspecting, or coding – to be performed by a project team member.
* **authority** – Authority is the right to apply project resources, use project funds, make decisions, or grant approvals. Team members' levels of authority should match their individual responsibilities.
* **responsibilities** – The responsibilities of project team members define the work they're expected to perform as part of completing the project's activities.
* **competencies** – Competencies are the skills team members need to perform project activities.

### Project organizational chart

The project organizational chart displays the reporting relationships of project team members. The human resource plan may contain just one chart that gives an overview of the entire project team, or more detailed charts representing different functional groups within a project.

The components are the organizations or departments that will be involved in the project, the current working arrangements among the organizations or departments, and the formal and informal relationships among project team members.

### Staffing management plan

The staffing management plan describes the timing and methods that will be used to meet human resource requirements. It may be formal or informal, and broad or detailed, depending on the needs of a particular project. It is updated to reflect changes that occur as a project progresses.

There are seven components to any staffing management plan.

#### Staff acquisition

The staff acquisition component specifies how team members will be acquired, and what assistance is required from the Human Resource Department in terms of recruiting and resource assignment decisions. This section states whether resources will be sourced internally or externally, and whether they will work from a central location. It also outlines the budget for acquiring project staff.

#### Staff release plan

The release criteria component outlines the methods and timelines for releasing project team members. Team morale is improved when there is a plan in place for transitions to upcoming projects, and this type of plan also helps ensure that funds for resources are used optimally. By planning how staff will be acquired and released, you help to boost staff morale and confidence, which ultimately leads to improved productivity. Additionally, the staff acquisition and release plans clarify the responsibilities of the project manager and of the Human Resource Department in terms of acquiring and releasing project staff.

#### Resource calendar

The resource calendar provided in a staffing management plan is a histogram charting when project team members will be needed for the project. So it identifies when resources will join and leave the project. It also outlines when acquisition activities – such as recruiting – should begin. It may be broad, provide limited details, or be highly detailed.

#### Training needs

If the team members to be assigned to a project don't have the required competencies, it may also outline a training plan.

#### Recognition and rewards

The staffing management plan may include criteria for rewards and recognition to help keep project team members motivated. It is best to set up a reward or recognition system at project start so that staff know what to expect and the rewards can be planned as part of the schedule or budget. And, to be effective, recognition and rewards should be based on activities and performance that are under team members' control.

#### Compliance

The Human Resources Department is ultimately responsible for ensuring employment activities comply with government legislation, union contracts, and the company's human resource policies. However, project managers need to take these compliance issues into account when preparing the staffing management plan. Some areas to consider include anti-discrimination legislation, family and medical leave, and military leave. Anti-discrimination legislation ensures project staff members are not treated unfairly based on race, religion, disability, age, gender, or other protected classes. Your staffing management plan should show what steps you have taken to make sure your project does not exclude individuals from protected classes. It may include strategies for accommodating staff members who you know are leaving for or returning from medical leave during the life of the project. Also, the plan may contain strategies for handling replacement of team members should any of them be called to active duty and require military leave.

#### Safety

The staffing management plan may include a safety component that outlines procedures and processes for protecting team members from safety hazards. Work on a range of different project types could pose safety threats to project team members. These may include construction projects, research and development projects, or projects occurring at hazardous sites. For construction projects, the use of appropriate safety equipment and clothing are requirements. The safety section of the plan should outline these requirements. If electrical work is involved, it may also outline required safety precautions for working with electricity. Some research and development projects require staff members to work with dangerous chemicals or substances. Best practices and safety equipment requirements should be spelled out in the safety component of the staffing management plan. When staff are expected to work at hazardous sites, such as where oil spills from tankers have occurred or in earthquake zones, hazard regulations and best practices should be covered in the safety section of the staffing management plan.

As a project progresses, the human resource plan may be updated as changes occur.

The human resource plan is the only output of the Develop Human Resource Plan process. It should include three components – a roles and responsibilities section, organizational charts, and a staffing management plan.

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**Topic:** The Human Resource Plan

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# SkillBrief

# Acquire Project Team Inputs and Techniques

### Inputs for acquiring a team

The project management plan is the first input to the Acquire Project Team process. In particular, it contains the human resource plan.

To find the right people for your team, you first have to know what skills and how many individuals are required, and for how long. The bulk of this information is available in the human resource plan.

This plan contains details of

* **team roles and responsibilities** – To acquire appropriate people to work on a project, you have to know what roles and responsibilities they'll have to fulfill. The roles and responsibilities component of the human resource plan contains descriptions of the roles that must be included on the project team, and their associated responsibilities, competencies, and levels of authority.
* **project organizational charts** – Project organizational charts outline the reporting structures within the project team and the organization. They can help make it clear what positions, and how many, are needed for the team.
* **the staffing management plan** – The staffing management plan includes the times, dates, and durations for which particular resources will be needed. The resource calendar in the plan also outlines how many resources are required for each activity. So as an input, the plan identifies how many human resources you need to acquire, the skills they must have, and the periods for which the different resources are needed.

In addition to the project management plan, the following serve as important inputs to the Acquire Project Team process:

* **organizational process assets** – include documented policies, guidelines, procedures governing staff assignments, or historical data from past projects. They provide information about the departments and processes involved in recruiting, hiring, outsourcing, training, and orienting team members.
* **enterprise environmental factors** – include the availability, costs, abilities, interests, and experience of potential team members. Your company's location or the fact that it has multiple locations will also affect the process of acquiring human resources.

Ultimately, taking the time to acquire project team members with the right skills provides the foundation for achieving project goals.

### Tools and techniques

Once you have information about the team required to complete a project successfully, you can use the tools and techniques of the Acquire Project Team process to ensure that the process of assembling this team goes smoothly.

#### Pre-assignment

Pre-assignment involves selecting project team members in advance. This occurs if particular workers have unique expertise or skills, if a client has requested a specific employee, or if someone has been promised involvement in a project. When the involvement of specific staff members is promised as part of a project proposal, these staff should be identified in the project charter.

#### Negotiation

You may need to persuade internal functional managers or managers of other projects to release people for your project team. You may also need to persuade external organizations to provide resources on a contractual basis. These negotiations hinge on the availability and skills of the resources. When negotiating, be sure to discuss the skills and personal characteristics of the team members you want on your project.

Negotiating for staff can be politically complicated. There are four basic steps you can follow:

1. **pick your "dream team"** – You should go through the work breakdown structure and staffing management plan and pick the best possible candidates for each task. You should also select one or two other potential candidates to fall back on if the ideal candidates are unavailable.
2. **identify potential barriers** – Barriers to acquiring the best possible team members may include availability issues, relationships with managers, your level of authority, and the organizational structure of your company. Identifying the barriers is the first step in overcoming them.
3. **plan your negotiation strategy** – Your ability to influence others plays an important role in negotiating staff assignments, as do the politics of the organizations involved. Taking into consideration the barriers you face in getting the team you want, you should plan a negotiation strategy carefully before putting it into action.
4. **negotiate for the team** – Once you've planned a strategy, you need to negotiate to secure the human resources you've identified as the most suitable. It's best to start by negotiating for the individuals who are most critical for a project. You can then work your way through your list until you have all the people that are required.

#### Virtual teams

A virtual team is a group of people who work primarily off-site and interact via electronic means. Creating a virtual team enables project managers to acquire team members regardless of their locations, mobility, and working hours. It makes it unnecessary to rule out people with required skills who have other work commitments, and eliminates travel expenses for the team members.

You can acquire in-house staff from geographically dispersed branches or divisions of the organization. To function, this type of team will need to collaborate using technology and applications that facilitate remote collaboration. Communication plays a vital role in the health of a virtual team. Because communication is so critical, it can be a weakness of the strategy.

When working with a virtual team, a project manager needs to communicate current and up-coming tasks, specifying who will be responsible for carrying them out. The manager also needs to state the exact processes for getting the work done and outline hand-off procedures. This is to ensure no deliverables or required activities fall through the cracks. Additionally, the project manager should ensure that any conflicts or issues are resolved quickly and should acknowledge the accomplishments and contributions of individual team members.

#### Acquisition

If an organization lacks the in-house human resources to complete a project, it will be necessary to acquire external resources. Acquisition involves contracting staff from third-party organizations.

To get best possible project team, you use the project management plan, organizational process assets, and enterprise environmental factors as inputs for the Acquire Project Team process.

You then acquire the team using one or more tools and techniques – pre-assignment, negotiation, use of virtual teams, and acquisition.

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**Topic:** Techniques for Acquiring Human Resources

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# Acquire Project Team Outputs

**Outputs**

Once negotiations are finalized and all project staff assignments have been made, you are set to generate the outputs of the Acquire Project Team process:

* **project staff assignments** – Project staff assignments are published in a project team directory. They may also be documented in memos and plan documents, such as project organization charts, RACI matrices, and in project schedules and resource calendars.
* **a resource calendar** – The resource calendar documents the time periods for which each project team member can work on the project. This document is a key input to the Estimate Activity Resources process, which occurs in the Project Schedule Management knowledge area.
* **project management plan updates** – The project management plan may need to be updated due to unforeseen staffing issues or initial failure to acquire all the needed team members. Various parts of the staffing management plan – such as release criteria, and training needs – may also need to be updated because the plans for acquiring team members conflict with the realities. Similarly, roles and responsibilities or the organizational chart may need to be updated to reflect project realities.

#### Updating human resource plans

The human resource plan will need to be updated whenever there is a project change that impacts work assignments. This includes updates to the roles and responsibilities section of the plan, the project organizational chart, and the staffing management plan.

Typically, you need to update the human resource plan throughout the life of a project, to reflect changes in the project's human resources. A wide range of scenarios may result in your having to update the plan. For example, you may need to replace members of the project staff, adjust staffing levels to respond to changes in project scope or the schedule, or release staff due to budget cuts.

The "Compliance" section of the staffing management plan is less dependent on specific staffing changes. However, this component may have to be updated to reflect external changes related to organizational policies, government regulations, or union contracts.

The outputs of the Acquire Project Team process include project staff assignments, a resource calendar, and project management plan updates. Assignments are recorded in the program team directory. The resource calendar identifies when staff are available for project work.

Changes in the project that affect who is assigned to tasks, staff numbers, or when staff are expected to work may affect the human resource plan. You may need to update the roles and responsibilities component, the project organizational chart, and the staffing management plan to reflect these changes.

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**Topic:** Recording Human Resource Assignments

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# Follow-on Activity

# Factors Influencing HR Planning

**Purpose:** Use this follow-on activity to investigate the enterprise environmental factors and organizational process assets that affect human resource planning in your company.

**Instructions for use:** To use this tool, use the checklist provided as a guide to identifying the factors that influence human resource planning in your company and then add any additional items you discover to the list.

| **Checklist of influencing factors** | | |
| --- | --- | --- |
| **Checkbox** | **Influencing factor** | **Notes** |
| Row 2 Column 1 | Existing human resources | Row 2 Column 3 |
| Row 3 Column 1 | Personnel administration policies | Row 3 Column 3 |
| Row 4 Column 1 | Market place conditions | Row 4 Column 3 |
| Row 5 Column 1 | Organizational culture and structure | Row 5 Column 3 |
| Row 6 Column 1 | Historical data | Row 6 Column 3 |
| Row 7 Column 1 | Organizational templates | Row 7 Column 3 |
| Row 8 Column 1 | Company policies | Row 8 Column 3 |
| Row 9 Column 1 | Company procedures | Row 9 Column 3 |
| Row 10 Column 1 | Row 10 Column 2 | Row 10 Column 3 |
| Row 11 Column 1 | Row 11 Column 2 | Row 11 Column 3 |
| Row 12 Column 1 | Row 12 Column 2 | Row 12 Column 3 |
| Row 13 Column 1 | Row 13 Column 2 | Row 13 Column 3 |
| Row 14 Column 1 | Row 14 Column 2 | Row 14 Column 3 |

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# Follow-on Activity

# Acquiring the Project Team

**Purpose:** Use this follow-on activity to identify the techniques for acquiring human resources that are being used in a current project within your company.

**Instructions for use:** To use this tool, research the techniques that were used on a previous project or that are being used in a current project in your organization. Use the questions to guide you in understanding how and why each technique was used.

### Pre-assignment

#### Selecting project team members in advance

Does the project charter list specific people for the project?

Did the client specify people for the project in the contract?

Are there any workers with unique skills that were earmarked for the project?

### Negotiation

#### Negotiating with managers or third-party organizations for team members' skills and availability

Who was approached for team members?

What arguments were put forward for specific team members?

Who had the authority to permit team members to be assigned to the project?

What skills were negotiated for?

### Virtual teams

#### Working with dispersed groups using collaborative software and electronic communication

Is there a virtual team within the project?

Where do different team members work from?

What collaborative software, such as email or chat forums, are available to the team for sharing resources?

How often do the team members meet – either in person, or by conference call?

How do they communicate?

What processes do they follow?

### Acquisition

#### Sub-contracting or hiring third-party consultants

Is any of the project work sub-contracted out?

Have any external consultants or contract workers been hired for project work?

If so, why was the acquisition made? Was this due to a lack of in-house skills? Or a lack of available in-house staff?

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**Topic:** Techniques for Acquiring Human Resources

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# Learning Aid

# E-mail Communication

**Purpose:** Use this learning aid to review an example of an end-of-day e-mail the project manager sends to all members of a virtual team.

Hi team,

Congratulations on getting the first component through – it is looking good so far. If you have any problems with the next section, please let me know.

A reminder about processes – when updating shared documents on the project site, please remember to check out the document before you open or update it. If you do make any changes, please remember to e-mail me, and cc Candice, Billy, and Jean.

Our conference call will be held on Tuesday 10:30 EST. We will be discussing the product's Bluetooth functionality and menu options. Please read through the attached document to prepare for the call.

Kind regards

Darryn

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**Topic:** Techniques for Acquiring Human Resources

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# Job Aid

# How Human Resource Changes Can Impact a Project

**Purpose:** Use this job aid for examples of how human resource changes can impact a project.

| **How human resource changes can impact a project** | | | |
| --- | --- | --- | --- |
| **Area** | **Change** | **Impact** | **Explanation** |
| Project Time Management | Acquiring new staff | Activity durations | Activity durations may be affected because people work at different speeds, and if you choose to put more than one resource on a task to cut duration |
| Project Time Management | Re-assigning resources to activities | Schedule updates | The schedule may have to be updated due to changes in resourcing needs on other projects, or people taking unplanned leave |
| Project Cost Management | Acquiring new staff | Activity costs | Activity costs may change with new staff because staff members have varying salary ranges |
| Project Cost Management | Stacking resources on a task to meet a deadline | Increases costs | Because where you budgeted for one resource, you now have to pay for two or more to complete the task |
| Project Scope Management | Acquiring staff with less expertise or qualifications | Update WBS | You need to add a "Training" deliverable to the WBS, as part of the work involved in project management |
| Project Risk Management | Acquiring new staff | New quality risk | Low levels of experience increases the risk of error |
| Project Risk Management | Acquiring new staff | Schedule risk | Individuals who work at a relatively slow pace increase schedule risk |
| Project Risk Management | Acquiring new staff | HR risk | A new team member's personality may increase or decrease the risk of conflict within the project team |
| Project Procurement Management | Acquiring staff internally | Update procurement management plan;   Update budget | Eliminates the need to contract externally, which may in turn affect costs |
| Project Procurement Management | Losing key team member(s) | Contractual obligations | Contractual obligations may be affected if your company won a contract based on a guarantee of the involvement of certain individuals with special expertise |
| Project Communications Management | Acquiring new staff | Update communication management plan and list of internal project stakeholders | The names of individuals who require information and who will send information within the project team must be updated |

Consider this example. You hire Joe as a programmer to replace someone who has had to leave the project team. Joe is the only person you can find on short notice. His hourly rate is twice that of the person he's replacing, but he works almost twice as fast. Because he's a Java and SQL whiz, you don't need to contract an external expert you were going to need to review code. You also won't need to train Joe in the use of Flash like you were going to have to do with the other person who left.

As well as updating HR-related documents, there are several changes you will have to make to accommodate the addition of Joe to the team.

First you will need to make changes to the budget to account for the higher rate Joe charges, and for the decreased training and procurement costs.

You make changes to the project schedule to account for decreased programming durations and the removal of training time.

In the WBS, you remove the training and procurement activities that are no longer required.

In the risk management plan, you note the decreased threat – or increased opportunity – that this change could result in.

Finally, you add Joe to the communication management plan, and remove the name of the person he replaced. You also do this in all other relevant documents.

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# Job Aid

# Staffing Management Plan

**Purpose:** Use this job aid to review the components of a staffing management plan.

|  |  |
| --- | --- |
| **Staffing management plan components** | |
| **Staff acquisition** | The staff acquisition component outlines the plan for acquiring human resources for the project. For example, it outlines whether human resources will come from within the organization or from external, contracted sources. |
| **Resource calendar** | The resource calendar component details when project team members will be needed for the project. It also outlines when acquisition activities, such as recruiting, should begin and when staff will be released. |
| **Staff release plan** | The release criteria component outlines the methods and timelines for releasing project team members. Team morale is improved when there is a plan in place for transitions to upcoming projects. |
| **Training needs** | The training needs component ensures that team members have the needed competencies to fulfill their role within the project. This plan may include start-up training to orient team members, training in new technology, additional qualifications for team members, and ongoing assessment of training needs. |
| **Rewards** | The rewards and recognition component should include the criteria for staff to earn rewards or recognition. To be effective, recognition and rewards should be based on activities and performance under a team member's control. |
| **Compliance** | The compliance component should include strategies to ensure that staffing practices within the project comply with government regulations, union contracts, and other human resource policies. |
| **Safety** | The safety component outlines procedures and processes that safeguard team members from safety hazards. |

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**Topic:** The Human Resource Plan

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# Job Aid

# Acquiring Human Resources

**Purpose:** Use this job aid to review the tools and techniques used in the Acquire Project Team process.

|  |  |
| --- | --- |
| **Acquire Project Team tools and techniques** | |
| **Pre-assignment** | Pre-assignment entails assigning project team positions in advance. This occurs if workers have expertise or unique skills, if a client has requested a specific employee, or if someone has been promised involvement in the project. When staff members are promised as part of the project proposal, they should be identified in the project charter. |
| **Negotiation** | You may need to persuade internal functional managers or project managers to release people for a team. You may also need to persuade external organizations to provide resources on a contractual basis. These negotiations hinge on the availability and skills of the resources. When negotiating, be sure to discuss the skills and personal characteristics of the team members you want on your project. |
| **Virtual teams** | Creating a virtual team enables project managers to acquire team members regardless of location, mobility, travel expenses, working hours, and other commitments. Proactive communication is required to ensure that processes are followed and to keep the team cohesive. |
| **Acquisition** | If an organization lacks the in-house staff resources to complete a project, it is often necessary to acquire external staff resources. This is usually done by hiring consultants, or by subcontracting elements of the project work. |

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**Topic:** Techniques for Acquiring Human Resources

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Managing project human resources

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# SkillBrief

# Developing a Project Team

### The Develop Project Team process

The Develop Project Team process falls under the Project Human Resource Management knowledge area. Its aim is to develop an open environment that promotes teamwork. The PMBOK® Guide describes this process as, "improving the competencies, team interaction, and the overall team environment to enhance project performance."

To develop your team, you should be mindful of a few objectives:

* **improving knowledge and skills** – When choosing your team, you ensure that your team members have the knowledge and skills to do their jobs. However, these skills can and should always be improved upon to help increase quality of work. Project deliverables become easier and faster to attain, while costs decrease.
* **encouraging trust and agreement** – You need to create a sense of trust and agreement between team members so that they find it easier to work together. You also promote cultural diversity with trust and agreement.
* **creating a dynamic and unified team** – A dynamic and unified team boosts team productivity, encourages collaboration, and gets everyone to work for a common cause. Team members are more likely to share their knowledge and skills.

As well as being aware of the objectives of developing a project team, you need to know what activities and responsibilities will help you achieve those objectives.

You have these responsibilities for developing your team:

* **motivating the team** – You challenge your team, provide constant motivation, and boost its morale by presenting it with new opportunities. Part of motivating a team is to provide feedback to team members so they know how they are performing, and recognize and reward good performance.
* **encouraging high performance** – You encourage high performance by developing good communication and trust among team members, improving members' skills, and implementing an effective conflict resolution system. This encourages collaboration and problem solving, and reduces discord.

In today's multicultural world, you will likely have team members from vastly different backgrounds.

Cultural diversity presents an opportunity to capitalize on the advantages that multicultural team members bring.

A culturally diverse team can add value to a project in many ways:

* provides unique ways of thinking and problem solving
* generates original, collaborative ideas
* better fulfills the needs of the multinational customer

It's important to focus on the development of the team as a whole. But promoting individual development is an equally important responsibility. This means providing individuals on your team with opportunities to further develop and enhance their skills and knowledge. This way, they will feel appreciated and will be motivated to perform better.

Team development requires the right resources. Some may be readily available, but some may be difficult to obtain, especially if they involve additional costs. So it's up to you as project manager to get help from higher management or stakeholders when you need those resources.

If you have been successful, your team will display these characteristics:

* energetic and enthusiastic
* motivated
* creative
* good problem solvers
* trusting of each other and you

Taking the time to develop your project team helps you achieve a highly effective team that produces high-quality results.

### Inputs to developing a project team

To carry out the Develop Project Team process, you need to gather three inputs:

* **project staff assignments** – tell you who is on the team. You can gather this information through documentation such as the project team directory
* **the project management plan** – contains the human resource plan, which provides guidance for developing, defining, managing, and controlling a project's human resources.
* **resource calendars** – chart the exact times team members are engaged in project activities, on vacation, or busy with other tasks. You then schedule team development activities when team members are available.

These inputs help you get to know your team members and their skills. They are a valuable source of information, so you should keep them at hand as you go ahead with team-development.

#### The human resource plan

The key areas of information in the human resource plan that provide input to this process are:

* **the project roles and responsibilities –** contain information about each team member's role on the project, the level of authority, responsibilities, and competencies. When developing the team, this information helps predict how team members will interact. It also helps you identify opportunities for professional development, recognition, and reward.
* **the project organization chart** – graphically represents the team members and their relationships. You can examine this chart to identify the natural subgroups within a team. This can help when planning team-building exercises or other development activities.
* **training needs –** identify team members who may need training and can also show how team members can achieve certifications that may benefit the whole project. This is important to team development because it accounts for the need to improve upon team members' skills.
* **project team development plans –** include training and reward strategies aimed at developing the project team as a whole. Corporate outings and team-building activities qualify as project team development plans. These encourage team work and group success.

A staffing management plan forms part of the human resource plan. This document details how and when staffing requirements are met.

The human resource plan is a dynamic source of information. It can be changed as the project progresses and as you get to know your team members and their needs.

The Develop Project Team process ensures competent, motivated team members and encourages teamwork. A project manager's objectives should be to improve knowledge and skills of members, encourage trust and agreement among them, and create a dynamic team.

To carry out the Develop Project Team process, you need project staff assignments, the project management plan, and resource calendars. Project staff assignments tell you who is on the team. The human resource plan provides information on your team members' skills and abilities. Resource calendars tell you when resources are available.

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**Topic:** Introduction to Developing a Project Team

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# SkillBrief

# Project Team Development Strategies

Developing successful teams means bringing together a team for a common goal, getting individuals to work together, and keeping them motivated. To do this, you use the tools and techniques of the Develop Project Team process.

#### Interpersonal skills

Team development begins with the project manager. To build a team, you must possess solid interpersonal skills.

You can apply different interpersonal skills to different situations. These skills are

* **listening and empathy** – When a team member is having difficulty with a task, you may need to apply these skills in a private conversation. By listening to the problem and showing concern, you can help solve the problem.
* **negotiation** – If team members come from different departments, you may need to negotiate with departmental managers.
* **persuasion and influence** – Where certain team members come from other departments, you need to use persuasion and influence to keep these members on schedule.
* **group facilitation –** In feedback sessions where all project members participate, you need to employ group facilitation skills to keep the discussions professional and beneficial.

#### Ground rules

The project manger sets ground rules, which define what behavior is expected from team members. Establishing rules has several advantages for project teams. It

* outlines the expected behavior of team members at the outset
* promotes a shared responsibility for adhering to a set of principles
* decreases misunderstandings
* increases productivity

#### Co-location

Another strategy for developing project teams is co-location. Co-location is when the project team works together in the same physical location. This can span the entire period of the project or can be implemented at strategically important times.

Some of the benefits of co-location are

* good will
* empathy
* a sense of community
* enhanced collaboration

#### Training

Training is an important part of developing a team. By training team members, individuals are better equipped to perform tasks. This benefits the team because the team's performance is better when members perform their tasks well.

There are several different ways in which training can take place. These are

* **formal, planned** – as happens in a classroom
* **formal, unplanned** – when a project manager observes a team at work, then carries out ad hoc performance appraisals
* **informal, planned** – when a senior team member is asked to mentor a junior colleague
* **informal, unplanned** – during day-to-day conversation

#### Team building

Successful teams come about when individuals work as a cohesive unit.

One way to achieve cohesion is through team-building activities, which aim to foster good working relationships by increasing the comfort level of the team.

The main goals of team building are to build trust, open communication, and leadership. As project manager, you're taking a collection of individuals and transforming them into an integrated work unit.

The life span of a team can be classified in five stages:

1. **forming** – Team members are usually more reserved and formal towards each other in this opening stage in which a team is assembled for a specific project.
2. **storming** – The team begins to address the project work and make decisions. The environment may become destructive as individuals vie for power and status.
3. **norming** – The team is more settled. Energy is focused on the work of the project, instead of personal rivalry.
4. **performing** – Team members trust each other and work well together, making it the most productive phase of the project.
5. **adjourning** – The final stage which involves completing the project and breaking up the team.

The two elements that affect the need for team building are performance and conflict. Team building becomes critical, regardless of the stage, at project initiation, during times of conflict, when significant changes are introduced, or when a new member joins the team.

#### Recognition and rewards

One of the most important aspects of team building is motivating your team to perform well.

During the Develop Project Team process, recognition and rewards are used as team development tools. These tools are planned and managed as part of two human resource management processes that occur prior to this point in the project:

* **Develop Human Resource Plan process** – the rewards and the criteria for earning them is first planned
* **Manage Project Team process** – the performance of individual team members and the team as a whole is tracked to identify excellence

Rewards and recognition are given to the relevant project members or teams.

Rewards can vary, depending on the context. Commonly, rewards are financial, but they can also include opportunities for development and application of professional skills, use of company resources, or time off.

Recognition can be private or public. Public recognition can be internal to the company, or external.

For recognition or reward to be effective, it must be given only when a desirable behavior is displayed. You should reward desirable behavior that is done voluntarily or in compliance with management objectives. But if the behavior is done to correct a team or team member's own mistake, or to make up for poor planning, you should not reward the behavior.

Recognition and rewards should be available to the team at all times.

Recognition or a reward can only be effective if its recipient values it. To ensure this, the reward needs to satisfy a need that the recipient values. To know how effective recognition or a reward will be, you need to understand the individuals on your team.

While individual rewards may be an effective motivator to bring out the best in team members, it can have a negative impact on the rest of the team. If rewards are based on performance, resentment can develop if the same people keep winning.

A good rule is not to always confine recognition and rewards to individuals.

Project managers develop teams who have a shared desire to accomplish a specific goal. To do this, they need interpersonal skills, set ground rules, introduce team-building activities, determine co-location, and conduct training. Team-building can turn a group of individuals into a cohesive unit. Teams can also be motivated by using recognition and rewards effectively.

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**Topic:** Strategies for Developing a Project Team

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# SkillBrief

# Assessing a Project Team's Performance

Synergy means that by working together towards common objectives, team members can achieve extraordinary results.

For a project team to experience the benefits of synergy, the project manager must monitor, manage, and assess its performance, and find ways to improve it. The project manager achieves this using the major output of the Develop Project Team process – team performance assessments.

There are two types of outcomes you can assess:

* **direct measures** – relate to how the project's objectives are achieved, on time and within budget. They are easily quantifiable and they indicate a project's success. You measure success directly in terms of meeting objectives, finishing on time, and on budget.
* **indirect measures** – relate to the work itself and to the people who do it. They help the team to achieve success.

You should evaluate the team's performance throughout the project so that you can detect team performance problems in time to make the changes that will keep your team's performance on track.

Continuous assessment enables the project team to meet its objectives and to improve its performance in future projects.

### Outcomes for assessing performance

Team performance assessments need to be relevant, objective, and based on measurable criteria. So the appropriate indicators to measure performance against must relate to the project's objectives, schedule, and budget.

There are two types of appropriate outcomes you can use as direct indicators of team performance:

* **task-oriented outcomes** – relate to what the team does on the job. For a task to be an appropriate indicator, team members must perform it.
* **results-oriented outcomes** – are the effects of the team's efforts or the finished product. They measure how close the team comes to meeting the project's objectives, schedule, and budget.

The goal of team performance assessment is to enable teams to achieve project success. This involves assessing the direct indicators and finding ways to improve performance. A good project manager will spend time building up the team by providing guidance, support, and encouragement so that members perform at their best.

### Indirect measures of performance

While measurable and quantifiable measures are important for performance assessment, you cannot forget indirect measures. Good team performance depends on many indirect qualities. To be able to measure these, you can divide them into

* **job-related qualities** – refer to the abilities, skills, and competencies that are required to complete assignments.
* **people-related qualities** – are the qualities that help the team perform better. Active listening skills, coaching skills, and effective communication are some important people-related qualities. When these qualities are missing, it can lead to conflict, dissatisfaction, and project failure.

One of the most useful indirect measures is the staff turnover rate. The normal cycle is to acquire and release resources, such as staff, as required. Staff turnover rate measures the numbers of individuals who voluntarily leave their employment position. The rate is especially useful because it is quantifiable.

High staff turnover can be related to both people- and job-related qualities.

Team cohesiveness is a people-related quality that depends on all the other people-related qualities such as active listening and effective communication. Observing team cohesiveness gives you a high-level overview of team performance.

Cohesiveness is indicated by a willingness to openly share information and experiences, and to help each other improve overall project performance. This is where the results of team-building efforts become useful. A cohesive team can handle stress, deadlines, and difficulty more effectively.

You should measure indirect indicators early in the project to develop a performance baseline. This baseline enables you to monitor and track improvements in the team as the project progresses. It also enables you to detect when things are going well and to take action early if they're not.

Indirect measures are often easy to observe but difficult to measure. Team performance assessments enable project managers to assess the indirect measures of performance. In particular, they help you identify weaknesses in the team.

Assessment begins with information gathering, and there are many methods that are suitable, including interviews, focus groups, and the nominal group technique.

Using questionnaires, team members first assess themselves. You evaluate the results and calculate mean scores for each question, and then complete your own assessment. From the final performance values, you develop a performance baseline. When you conduct future assessments, you compare the results against the baseline to detect changes. After each assessment, you document recommendations for improvement.

The questionnaire method provides you with some insight into team performance. You can supplement this if you observe team interactions and listen to staff feedback.

It's important to consider the implications of your recommendations, especially when they benefit the project rather than individual team members.

The other output of the Develop Project Team process are the enterprise environmental factor updates which affect these project documents:

* personnel administration records
* employee training records
* skills assessment records

The Develop Project Team process has two outputs – team performance assessments and enterprise environmental factor updates. Team performance assessments must be relevant, objective, and based on measurable criteria. Direct measures of performance are based on meeting objectives, finishing on time, and finishing on budget.

Indirect measures of team performance include both job-related and people-related qualities, staff turnover rate, and team cohesiveness. With strong indirect measures of team performance, a team is better equipped to succeed at the direct indicators.

Direct measures of team performance are task- or results-oriented. Task-oriented indicators measure how well the team performs the tasks necessary to do the work. Results-oriented indicators measure how close the outcomes of the work are to the objectives.

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**Topic:** Team Performance Assessment

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# SkillBrief

# Managing a Team's Performance

You use the Manage Project Team process to ensure the people responsible for carrying out the work on your project function as effectively as possible to meet project requirements.

The process involves tracking the project team's performance, providing feedback, resolving performance issues, and managing changes. It's important to assign team members appropriate roles based on their skill levels, and to set up reward and recognition systems that give team members credit for their work.

The team management skills of a project manager fall into four key areas:

* conflict management
* negotiation
* leadership
* communication

### Inputs to the Manage Project Team process

As well as having the right skills and systems in place, a project manager must draw on several sources of information to manage a team effectively. Among these are the five inputs to the Manage Project Team process.

#### Project staff assignments

Project staff assignments identify all the members assigned to work on a project. A project manager uses this information to identify who's on the project team and therefore whose contributions must be monitored and evaluated.

#### Project management plan

The project management plan contains the human resource plan, which defines the roles, responsibilities, level of authority, and required level of competency for team members. As an input, it provides a clear indication of expectations for each person on the team.

#### Team performance assessments

Ongoing assessments of how well the project team is performing are vital. These assessments can be formal or informal, and take into account indicators such as staff turnover rates, team dynamics, and skill levels. The information gathered enables project managers to identify and resolve problems, reduce conflict, and take steps to improve teamwork. Performance assessments are the basis for performance reports.

#### Performance reports

Performance reports illustrate how the project team's performance aligns with the performance levels laid out in the project management plan. Performance is measured in areas such as schedule, cost, quality, and scope control. Data from performance reports helps project managers identify and resolve performance problems, plan future human resource requirements, and make appropriate updates to the staffing management plan.

#### Organizational process assets

These include company policies and structures related to recognition and reward systems. For example, bonus structures or the company's Intranet or newsletter may recognize performance. A company may also recognize high performers by awarding them specific apparel or certificates of appreciation.

### Tools and techniques of the Manage Project Team process

There are five basic techniques you use as part of the Manage Project Team process.

#### Observation and conversation

Part of your role is to stay in touch with the work and attitudes of the team. Observation and conversation may be used to achieve this. Observation does not require interaction with those being observed and is an activity performed outside a situation, whereas conversation is interactive and places you inside a situation. Observational skills are useful for identifying various issues that may arise, but conversation is a powerful and necessary tool when it comes to actually dealing with people.

#### Project performance appraisal

Project performance appraisals are regular reviews of team members' performance. These give team members a chance to receive feedback from supervisors.

They can be used to clarify team member responsibilities, explore any undiscovered or unresolved issues, and develop training plans and future goals.

#### Conflict management

Sources of conflict can be resources, schedules, priorities, policies and procedures, and project costs, as well as different personal work styles.

Unresolved conflicts can have several damaging effects on a project:

* loss of productivity
* a reduction in the level of the team's creativity and capacity to innovate
* a reduction in team cooperation and problem-solving abilities
* the loss of valued team members from the project

Conflict management, including conflict resolution, should focus on issues that affect the whole team and the success of the project.

When conflict threatens the effectiveness of a team, you should call everyone together and openly discuss the problem.

In conflict resolution, the objective is not to dwell on what has happened but to resolve the problem.

Generally, the best approach when a conflict occurs is to encourage the individuals involved to try and resolve the conflict themselves through open communication.

But if that fails or the conflict is serious enough to threaten a project, the next step is to discuss the conflict openly with the team as a whole.

#### Issue log

The project manager can use the issue log to keep track of issues that may need to be dealt with during the course of the project.

The issue log should record general concerns that are preventing the team from reaching its goals. It can be used in conjunction with conflict management, so that you have a record of when problems arose, what those problems were, who was involved in handling the problems, and how and when the issues were resolved.

#### Interpersonal skills

The ability to use interpersonal skills effectively helps the project manager interact with the team. Interpersonal skills include the ability to influence others and to communicate ideas clearly, as well as leadership skills, and effective decision-making and listening skills.

All of these skills are invaluable to the project manager. They help him gain the trust of team members and reach decisions and resolve problems.

Interpersonal skills are particularly important for resolving problematic issues or conflicts.

When things get tense or the team has to face particular challenges, the project manager is the leader who must use communication and other skills to resolve issues and get the team moving forward.

Inputs for the Manage Project Team process include project staff assignments, the human resource plan – which is included in the project management plan, team performance assessments, performance reports, and organizational process assets.

Tools and techniques you use to manage a project team are observation and conversation, project performance appraisal, conflict management, an issue log, and interpersonal skills.

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**Topic:** Inputs and Strategies for Managing Team Performance

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# SkillBrief

# Managing a Team with Interpersonal Skills

Although there are a wide variety of interpersonal skills that are relevant to project management, the skills project managers use most often are leadership, influencing, and effective decision making.

### Leadership

Leadership is about communicating the vision of the project in a way that motivates and inspires the team and about establishing direction for the team. To manage a project team effectively, you need the skills of both a leader and a manager.

Warren Bennis, a pioneer in the field of leadership studies, described a leader as someone "who does the right thing," and a manager as someone "who does things right." A project manager must be able to do both. "Doing the right thing" is essentially about increasing effectiveness while also inspiring and motivating the project team. "Doing things right" is about implementing and managing the right processes so that a project's technical performance, cost, and schedule objectives are met.

A leader must model ethical behavior, communicate a vision effectively, and have charisma. It's also important that a leader knows how to use non-coercive influence to direct team members towards accomplishing project objectives.

Not all leaders have the same style. Understanding the pros and cons of different leadership styles can help you decide on your own style.

In general, leadership styles fall into two categories:

* **task-oriented** – focuses on achieving the tasks or objectives of a project. It is typically a highly structured approach in which leaders dominate and are socially distant from other team members.
* **people-centered** – tends to focus on enhancing group cohesiveness and is a fairly democratic approach. The leader shows consideration for team members' needs and encourages participation in decision making.

The best leadership style is usually a blend of task-centered and people-centered approaches. It balances focusing on the need to get the job done with an awareness that keeping a project team motivated and working well is a vital ingredient in this.

### Influencing and decision making

To influence others, you need to convey your points in a clear and persuasive manner. This skill is often critical to ensuring a project's success because it is by influencing others that you can get things done.

As a project manager, you may need to exert influence over a range of different people. The skill of influencing others means getting people to want or agree to do what you know must be done if the project is to succeed.

Organizational structure affects the way you use influencing skills.

Some key influencing skills are persuasion, active listening, considering others' perspectives, and the ability to reach agreement while maintaining mutual trust.

The ability to persuade others depends on being able to articulate your position clearly and convincingly.

Active listening requires that you listen attentively, ensuring you understand what the speaker says and continually demonstrating your understanding.

To influence others effectively, it's also important to consider other perspectives. This involves putting yourself in the shoes of the people you need to influence. Often understanding and empathizing with another person's point of view is the first step in getting your point across and in reaching an acceptable solution.

A final important aspect of influencing others is being able to reach agreement while maintaining mutual trust. This involves gathering information about a problem by speaking to the key players and then finding a solution that makes everyone happy - and, as far as possible, making sure that no one mistrusts your motives or tactics.

### Effective decision making

Effective decision making is the ability to make informed and timely decisions. The ability to make decisions is critical for a project manager.

To help ensure you and other project team members make effective decisions throughout a project, you should abide by these guidelines:

* remain focused on project objectives
* implement a clear decision-making process that involves gathering facts, carefully considering the options, consulting with others, and choosing a clear course of action
* use decision-making opportunities to involve team members, stimulate their creativity, and develop their decision-making and problem-solving skills
* consider how decisions will affect all aspects of the project to manage opportunities and risks

Not every decision requires special attention – many are simple and routine. But the more risky or costly a decision may be, the more attention it requires.

To manage a project team effectively, it's essential that a project manager has good interpersonal skills. Key among these are leadership skills, the ability to influence others, and the ability to make effective decisions.

Leadership is required to guide and motivate the project team. Typically, the best leadership style combines aspects of task-oriented and people-centered approaches.

Influencing skills include persuasion, active listening, considering others' perspectives, and the ability to reach agreement while maintaining mutual trust.

Effective decision making requires a focus on project objectives, making use of a well-defined decision-making process, involving the team, and considering how decisions will affect all aspects of a project.

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# SkillBrief

# Managing Conflict

Conflict management is a technique project managers use to improve team productivity and foster positive working relationships. However, this doesn't mean preventing or avoiding all conflict.

When managed properly, conflict can lead to increased team creativity and better decision making.

Various causes of conflict can exist among project team members:

* schedules
* priorities
* resources
* technical beliefs
* administrative policies and procedures
* project costs
* personality-based differences

When conflict that could threaten or delay a project arises in a team, it's the project manager's responsibility to ensure that it's promptly resolved.

When conflict first arises, the best approach is to encourage the individuals involved to work out the issue on their own, without direct involvement of the project manager. If they can't work things out, then you need to meet with all parties in private to facilitate a satisfactory resolution. If an agreement still isn't reached and the conflict continues, the next step is to take disciplinary actions, as per process outlined in your company's Human Resources manual.

There are two characteristics of conflict. The first is that conflict is natural and forces a search for alternative approaches and solutions.

The second is that conflict is a team issue. Conflict between two or more people in a team becomes an issue for the entire group because it may affect the work of the team as a whole.

In turn, the conflict resolution process has three characteristics:

* openness, which is key when you want to resolve conflict
* a focus on the present, not the past
* a focus on issues and not personalities

There are several ways to deal with conflict, and different approaches suit different situations. However, not all are appropriate for reaching long-lasting solutions.

Among the approaches to conflict resolution are these six, ranging from least to most effective at achieving long-term solutions:

* **withdrawing or avoiding** – involves retreating from an actual or potential conflict situation.
* **forcing** – involves pushing one viewpoint at the expense of others. This occurs when someone makes a decision that results in one person winning and one person losing. This action results only in win-lose solutions.
* **smoothing or accommodating** – involves emphasizing areas of agreement rather than areas of difference. This is when people downplay a conflict, often to prevent arguments or ill feeling. Sometimes a project manager may need to use this approach to keep tempers from flaring, but ultimately it is only a temporary solution.
* **compromising** – involves negotiating a solution that will bring about some degree of satisfaction to all parties involved. This involves both parties meeting each other halfway and, in the process, giving something up. That's why this approach is often seen as providing only lose-lose solutions, although it can provide a way to move forward.
* **collaborating** – focuses on working to combine multiple differing perspectives into one shared perspective. This approach leads to general agreement and commitment to a solution among all team members.
* **confronting or problem solving** – involves identifying the root cause of a problem and its best solution by examining alternatives. It requires a give-and-take attitude, as well as open dialog in which team members assess and consider options. This approach often provides a long-lasting solution to conflict because it involves everyone in a team working to find a solution to its cause.

Conflict resolution approaches include withdrawing or avoiding, forcing, smoothing or accommodating, compromising, collaborating, and confronting or problem solving.

The best technique to use depends on the nature of a situation, although confronting or problem solving and collaborating are usually most effective in achieving long-term solutions.

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**Topic:** Conflict Management

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# SkillBrief

# Documenting Team Management Results

The way a project manager handles a team can have a huge impact on a project. Inevitably, changes to the team will have repercussions throughout the project. As the project manager, you need to handle the impact of these changes. You also need to ensure that various project documents are updated to reflect their effects.

These updates become the outputs of the Manage Project Team process.

### Change requests

Change requests can sometimes arise because of changes in the project team. For instance, a staff member leaving or joining the project team could alter the planned duration of the project and thus affect the schedule.

Hiring a new team member either to replace the person leaving or to increase the capabilities of the current project team will also affect the project budget.

Preventive action can help reduce the impact and frequency of problems arising from changes in a project team.

For instance, you can ensure that all roles in the team are clearly defined so that in the event of team members becoming unavailable, they can be quickly replaced.

A good way to ensure that work continues smoothly even if there are changes to a team is to cross-train your staff. This involves ensuring each team member has a broad skillset. One or more team members can then fill the roles of another member, if necessary.

### Project management plan updates

The Manage Project Team process will invariably lead to updates to the project management plan. You may, for example, decide to reassign a team member. This will affect some of the documents that are contained within the plan.

Staffing changes will trigger updates to the staffing management plan and its components – the human resource plan, project organizational chart, resource calendar, and recorded training needs.

Changes to the staffing management plan may also prompt changes to other aspects of the project management plan, such as the cost performance and schedule baselines, and the procurement management plan, since the changes might involve increases in staff costs, delays in staff availability and the necessity to obtain equipment.

### Enterprise environmental factors updates

Updates to enterprise environmental factors are required primarily to reflect the results of team members' performance appraisals and any changes in personnel skills.

Performance appraisals of team members are used as an input to the performance appraisals performed at an organizational level. For example, a functional manager is likely to draw on your appraisal of an employee's work when conducting annual performance appraisals of all employees in a department.

Some organizations keep a database of the skillset of employees. This is an example of an enterprise environmental factor that will be updated when a team member acquires any new skills during the course of a project – for instance, through formal training, coaching, or on-the-job experience.

This ensures your organization has an accurate record of the skills and performance levels of its employees.

### Organizational process assets updates

There are some organizational process assets that may need to be updated as a result of the Manage Project Team process.

#### Historical information and lessons learned

The experience of managing a project team will enable you to refine your approach to team management. Drawing on insights and knowledge you've gained, you may update documents like the staffing management plan, position descriptions, organizational charts, and issues and solutions documented in the project log.

You can also record any improved techniques for conflict resolution, improved ground rules, successful reward and recognition strategies, methods for virtual team management, negotiating techniques, and team building and training methods.

#### Templates

An organization may use templates for documents like the issue log, performance reports, and performance appraisals. Your experiences in managing a project team may enable you to improve on these templates – in which case, they should be updated to facilitate effective team management in the future.

#### Organizational standard processes

The process of team management often results in improvements to organizational processes. For example, you may improve on a process for dealing with conflict situations or for conducting fair performance appraisals. The processes should then be updated so other managers can improve their own performance and the performance of their teams in the future.

The four outputs of the team management process are change requests, updates to the project management plan, the enterprise environmental factors, and the organizational process assets.

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**Topic:** Document Updates Resulting from Team Management

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# Follow-on Activity

# Tools and Techniques for Developing a Project Team

**Purpose:** Use this follow-on activity to review the tools and techniques that are available to you for developing project teams.

**Instructions for use:** To use this tool, consider how each of the available tools and techniques can help you to develop your current project team and how you might choose to use those tools and techniques in future.

| **Tools and techniques for developing a project team** | | | |
| --- | --- | --- | --- |
|  | **Description of available resources** | **Current teams** | **Future teams** |
| **Interpersonal skills** | Row 2 Column 3 | Row 2 Column 4 | Row 2 Column 5 |
| **Ground rules** | Row 3 Column 3 | Row 3 Column 4 | Row 3 Column 5 |
| **Co-location** | Row 4 Column 3 | Row 4 Column 4 | Row 4 Column 5 |
| **Training** | Row 5 Column 3 | Row 5 Column 4 | Row 5 Column 5 |
| **Team-building activities** | Row 6 Column 3 | Row 6 Column 4 | Row 6 Column 5 |
| **Recognition and rewards** | Row 7 Column 3 | Row 7 Column 4 | Row 7 Column 5 |

****For online use, complete each row as described in the instructions. If you would like to work with the page as hard copy, simply print it out using the Print link at the top of this page.****

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# Follow-on Activity

# Conflict Resolution

**Purpose:** Use this follow-on activity to record any team conflicts, as well as your reactions to these.

**Instructions for use:** To use this tool, record the conflicts you encounter over a period of a week in the table. Add your instinctive responses to each situation. Then objectively decide whether your approach was the best way to move forward or whether you should have tried to use one of the other approaches. Keep the results of this exercise in mind when you deal with future conflicts.

| **Conflict resolution record** | | |
| --- | --- | --- |
| **Situation** | **Instinctive approach** | **Objective assessment** |
| Row 2 Column 1 | Row 2 Column 2 | Row 2 Column 3 |
| Row 3 Column 1 | Row 3 Column 2 | Row 3 Column 3 |
| Row 4 Column 1 | Row 4 Column 2 | Row 4 Column 3 |
| Row 5 Column 1 | Row 5 Column 2 | Row 5 Column 3 |
| Row 6 Column 1 | Row 6 Column 2 | Row 6 Column 3 |
| Row 7 Column 1 | Row 7 Column 2 | Row 7 Column 3 |

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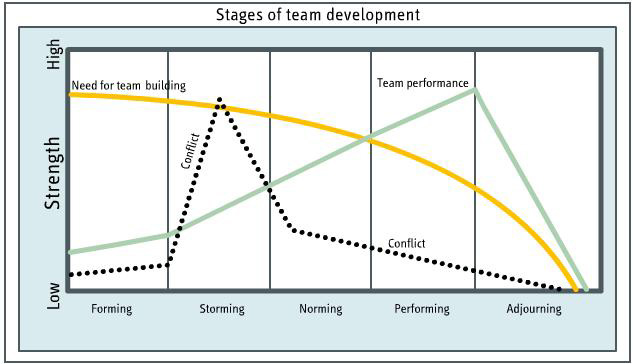
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# Learning Aid

# Stages of Team Development

**Purpose:** Use this learning aid for a visual representation of the stages of team development.



Stages of team development

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# Learning Aid

# Curriculum Project

**Purpose:** Use this learning aid to review the details of the curriculum project.

A team of educators is developing a new curriculum for local government. It must submit a report on learning outcomes within six months. The report must contain a quantitative analysis of scarce skills in the market, and detailed responses to each scarce skill. In particular, mathematics, science, chemistry, and physics must be dealt with. The budget for the market research component is $15,000.

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# Learning Aid

# Software Development Project

**Purpose:** Use this learning aid to review the details of the software development project.

A software development team is developing a new low-resource operating system, which must be finished in time for a summer release. The development requires regular brainstorming meetings to assess the development progress. The system must limit itself to use less than 15% of system resources for any computer it is installed on. The budget is $80,000.

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# Learning Aid

# Investment Project

**Purpose:** Use this learning aid to review the details of the investment project.

An investment team of three fund managers is responsible for the performance of a hedge-fund. The fund must outperform their main competitor's fund by at least 7% daily, averaged over the month. The team meets every two hours throughout trading to discuss the next trade – it must reach consensus and file a trading report, documenting the decision and reasons. Team members work well together now, but in past projects, there were serious conflicts of opinion, which the project manager handled with effective conflict reducing strategies. At times, the team is subjected to assessment by opinion polls in investment journals.

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# Job Aid

# Team Building and Team Development Stages

**Purpose:** Use this job aid as a summary of information related to team building and the stages of team development.

## What is team building?

Team building is an activity, or set of activities, that aims to foster good working relationships in teams by increasing the comfort level between team members.

The main goals of team building are to promote trust, open communication, and good team leadership.

Team building is important as it helps you bring together a collection of individuals with different needs, backgrounds, and expertise, and transform them into an integrated, effective work unit.

## When to apply team building

Because things are always changing on a project, team building is an ongoing exercise that takes place throughout the lifecycle of a project. Project managers must observe their teams, so that they can identify when to apply team building strategies.

Team building should definitely be applied in these situations:

* at project initiation
* when there is conflict
* when there is a big change to the project
* when a new team member joins

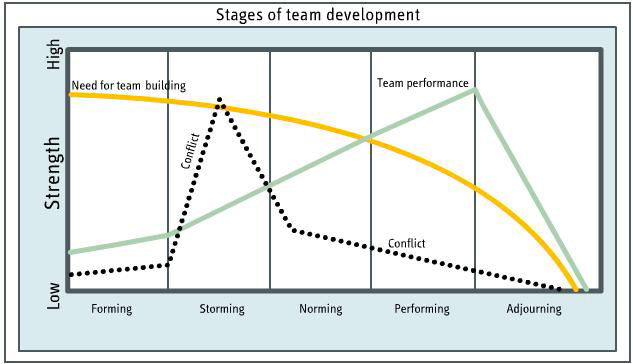
## The relationship between the team development process and team building

As a project progresses, teams go through various changes in their dynamics. Barring major changes to the project, the need for team building is highest at the start of the project and decreases as the project team becomes more functional.

According to American psychologist, Dr. Bruce Tuckman, teams go through five stages:

1. **forming** – Forming is the opening stage, in which a team is assembled for a specific project and told what everyone's roles and responsibilities are. Team members are usually more reserved and formal towards each other in this early period of the project. They tend to be independent and not as open with each other in this phase.
2. **storming** – At the storming stage, the team begins to address the project work and make decisions. If team members are not collaborative and open to differing ideas and perspectives, conflicts may emerge. The environment may become destructive as individuals vie for power and status within the project team.
3. **norming** – By the norming stage, the team is more settled, with members knowing and accepting their roles in the team. Energy is now focused on the work of the project, instead of personal rivalry and the need for team building begins to decrease.
4. **performing** – At the performing stage, team members trust each other and work well together, making it the most productive phase of the project in terms of output. The team is fully functioning and the need for team building drops off dramatically, unless something changes within the team (for example, if a new conflict arises; a new team member joins, or there is a change in the project). Team members work through issues and problems smoothly and effectively.
5. **adjourning** – Adjourning is the final stage. It involves completing the project and breaking up the team. Team building is generally no longer needed as team has served its purpose and the need for the team diminishes.

## Stages of team development



Stages of team development

## Considerations for planning team building exercises

Different team-building activities can be carried out, but to decide which is right for your team at a particular moment, you need to evaluate several factors, including

* the reason team building is needed
* the size of the team
* the types of personalities in the team
* the time available for team-building activities
* the budget available for team-building activities

Team-building activities can range from simple activities like group lunches and social gatherings, to five-minute ice-breakers during meetings, to more complex activities like day-long facilitated sessions or weekend retreats.

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# Job Aid

# Indirect Indicators of High-performance Teams

**Purpose:** Use this job aid to determine how your team measures up against the indirect indicators of high-performance teams.

High-performance teams share certain characteristics that enable them to perform at their best. Assess your team's performance against these characteristics to obtain an indirect measure of how effectively it is performing.

The job-related characteristics of high-performance teams include

* the skills and competencies to complete assignments effectively
* the ability to learn quickly and adapt to new work situations

People-oriented characteristics of effective teams include

* active listening skills
* coaching skills
* effective communication skills
* low staff turnover rate
* strong team cohesiveness
* effective group decision making and consensus
* clear sense of purpose and direction
* ability of team structure and responsibilities to evolve as needed
* broad information sharing between members
* strong capacity for conflict resolution and resource sharing
* good morale and team spirit
* continuous improvement of work processes, efficiency, and quality
* commitment to the project
* commitment to other project team members and project manager
* high job satisfaction
* a sense of belonging and purpose

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# Job Aid

# Sample Performance Appraisal

**Purpose:** Use this job aid to review a sample performance appraisal form.

|  |  |
| --- | --- |
| **Sample performance appraisal form** | |
| **Scale** | **1. EXCEPTIONAL** – The employee consistently exceeds expectations for all aspects of the job.  **2. HIGHLY EFFECTIVE** – The employee regularly exceeds expectations in several areas.  **3. SOLID PERFORMANCE** – The employee fulfills expectations.  **4. NEEDS IMPROVEMENT** – The employee's performance does not always meet expectations. Performance improvement is required.  **5. NOT EFFECTIVE** – The employee's performance almost never meets expectations. Immediate improvement is required |
| **Name** |  |
| **Department** |  |
| **Position** |  |
| **Time in position** |  |
| **Review period** |  |
| **Section A** | **Cooperation** |
| **1** | Willingness to be of assistance to coworkers |
| **2** | Adaptability to schedule changes |
| **3** | Attitude when it is necessary to repeat work |
| **4** | Willingness to exceed minimum requirements |
| **Comments** |  |
|  |  |
| **Section B** | **Conscientiousness and attendance** |
| **1** | Promptness starting work |
| **2** | Record of attendance |
| **Comments** |  |
|  |  |
| **Section C** | **Dependability** |
| **1** | Reliability handling a task from start to finish |
| **2** | Capacity to meet targets and deadlines |
| **3** | Capacity to overcome obstacles and meet goals |
| **4** | Ability to adapt to change |
| **5** | Consistency of work performance |
| **6** | Willingness to accept responsibility for actions |
| **Comments** |  |
|  |  |
| **Section D** | **Initiative** |
| **1** | Ability to spot what must be done and take action |
| **2** | Tendency to seek help when necessary |
| **3** | Level of self-motivation |
| **4** | Awareness of and efforts towards achieving overall project goals |
| **5** | Tendency to make well-thought-out suggestions for improving the project |
| **6** | Level of commitment to self-improvement |
| **Comments** |  |
|  |  |
| **Section E** | **Attitude** |
| **1** | Contribution to morale |
| **2** | Willingness to offer assistance |
| **3** | Consideration for other people |
| **4** | Ability to accept constructive criticism |
| **5** | Level of pride in work |
| **Comments** |  |
|  |  |
| **Section F** | **Productivity and skills** |
| **1** | Skill level verses the requirements of position |
| **2** | General standard of work produced |
| **3** | Time taken to finish tasks |
| **4** | Efficiency when utilizing project resources |
| **Comments** |  |
|  |  |
| **Section G** | **General comments and future plans** |
| **1** | General comments: |
|  |  |
|  |  |
|  |  |
| **2** | Areas that require development: |
|  |  |
|  |  |
|  |  |
| **3** | Expected future improvements / accomplishments: |
|  |  |
|  |  |
|  |  |
| **Date** |  |
| **Employee's signature** |  |
| **Supervisor's signature** |  |
|  |  |
| **Comments on evaluation process** |  |
|  |  |
|  |  |

**Course:** Managing Project Human Resources  
**Topic:** Inputs and Strategies for Managing Team Performance

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# Job Aid

# Decision-making Process

**Purpose:** Use this job aid to review a process you can use to help ensure effective decision making in a project.

### Important decision-making steps

1. Define and clarify the issue. Assess its importance in terms of the project meeting its objectives. Does it warrant action?
2. Gather all the facts about the issue, determine its causes, and identify relevant environmental factors in your organization. Consult with members of the project team, stakeholders, and possibly other project managers in your company who can provide information about the issue.
3. Think about or brainstorm possible options and solutions. Where appropriate, involve the team and encourage the use of creativity.
4. Consider and compare the pros and cons of each option for addressing the issue. You could use group creativity and decision-making techniques, such as the nominal group technique, at this stage.
5. Select the best option. Make sure it is clear. Don't try to please everybody through compromise.
6. Explain your decision to those involved or affected by it. Manage risk by following up to ensure that the decision has been properly implemented.

**Course:** Managing Project Human Resources  
**Topic:** Interpersonal Skills

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Stakeholders and the communications management plan

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# SkillBrief

# Project Communications

A project is not able to function without exchanges of information between all parties. Like a body without a central nervous system and a brain, a project without communication does not have the means to coordinate the activities of the different parties and achieve its goals.

Communication is what links all the people involved in a project – such as the project manager, project team, external stakeholders, suppliers, and managers within the relevant organizations. By some estimates, project managers spend up to 90% of their time on communications-related activities – illustrating that communication plays a crucial role in projects.

This role of the project manager falls into the Project Communications Management knowledge area, which consists of six types of activities. These are generating, collecting, distributing, storing, retrieving, and disposing information.

Communication is not just about managing project information. It's actually a general management discipline and deals with managing people as well.

Managing communication – as part of project management or as a general management discipline – requires particular skills. These are

* **listening** – enables the project manager to gather as much useful information as possible and to ensure there are no misunderstandings
* **questioning and probing** – are important skills for getting a better understanding of ideas and situations
* **educating** – is a key skill because it makes team members more efficient by increasing their knowledge base
* **fact-finding** – assists in obtaining and confirming information to ensure its accuracy
* **setting and managing expectations** – is important to ensure the project's goals are met
* **negotiating** – is required so that mutually acceptable agreements can be reached
* **resolving conflict** – is important for ensuring communications stay productive and project work is not disrupted
* **summarizing** – is important both as a means of communicating only the information that is actually required and as a way of encapsulating a situation to help you identify a way forward

### Dimensions of communication

One of the keys to effective communication is knowing what form of communication is most appropriate in any given situation. To decide on the best form, it's important to think about the many dimensions of communication.

In considering this, you should ask yourself questions like, "Who am I communicating with?", "What is the direction of the communication?" and "How formal should the communication be?"

In answering, "Who am I communicating with?" you need to determine the exclusions of a project. The answer will tell you who is part of the project and who is outside the project.

Communication can be internal – with team members, managers, stakeholders, or others included in the project. Or it could be external – for example, with customers or people working on other projects.

In answering "What is the direction of the communication?" you work with the hierarchy within your organization.

Vertical communication involves communicating with people either lower or higher in the hierarchy. In communicating with people up the chain of authority, you may use a more formal style of communication than with those over whom you have authority.

Horizontal communication involves communicating with peers – people on the same level as you in the organizational hierarchy. Your tone and style of communicating with peers may be less formal than what you would use with your bosses.

The question "How formal should the communication be?" is answered by the context in which you are communicating. Formal types of communication, such as written briefings and structured presentations, should be used when professional communication is required. Informal communications, like phone calls between close work colleagues or impromptu meetings, are suitable for regular day-to-day communications.

Whenever you communicate with someone, you communicate both verbally and nonverbally.

Volume, tone, and choice of language are all elements of **verbal** – or oral – communications. They can indicate if someone is calm, in charge, happy, or frustrated and angry.

**Nonverbal** communications is embedded in written and face-to-face communications. Handwriting style, spacing of words, and the use of emotions are elements of typical nonverbal communications in e-mails, reports, or letters. Body language, such as facial expressions, posture, and eye contact, is used as nonverbal communications during face-to-face meetings.

Communication links the various parties involved in a project. Managing project communications is one of the project manager's most important roles. It involves all aspects of handling project information and managing people.

Communication has many dimensions, including who you are communicating with, the direction of the communication, and how formal the communication is.

Good communication enhances a team's commitment to a project, ensures stakeholder buy-in and collaboration, ensures work is performed correctly, and decreases stress.

**Course:** Stakeholders and the Communications Management Plan  
**Topic:** Communication Skills in the Project Environment

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# SkillBrief

# Project Communications Management and its Process Groups

Successful projects are built on successful communications. They depend on the right people getting the right information at the right times. Making sure this happens involves several processes that fall in the Project Communications Management knowledge area.

The Project Communications Management knowledge area includes five processes that occur throughout a project's life cycle.

#### Identify Stakeholders

You identify and describe the individuals and organizations that the project affects. In describing each person or organization, you document information about their interests, involvement, and possible impact on a project's success.

You start the actual planning of a communications strategy only once the stakeholders have been identified.

#### Plan Communications

You determine the information and communications needs of the project's stakeholders. This is documented in a communications management plan.

For each stakeholder, you define the types of information needed and the format for communicating the information. You also decide who will prepare the information and the frequency at which it must be distributed.

#### Distribute Information

You send out relevant information to stakeholders using the formats that are described in the communications management plan.

Formats include status reports, project meetings, and review meetings.

#### Manage Stakeholder Expectations

You communicate and work with stakeholders to satisfy their project requirements and address problems as they arise. This can include discussing project work and specific issues, and improving project performance by implementing changes stakeholders request.

Because stakeholders often have a high degree of influence over a project, it's essential to use good and frequent communications during this process.

#### Report Performance

You collect information about project performance and accomplishments. This information can refer to factors such as costs, schedule, scope, and quality.

The information is then reported to stakeholders in the appropriate formats, such as status reports, progress measurements, or forecasts.

The processes for managing communication fall into four of the five project management process groups:

* **Initiating** – the Identify Stakeholders process is carried out
* **Planning** – the Plan Communications process is carried out
* **Executing** – the Distribute Information and Manage Stakeholder Expectations processes are carried out
* **Monitoring and Controlling** – the Report Performance process is carried out

Although the Project Communications Management processes can be associated with different phases of a project, they iterate throughout the project. They also interact – the outputs from one process become inputs to other processes.

The Identify Stakeholders process has two outputs – the stakeholder register and the stakeholder management strategy. These outputs feed into the Plan Communications and Manage Stakeholder Expectations processes.

Although the Manage Stakeholder Expectations process is part of the Executing process group, it begins at the same time as the Plan Communications process and continues for the rest of a project.

The Plan Communications process is the only process from the Planning process group. It produces the communications management plan.

This document contains critical information that feeds into two subsequent processes:

* **Distribute Information** – Information is distributed to stakeholders as described in the communications management plan. The plan specifies what information to send to whom, how to send the information, in what format, and how frequently.
* **Report Performance** – Performance is reported according to the methodologies laid out in the communications management plan. The plan specifies the required content, level of detail, and format for the reports, who is responsible for releasing information, and at what times.

Depending on the project, the activities and responsibilities of the various processes can vary. The communications strategy used on a large project may be very complex, whereas a small project requires only regular status reports to the stakeholders. The important thing is to ensure that communication is accurate, effective, and appropriate in terms of project requirements.

The Project Communications Management knowledge area includes five processes – Identify Stakeholders, Plan Communications, Distribute Information, Manage Stakeholder Expectations, and Report Performance. These processes fall into different project management process groups, but are iterative and overlap. The outputs of some processes act as inputs to other processes. Together, they ensure that communication is accurate, effective, and appropriate in terms of project requirements.

**Course:** Stakeholders and the Communications Management Plan  
**Topic:** Communications Management and the Process Groups

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# SkillBrief

# Identifying Stakeholders Requirements

In project management, the Identify Stakeholders process involves identifying which people and organizations will affect – or be affected by – the execution of a project.

Remember that stakeholders can comprise people and organizations both within and outside your organization. Internal stakeholders include the project team, operations managers, and functional managers. External stakeholders are sellers and business partners, and customer or users.

Correctly identifying these stakeholders will significantly increase a project's chances of success, since it will allow you to forge the right kind of relationships with people and organizations involved in your project. If you do not form the right kind of relationships, you could easily run into problems.

As well as knowing who the stakeholders are for a project, you need to know the extent to which they can affect the project, positively or negatively.

It's important to record each stakeholder's level of interest, influence, and involvement in the project – especially if there are a large number of stakeholders. This is vital so you can gauge how best to manage different stakeholders and their expectations. Knowing which stakeholders will have a greater influence on your project can help you prioritize your communications with them.

To identify stakeholders and their interests, you need information from various sources.

#### Project charter

The project charter authorizes the project and identifies stakeholder requirements at a high level.

#### Procurement documents

Procurement documents detail the project's contractual obligations and the stakeholders to whom legal commitments have been made. They may also outline the respective obligations of the performing organization and project's suppliers. Everyone involved in a contract is a project stakeholder.

#### Enterprise environmental factors

**Organizational culture** is the unofficial, but accepted, setup in an organization. It affects how decisions are made and who has the authority to make them. This is vital information when identifying and categorizing stakeholders. Some organizations have a prescriptive management style where executives and upper level managers keep a tight rein on projects.

Others have a more relaxed approach where more autonomy is given to project managers. In this case, project managers are major project stakeholders, because the organizational culture gives them a high level of influence, even though they don't possess the highest level of power.

**Organizational structure** represents the official hierarchy within an organization. The hierarchy is often represented in an organizational chart. The lines of authority represented in this chart will tell you who has influence within the organization. This helps you to identify project stakeholders. In an organization with a highly functional structure, for example, all project staff report to their functional managers and to a project manager.

If aspects of a project – such as the product it develops or the production methods it uses – must comply with certain **regulations or standards**, the governing bodies overseeing these should be included as external project stakeholders.

#### Organizational process assets

Examples of organizational process assets include

* **stakeholder register** – is the document, typically in the form of a table, that identifies all project stakeholders and their details. Your organization may have a standard template for creating this document. Alternatively, you may be able to use a register from a previous project as a template.
* **lessons learned** – can guide you in identifying stakeholders for a current project. For example, lessons learned may include types of stakeholders who weren't initially identified, but who ended up having a huge impact. They can also include detailed information about stakeholder relationships that aren't apparent during planning or lists of stakeholders who provided the highest levels of support on past projects.
* **stakeholder registers from past projects** – can save time and help you identify stakeholders you may otherwise neglect. You may be able simply to update one of these registers and customize it so that it fits the needs and circumstances of a current project.

The Identify Stakeholders process thus involves identifying all people and organizations who may affect, or be affected by, a project. It's important to do this to ensure stakeholders and their expectations can be appropriately managed.

Inputs for the process are the project charter, procurement documents, enterprise environmental factors, and organizational process assets. These inputs can help you identify stakeholders and their likely influence, interests, and involvement in a project.

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**Topic:** Requirements for Identifying Stakeholders

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# SkillBrief

# Tools, Techniques, and Outputs of Identify Stakeholders

Stakeholders in a project may provide invaluable support, have little effect on the project, or create obstacles that ultimately prevent the project from succeeding. So an important part of managing a project is making sure you know who the stakeholders are, which of these people are in a position to significantly affect the project, and what their likely reactions are going to be. This knowledge helps you encourage beneficial responses and minimize negative influences.

## Tools and techniques

You use two basic techniques during the Identify Stakeholders to clearly identify and accurately evaluate your project's stakeholders.

### Stakeholder analysis

Stakeholder analysis involves identifying stakeholders and analyzing the effects they may have on a project, based on their relative levels of interest, power, and influence. Knowing all the parties who are involved in your project is vital but defining criteria which enable you to differentiate between them is just as important.

Conducting a stakeholder analysis is beneficial because it identifies many useful facts about a project's stakeholders:

* the interests of all stakeholders who affect a project
* the key individuals to keep informed during execution of a project
* potential disruptions to a project as a result of negative reactions from stakeholders
* stakeholders who should be encouraged to participate in various stages of a project
* ways to minimize negative impact due to stakeholder involvement in a project
* appropriate communications plans for engaging with each stakeholder
* strategies for managing antagonistic stakeholders and making the most of potential alliances

Performing a stakeholder analysis involves three main steps.

#### Step 1

You identify all potential stakeholders and record relevant information about them.

The stakeholder categories are

* **key stakeholders** – the most important players in a project. They have the potential to significantly affect its progress and outcome. Anyone in a decision-making or management role – like the project sponsor, primary customer, or high-level company executives – can be considered a key stakeholder. It's often useful to interview key stakeholders to help identify other stakeholders you may have overlooked.
* **other stakeholders** – unlikely to have a significant impact on the course a project takes or on its success. It's important to identify these stakeholders, but they don't require the same level of management as key stakeholders.

To identify stakeholders and learn more about them, you can ask the following questions:

* Have there been similar projects before and to what extent did they succeed?
* Who is likely to support the project?
* Who is likely to oppose the project?
* What legal challenges might exist?
* Are the stakeholders and their interests stable?
* What are the risks to the project from other projects?

#### Step 2

You classify the stakeholders you've identified according to their levels of

* **power** – the level of authority that a stakeholder holds within an organization, often related to the person's authority to make decisions that will impact the project
* **influence** – the amount of active involvement a stakeholder has in the project, which may be positive or negative
* **impact** – the ability to effect changes to the project's planning or execution
* **interest** – the stakeholder's level of concern about the project

A useful way to rate stakeholders is to use a classification grid – for instance, with level of power on one axis and level of interest on another. Alternatively, you could use the axes to rate stakeholders according to any combination of power, influence, impact, and interest.

#### Step 3

You use what-if scenarios to assess key stakeholders' likely reactions to the project and to various hypothetical situations. This knowledge will in turn enable you to plan how to win or enhance stakeholder support and how to mitigate potential negative impacts to the project.

### Expert judgment

The second technique you use in the Identify Stakeholders process is expert judgment. Advice from people with relevant expertise can help you identify and analyze stakeholders more accurately. These experts may have specialized training in a relevant area or specialized knowledge about a project's stakeholders.

You can obtain expert opinions through one-to-one meetings, interviews, focus groups, or surveys.

## Outputs

Conducting a stakeholder analysis results in two outputs – the stakeholder register and the stakeholder management strategy. These are also the outputs of the Identify Stakeholders process.

#### Stakeholder register

The stakeholder register is derived from the stakeholder table. It identifies stakeholder categories and stakeholder details such as stakeholders' names, roles, e-mail addresses, and telephone numbers. The register also indicates the level of potential influence stakeholders have on the project. This is often a public document, so it shouldn't contain sensitive details about stakeholders.

#### Stakeholder management strategy

The stakeholder management strategy is a plan for managing key stakeholders who can significantly impact a project. It's designed to optimize these stakeholders' support for the project and to reduce possible obstacles.

It contains information such as the name and category of the stakeholder, the stakeholder's level of potential influence on the project and likely attitude towards the project. It also contains the strategy that is to be employed for each stakeholder to maximize support and reduce obstacles.

A project manager can decide what level of detail to include in the stakeholder register. The important thing is to ensure you include the basic information you collected through stakeholder analysis – such as each stakeholder's likely level of impact and influence.

Once you have established details about each stakeholder's level of interest, influence, and likely attitude to the project, you can enter this information into a table detailing your stakeholder management strategy. You base the strategies for dealing with stakeholders on their level of power, influence, impact, and interest.

Recording a strategy for each stakeholder helps ensure all stakeholders will be managed appropriately throughout the project.

Two techniques are used during the Identify Stakeholders process - stakeholder analysis and expert judgment.

The outputs of the Identify Stakeholders process are the stakeholder register and the stakeholder management strategy.

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**Topic:** Stakeholder Analysis

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# SkillBrief

# Plan Communications Inputs

If communication isn't planned and managed carefully, it will eventually break down. A breakdown in communication is a threat to a project's productivity and can ultimately lead to its failure.

But with careful planning and management, you can ensure that the right people receive the information they need, at the right time.

The second process in the Project Communications Management knowledge area is the Plan Communications process, which falls in the Planning process group. You begin this process by determining the communication needs of stakeholders. This involves identifying what information each stakeholder requires when and how often they need to receive it.

How people communicate in projects varies widely and depends on many factors. For instance, one of the factors is communication technology. Do stakeholders have access to e-mail or only to hard copy mail?

A large part of planning communications is to assess the factors that influence how stakeholders communicate and to decide which approach to follow. Then you select the communications media and methods that best suit the stakeholders and the project.

So planning helps you determine stakeholders' needs and establish the appropriate communication methods. But for it to be relevant and useful, the planning process must also ensure that communication is both

* **effective** – occurs when required information is provided in the right format, on time, when it has the desired impact and achieves the planned objectives
* **efficient** – means providing the necessary information, and no more or less

Planning communications achieves three important functions:

* it prevents delays in communication – such as when someone gets a message late and, as a result, misses an important meeting
* it controls sensitive information – for instance, it prevents staff assessment results from being published accidentally in a shared folder on your network
* it ensures information reaches all the right people, so no team member is excluded from a process update memo for example

A communications plan helps you to avoid these problems by documenting the most effective and efficient means of communicating with stakeholders. In the plan, you document strategies for engaging with stakeholders and especially for motivating project team members. The communication strategies should ultimately help the team to focus on and achieve a project's objectives. Strategies can be formal, such as reports, or informal, such as e-mails.

As with most project planning, communications planning is iterative. The project manager creates the communications management plan during the planning phase of a project and then revises it whenever there are changes to stakeholders or their communications requirements.

There are four inputs to the Plan Communications process. The first two inputs are actually the two outputs of the Identify Stakeholders process – the stakeholder register and the stakeholder management strategy.

#### Stakeholder register

The stakeholder register is a list of all project stakeholders and their details, including their names, contact information, and roles and responsibilities in the project. So the register identifies all the people whose communication needs must be addressed during planning. It may also shed some light on what these needs are.

#### Stakeholder management strategy

The stakeholder management strategy is a plan for dealing with stakeholders. It often takes the form of a stakeholder analysis matrix and identifies different stakeholders' likely level of impact on a project.

Those with the biggest impact, be it positive or negative, should be at the center of the communications strategy. Usually this includes the project team, because its members are the most closely involved in the progress and success of project work.

It can also include external consultants who monitor project results on an ongoing basis and require daily status reports, or other stakeholders with high levels of interest and influence over a project.

The other set of inputs that influences the Plan Communications process is enterprise environmental factors and organizational process assets.

#### Enterprise environmental factors

The project environment, both within and outside the performing organization, influences the information needs of stakeholders and the communication methods that are most appropriate.

There are many enterprise environmental factors that can influence the way communications work on a project. Among these are four main examples:

* the organizational structure of the performing organization
* the existing project management information and communication systems in the organization
* the physical proximity of the stakeholders
* aspects of the socio-economic environment that affect project risk

#### Organizational process assets

There are two organizational process assets that contribute greatly to planning communication:

* **historical information** – Information about communication decisions in past projects and about the effects of these decisions can greatly improve communications plans for current projects
* **lessons learned from past projects** – Communication management decisions and outcomes from previous projects may have been recorded in lessons learned logs, and become a key planning input for your current project

To have effective and efficient communication in a project, you first need to implement the Plan Communications process. This process enables you to establish how to meet the communications needs of the stakeholders. You also use it to define the communications methods.

Plan Communications has four inputs. Two are outputs from the Identify Stakeholders process – the stakeholder register and the stakeholder management strategy. The other two inputs are enterprise environmental factors and organizational process assets.

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**Topic:** Inputs to Planning Communications

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# SkillBrief

# Communication Models, Breakdowns, and Methods

## Communication models

A communication model is a theoretical description of the way communications work. It demonstrates how information travels between sender and receiver. The basic communication model consists of a

* **sender** – The sender is the source of the message – the party who sends a message to the receiver. The sender can be one person or a group.
* **message** – The message is the thought or idea – that is, the actual information – that the sender wants the receiver to get.
* **encoding processes** – The message is expressed in a way that the sender believes the receiver will understand it, most often in words or in writing or with body language and movement. The expressed message is then encoded into a format that can travel across the medium.
* **medium** – The medium is the physical path by which the encoded message travels. For example, messages travel across fiber optic cables in a network or telephone wires.
* **noise** – Any factor that interferes with the delivery of a message or compromises its meaning is classified as noise.
* **decoding processes** – The message is first decoded into an expression that the receiver can understand. Then the receiver decodes the expressed message into meaning.
* **receiver** – The receiver is the person or group of people for whom the message is intended.
* **feedback** – Feedback is the acknowledgement the receiver sends to the sender that the message was received.

## Communication breakdowns

Many conflicts arise out of misunderstanding and poor communication. Sometimes all it takes is a few badly chosen words or actions, and the message one party is trying to communicate is tainted by noise – causing the other party to receive the wrong message.

In a project, any number of conditions could combine to cause noise between a project manager and stakeholders. This noise can then lead to a communication breakdown, which may be disastrous for a project.

Noise can be defined as anything that results in distortion of a message, distracts attention from it, creates misunderstandings, or involves interference with the communication processes.

The timing of communications also contributes to communication breakdowns. Incorrect timing can cause problems for project managers, team members, and other stakeholders.

It's important for the senders of messages to

* make sure any message you send is clear, complete, and in an appropriate format
* confirm that the message has been properly understood

Similarly, it's important for the receivers of messages to

* make sure you receive the full message
* confirm your understanding of the message with the sender

## Communication technologies and methods

In today's technologically-advanced environment, there are many ways to communicate.

A project manager should choose the technologies that best match the needs of a project and of its stakeholders. The choice of a technology depends on

* **the nature of the message itself** – match the medium you use to the nature of the message
* **stakeholders' needs** – match the medium to the needs of the receivers of the message
* **the qualities of the technology** – promote productivity among team members and consistent messages, are quick and easy to use, and are easily accessible for stakeholders

**Teleconferencing and videoconferencing** are used when a project's stakeholders are geographically dispersed, as is the case when a project uses virtual teams and foreign suppliers. Participants usually stay focused on the matter at hand, with less socializing than in face-to-face meetings. This makes it easier to stick to meeting agendas.

Electronic mail, or **e-mail**, enables you to transfer information quickly to one or many recipients. E-mail is perhaps the most commonly-used form of communication in projects today and has the advantage of speed, wide reach, effective method of group communication, and cost savings.

A **web site** on the Internet holds information relevant to the project and can serve as a central point for project communications. It can

* host discussion boards
* be used to upload and download project files
* be secured so that only the relevant persons have access

**Groupware** is a type of software that is designed specifically for collaborative work. It can be used for any task where different team members need to work simultaneously on the same thing. It is advantageous because it

* is accessible from anywhere
* enables version control of files and sharing of information that is up to date
* facilitates teamwork and group discussions
* helps avoid negative group dynamics that can occur in person

Project managers use special software for much of their work. **Project management software** tracks project activities and tasks, and enables project managers to communicate management-related information to stakeholders.

In addition to the principles of good communication technology, project managers should consider these communication technology factors that can affect a project:

* project environment
* technology availability
* project duration
* project team capabilities
* urgency of informational needs

The different types of communication technologies fall into three broad categories of methods. It is helpful to understand which methods are appropriate given the situation:

* **push communication** – occurs when information is distributed to specific recipients who need the information, does not require any type of follow-up to check if the information is actually received or understood by the recipients
* **pull communication** – occurs when recipients access a resource to download or acquire the information they need, is recommended where large volumes of information must be communicated, or information must be communicated to large audiences
* **interactive communication** – occurs when two or more parties exchange information with each other, ensures that all participants receive the information and attain the required understanding.

Communication models describe the process through which communications occur. Communication breakdowns can occur as a result of noise, the use of an inappropriate medium, language or cultural barriers, or poor timing. The type of communication technology or method used to deliver information depends on the nature of the information, the needs and preferences of stakeholders, and the required qualities of the technology.

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**Topic:** Communication Models and Methods

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# SkillBrief

# Plan Communications Outputs

The two outputs of the Plan Communications process are the communications management plan – which is the main output – and project document updates.

### Communications management plan

In broad terms, the communications management plan can be described as a detailed guide to the strategies that must be used for transferring information in a project. It forms part of the project management plan or can be a subsidiary of it. The plan can take a variety of forms. It can be detailed or merely provide a brief overview. It can be informal or formal, depending on the needs of a particular project.

A basic communications management plan answers the following questions.

#### Who requires information?

By asking yourself who, you are asking about the various stakeholders who require project information. So a useful section to have in your plan is a list of stakeholders. You can include stakeholders' names and designations, and specify whether they're internal or external. If there are a lot of stakeholders in a project, you can group them into categories based on their roles.

#### What information do different stakeholders require?

You need to know what information must be transferred to each stakeholder. You record this in the Communication format column in your plan. For example, a client may require status reports and a contractor may require design plans.

#### How must the information be delivered and in what format?

As well as knowing what information each stakeholder requires, you need to know how the information must be communicated. You can include a column in your plan to record the medium used to send the information. A typical example is e-mail.

#### When must communications occur and, if applicable, how often?

You need to record when or how often information must be conveyed. You could have a Timing or Frequency column in your plan to correspond with this. For example, if a stakeholder requires regular reports, you could enter "weekly" in that column. If they require updates only when there is new information, you could enter "as needed" instead.

#### By whom must the information be sent?

You need to know who is responsible for conveying the required information. Your plan should therefore contain a column in which you can record the names or designations of these people. If the information is confidential, you can include the names of the people who are responsible for releasing that information.

A complete communications management plan could include this additional information:

* a process for escalating and resolving communications problems that arise
* a glossary of common terms to help ensure everyone has a shared understanding of the plan
* a process for updating the communications management plan as the project progresses
* the purpose or reason for conveying specific information to each stakeholder or group of stakeholders
* information flow charts showing how information must be channeled
* details of any constraints to communication, such as legislation protecting the confidentiality of specific types of information
* guidelines for different forms of communication, such as meetings, e-mail, and information postings on project web sites

So the way you choose to structure and populate a communications management plan will depend on the project and on your preferences. Ultimately though, it's important that this plan provides enough detail to guide successful communications and satisfy stakeholders throughout the project.

### Project document updates

Like many other project management processes, planning communications can give rise to new information or decisions that affect other aspects of a project. This must be reflected in relevant documents.

Three documents most often need to be updated as a result of communications planning.

#### Project schedule

The project schedule is important for keeping track of time during a project. You may find during the course of a project that you have to adjust the frequency that information is transferred to stakeholders. This in turn may require you to adjust the project schedule to correspond with the timing of stakeholder communications.

#### Stakeholder register

The stakeholder register is a detailed list of all stakeholders, their contact information, and likely levels of potential influence over the project. During the planning process, you may find that you revise the attributes of stakeholders. For instance, you may discover that a stakeholder you assumed would have minor influence the project actually has more power than you at first believed. You should then update the register accordingly.

#### Stakeholder management strategy

The stakeholder management strategy documents methods for dealing with stakeholders, to maximize their support and reduce the impact of potential obstacles they pose. You may need to update this document based on rethinking the strategies as you work through the details of the communications management plan.

The main output of the Plan Communications process is the communications management plan, which provides detailed strategies for the transfer of information in a project. In particular, it tells you who must receive what information, from whom, how often, and in what format.

Project document updates are another output of the process. Types of documents that may be updated are the project schedule, stakeholder register, and stakeholder management strategy.

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**Topic:** Results of Communications Planning

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# SkillBrief

# Influences on Communication Requirements

You carry out a communications requirements analysis to determine the information needs of project stakeholders. Specifically, you look at the type of information needed, its format, and the value of the information.

You should communicate information only if it adds value to a project, either by promoting its success or by preventing its failure. Additionally, you should give stakeholders just enough information to make informed decisions.

The inputs of the Plan Communications process are all used in communications requirements analysis:

* **stakeholder register** – identifies the recipients of project communications
* **stakeholder management strategy** – contains information how to communicate with each stakeholder
* **enterprise environmental factors** – consider influences that are internal and external to the project when analyzing communications requirements
* **organizational process assets** – are lessons learned and other information about previous project communications that can help you analyze communications requirements for a current project

#### Communication channels

Communication travels across lines, or communication channels. The more stakeholders in a project, the more communication channels exist – increasing the complexity of project communications.

You can calculate the number of potential communication channels in a project using a simple formula. You take the total number of stakeholders, represented in the formula as the variable n, multiply it by the same number minus 1, and divide the result by 2.

As the number of stakeholders for a project increases, the number of communication channels rises dramatically. Correspondingly, the risk of communication breakdown increases. So the more stakeholders a project has, the greater the need for consistency of information through careful communications planning.

The number of communication channels helps you determine what communication methods are the most suitable.

#### Stakeholder register

The stakeholder register includes important information, such as the

* **names and contact details** – The project manager must know the names and contact details of the stakeholders when it's time to contact them, for example to invite them to a meeting.
* **number of stakeholders** – This number is important in calculating the number of potential communication channels on a project. The more channels exist, the more complex the communications management plan will be.
* **role** – The role of each stakeholder is important when determining who should get what information.s

#### Stakeholder management strategy

The stakeholder management strategy outlines how to communicate with different stakeholders, based on their interests, influence, and attitudes toward the project.

Three characteristics of stakeholders are especially important in terms of selecting appropriate management strategies:

* **level of power over the project** – Powerful or influential stakeholders are very important in making your project a success. You should communicate more frequently with them, keep them feeling positively about the project and about your ability as a leader, and leverage the influence they have to help you meet project objectives.
* **potential to summon support for the project** – It's important to build good relationships with stakeholders who can summon support for your project, inside and outside your organization. These people can help keep other influential stakeholders happy.
* **negative bias** – Much of your communication early in a project may have to be focused on winning over skeptics among upper levels of management in your organization or even on your project team. You should plan regular face-to-face meetings, making use of your interpersonal skills to reassure these stakeholders.

Although the stakeholder management strategy details how to communicate with each stakeholder, you can quickly get the big picture by working with a stakeholder analysis matrix. This matrix is a basic visual representation of how communications with different stakeholders should be managed.

Stakeholders fall into four different management strategies – keep satisfied, manage closely, monitor (minimum effort), and keep informed – depending on their level of influence and interest in the project.

Stakeholders with high interest and influence should be closely managed, while those with low interest, but high influence, should be kept satisfied. Stakeholders with high interest and low influence should be kept informed of relevant developments, while minimum effort should go to those with low interest and influence – you should only monitor their activities.

#### Enterprise environmental factors

An **organizational structure** hierarchy displays the authority and reporting relationships within a project or company, including heads of departments and others who have decision-making powers. This can alert you to people with whom you need to manage project communications closely. It also highlights project staff with specialized knowledge.

Another way organizational structure affects communications planning depends on whether you have a functional or a projectized structure.

Communications planning must also take into account the **technology** used within the organization and by external stakeholders to avoid system and software incompatibility.

For example, if you usually distribute information and deliverables to external stakeholders by uploading files to an FTP site, the external stakeholders need to be able to access the site. If their systems have firewalls blocking this access, you need to plan an effective alternative or devise a technical solution for information distribution.

Another enterprise environmental factor that can influence communications planning is the **geographical layout** of stakeholders and their relative proximity to project facilities.

If your team members, other internal stakeholders, and even customers are located in the same building or city, face-to-face meetings are more feasible than if the stakeholders are scattered over a wide geographic area.

Where certain stakeholders are more spread out, you need to rely more heavily on e-mail, teleconferencing, and other telecommunication methods to gather and distribute information.

As regulatory and socio-economic conditions change, so too can the degree of project **risk** and stakeholders' risk tolerance. This means it's important to consider risk as part of communications planning.

Generally, the more uncertain the project environment, the more frequent communication with stakeholders should be.

An important technique for planning successful project communications is communications requirements analysis. This involves using the stakeholder register, stakeholder management strategy, enterprise environmental factors, and organizational process assets to help you determine the communications requirements of all stakeholders.

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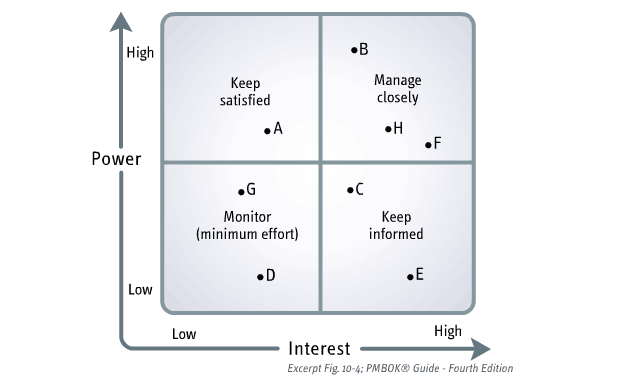
# Follow-on Activity

# Stakeholder Classification

**Purpose:** Use this follow-on activity to practice classifying project stakeholders.

**Instructions for use:** To use this tool, print the classification grid or create a similar grid yourself. Then plot stakeholders according to the level of their interest and power, or any combination of interest, power, influence, and impact.

The classification grid is for rating stakeholders in terms of level of interest and power. However, you can also rate stakeholders according to any combination of power, influence, impact, and interest.



Classification grid

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# Follow-on Activity

# Enterprise Environmental Factors and Project Communications

**Purpose:** Use this follow-on activity as a checklist of possible enterprise environmental factors that may influence communications on a project.

**Instructions for use:** To use this tool, consider a project you are working on and how each of several enterprise environmental factors may influence project communications. Then record your thoughts for each category in the table provided.

| **Enterprise environmental factor categories** | |
| --- | --- |
|  | **Your thoughts** |
| **Commercial databases** | Row 2 Column 3 |
| **Company work authorization systems** | Row 3 Column 3 |
| **Existing human resources** | Row 4 Column 3 |
| **Geographical layout** | Row 5 Column 3 |
| **Government or industry standards** | Row 6 Column 3 |
| **Infrastructure** | Row 7 Column 3 |
| **Marketplace conditions** | Row 8 Column 3 |
| **Organizational culture** | Row 9 Column 3 |
| **Organizational structure** | Row 10 Column 3 |
| **Personnel administration** | Row 11 Column 3 |
| **Project risk** | Row 12 Column 3 |
| **Technology** | Row 13 Column 3 |

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# Learning Aid

# Medical Supply Company Project Charter

**Purpose:** Use this learning aid to review the full project charter for a medical supply company project.

|  |  |
| --- | --- |
| **Project charter** | |
| **Project title** | Technical support – India |
| **Project start date** | January 1 |
| **Project finish date** | December 31 |
| **Prepared by** | Amrit Khan, IT manager |
| **Dated** | November 31 |
| **Business need** | There is a business need to streamline company operations and reduce the costs of providing technical support in the United Kingdom. A call center in India can provide multiplex management applications that can integrate all current help desk systems. This outsourcing solution will improve service response times and reduce operating costs.  **Appendix 1** – Risk analysis  **Appendix 2** – Alternative solution analysis  **Appendix 3** – Cost benefit analysis |
| **Measurable objectives and success criteria** | The objective of this project is to outsource the administration of inbound IT help desk services that will be responsible for handling technical support worldwide. This will reduce operating costs by 60%. The offshore supplier is to provide consistent high-quality services to improve customer satisfaction. |
| **Project requirements** | The outsourcing of inbound technical support administration offshore project will involve   * linking the offshore facility to the corporate computer network using LAN technology, firewall, and secure VPN for remote access * installing a multiplex management system that will be designed and configured by the offshore facility to provide tailored technical support services through e-mail, chat, voice, and the Web to customers worldwide * compiling all product-related queries and problems in usage posed by customers to the offshore facility into a database that can be fed back into the development process to make product and service improvements * training offshore agents on all in-house products and services |
| **Product scope description** | The offshore facility will be linked to the corporate computer network using LAN technology, firewall, and secure VPN for remote access.  The offshore facility will provide customized technology to support services through e-mail, chat, voice, and the Web. This software will include real time and historical reporting functionality to control and monitor quality.  Offshore agents will receive training via e-learning videos, web-based training software, and online manuals to provide high-quality technical support to global customers. |
| **Milestones and deliverables schedule** | **Phase 1:** Analyze the current system (January to February)  **Phase 2:** Create a shared vision for the new system (March to May)  **Phase 3:** Blueprint for future technical support operations (June to July)  **Phase 4:** Train offshore agents (August to September)  **Phase 5:** Implementation and rollout (October to December) |
| **Summary budget** | **Phase 1:** $25,000  **Phase 2:** $25,000  **Phase 3:** $150,000  **Phase 4:** $150,000  **Phase 5:** $350,000  **Appendix 4** – Cost estimates |
| **Approval requirements** | **Acceptance process:**   * End users have ten business days from initial delivery to confirm that a deliverable substantially conforms to specifications. * If an end user does not provide notice to the Project Management Office (PMO) during the ten-day period, the deliverable will be deemed accepted. * Should any deliverable be rejected, specific reasons must be supplied to the PMO, which has ten business days (or longer, if mutually agreed in writing) to correct the issues identified. The deliverable will then be resubmitted to the acceptance process.   **Appendix 5** – Quality specifications |
| **Roles and responsibilities** | **Amrit Khan**  **Role**  Manage the project team to complete the project on time, within budget, and according to requirements.  **Responsibilities**   * Analyze and understand the project's scope, product requirements, assumptions, and constraints. * Develop the project management plan and all subsidiary plans. * Lead the project team in the creation of all project deliverables. * Track and report on overall project progress and performance. * Manage the project's budget. * Balance competing demands for quality, scope, time, and cost. * Perform risk management to control project scope and quality. * Interface with all stakeholders and manage their expectations.   **Authority**   * Assemble the project team in coordination with the project sponsor. * Manage the project team according to the agreed schedule. * Negotiate and approve requirements and changes to project goals, scope, and the timeline as necessary. * Adapt the project management plan to the needs of the project.   **Project team**  Lead programmer: Mark Collins  Lead web designer: Sarah Mills  Lead testing: Eric Gains  Five networking specialists  Four IT professionals  One web designer   Three test users |
| **Project sponsor approval** | Signing this document records your agreement to the contents of the project charter and confirms the order to proceed with the project.    \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  **Catherine Barden**  Vice president of operations |

**Course:** Stakeholders and the Communications Management Plan  
**Topic:** Requirements for Identifying Stakeholders

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# Learning Aid

# Quick 24x7 Supermarket Project Information

**Purpose:** Use this learning aid to review the communication requirements for the supermarket project.

## Scenario information

A supermarket chain, Quick 24x7 Superstores, is set to open a new branch in a large mall. However, before they can move in, significant improvements must be made to the section of the mall they will be leasing. As a result, the mall's owners, the Managec Group, has embarked on a project to renovate this area of the mall.

#### Stakeholder register

The project has eleven stakeholders, of which eight are key stakeholders. The key stakeholders' details are recorded in the partial stakeholder register.

| **Stakeholder register (partial)** | | | | | |
| --- | --- | --- | --- | --- | --- |
| **Stakeholder categories** | **Name** | **Role** | **E-mail** | **Telephone number** | **Level of potential influence on the project** |
| Internal | Tina Burns | Project sponsor | TBurns@managecgoup.org | 212-555-8354 | High |
| External | Tyrone Oswald | Project sponsor | TyroneO@quick24x7.com | 206-555-3648 | High |
| External | Mario Estevez | Mall manager | Mario.Estevez@hortalez.com | 212-555-3389 | High |
| Internal | Joseph Baker | Project manager | JBaker@managecgroup.org | 212-555-8354 | High |
| External | Sara Wang | Store planner | SaraW@quick24x7.com | 206-555-3649 | Medium |
| Internal | Rick de Lange | Construction manager | RdeLange@managecgroup.org | 212-555-8355 | High |
| Internal | Larry Brantucci | Lead design engineer | LBrantucci@managecgroup.org | 212-555-8356 | High |
| Internal | Tom Herwig | Site foreman | THerwig@managecgroup.org | 212-555-8357 | Medium |

#### Stakeholder management strategy

The strategies for managing some of the key stakeholders are shown in the partial stakeholder management strategy.

| **Stakeholder management strategy (partial)** | | | | | |
| --- | --- | --- | --- | --- | --- |
| **Stakeholder category** | **Name** | **Role** | **Level of interest in the project** | **Level of potential influence on the project** | **Likely attitude towards the project** |
| Internal | Tyrone Oswald | Project sponsor | High | High | Generally positive, but worried about cost overruns |
| External | Mario Estevez | Mall manager | Low | High | Negative, due to construction inconveniencing mall customers and staff |
| Internal | Jason Bradford | Form builder | High | Low | Very positive |
| Internal | Scott Lipsey | Electrician | Low | Low | Generally positive |

#### Organizational chart

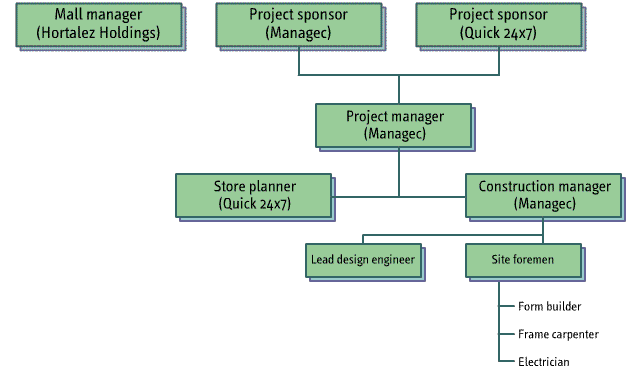
The project runs according to a functional organizational structure. There are two heads of the project – the Managec project sponsor and the Quick 24x7 project sponsor. Also on their level is the mall manager, although he is not directly connected to the authoritative hierarchy of the project.

The project manager from Managec reports to the project sponsors who are from Managec and Quick 24x7.

The store planner from Quick 24x7 and the construction manager from Managec report to the project manager.

The construction manager has two subordinates – the lead design engineer and the site foreman.

The site foreman supervises a form builder, frame carpenter, and electrician.



Organizational chart

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# Learning Aid

# Central-West e-Banking Project Information

**Purpose:** Use this learning aid to review the communication requirements for the Central-West e-Banking project.

## Scenario information

A company, Mathemetric Ltd., will be supplying the software for a new online banking interface at Central-West Bank.

#### Stakeholder register

The project has five stakeholders whose details are recorded in the stakeholder register.

| **Stakeholder register** | | | | | |
| --- | --- | --- | --- | --- | --- |
| **Stakeholder categories** | **Name** | **Role** | **E-mail** | **Telephone number** | **Level of potential influence on the project** |
| External | Taku Adachi | Project sponsor | Director@centralwestbank.com | 206-555-4926 | High |
| Internal | Sally McMahon | Project manager | SallyM@mathemetric.com | 206-555-3646 | High |
| Internal | Debora Wade | Analyst | DebbieW@mathemtric.com | 206-555-5371 | High |
| Internal | James Brauer | Visual designer | JamesB@mathemetric.com | 206-555-5386 | Medium |
| Internal | Alex Chung | Programmer | AlexC@mathemtric.com | 206-555-5372 | Low |

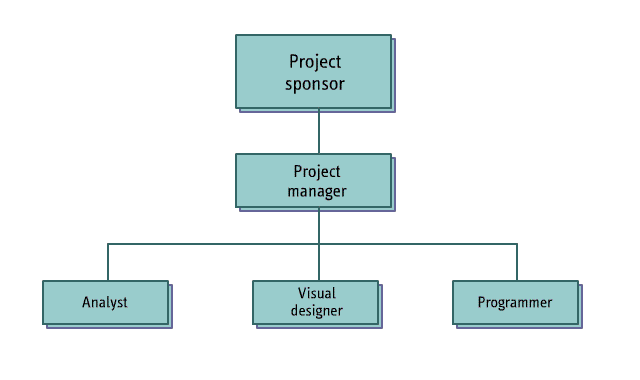
#### Stakeholder management strategy

The strategies for managing the stakeholders are recorded in the stakeholder management strategy.

| **Stakeholder management strategy** | | | | | |
| --- | --- | --- | --- | --- | --- |
| **Stakeholder category** | **Name** | **Role** | **Level of interest in the project** | **Level of potential influence on the project** | **Likely attitude towards the project** |
| External | Taku Adachi | Project sponsor | High | High | Positive, but worried about size of Mathemetric's project team |
| Internal | Debora Wade | Analyst | Low | High | Negative, due to the number of staff available on the project |
| Internal | James Brauer | Visual designer | High | Low | Very positive |
| Internal | Alex Chung | Programmer | Low | Low | Generally positive |

#### Organizational chart

The project runs according to a projectized organizational structure. The project consists of main three streams of work – analysis, visual design, and programming.



Organizational breakdown structure

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# Learning Aid

# Partial Stakeholder Management Strategy

**Purpose:** Use this learning aid to review the partial stakeholder management strategy for the technical support outsourcing project.

| **Stakeholder management strategy** | | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| **Stakeholder categories** | **Name** | **Role** | **Level of interest in the project** | **Level of potential influence on the project** | **Likely attitude towards the project** | **Management strategy to maximize support and reduce obstacles** |
| Internal | Catherine Barden | Project sponsor | High | High | Very positive | Row 2 Column 7 |
| External | John Anderson | Telecommunications provider liaison | Low | High | Generally positive | Row 3 Column 7 |
| Internal | Mark Collins | Programming team lead | High | High | Generally positive, but worried about excessive demand on his team | Row 4 Column 7 |
| Internal | Sarah Mills | Web and design team lead | High | High | Negative, due to high demand on her team | Row 5 Column 7 |
| Internal | Eric Gains | Testing team lead | Low | Low | Generally positive | Row 6 Column 7 |
| Internal | William Benson | Tester | High | Low | Very positive | Row 7 Column 7 |

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# Job Aid

# Stakeholder Analysis Steps

**Purpose:** Use this job aid to review the steps involved in performing stakeholder analysis.

You perform three steps during a stakeholder analysis.

### Step 1 – Identify all potential stakeholders and record relevant information

First you identify all potential stakeholders and separate them into key and other stakeholders. You interview key stakeholders to ensure that you've identified all other stakeholders.

### Step 2 – Create a stakeholder classification grid

Second, you classify stakeholders based on

* their potential impact
* the potential support they generate for the project

To do this, it is useful to plot stakeholders using a classification grid. The grid rates stakeholders according to any combination of dual attributes: power, influence, interest, or impact. This helps you develop an appropriate strategy for approaching and managing each of the stakeholders.

**Power** is the level of authority that a stakeholder holds within the organization. Power is often related to the person's authority to make decisions that will impact the project.

**Influence** is the amount of active involvement a stakeholder has in the project. Influence may be positive or negative.

**Interest** is the stakeholder's level of concern about the project.

**Impact** is the ability to effect changes to the project's planning or execution.

### Step 3 – Assess stakeholder reactions

As the final step, you use a variety of what-if scenarios to analyze stakeholders' opinions of the project and assess the possible range of stakeholder reactions. Anticipating the reactions of particular stakeholders will enable you to plan how to take advantage of likely favorable reactions and mitigate less favorable reactions.

**Course:** Stakeholders and the Communications Management Plan  
**Topic:** Stakeholder Analysis

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# Job Aid

# Communications Management Plan

**Purpose:** Use this job aid to review a sample project communications management plan, given a project scenario.

## Project scenario

The project is to develop a web site for Joe, a small business owner. The organization carrying out the project is a web development company that develops web sites for small to medium businesses. The project team is small because this is a relatively low-budget and straightforward project. The key phases of the project are planning, development, testing, and delivery. According to the contract between Joe and the company, the payment milestones line up with the completion of each phase.

During the planning phase, the project manager will present key milestones, a rough budget estimate, and draft schedule during a kick-off meeting at the client's site. In the meeting, the client's vision for the web site and requirements will also be discussed. Communication with the client and between project team members will be fairly informal, in keeping with the company's corporate culture and the nature of the project.

| **Communications management plan** | | | | | |
| --- | --- | --- | --- | --- | --- |
| **Stakeholder** | **Communication format** | **Frequency** | **Medium** | **Responsible person** | **Purpose** |
| Joe – the client | Presentation and informal discussion | At project kickoff | Meeting | Project manager | Discussion of project goals, client expectations, proposed web site design, milestones |
|  | Presentation and informal discussion | At project wrap-up | Meeting | Project manager | Post-mortem wrap-up to discuss client satisfaction |
|  | Status and milestones report | Weekly | E-mail | Project manager | Keep client up-to-date on project status, milestones achieved, and any issues |
|  | Issue resolution | As needed | Telephone | Project manager | Discuss concerns and provide timely resolution of issues |
| Ruth – Contracts officer | Project contract | At each milestone | E-mail | Project manager | Notify contracts officer at each payment milestone to invoice client |
| Judy – Scheduling and HR coordinator | Consultation | During planning and when needed thereafter | Verbal/E-mail | Project manager | Provides information for staffing resources |
| Project team: Mark, Jill, Ed, Andy | Status meeting | Weekly – Monday morning | Verbal | Project manager | Discuss current and upcoming tasks; set priorities; resolve issues |
| Project team | Project documents and deliverables | As needed | LAN | Project manager  Team members | Project planning documents are kept on the organization's LAN for convenient access by all team members |
| Project team | Routine communications | As needed | E-mail/Verbal | Project manager  Team members | Informal communication about ongoing work |
| Project team | Facilitated sessions | As needed | Verbal | Project manager | Conduct team building sessions; conflict resolution |
| Mark – writer on team | Writing status reports | Daily | E-mail | Mark | Inform project manager of progress by end of each day, including percent complete, estimated completion dates, and issues |
| Ed – developer on team | Development status reports | Daily | E-mail | Ed | Inform project manager of progress by end of each day, including percent complete, estimated completion dates, and issues |
| Andy – quality reviewer on team | Quality reports | Every three days | E-mail | Andy | Inform project manager of results of quality reviews on work done so far; raise any issues |
| Jill – graphic artist on team | Design status reports | Daily | E-mail | Jill | Inform project manager of progress by end of each day, including percent complete, estimated completion dates, and issues |

**Course:** Stakeholders and the Communications Management Plan  
**Topic:** Results of Communications Planning

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Process for managing project communications

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# SkillBrief

# Inputs to the Distribute Information Process

The Distribute Information process involves making the information that's relevant to project stakeholders available to them, on time and in the right format. This process is performed throughout a project's life cycle, but its main influence is felt in the Executing process group.

The Distribute Information process involves executing the activities outlined in the communications management plan.

#### Project management plan

The project management plan contains the communications management plan which specifies who must receive what information, when, and how – or in what format. It can be a formal or informal document, and highly detailed or broadly framed, depending on the needs of the project.

One component of the communications management plan is a communication requirements matrix. This is a table that contains

* the names of project stakeholders
* the communication format in which the information will be transmitted, including the level of required detail
* the frequency of the communications
* the medium in which the information must be presented
* the person responsible for communicating the information
* the purpose of each communication

The communications management plan usually also contains information such as the process for escalating issues, a glossary, charts showing the required flow of information and possible communication channels, and details of identified communication constraints.

#### Performance reports

Performance reports are outputs of the Report Performance process, which also falls in the Project Communications Management knowledge area.

In the Distribute Information process, performance reports are both inputs and outputs, flowing to and away from the project manager. There are two types of reports that relate to progress on a project:

* **status reports** – The project team provides status reports to inform the project manager about where the project is at and what it has accomplished to date. These reports contain information about the percentages of tasks completed, estimated completion dates, and any issues that are affecting performance.
* **performance reports** – The project manager regularly creates and distributes performance reports to certain team members and other internal stakeholders, such as members of the change control board. These reports may be simple and just give a snap-shot of cost and schedule performance. Alternatively, they may contain a highly detailed account of what is currently happening on the project and forecasts of future performance.

#### Organizational process assets

Examples of organizational process assets include

* **templates for communication methods** – These include templates for performance and status reports, and for the project's kickoff presentations that you use when you meet with the customer or sponsor.
* **policies and procedures** – Companies have certain policies and procedures that affect how information is distributed. These include specific rules against the use of instant messaging to discuss project decisions, policy about e-mail etiquette, and permissions for group share technologies. They may also include a green policy that discourages unnecessary use of paper-based communication.
* **historical information and lessons** learned – Projects can sometimes draw on historical information and lessons learned from similar past projects. You work those into the schedule and communications management plan for the current project.

### Factors influencing communication

In addition to the inputs it uses, several factors influence the Distribute Information process and the success of project communications.

#### Sender-receiver models

Sender-receiver models describe how communications occur. At its most basic, a model represents a two-way process between a sender and a receiver. In a project, the model must include feedback loops which represent the necessary channels through which the stakeholders can communicate with the sender. The aim is to achieve better understanding. In addition, a project manager must remove any barriers to communication.

#### Media choices

Project managers must choose the most appropriate communication methods and media for distributing information. All media choices are situation-specific. They should depend on considerations like the needs of the receiver, the nature of the information, and how time-sensitive it is. Using an inappropriate medium can make information difficult to understand or interpret, or result in its being overlooked.

#### Writing style

The style of a written message has a significant impact on the way an audience receives the message. So it's important for project managers to have effective writing skills. They may benefit from training on aspects of writing such as the use of active versus passive voice, proper sentence structure, and word choice.

#### Facilitation and meeting skills

Meetings are the best format for presenting certain types of information, such as detailed project performance reports. However, ensuring appropriate content is covered is only half the battle. It's important that project managers are skilled at facilitating communication during meetings. Otherwise, the meetings may dissolve into argument and confusion. It's also important to develop good meeting management skills. These include skills for preparing an agenda, handling conflicts, drawing out silent participants, building consensus, and keeping to a schedule.

#### Presentation techniques

Many factors other than the content of a presentation affect its success. Presenters must be aware of how the design of visual aids, as well as their body language, tone of voice, and diction, affect the way an audience interprets information.

The inputs to the Distribute Information process are the project management plan, performance reports, and organizational process assets – including templates for communication methods, policies and procedures, historical information, and lessons learned. Factors other than these inputs that influence project communications include sender-receiver models, media choices, writing style, facilitation and meeting skills, and presentation techniques.

**Course:** Processes for Managing Project Communications  
**Topic:** Influences on Communicating Project Information

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# SkillBrief

# Project Communication Tools and Techniques

Once the inputs are gathered for the Distribute Information process, you must use certain tools and techniques to distribute information in accordance with the communications management plan, which is part of the project management plan. These tools and techniques include communication methods and information distribution tools.

Communication methods are the techniques used to distribute information and to ensure this information is understood. The project manager typically decides what, when, and how communication methods are to be used in a project, based on stakeholders' communication requirements.

Information can be distributed via three main types of communication methods. These include

* **interactive communication** – includes a multidirectional exchange of information. This is the most efficient way to ensure that all participants maintain a common understanding.
* **push communication** – involves sending information to specific recipients. This ensures the information is distributed, but not that it was necessarily received or understood by the intended recipients.
* **pull communication** – involves sending information only to people who specifically request it. This is useful when a large amount of information must be accessible to many recipients and it's appropriate for the recipients to use their own discretion about which parts of the information they want to access.

Along with specific communication methods, there are a number of tools you can use to distribute information. These tools fall into these three categories:

* systems for handling hard copies, such as mail or courier services
* electronic systems for written communication and information distribution, such as shared online databases, e-mails, instant messaging, faxes, and web publishing.
* verbal communication systems, such as voicemail, telephone, and video and web conferencing

Communication methods and information distribution tools are applied throughout a project's life cycle, as the project manager and team plan, develop, test, and deliver the project's deliverables.

The road map that the project manager uses to distribute information is the communications management plan and, in particular, the communication requirements matrix. These guide the project manager in determining which communication methods and information distribution tools are most appropriate in different situations.

It's important that, where possible, the planned communication strategies are integrated with the project schedule. This helps ensure that all required information is given to stakeholders in a timely manner.

A project manager is likely to receive many unplanned and unexpected requests for information. To respond appropriately, it's important to establish which communication methods and tools to use in different situations

The two tools and techniques that are used during the Distribute Information process are communication methods and information distribution tools. The three communication method categories with which information is distributed are interactive, push, and pull communication. Information distribution tools include systems for handling hard copies, electronic systems for written communication, and verbal communication systems.

**Course:** Processes for Managing Project Communications  
**Topic:** Distributing Project Information

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# SkillBrief

# Distribute Information and Organizational Process Assets

As communications occur during a project's execution, it's important to record the information you obtain. This information then becomes an asset to a current project and for future projects. So the single output of the Distribute Information process is updates to organizational process assets.

Among the types of organizational process assets used in the process of distributing project information are

* **stakeholder notifications** – These inform stakeholders about resolved issues, approved changes, and the general project status. They may be designed for e-mail distribution or for mailing as hard-copy memos. Stakeholder notifications are updated if new information comes to light during the Distribute Information process.
* **project reports** – These are both formal and informal reports that detail a project's status. Project reports are created and updated as necessary during the Distribute Information process. Other reports that may also be used include those for recording lessons learned, creating issue logs, and compiling project closure reports.
* **project presentations** – These provide formal or informal information to the level and needs of its audience. An organization may use standard templates for creating project presentations.

Three other types of organizational process assets that may be updated as a result of the Distribute Information process are

* **feedback from stakeholders** – The project manager records stakeholder feedback received during project execution and sends it out to the appropriate recipients. This input can be very important in helping the project team improve performance and better meet stakeholder expectations.
* **project records** – These are project files that contain correspondence, memos, minutes from meetings, and other documents that describe the project. This information can be maintained in a project notebook or register, and can be stored either electronically or as hard copy. Project records need to be updated whenever new information comes to light during the course of a project.
* **lessons-learned documentation** – This should be updated with any information that emerges about the causes of problems and the reasoning behind the chosen corrective actions. This information becomes part of the organization's historical database, ready for use on future projects.

Organizational process assets updates are an output of the Distribute Information process. Types of organizational process assets that are used to distribute information and that may be updated are stakeholder notifications, project reports, project presentations, feedback from stakeholders, project records, and lessons-learned documentation.

**Course:** Processes for Managing Project Communications  
**Topic:** Assets from Information Distribution

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# SkillBrief

# Managing Stakeholder Expectations

### Managing stakeholder expectations

For a project to succeed, a project manager has to consider all stakeholders' wants and needs, and then manage the project in a way that both meets its objectives and keeps stakeholders satisfied.

A project stakeholder is anyone who has a vested interest in a project and may be affected either positively or negatively by its outcome. In addition to those who provide financial backing, this may include customers, managers, project team members, contractors, suppliers, and company CEOs. Managing a project effectively requires that you consider the perspectives of all these stakeholders

It's the project manager's responsibility to manage stakeholder expectations. This begins with having a good understanding of each stakeholder's needs and wants for a project. You'll have to consider how each stakeholder experiences the project. From this you should be able to assess what results they expect at the end of the project.

You then negotiate with and influence the stakeholders to ensure their expectations are in line with the stated project goals. This means you confine expectations to what is actually achievable within the project's scope, in order to limit any dissatisfaction with the project. And you identify sources of potential concern, and resolve known concerns, as soon as they arise.

One way of aligning stakeholders expectations with a project's objectives is to ensure that the stakeholders understand the project's benefits and risks. The project manager can also encourage a key stakeholder to provide active support and assistance with risk assessments. This helps create a unified approach, which increases the probability of a project's success. It also effectively reduces the risk that unresolved issues or disruptions will impact the project.

### Inputs

There are six main inputs for the Manage Stakeholder Expectations process

#### Stakeholder register

The stakeholder register includes all information about identified stakeholders, such as their names, roles, expectations, and levels of influence.

#### Project management plan

The communications management plan, a subsidiary of the project management plan, drives all communication with stakeholders, enabling the project manager to ensure that the right stakeholders get the information they need, in the appropriate way, when they need it.

#### Stakeholder management strategy

The stakeholder management strategy describes the approaches to be taken to increase stakeholder support and minimize negative impacts stakeholders may have on the project. It identifies

* key stakeholders who can significantly impact the project
* the level of participation required of each stakeholder
* stakeholder groups and appropriate plans for their management

#### Issue log

The issue log enables you to keep track of identified and potential issues as they arise, so as to limit their impact on the project and to ensure a common understanding. You give each issue a tracking number and describe the impact if it isn't resolved, as well as who the issue has been assigned to for resolution. And you list all the relevant dates, such as when it originated, when it should be resolved by, and the date of actual resolution. Last you list the action status of the issue.

#### Change log

A change log documents and tracks the status of change requests. It describes each change request and its current status and outlines its likely impact on the project. It provides a quick overview of the potential risks associated with changes and – where implemented changes have negative impacts – a useful source for lessons learned that you can apply to future projects.

The issue and the change logs are the primary sources of information about project issues and changes. Each time an item is entered into one of these logs, the project manager must decide which stakeholders, if any, need to be informed. These changes, and their impact to the project in terms of time, cost, and risk, must be communicated to the appropriate stakeholders to ensure a common understanding.

As a project manager, how do you decide what information to pass on to stakeholders? It helps if you try to predict some of these questions that stakeholders are likely to ask:

* What cost impact will this issue or change have on the project?
* What is the cost if the issue is not resolved or the change request is rejected?
* When will my change request be reviewed?
* Will the project still finish on time if a change request is approved?
* How will this change request affect the total risk?
* What risk does this issue bring to the project?

#### Organizational process assets

Organizational process assets comprise the last input for managing stakeholder expectations. These assets or resources can guide your communication with stakeholders and help to resolve issues. Examples of organizational process assets that can affect the Manage Stakeholder Expectations process include

* **organizational communication requirements** – determine how, when, and what you must communicate to stakeholders
* **issue management procedures** – affect the processes you use to record and manage project or customer issues
* **change control procedures** – may need to be applied when resolving issues or concerns raised by stakeholders
* **historical information about previous projects** – can guide you in a current project, prompts you to repeat strategies that were successful, and avoid those that weren't

The inputs to the Manage Stakeholder Expectations process provide a project manager with the information and tools to manage stakeholders by influencing their expectations and resolving issues. This helps to ensure stakeholder satisfaction with what the project achieves. Inputs to the Manage Stakeholder Expectations process include the stakeholder register, stakeholder management strategy, project management plan, issue log, change log, and organizational process assets.

**Course:** Processes for Managing Project Communications  
**Topic:** Inputs to Managing Stakeholder Expectations

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# SkillBrief

# Manage Stakeholder Expectations Techniques and Outputs

### Using communication methods

The project manager manages stakeholder expectations in order to coordinate stakeholder efforts. This enables you to keep the project within scope, budget, and schedule, and to achieve the project's objectives and vision. Another reason for managing stakeholder expectations is to ensure that expectations align to the reality of what a project is going to achieve, so that the stakeholders will be satisfied with the outcomes.

The communications management plan, which is part of the project management plan, describes the communication methods for dealing with stakeholders. One communication method that is sometimes necessary to use is push communication, but the best method is interactive communication. The other method – pull communication – is usually inappropriate for managing stakeholder expectations. With push communication, information is delivered only to those people who need it.

The best way to influence stakeholders, or in fact people in general, is through interactive communication. The answers typically involve a face-to-face meeting or telephone conversation, as these allow for maximum verbal and nonverbal communication.

### Using interpersonal skills

Interactive communication requires good interpersonal and management skills. Interpersonal skills are the personal attitudes and abilities that identify a good project manager from a weak one. These skills cover a wide range of attributes, including motivational, leadership, and group management abilities. Interpersonal skills are important in managing stakeholder expectations, as well as in all other areas of business. They include the skills involved in

* **building trust** – Stakeholders worry less, raise fewer objections, and accept decisions and completed deliverables more readily, if they trust you. You build trust by being open about problems and progress, at the same time as expressing confidence that any issues can be resolved.
* **resolving conflict** – Unrealistic stakeholder expectations can lead to conflict. Resolving conflicts requires certain skills. You may need to resolve technical arguments, open communication channels between staff and management, or resolve personality differences.
* **using active listening** – To manage stakeholder expectations with active listening involves really hearing their concerns, considering them seriously, and acknowledging what has been said by paraphrasing to check your understanding. You also need an empathetic, open, and receptive attitude, and to maintain eye contact.
* **overcoming resistance to change** – As a project manager, you need to overcome your resistance to change because some changes are positive. By being receptive, you stand to benefit the project. Other times, it may be a stakeholder who resists necessary change. You need to be able to overcome others' resistance as well, patiently yet persistently explaining the benefits of the change.

### Using management skills

To manage stakeholders in an interactive way and to influence their expectations, you need good management skills that focus on ensuring a project team works in a coordinated and harmonious way and achieves a project's objectives. These include

* **technical skills** – The skills related to the processes or tasks used to complete work. You obtain these skills through specialized training and experience. Solid technical skills are essential for a project manager, particularly when you must justify technical scope changes to stakeholders, who might include technicians or industry expert
* **conceptual skills** – Those skills involved in seeing the "bigger picture." A project manager with good conceptual skills understands the role of a project in the context of the organization and its industry, and takes internal and external environmental factors into account. Good conceptual skills are necessary for planning and managing large projects, and especially for motivating or influencing stakeholder decisions.

An important part of managing stakeholder expectations is communicating project objectives, and current and forecasted performance, to stakeholders. To do this effectively, a project manager also requires strong presentation, writing, public speaking, and negotiating skills.

Presentation skills involve your abilities to present information to stakeholders in an interesting, concise, and accurate way. This requires computer skills for electronic presentations like slide shows, careful use of audio-visual aids, and good public speaking skills. An effective presentation will often stimulate audience interaction and feedback.

Project managers need good writing skills so they can create relevant, well-structured, clear, concise, and accurate documents. You should carefully check your documents for errors – a grammatical error could change your intended meaning and cause embarrassment.

Your skill at public speaking involves how you handle yourself in front of a group.

### Outputs of managing expectations

As you communicate project performance and project issues to stakeholders, you'll receive feedback from them, which often leads to new or updated documents. These are the outputs of the Manage Stakeholder Expectations process. They are change requests, project document updates, project management plan updates, and organizational process assets updates.

The project's change control process involves considering a request and, if it seems valid, passing a formal change request to the change control board for review and approval. When change requests are approved or changes occur among stakeholders, it often means you need to update certain project documents. Among the documents you're most likely to update as a result of managing stakeholder expectations are the

* **stakeholder management strategy** – It's worth consulting stakeholders on occasions to find out how they prefer to receive communications.
* **stakeholder register** – You need to update the stakeholder register as new stakeholders are identified or original stakeholders are replaced.
* **issue log** – This must be updated whenever existing issues are resolved or new ones are identified.

The communications management plan often requires updating when managing stakeholder expectations. These expectations can result in updates to a variety of organizational process assets.

Managing stakeholder expectations requires solid communication methods and skills. Of the three communication types – push, pull, and interactive – the most effective is interactive. A project manager needs well-developed interpersonal skills to manage stakeholders' expectations effectively. These skills include building trust, active listening, resolving conflict, and overcoming resistance to change. In addition, managing stakeholders' expectations requires both technical and conceptual management skills. It also requires good presentation, writing, public speaking, and negotiating skills. Outputs from the Manage Stakeholder Expectations process are change requests and updates to project documents, project management plans, and organizational process assets.

**Course:** Processes for Managing Project Communications  
**Topic:** Stakeholder Management Skills

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# SkillBrief

# Inputs, Tools, and Techniques of the Report Performance Process

### Inputs to the Report Performance process

Report Performance is the process you use to collect and distribute the performance information of a project. This information enables you to assess and communicate project progress and performance and forecast project results. By using the Report Performance process regularly throughout a project, you can compare actual progress to estimated progress.

The Report Performance process uses these five inputs to help determine project performance.

#### Project management plan

The project management plan provides information about the expected values or the baselines for various aspects of your project, including scope, cost, and schedule. The performance measurement baseline represents the planned project performance. This can be compared to the actual performance values generated during the project's execution.

The performance measurement baseline is often depicted as an S-curve. It I a time-phased budget and reflects the project's scope. Scope changes are noticeable on the graph as abrupt changes in the graph's incline. This graph indicates

* **time** – By placing time on the X-axis, you represent the ideal rate of tasks that are performed in a project. If the actual work does not align to this expected value, you are ahead or behind schedule
* **cumulative values** – The values on the Y-axis allow you to pinpoint the expected total cost or budget expended at every stage of a project. If the actual costs produce readings that differ from the baseline, you know you are under or over budget.
* **performance measurement baseline** – This represents the planned budget expenditures over the project's life. The line takes an S-shape because the rate of expenditure is low during initiation and planning, then increases during the execution phase when most work is carried out. Spending starts to decrease as the project nears completion. Any deviation in actual values derived while completing the project are quantified by comparing the actual performance to the baseline.

#### Work performance information

To generate this input, information is collected about the results of activities performed during a project. As you prepare to report performance, you add work performance information to the performance measurement graph. The result is a line that represents actual costs.

#### Work performance measurements

These consist of information that has been analyzed and processed using measurement formulas.. You do this by subtracting actual results from planned results.

#### Budget forecasts

Budget forecasts provide information and estimates on the additional capital that is needed to complete the entire project. Budget forecasts are important to people who have to approve all budget increases.

#### Organizational process assets

These typically include report templates, policies and procedures that define the measures and indicators to be used, and variance limits that an organization has defined.

### Tools and techniques of the Report Performance process

There are four basic tools and techniques for reporting project performance:

* **variance analysis** – an after-the-fact examination of the causes leading to a discrepancy between planned and actual project performance
* **forecasting methods** – techniques for predicting likely future project performance. They can be based on trends in the project's performance levels to date or on causal factors likely to impact on the project
* **reporting systems** – standardized software tools that enable the project manager to capture project performance information, store it, and distribute it to stakeholders
* **communication methods** – techniques for keeping all the project stakeholders informed about the project's progress.

There are several steps that are common to the variance analysis process:

1. verify the quality of work performance information collected to ensure that it is complete, consistent, and credible when compared with other project or status information
2. determine variances between baseline and actual values
3. evaluate the impact of the variances in project performance on all areas of the project
4. analyze and document the variances in order to find their sources or to detect trends in the types of variations happening in the project

Generally, forecasts are particularly useful to high-interest or high-power stakeholders who want to know how the project will develop. Forecasting methods can be categorized into three main types:

* **time series** – the most common approach to forecasting, uses past performance as a basis for estimating future project performance.
* **causal or economic** – assumes it is possible to identify the factors influencing the variable that's being forecast. Forecasts are made using this causal understanding of the project's processes.
* **judgmental** – draws on intuitive judgments, opinions, and probability estimates.

Judgmental forecasts are most often performed using five basic methods:

* **personal insight** – a single person, such as an expert, uses her skill, experience, and judgment to offer a forecast
* **focus groups** – a panel of experts, or a focus group, prepare the forecast
* **the Delphi method** – several experts who do not interact personally reply to questions anonymously through mail, thus eliminating any bias on the part of those involved
* **historical precedent** – previous similar experience or historical precedent help make a forecast
* **market surveys** – customers provide data to be examined and used to make forecasts about the population at large

Reporting systems are among the tools and techniques for reporting performance. Most project management programs will have some form of report gathering capacity that enable you to capture, store, and distribute performance information to your stakeholders.

The last technique for reporting project performance concerns the communication method you choose. Communication about performance generally happens during status review meetings where information regarding the project's performance and progress is exchanged and analyzed.

The five inputs of the Report Performance process are the project management plan, work performance information, work performance measurements, budget forecasts, and organizational process assets. The four techniques for reporting project performance are variance analysis, forecasting methods, reporting systems, and communication methods.

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**Topic:** Variance Analysis and Forecasting

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# SkillBrief

# Reporting Performance Outputs

The Report Performance process helps ensure that project stakeholders have the information they need about the progress of a project. Drawing on the necessary inputs, such as work performance information and measurements, the process uses various tools and techniques to collect performance information. Ultimately, it presents this information in a report format that is appropriate for the project's stakeholders.

#### Performance report

The primary output of the Report Performance process, then, is your project's performance report. A performance report organizes and compiles the results of variance analyses you performed on the different areas of project performance – such as cost, schedule, or quality. There are typically sections that list the baseline values, actual results, and the variance. The report must be easy to read and understand. It needs to include details about the latest progress of a project, providing the level of detail that is appropriate to its target stakeholders. There's no point in putting in details that the stakeholder doesn't need to know.

Performance reports can range from simple status reports to detailed tables of data. A status report lists the percentage of the project completed and status dashboards for scope, schedule, cost, and quality. A more detailed version of a status report includes information, sometimes in supporting documentation, about wider issues of project performance and forecasts and plans for future project developments.

A section on the current status of risks and issues, or details of planned work are often found in a detailed status report. So are a summary of approved changes or the results of a variance analysis. You can also include an analysis of past project performance, forecasts for future project performance, or any other information that is relevant or may be of interest to stakeholders.

When deciding on how much detail the performance report to stakeholders requires, you have to ensure that the level of information is appropriate to their status as a stakeholder. You determine their status with the help of a power and interest grid.

Performance reports are your means of presenting the project to your stakeholders. If the project is doing well, they will be a source of satisfaction. If the progress is slower than expected, the report prevents the stakeholder from developing a false impression of success. It's better to let stakeholders know when things are not going as expected upfront.

The most common formats for the basic elements of both types of performance reports are Gantt charts, histograms, S-curves, and tables. These charts can be used to represent the information gathered during the execution of the project. They can also be used in conjunction with the baseline values estimated for project performance during the planning stages.

#### Change requests

The process of analyzing a project's performance – and reporting on the results – often prompts suggestions for changes to the project management plan. This is very likely if the project is not performing as well as planned. Change requests arising from performance reports usually take one of two forms:

* **recommended corrective action** – Poor performance often leads to recommended corrective action. Performance is assessed and a recommendation is made for a change that will bring performance back in line with the project management plan.
* **recommended preventive action** – This is usually a result of an analysis into the project performance to date, in particular one that reveals a potential for reduced, future performance. A change request is a response to this perceived threat to the project and is designed to reduce the probability of negative performance.

#### Updates to organizational process assets

The lessons-learned log is the asset most likely to be generated as a result of the Report Performance process. Every time you measure an activity's performance, you learn something about it. You find out how long it takes, what it should cost, and what skills team members need to perform the tasks at optimum efficiency. All the results gained from measuring performance are included in the log.

An update to the lessons-learned log records the issue and the effect it has on the project. It also records what action was taken to correct the problem and provides recommendations for future projects that may face similar difficulties. Project managers on similar projects in the future may be able to use the log to help determine how long a rollout process should take.

The Report Performance process provides both the current project and future projects with a way to communicate how a project is performing. It enables the stakeholders and project managers to make informed decisions about changes that affect a project's future performance. This process is also an opportunity for the organization to collect a database of information about how past projects performed, which helps current and future projects improve on performance.

The Report Performance process has three outputs. Performance reports can range from simple reports to ones that are more complex and highly detailed. Change requests are generated as a result of concerns raised about project performance. They can either be recommended corrective or recommended preventive actions. Updates to the organizational process assets may result in changes to the lessons-learned log, which are retained to aid future projects.

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**Topic:** Performance Reports

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# Follow-on Activity

# Factors that Influence Project Communications

**Purpose:** Use this follow-on activity to self-evaluate the factors with regards to your project that influence project communications.

**Instructions for use:** To use this tool, consider the factors that influence communication. Then evaluate your skills in relation to each factor.

| **Project communications factors** | |
| --- | --- |
| **Factor** | **Self-evaluation** |
| Ability to create graphs and charts to reflect performance information | Row 2 Column 2 |
| Facilitation and meeting skills | Row 3 Column 2 |
| Presentation skills | Row 4 Column 2 |
| Writing skills | Row 5 Column 2 |

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Given your results, in which of these categories do you think you can seek extra training through your HR Department or online sources?

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**Topic:** Influences on Communicating Project Information

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# Follow-on Activity

# Reviewing Performance Reporting

**Purpose:** Use this follow-on activity as a basis for examining how performance is reported in your own organization.

**Instructions for use:** To use this tool, answer some questions about how your organization reports performance. Ask an experienced project manager for help, if you are unsure.

| **Questions on reporting performance** | |
| --- | --- |
| **Question** | **Answer** |
| How is variance analysis performed in the company? | Row 2 Column 2 |
| At what stages during a project is variance analysis performed? | Row 3 Column 2 |
| How do you go about checking that the information used for your analysis is accurate? | Row 4 Column 2 |
| How do you recognize a trend in the variances for your project performance? | Row 5 Column 2 |
| What forecasting methods does the company typically use? | Row 6 Column 2 |
| How do you go about finding reliable expert opinion? | Row 7 Column 2 |
| Which method of forecasting has proved most reliable in the past? | Row 8 Column 2 |
| What reporting systems does the company most commonly use? | Row 9 Column 2 |
| How are performance reports most commonly presented to stakeholders? | Row 10 Column 2 |
| How often is progress reported to stakeholders? | Row 11 Column 2 |

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# Learning Aid

# Web Site Development Communication Requirements Matrix

**Purpose:** Use this learning aid to review an example communication requirements matrix.

| **Communication requirements matrix** | | | | | |
| --- | --- | --- | --- | --- | --- |
| **Stakeholder** | **Communication format** | **Frequency** | **Medium** | **Responsible person** | **Purpose** |
| Joe – client, small business owner | Presentation and informal discussion | At project kickoff | Meeting | Project manager | Presentation and discussion of project goals, client expectations, proposed web site design, and milestones |
| Joe | Presentation and informal discussion | At project wrap-up | Meeting | Project manager | Postmortem wrap-up to discuss client satisfaction |
| Joe | Status of deliverables/milestones report | Weekly | E-mail | Project manager | Keep client up to date on project status and any issues |
| Joe | Issue resolution | As needed | Telephone | Project manager | Discuss concerns and provide timely resolution of issues |
| Rob – program manager, small-to-medium business | Project intranet site | Weekly – every Friday by noon | LAN/Web | Project manager | Provide weekly project performance reports |
| Project team:  Mark – writer  Jill – graphic artist  Ed – developer  Andy – quality reviewer | Team status reports | Daily | E-mail | Each team member | Inform project manager of progress by end of each day, including percentages of tasks completed, estimated completion dates, and any issues |
| Project team | Project documents deliverables | As needed | LAN/Web | Project manager and team members | Project planning documents and deliverables will be kept on the project's web site for convenient access by all team members |
| Project team | Status meetings | Weekly, every Monday morning | Verbal | Project manager | Discuss current and upcoming tasks, set priorities, resolve issues |
| Project team | Facilitated sessions | As needed | Verbal | Project manager | Conduct team building sessions and conflict resolution |
| Project team | Routine communications | As needed | E-mail, IM | Project manager and team members | Day-to-day communication about on-going work |
| Ruth – contracts office | Project contract | At each milestone | E-mail | Project manager | Project manager will notify contracts officer at each payment milestone to invoice client |
| Judy – scheduling and HR coordinator | Consultation | During planning, as needed thereafter | Verbal/E-mail | Project manager | Provides information for staging resources |

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**Topic:** Influences on Communicating Project Information

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# Job Aid

# Distribute Information Tools and Techniques

**Purpose:** Use this job aid to review the tools and techniques for the Distribute Information process.

| **Tools and Techniques** | | |
| --- | --- | --- |
| **Tool or technique** | **Category** | **Example** |
| Communication methods | Interactive | Meetings, phone calls, video conferencing |
|  | Push | Letters, memos, reports, e-mails, faxes |
|  | Pull | Intranet sites, e-learning, knowledge repositories |
| Information distribution tools | Systems for handling hard -copy documents | Courier systems, filing cabinets |
|  | Electronic systems for written communication | Shared online databases, e-mail, instant messaging, faxes, web publishing |
|  | Verbal communication systems | Voicemail, telephone, video and web conferencing |

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**Topic:** Distributing Project Information

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# Job Aid

# Managing Stakeholders

**Purpose:** Use this job aid to revise the skills for managing stakeholders.

The most effective communication for influencing stakeholders is interactive – when you talk directly to them. Other types of communication are push communication, where you send information to stakeholders, and pull communication, where stakeholders retrieve information.

With interactive communication in particular, the project manager needs many communication skills. Here are some interpersonal and management skills that you should find useful in managing stakeholder expectations, influencing their desires, and resolving conflict.

#### Interpersonal skills

Examples of interpersonal skills are

* building trust by being honest, demonstrating ability and confidence, and practicing tolerance and respect
* resolving conflict, defusing tense situations, and negotiating solutions to practical problems
* listening actively, which means paying full attention to someone and taking them seriously
* overcoming resistance to change by considering all suggestions seriously
* developing a cohesive and motivated team through leadership skills, which include both interpersonal and management skills

#### Management skills

Examples of management skills are

* technical skills, which involve using proper planning, organizing, estimating, monitoring, and scheduling methods and tools, and having a good grasp of technical environmental factors
* conceptual skills, which include having the broad vision of the organization, understanding the context of the project and the politics within the organization, and collaborating with other departments and disciplines for a project's advantage
* communicating well through writing, public speaking, and presentation
* negotiating beneficial solutions for everyone, which means applying interpersonal skills, self-confidence, and assertiveness to achieve compromises which work to the advantage of all stakeholders and towards a project's objectives
* being sensitive to the needs of all stakeholders
* developing the project team and building cohesiveness and morale
* maintaining a positive attitude
* mentoring and encouraging participation
* maintaining a spirit of cooperation and an open atmosphere where people can express opinions
* giving rewards and recognition when appropriate
* delegating rather than giving orders

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**Topic:** Stakeholder Management Skills

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Risk Management planning

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# SkillBrief

# Defining Project Risk

## Types of project risk

Every project faces uncertainty, or risk. Project risks have two characteristics:

* they're events that might happen
* they have the potential to impact one or more project objectives

Risks always happen in the future. To get a better idea, try thinking of a risk as a surprise or unexpected event. Surprises can be pleasant or they can be disagreeable. Project risks are the same.

There are two types of project risks:

* **positive** – also known as opportunities, these can benefit a project's objectives
* **negative** – also called threats, these have the potential to harm a project and its objectives

One type of situation that presents obvious threats and opportunities in a project is when innovation has been introduced.

Innovation presents threats and opportunities to a project. It implies you are trying new things instead of following old, well-established principles or procedures. However, you cannot predict whether innovation will work out.

So with innovation comes an increase in project risk.

Being able to identify risks means being able to foresee possible, unexpected events that may impact on project objectives. However, you should also be able to determine whether the risk is good or bad.

## Examples of risk

Project risks can be found throughout a project's life cycle. To identify potential risks, you should think of events that could cause risks, and which areas of the project may be affected by each event.

Areas affected by risk include

* **the project budget and schedule** – The project may fall behind schedule because decisions are not made efficiently. Managerial or administrative failures may cause the budget to suffer as you find it difficult to get the funding you need to complete tasks.
* **scope and project requirements** – Uncontrolled change requests and bad scope definition, including a project's inability to meet a client's desired goal or attain unfamiliar objectives, will generate scope creep.
* **technical and hardware issues** – During the integration of a new and an existing system or during the testing of an IT project – usually undertaken at the end of the process, an installation or upgrade might be found to be unstable, quality might be substandard, software unsuited to the set task, or the user interface too complex to use without training.
* **project management processes** – Negative risks to the project's viability are posed by significant change requests being made by those who've not been involved in the requirements identification process.
* **personnel issues** – Team morale may suffer if members are unsure about what is expected of them. The use of untested sub-contractors may contribute to uncertainty.
* **political and legal concerns** – Factors such as location and public participation increase the likelihood local government might change project requirements or demand compliance with new or changed regulations.
* **contracts** – Planned or unplanned changes to the contracts of parties committed to the project many generate negative risks.
* **business, environment, and management** – Employee resistance to change might pose a threat. Also, increasingly strict or regularly updated environmental laws designed to mitigate negative risks may well increase them for the project team. Poor team management – for example, an absentee project sponsor, can pose a threat to several project areas or objectives.

Part of managing a project is being able to identify risks. It helps to remember that a risk can be positive or negative and that it can impact any part of a project.

All projects face risks of some kind. A project risk is a future event that might happen and has the potential to impact one or more of the project's objectives. Risks can be negative or positive. If they are negative, they are often called threats and may harm a project. Positive risks are called opportunities and can benefit a project. Risk becomes more likely when innovation is introduced.

You can find risk in almost all areas of a project. Some areas include the budget, schedule, the project plan, project scope, and project requirements. You may also face technical, hardware, personnel, political, legal, contractual, environmental, and business issues.

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**Topic:** What is Project Risk?

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# SkillBrief

# Recognizing Project Risk Management Processes

To manage risks successfully, you need to identify as many risks as possible, understand their likelihood, causes, and impacts, and then plan appropriate responses.

The processes of the Project Risk Management knowledge area help you do this. The importance of planning in risk management is such that five out of six Project Risk Management processes occur in the Planning process group.

By assigning so much time and resources to risk planning, you're able to monitor and control risk during the execution of the work.

#### Planning process group

The first risk management process is **Plan Risk Management**, which you use to develop the risk management plan. It also enables you to develop strategies for planning and controlling risk throughout the project.

The **Identify Risks** process involves identifying as many potential risks as possible and documenting these in a risk register. This process may involve many stakeholders – from the project manager, the team, and the customer to external risk management experts.

Once you've planned risk management and identified the risks, you use the **Perform Qualitative Risk Analysis** and **Perform Quantitative Risk Analysis** processes to explore the impact and priority of each risk.

When risks have been sufficiently analyzed, you use the **Plan Risk Responses** process to determine the most appropriate and effective actions to take when a risk event actually occurs.

Part of this process is ensuring each response is accounted for in the project schedule and budget. For example, you can assign buffers to allow for the risk response. You also ensure that each response is assigned someone who will be responsible for its implementation.

You design a risk response to reduce or minimize the effects of negative risks or exploit the benefits of positive risks. Suppose you're concerned about not meeting a project deadline. An appropriate response is to add overtime work to the schedule so that the project is completed on time.

Your response also needs to include the cost buffer to pay for the extra work.

Planning responses to potential opportunities will be different. You may decide to add the extra earned value from a project completed ahead of schedule to your profit margin. Or you may choose to strengthen your relationship with your client by creating added value.

When planning to capitalize on an opportunity, you must decide up front how far you'll go to get the reward. You must be careful not to invest so much in the potential gain that the cost begins to outweigh the benefit.

#### Monitoring and Controlling process group

The last process – **Monitor and Control Risks** – deals with detecting risk events, managing responses, and improving risk management. It is part of the Monitoring and Controlling process group.

It is a critical process because it ensures that the risk management plans are implemented correctly and revised as needed.

### Project Risk Management outputs

#### Risk management plan

The risk management plan is the output of the Plan Risk Management process. The risk register is the Identify Risks process output. Both are used and updated throughout the remainder of the risk processes.

The risk management plan contains the

* methodology, approaches, tools, and data sources for risk management
* roles and responsibilities of the risk management team
* budgeting of resources and cost estimates for risk management, and the protocols for applying the contingency reserve
* timing and frequency of risk management activities, and the schedule for applying the contingency reserve
* risk categories or the structure that identifies risks to a consistent level of detail

#### Risk register

The output of the Identify Risks process is the risk register, the two main functions of which are to

* **list identified risks** – As the project progresses, the list increases until it represents all the risks the project is likely to encounter. It contains the results of all the other risk management processes. These results include a complete description of the risk – what could happen, what will cause it, and the impact it will have.
* **describe potential responses** – The most common responses include adjusting the schedule, increasing the budget, reducing the quality requirements, or modifying the scope. In severe cases, the project is concluded early. Other responses are to bring in staff from other parts of the organization or hire external experts to resolve the problems.

The five planning processes occur in sequence, but the sequence is flexible. Say you identify a serious risk requiring a detailed contingency plan. You immediately delegate this plan to someone to get a head start on managing the risk. To be efficient and practical, you switch between the processes as they suit the project.

### Iterative planning

Risk management planning is iterative. As more information becomes available, you identify new risks and

* analyze each qualitatively and quantitatively
* determine the causes and impacts
* plan responses

As risks are triggered and the project environment changes, you reanalyze previously identified risks. You should review the risk management plan on a regular basis during status and reporting meetings with the project team.

The iterative nature of risk planning also enables you to deal with previously unknown risks that emerge; for example, by revising risk documentation and developing new responses.

The Project Risk Management knowledge area has five processes in the Planning process group and one in the Monitoring and Controlling process group. The risk planning processes are Plan Risk Management, Identify Risks, Perform Qualitative Risk Analysis, Perform Quantitative Risk Analysis, and Plan Risk Responses. The Monitor and Control Risks process is part of the Monitoring and Controlling process group.

Risk management is iterative. As the work proceeds and information becomes available, the project manager updates the risk planning documentation – the risk management plan and the risk register. This ensures continuous risk management improvements.

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**Topic:** Risk Management Processes

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# SkillBrief

# Examples of Risk Management Activities

Some risks are worth taking and some you will go out of your way to avoid. Risk management gives you an increased certainty that a project will succeed in its objectives.

When it comes to risk management, you should aim to increase the likelihood of a positive outcome. You do this by reducing the probability of negative events and by limiting their impact if they do happen.

For risk management to succeed, you as the project manager need to make a conscious decision to manage risk. And you must be committed to responding proactively to risks. If you only respond when an event occurs, you will waste time and resources needlessly trying to manage it.

Risk management has two key roles:

* reducing uncertainty about identified risks
* determining appropriate responses for unavoidable risks

These roles enable you to eliminate negative outcomes and take advantage of positive outcomes.

## Reducing uncertainty

To reduce uncertainty in a project, you determine the probability of a risk occurring, the consequences and impact, and the potential causes.

### Probability

Probability can be low, medium, or high. For example, you may need to determine how bad weather will affect your construction project. Based on experience, you feel this risk to be low, but you consult historical records. An 8% chance of heavy rainfall during the project life cycle confirms your assessment.

### Impact

A risk can impact any area of a project:

* cost
* schedule
* quality
* scope

When you consider the impact of a risk on your project's objectives, you look at its severity. Risks are rated low, medium, or high. You quantify these ratings and give each a threshold. For example, a risk might be low if it stands to impact the budget by less than 10% and high if greater than 20%.

A risk's impact often depends on the stage the project is at. Impact might increase as the project continues.

Early in the project, before the budget is spent and the schedule used up, the impact of such a mistake may be relatively low as it is still possible to redesign the phone. However, once the design, product requirements, and scope have been approved and mass production has started, correcting the market research error could be extremely costly.

### Cause

Apart from the general risks to a project, such as the possibility of cost or schedule overruns, there are also many specific risks. If you identify the causes for a specific risk, you can find ways to avoid or mitigate it. You can also explore reasons why a risk is likely to be realized and why it will have the impact you predict.

As project manager, you need to consider the cause of the risk.

The more you can control the cause of a risk, the better you can mitigate it.

Sometimes you have little or no control over the cause of risk. For instance, your project may be reliant on oil. You have no control over commodity prices and a rapid price increase could impact your project severely.

## Developing responses

Risk management helps you deal with and avoid risks that you can predict. But it also enables you to prepare for risks that you can't avoid or predict. Developing appropriate responses to risks that you can't avoid during the planning stage is the most important way to manage and control risk in a project.

When you're faced with risks you can't avoid, you develop a response during planning. Then if the risk event occurs, you implement the response.

You then follow up by asking how effective your planned response was at controlling the damage caused by the risk.

Or if the risk also posed an opportunity, was the response effective at maximizing the benefits to the project?

Appropriate risk responses include

* increasing the budget to cover the cost of the contingency plan
* adjusting the schedule according to the new conditions after the risk event
* stacking resources, which means moving staff within the project to handle bottlenecks or the situation more effectively
* changing the scope when beneficial or unavoidable
* closing the project prematurely in the case of a catastrophic event

### Unknowns

As carefully as you plan your responses to risk, you can never eliminate uncertainty completely. There are two categories that all risks fall into:

* **known unknowns** – are risks you can identify early in the project and mitigate against, based on events that have occurred in similar past projects. Or they can simply be common-sense predictions about what might possibly go wrong.
* **unknown unknowns** – are unforeseen events that no one identified as possible risks before they happened.

Risk management is about reducing uncertainty about identified risks and determining appropriate responses to risk. To assess a risk, you determine its probability, investigate its consequences and impacts, and establish its causes.

To mitigate unavoidable risk, you need to develop appropriate responses such as adjusting your schedule, increasing your budget, or moving staff on the project. You also need to identify and maximize the benefits of positive risks. Risks can be either known unknowns or unknown unknowns.

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# SkillBrief

# Inputs to the Plan Risk Management Process

Both internal and external project risks come about for a number of reasons. Some of these you'll be aware of in advance, whereas others will occur unannounced. What's important is that you, as the project manager, know how to prepare for these risks.

This involves meeting with the key project stakeholders to discuss and decide what their approach to risk management will be for the duration of the project.

At the end of the risk management planning process, you produce a risk management plan that documents your decisions.

Plan Risk Management is the process of defining how to conduct risk management activities for a project. By planning carefully, you increase the chances of success for the other five risk management processes.

Planning risk management is important because it ensures that you set aside enough resources and time for risk management activities. It also enables you and the project stakeholders to establish an agreed-upon basis for evaluating project risks.

The amount of risk planning you do depends on the size and importance of your project. The larger and more important the project, the more complex and important the Plan Risk Management process will be. Medium and large projects can have significant risk and risk planning is more complex and formal. Small projects may not have as much risk and therefore risk planning is often kept fairly informal.

### Project scope statement

The project scope statement contains a description of the project's deliverables and objectives. It also provides a basis for making future project decisions and for confirming or developing a common understanding of project scope among the stakeholders.

During risk management planning, the project scope statement is the first place you start looking when identifying the extent of risk in a project. This is because it contains clues about how much overall uncertainty the project team will encounter as the project is planned and executed.

Furthermore, the project scope statement lists and describes the specific project constraints and assumptions. These provide clues for potential risks.

With regards to project constraints, everything that limits the team's options are listed. These include a predefined budget or a schedule's milestone that the customer or performing organization issues. Constraints often represent areas of risk because the impact is high if they need to be changed for any reason.

Consider any project with an imposed completion date. Risks originate from any aspect of the project that may cause delays.

Project assumptions should always be identified as risks. You can express each risk in terms of the potential that the assumption proves to be false.

### Cost management plan

The cost management plan is a document that sets out the format and establishes the activities and criteria for planning, structuring, and controlling the costs of a project.

During the Plan Risk Management process, the cost management plan defines how risk budgets, contingencies, and management reserves will be reported and accessed.

### Schedule management plan

The schedule management plan contains directions for reporting and assessing activity duration contingencies. The risk management plan should incorporate schedule contingencies for the time it will take to analyze the new risks and develop appropriate risk responses.

The schedule management plan will guide the team in determining how much extra time it should allow for integration testing beyond the time typically required.

### Communication management plan

In general, the communications management plan defines the interactions that will occur on the project.

As an input to risk management planning, the communication management plan identifies who will be available to share information about risks and when.

### Enterprise environmental factors

There are enterprise environmental factors that influence a project's risk and serve as inputs to the Plan Risk Management process. These include risk attitudes and tolerances that demonstrate the degree of risk that an organization is willing to endure.

One of the key enterprise environmental factors to consider as an input is the risk tolerance level of the organization and its stakeholders.

Risk tolerance is the balance between the negative consequences of a risk and its potential benefits. When the benefit outweighs the negative consequences, stakeholders may be willing to take a risk. If the cost or impact is too great given the amount of benefit that can be derived, stakeholders may avoid taking the risk.

### Organizational process assets

Organizational process assets are your organization's existing risk management policies and guidelines. These six organizational process assets can influence the Plan Risk Management process:

* risk categories that are typical for the types of projects your company carries out
* risk statement formats that are typically used for risk planning in your organization
* roles and responsibilities of individuals within your company who oversee risk planning
* authority levels for decision making
* lessons learned from risk management activities in previous similar projects
* stakeholder registers from past projects since they often contain information about various stakeholders' levels of risk tolerance

Risk categories, identified by the project manager, are the groups of risks that can occur. The roles and responsibilities include the persons responsible for handling the potential risk.

Also, the project team can learn valuable lessons from previous projects. This information will decrease or eliminate the risks to the project.

The inputs to the Plan Risk Management process are the project scope statement, the cost management plan, the schedule management plan, and the communications management plan. Also included are enterprise environmental factors and organizational process assets. The risk management plan is created to monitor and control project risks using these inputs.

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# SkillBrief

# The Plan Risk Management Technique

Once you have gathered the inputs to the Plan Risk Management process, you apply the process' only tool and technique, which is planning meetings and analysis.

Planning meetings takes input from experts from the different project areas, drawing on the experience of many people. Five types of people should attend these meetings:

* project team members
* stakeholders
* functional managers
* those who might have involvement in the risk management process
* those who have useful information related to planning risk management activities

All participants should have access to the inputs, particularly to the management plans. As project manager, it's your responsibility to facilitate planning meetings and analysis, and guide your team in making timely and appropriate decisions.

You need to be mindful of reticent individuals who have a legitimate say in your project. You could encounter delays or cost overruns at a later stage if they make their thinking known only after a project's developments have begun.

Also, you shouldn't try to do everything in one meeting. You need to arrange your stakeholders into logical groups. You then set up a series of smaller, focused meetings with each group.

## Risk management plan sections

Before you set up a meeting that aims to discuss sections of the risk management plan, you should understand the kind of information the plan usually contains. You use this knowledge when preparing the agenda for the risk management planning meeting. You need to cover seven agenda items.

### Methodology

Methodology describes how the risk management plan will be executed. You need to discuss elements such as methods your team will use during risk identification and analysis, tools, and where to find sources of risk information

These are the different categories of risk management methods:

* **methods for identifying risks** – brainstorming sessions, interviewing subject matter experts, assumptions analysis, process flow diagrams, and cause-and-effect diagrams
* **methods for analyzing risks** – probability and impact assessments using probability and impact matrixes, probability distributions, and simulations
* **strategies for responding to risks** – avoiding and transferring risks to mitigating and accepting risks; strategy depends on the nature of the risk and the risk tolerance of the performing organization
* **methods for monitoring and controlling risks** – status meetings to assess project performance and reassess risks

The methods and tools you choose depend on the project's nature. They also depend on the budget and time approved for risk management activities. The more complex the project and the more budget you have to work with, the more tools available to you.

Some methods are relatively inexpensive. For example, brainstorming with stakeholders to identify risks will not cost much. Other methods, however, are more costly – an example would be running simulations or parallel environments. These require extensive planning, data gathering, and a high level of expertise.

### Roles and responsibilities

Roles and responsibilities describe the people responsible for managing the identified risks, their responses, and any activities involved in the process of managing risk.

When the risk register is created, each risk is assigned an owner. The owner is responsible for monitoring that risk, monitoring conditions that may cause it, and implementing the identified response.

Because risk management activities can be time consuming, a large, high-risk project may have a separate risk management team mandated to manage risks. This precludes bias.

### Budgeting

When budgeting, you assign resources and estimate costs of risk management and its methods. These are included in the project cost performance baseline and include an estimate of how much risk management activities will cost.

### Timing

Timing includes when and how often risk management activities take place. It also identifies the activities associated with risk management in the project schedule.

Adding risk activities to the project schedule may push the final product delivery date out too far. You may need to make compromises so that the schedule remains viable.

### Reporting

The risk management plan contains a reporting formats section that describes how to report the outcomes of the risk identification and risk analysis processes. It will also be decided how the project manager should communicate updates resulting from risk monitoring and control activities to the risk register.

Reporting formats include tables, reports from SQL databases, or Excel spreadsheets.

### Tracking

During the risk planning meeting, the team decides how risks are to be tracked and risk management activities documented. Your organization might use a risk database. When you type in the risk identification number, you will have instant information about each risk's status. The status information includes details such as occurrence, when and how it occurred, and the implemented responses. Your system may have an alert feature that alerts you to imminent threats.

### Risk categories

Lastly, you discuss the basis for risk categories, as derived from the risk breakdown structures used in other projects. Using risk categories improves the process by aligning the risk categories to sections of the work breakdown structure.

Risk categories allow you to systematically identify risks and provide a foundation for the Identify Risks process. This ensures that no aspects of the project work are overlooked. Technical, quality, performance, organizational, external, and project management risks are categories that can be used to identify risks.

The risk management plan contains the agenda items covered during planning meetings and analysis. It is the only output of the Plan Risk Management process.

The sole technique for the Plan Risk Management process is planning meetings and analysis. It enables you to create a risk management plan containing seven sections – methodology, roles and responsibilities, budgeting, timing, reporting formats, tracking, and risk categories. They ensure that project risks are effectively monitored and controlled through a project's life cycle.

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# SkillBrief

# Risk Probability and Impact

An important part of the risk management plan – the only output of the Plan Risk Management process – is a section defining how probability and impact will be defined for your particular project. When these definitions are developed, they are incorporated into a probability and impact matrix.

## Stakeholder's risk tolerances

You need to understand your stakeholders' risk tolerances as they comprise one of the main enterprise environmental factors serving as an input to the risk planning process.

Risk tolerance is the degree of risk that stakeholders are willing to endure before they adjudging a risk's impact too severe to benefit a project. If their risk tolerance is high, it means that they are risk takers.

It may become clear during the Plan Risk Management process that stakeholders' risk tolerances have changed from what they were at a project's initiation phase. These revised tolerances need to be described in the risk management plan. They will also impact how you define probability and impact on your project.

## Risk probability and impact

There is a distinct difference between risk probability and risk impact.

Risk probability is the likelihood that an event will occur. Flipping a coin is a good way to explain this concept. When you flip a coin there's always a 0.5 probability – or a 50% chance – of getting heads and an equal probability of getting tails.

Probability is sometimes expressed as a number from zero to one. Zero indicates that there is no probability of the event occurring, whereas one indicates a 100% certainty that the event will occur. The probability that an event will occur plus the probability that it won't always equals one.

Risk impact is the amount of danger or opportunity the risk event poses. It is concerned with the effect the risk event will have on the project's objectives, such as meeting the budget, finishing on schedule, and satisfying customers' expectations.

There are two scales you can use to rate probability and impact – a cardinal scale and an ordinal scale. A cardinal scale measures probability and impact from 0.0 – or very low – to 1.0, which is very high. An ordinal scale ranges from low to high. The project team must decide which scale is most appropriate.

Risk impact can also be expressed as cardinal or ordinal values. These are the equivalent values, expressed in a typical high-high to low-low scale. For example, high-high equals 1.0.

## Defining impact

To rate the impact of any given risk, the risk planning team must understand what criteria will be used to determine a low, medium, and high rating.

You need to develop a table that reflects how impact is defined for each objective. You list the objectives down the left column and the scale across the top row. The definitions appear in the intersecting cells. For example, if you know that a risk will create a cost overrun of 10 to 20%, it will be assigned a score of moderate or .20, depending on the type of scale you're using.

When you're thinking about how the risk tolerance impacts a project's risk management, you must remember it this way – the relationship between risk tolerance and definition thresholds is directly proportional. If risk tolerance is low, your thresholds for defining high impact will be relatively low. If the risk tolerance is high, the thresholds will be relatively high.

## Probability and impact matrix

During the Perform Qualitative Risk Analysis process, risks are prioritized according to how they affect a project's objectives.

The tool that the team will use to do this is called a probability and impact matrix, created during the Plan Risk Management process.

You can use shading to illustrate if a rating falls within the low, moderate, or high category of risk.

The probability and impact matrix is good to use if you are using a cardinal number scale. If you use an ordinal scale with low, medium, and high as the ratings, you need a probability and impact matrix that translates your two ordinal values into a combined probability and impact rating. In other words, each probability and impact combination has a risk rating.

Risks with low probability and low impact are rated as low-risk events. Risks with high probability and high impact are rated as high-risk events. Your team needs to decide how it will score medium and low, and medium and high combinations. As this matrix indicates, when medium probability is paired with low impact, the risk rating is low. When medium probability is paired with high impact, the risk rating is high.

Here's how you assign a priority rating using the ordinal probability and impact matrix:

* you know the risk of exceeding the budget has a medium probability
* you also know that if you do exceed the budget, the impact to the project is high

Whichever type of scale you use for your project, ordinal or cardinal, the probability and impact matrix and your impact definition table should be included in the risk management plan.

The Plan Risk Management process's sole output is the risk management plan.

Stakeholders' risk tolerance always impacts a project's risk management. As a result, these tolerances need to be revised to match the specific characteristics of the project. This may result in an update to the project management plan.

Impact definitions are recorded in an impact and probability matrix. Once the team has defined the probability and impact for the project, it enters the values into a probability and impact matrix.

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# Follow-on Activity

# Comparison of Risk Management Processes and Templates

**Purpose:** Use this follow-on activity to compare your organizational assets with risk management templates and processes used by another organization.

**Instructions for use:** To use this tool, print out the sheet and complete the activity.

1. Use the Internet to search for information about how other companies or organizations manage risk. Use terms such as "risk management." Add these sites to your favorite's folder.
2. Explore the Risk Management Planning process documented on each site to get a feel for the overall process.
3. Print copies of sample documents, examples, and checklists for your own use.
4. Locate your organization's corresponding documents, examples, and checklists, if they exist.
5. Compare your organization's documents with those you've downloaded from the web site.
6. Make notes about how you might like to revise your own documents based on what you have seen.

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# Follow-on Activity

# Recognizing Risk

**Purpose:** Use this follow-on activity to analyze a risk you encountered in a previous project.

Analyze a risk that you encountered in a previous project by recording some of its characteristics, how you responded to it, and the lessons you learned.

1. What was the risk?
2. How likely did you think it would be to occur, and did you estimate this occurrence correctly beforehand?
3. What impact did it have on the project's scope, budget, or schedule?
4. What did you determine the root cause to be?
5. What was your response and how effective was it?
6. What lessons did you learn from the situation?

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# Job Aid

# Elements of a Risk Management Plan

**Purpose:** Use this job aid to review the elements that appear in a risk management plan.

| **Components of the risk management plan** | |
| --- | --- |
| **Component** | **Description** |
| Methodology | This includes elements such as methods and tools that are used to identify, analyze, respond to, monitor, and control risks – for example brainstorming, probability and impact assessments, and project status meetings. |
| Roles and responsibilities | These describe the people who are responsible for managing the identified project risks and their responses, and for each type of activity identified in the risk management plan. |
| Budgeting | In the budgeting section, you assign resources and estimate the costs of risk management and its methods. |
| Timing | Timing documents include when and how risk management processes will be performed on a project. |
| Reporting formats | Reporting formats describe the content of the risk register and the format of this document. |
| Tracking | Tracking includes a description of how you document the history of the risk activities for the current project and how the risk processes will be audited. |
| Risk categories | Risk categories are a way to systematically identify risks and provide a foundation for understanding them. Risks can be categorized as either technical, quality, performance risks, organizational risks, external risks, or project management risks. |

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# Job Aid

# Risk Responses

**Purpose:** Use this job aid to review examples of potential responses to project risks.

| **Sample risk responses** | |
| --- | --- |
| **Risk-related situation** | **Possible response** |
| The contingency reserve is low because of many risk events being triggered | Increase the budget to boost the contingency reserve |
| Schedule is delayed by a risk event | Revise the schedule |
| More people are urgently needed in part of the project to avoid a risk event | Reassign staff to that work |
| A risk event prevents a certain feature of the product from being developed and no other solution is available | Change the product scope to exclude the affected features |
| A positive risk event occurs which offers an unforeseen opportunity to the project | Change the project scope so that you may take advantage of the opportunity |
| The project experiences a catastrophe, such as the customer's organization declaring bankruptcy | Close the project prematurely |

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Identifying project risks

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# SkillBrief

# The Identify Risks Inputs and Documentation Reviews

Identify Risks is the second process in the Project Risk Management knowledge area, and falls in the Planning process group.

The Identify Risks process is iterative – it can occur many times during a project's life cycle as new information about risks becomes available.

The process may occur at different times and involve different sets of stakeholders. However, it's essential to describe risks consistently, using the same format. This consistency enables a project team to weigh risks against one another, and to compare their likely impacts on a project.

## Inputs to the Identify Risks process

There are many possible inputs to the Identify Risks process. These can be grouped as follows:

* documents that assist in identifying risks
* activity cost and duration estimates
* project baselines and management plans
* other sources of information, including enterprise environmental factors and organizational process assets
* project documents that assist in ongoing risk identification

#### Risk management plan

The risk management plan details

* **the assignments of roles and responsibilities** – The team members who are responsible for risk management in particular areas will be able to identify relevant risks.
* **budget and schedule provisions for risk management activities** – You make provision for time and money required for risk management activities, such as risk analysis during the planning stage and monitoring and control activities throughout the project.
* **categories of risk** – Some commonly used categories of risk are external, financial, operational, and reputational risks. The categories can help you identify risks you might not have considered, and help group risks likely to require similar types of responses.

#### Stakeholder register

The stakeholder register records the names and details of people able to assist you in identifying and characterizing risks.

#### Activity cost and activity duration estimates

These estimates enable you to predict and quantify the risks of cost or schedule overruns or the opportunities for budget or schedule savings.

#### Project baselines

The most important project baseline is the scope baseline, which consists of the

* **work breakdown structure (WBS)** – identifies project work components at different levels – from key deliverables to individual work packages. It enables you to identify risks by lending structure to the work at each level of the project.
* **project scope statement** – identifies, among other things, assumptions about the project. Assumptions run the risk of proving false, but they help to identify risks.

#### Subsidiary project management plans

These include the cost management plan, schedule management plan, and quality management plan. These plans may generate or alleviate risk, depending on how accurate and realistic they are. This applies especially to cost overruns, delays, and quality defects.

#### Other sources of information

Other sources of information also form a distinct input group for the Identify Risks process. Sources include enterprise environmental factors and organizational process assets.

Enterprise environmental factors that enable you to identify risks include

* **industry-wide risks outlined in risk studies or academic papers** – these highlight particular threats or opportunities
* **industrial benchmarking** – you can identify risk areas where you see that your project's specifications deviate from industrial benchmarks
* **risk attitudes** – for instance, highly risk-averse stakeholders could be a benefit or a threat

Organizational process assets include historical project data and lessons learned. They are rich sources of information detailing previous projects' risks and will help you identify similar risks in your current project.

Organizational and project process controls will also help identify risks. Your company may have financial controls that ensure credit card expenditures are reviewed monthly. An abnormally high bill in any month might indicate a risk of overspending.

#### Project documents for on-going risk identification

These documents constitute a final input to the Identify Risks process. They generally become available as a project progresses.

You might consult work performance reports and updated baselines to identify new risks you didn't consider during the planning stage. Alternatively, you might use them to monitor risks you've already identified.

Earned value reports, which detail the value earned through work completed, can also help identify new risks. If work does not generate value, it jeopardizes the project.

## Documentation review

The documentation review is the first tool and technique you use to identify project risks. The review involves conducting a structured and comprehensive review of all inputs.

When conducting a documentation review, you need to

* **examine inputs to identify any contradictions and gaps** – You may want to updated cost estimates using recent prices rather than the cost baseline's older price estimates. Updating the baseline to reflect new estimates removes or reduces the risk that the activity will run over budget.
* **check the quality of management plans** – You must check that the budget, schedule, and quality management plans are complete, accurate, and realistic. You need to identify vague policy statements, unrealistic estimates, and unsubstantiated information. Such inaccuracies can pose serious risks to your project.
* **investigate constraints and assumptions** – You need to pay particular attention to assumptions and constraints listed in the project scope statement. Identifying associated risks ensures they can be addressed early. You also need to examine all assumptions concerning cost, duration, and quality that were used to generate estimates and project baselines. You must then document every risk associated with these assumptions.

When reviewing documents, include

* scope baseline documents, especially the WBS
* organizational process assets, in particular historical project information
* enterprise environmental factors such as industry and market reports, studies, and forecasts

Inputs to the Identify Risks process include the risk management plan; activity cost estimates; activity duration estimates; the scope baseline that includes the project scope statement and work breakdown structure; stakeholder register; cost, schedule, and quality management plans; project documents such as work performance and earned value reports; enterprise environmental factors; and organizational process assets.

The document review requires you to identify risks by reviewing all project inputs. During the review, you focus on identifying contradictions and gaps in the inputs, checking the quality of management plans, and analyzing constraints and assumptions.

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**Topic:** Documentation Review

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# SkillBrief

# Risk Information Gathering Techniques

Regardless of the technique you use to gather information, risk identification sessions should involve stakeholders with a diverse range of experience and expertise.

The main objective of the sessions is to identify risks and then categorize, clarify, and define them.

A risk identification session has various characteristics:

* **involve stakeholders with diverse experience** – Input from a multidisciplinary group is required to ensure that risks in particular areas aren't overlooked. Experts should be involved as much as possible. However, it's important to account for bias on the part of experts – who may tend to focus only on risks associated with their areas of expertise – as part of the risk identification process.
* **identify, categorize, clarify, and define risks** – The group should record as much information about risks as it can, and analyze these risks in order to categorize, clarify, and define them. This reduces uncertainty and helps ensure you can prepare for proper risk analysis and response planning.

Examples of the types of people who should be included in risk information gathering sessions include

* project team members
* members of the risk management team, if one is assigned for the project
* customers
* subject matter experts from outside the project team
* project managers who have worked on similar projects
* external stakeholders
* risk management experts

During sessions, it's useful to use a risk breakdown structure to guide participants in identifying, defining, and clarifying risks.

### Using appropriate techniques

The technique you choose to identify risks during planning meetings will depend on the context in which your project is run and on the availability of experts who need to participate in the process.

#### Brainstorming

Brainstorming involves getting all the subject matter experts, team members, and other managers together in one place and prompting them to identify as many potential project risks as they can.

This technique is good for generating ideas because one person's idea will often spawn others. It's also efficient and inexpensive – a single effective brainstorming session could conceivably identify most, if not all, project risks for a small to medium project in a few hours.

A facilitator may allow a time of freestyle brainstorming before attempting to categorize the risks that a group generates. Alternatively, the brainstorming may be structured according to pre-identified categories, such as those found in the risk breakdown structure or in the work breakdown structure.

A facilitator is also responsible for ensuring the session stays on track and that everyone gets a chance to participate.

Once risks have been named, the facilitator should ensure that descriptions, causes, and impacts of these risks are detailed.

There are four basic rules to follow when brainstorming. First you identify your objective or problem, then you record the ideas generated. The third rule is to prevent criticism of anyone else's ideas, and the final rule is to build on one another's ideas.

#### Interviewing

Interviewing involves using one-on-one question and answer sessions in which individual interviewees identify project risks based on their expertise or past experiences with similar projects.

The interviewing technique is best used for subject matter experts or individuals who can't attend a group meeting for geographic reasons. It can also be used where it would be inappropriate to involve someone – like the project client or a user representative at another organization – in a brainstorming session with internal stakeholders.

This method is less efficient than brainstorming because it involves getting only one person's opinions on project risks at a time.

To spark ideas in an interview, you can provide the person you interview with the project's work breakdown structure or a risk breakdown structure template, along with risk assumptions. Once the interviewee has identified as many risks as is reasonable, you should revisit each risk in order to classify it.

There are three classification techniques:

* **risk source** – use the risk breakdown structure as the basis to develop risk responses based on the a common route source, or cause
* **area of the project affected** – use the work breakdown structure to categorize risks based on the area of the project affected
* **project phase** – choose other useful categories such as project phase to determine areas of the project most exposed to risks

#### Delphi technique

The Delphi technique typically involves distributing a questionnaire for identifying potential risks to stakeholders and experts. Anonymous questionnaire responses are then combined, categorized, and circulated back to the group to confirm the findings and elicit further responses. This process is repeated until a consensus emerges.

The Delphi technique reduces the bias you may encounter in the results of a brainstorming session, where the most outspoken participants contribute while others remain silent.

Disadvantages are that it takes time to get responses back from participants, and it's potentially a lot of work to prepare questionnaires, compile responses, and send the responses out for further comment.

Questionnaires used for the Delphi technique may provide categories to encourage risk identification, as well as tables in which risks can be listed, described, and classified.

You can also use repeating sets of questions to ask participants to list and define risks based on risk categories.

Once all the questionnaires are returned from the participants, the facilitator combines all the responses into a single table, keeping the data anonymous. The risks in the table should be prioritized according to the frequency at which they were mentioned by respondents.

The table is attached to a second questionnaire and mailed to respondents, with a request that they comment on the prioritization of the risks and the information recorded about them.

This confirms findings and provides respondents with another opportunity to provide information. It may also lead respondents to identify new risks that have occurred to them in the interim between answering the first questionnaire and the second one.

The purpose of risk information gathering sessions is to identify, categorize, and clarify project risks. The three main techniques are brainstorming, interviewing, and the Delphi technique.

**Course:** Identifying Project Risks  
**Topic:** Gathering Risk Information

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# SkillBrief

# Contents of a Risk Register

A risk register is a table that lists information about each of the risks you identify during the Identify Risks process. It includes a description of each risk, its potential impact, and its root causes.

Information gathering sessions provide you with important information about project risks. However, if this information is not properly documented, it won't benefit the current project or serve as a useful resource for subsequent projects. To avoid this, it's important to record the output of the sessions in the risk register.

New and more detailed information continues to be added to the risk register as other risk management and general project management processes are conducted.

#### Tracking number, RBS, WBS, and date

The first four columns in the register enable you to track each risk and its context throughout the project life cycle:

* a tracking number uniquely identifies each recorded risk so it can be easily referenced and monitored.
* the RBS column links each risk to its category within the risk breakdown structure.
* the WBS column associates each risk with the work components it may affect within the work breakdown structure.
* the Date column lists the date at which each risk was identified.

Another identifying characteristic that could be included in the risk register is risk status, which could be recorded as pending, current, or ended.

#### Description

The Description column contains a clear and concise description of each identified risk.

#### Cause

The Cause column identifies the cause or causes of each identified risk.

#### Impact

The Impact column details the potential impact of each identified risk on the project. This section of the register may be further divided to detail the impact of each risk on specific project objectives.

#### Severity and likelihood

The Severity and Likelihood columns indicate the extent to which each risk could impact the project and the probability of the risk occurring. The options for these measures could be classified as

* none
* very low
* low
* medium
* high
* very high

#### Risk response

The Risk response column lists the responses planned for managing each of the identified risks. Responses may include accepting a risk if its cause lies outside of the management team's control, or adjusting the project plan to lessen its potential impact.

These responses can be useful as inputs to the Plan Risk Responses process.

#### Root causes

Another useful category that you can add to the risk register is root cause. The root causes of identified risks are the fundamental conditions or events that could result in the risks occurring. These causes may be identified during initial risk identification or through analysis of the risks documented in the risk register. Identifying the root causes of risks is an important step in developing effective risk responses.

#### Risk responses

During the Identify Risks process, you may develop several risk responses and determine several root causes for these risks. Information on causes and responses gathered during this process may be adjusted or further developed later.

It's important to record information you obtain during the Identify Risks process in the risk register. This document continues to be updated as other risk management and general project management processes are conducted.

The risk register identifies and describes identified project risks, and assigns them codes for tracking purposes. It also specifies the category to which each risk belongs, its causes and possible impacts, and appropriate risk responses.

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**Topic:** Risk Register

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# SkillBrief

# Conducting a Root Cause Analysis

In projects, root cause analysis is a technique you use to help identify and manage potential risks, as well as to develop preventive action.

It involves investigating risks to identify their root causes. You can then address these causes instead of just the symptoms.

Knowing the root causes of one risk can also help you identify further risks that you may not otherwise have picked up.

Although a root cause analysis can be performed by an individual, it's best to gather a group of experienced stakeholders for a brainstorming session. Varying perspectives and experience among stakeholders who understand the project, its product, and its environment can contribute to a better understanding of risks and their possible causes.

For each risk, the group involved in a root cause analysis should ask the following questions:

* What sequence of events leads up to the risk event?
* What conditions would allow the event to occur?
* What other risks could also be caused by the central issue?

Focused questions can help uncover the causes of a risk. Even after you've identified some of the possible causes of a risk, you should keep asking questions so that you can identify as many relevant causes as possible. In root cause analysis, being thorough produces the best results.

#### Root causes

In a root cause analysis, you usually find that risks have three basic types of causes:

* **physical** – relate to flaws in tangible items. There could be defects in the raw materials used in producing a product or faults in the tools, machinery, or equipment used to produce the product.
* **human** – are the results of human error. Someone may either carry out an undesirable action, or fail to carry out a desirable action. Human causes often lead to physical causes. Human causes may stem from various underlying factors, such as incompetence, absence, different understandings of what's required, or personality differences.
* **organizational** – relate to the systems, processes, or policies that impact a project. These causes can be internal, as in the case of a faulty manufacturing process that neglects an important safety check. Or they may be external – such as bad weather, fussy customers, or a weakening national economy.

#### Root cause analysis diagrams

Several diagramming techniques can assist you in conducting a root cause analysis.

**Cause-and-effect diagrams** – also known as Ishikawa diagrams or fishbone diagrams – can help identify the various factors that contribute to a risk.

You use these diagrams to outline the main categories of causes for a risk, and then to drill down into specific causes. Further analysis of each of the causes – through questions like "why?" and "how?" – is used to uncover the underlying reasons for them.

A **system or process flowchart** is a graphical representation of a system or process. It shows the sequence of its components and how the components link to each other.

In root cause analysis, a flowchart can be used to identify risks between the different components of a system or process.

**Influence diagrams** graphically map out a situation, showing how the factors of the situation may influence one another.

This is useful for root cause analysis – especially where a potential problem is related to a decision that will be made. It helps the project manager identify which factors will influence the decision.

Root cause analysis is used to determine and evaluate the main causes of risks to a project. This enables you to focus risk response planning on addressing risk causes, rather than on simply treating the symptoms.

Conducting a root cause analysis involves determining the sequence of events leading up to a risk event, the conditions that allowed the event to occur, and any other risks that could be caused by the central issue identified. Most root causes of risks can be categorized as physical, human, or organizational causes.

You can use several diagramming techniques, such as cause-and-effect diagrams, flowcharts, and influence diagrams, to assist you in conducting a root cause analysis.

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**Topic:** Introduction to Root Cause Analysis

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# SkillBrief

# Working with Cause-and-effect Diagrams

In many problem-solving situations, one simple rule often proves very effective – put it on paper first. Mapping or working something out on paper often leads to a better understanding or analysis of it. The same rule applies when you're investigating the causes of project risks.

Certain diagramming techniques can be useful in identifying risks and their causes. One of the most popular diagramming techniques is the cause-and-effect diagram.

It is also known as the Ishikawa diagram, after its inventor, the Japanese quality management specialist Kaoru Ishikawa.

When completed, a cause-and-effect diagram looks like the skeleton of a fish, so its third alternate name is fishbone diagram. It contains a spine with branches resembling the pattern made by fish bones.

Cause-and-effect diagrams are more typically used in quality management systems to explore the causes of defects or problems that have already occurred.

However, you can also use a cause-and-effect diagram to explore the root causes of an identified risk - which is simply a potential problem that may occur in the future.

Continually asking "why?" or "how?" for each cause helps you get to the root of the risk.

### Diagrammatic structure

There are four sections in the cause-and-effect diagram:

* **problem or risk** – At the head of the diagram is the problem that the root cause analysis seeks to address.
* **main cause categories** – The problem could have numerous potential causes, which are grouped into broad categories, for example, "Processes" or "People." They are displayed as branches off the top of the spine in the diagram.
* **causes** – Branches identify one or more causes in each of the main categories.
* **sub-causes** – Sub-causes are the factors that contribute to the causes of a problem.
* **other cause categories** – Equipment and the environment are examples of other cause categories.

Although four main cause categories are used here, you could also include other categories, depending on the project and its context. For example, appropriate categories might include time, energy, or regulations, and measurement.

Simply put, a risk can be thought of as a problem that hasn't occurred yet. Cause-and-effect diagrams don't only help in solving problems that have already occurred. They're also helpful for exploring the causes of risks, in an attempt to prevent them from happening.

### Creating the diagram

Identifying the causes of a risk using a cause-and-effect diagram involves four sequential steps.

#### Step 1 – Record the risk

First add a label identifying the risk you want to assess to one side of the page. This label forms the head of the diagram. From the head, draw a horizontal line – the spine – across the page. The rest of the diagram will develop from this spine.

#### Step 2 – Identify the major contributing factors

Use brainstorming or other methods to identify the main categories of causes that could contribute to the risk. Add labels for each of the main cause categories on either side of the spine, and connect them to the spine via branches.

#### Step 3 – List the possible causes

Next brainstorm ideas of what causes in each category could contribute to the risk. Once you've done this, drill down further to try to find the root causes. You add each cause as a branch from the category in which it belongs, and each sub-cause as a branch from the relevant cause.

#### Step 4 – Analyze the resulting diagram

Finally, with all possible causes of the problem documented in the diagram, you analyze the diagram to find which are the most likely causes.

When drawing cause-and-effect diagrams, three rules should always be followed:

* the diagram must contain the main categories of causes – for example, people, processes, equipment, and environment
* the main categories must branch off the central spine of the diagram
* the causes and subsequent sub-causes that branch off the main categories must be related to the main category and to the risk

A cause-and-effect diagram helps you identify the root causes of risks. This diagram includes four sections: the problem or risk, the main cause categories, the causes, and sub-causes.

To create a cause-and-effect diagram, you record the relevant risk or problem, add its main cause categories as branches, and investigate further to identify causes within each category and record your findings in the diagram. When the diagram is complete, you can analyze the risk for the most likely causes.

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**Topic:** Cause-and-effect Diagrams

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# SkillBrief

# Using Process Flowcharts

A diagramming technique that's useful during the Identify Risks process is creating system or process flowcharts. This can help you recognize new risks, as well as process-related causes of risks you've already identified.

You then use this information to complete the risk register, which is the only output of the Identify Risks process.

A flowchart graphically illustrates the logical sequence of steps in a process or system from start to finish. Presenting information or processes in a step–by–step manner lets you concentrate on individual steps and their relationships, which can make particular risks easier to identify.

In a project, you can use flowcharts to depict various types of processes:

* work processes
* project management processes
* the flow of communication in a project

Although flowcharts can use different styles, they typically include the use of

* **arrows** – indicate the sequence of the activities – which are represented as rectangles – within a process or system. An arrow leading back from a diamond to a previous activity indicates that this activity must be repeated if a decision or review has a specified outcome. This type of arrow is sometimes called a feedback loop.
* **circles or ovals –** signify the start or end of a process.
* **rectangles** – represent an activity or component within a process. Arrows between the rectangles identify the sequencing of the activities.
* **diamonds** – identify points at which a decision must be made or when a product must be reviewed. The activity that follows a diamond will depend on the decision or review outcome.

#### Identifying risks using flowcharts

To identify project risks and their causes from a flowchart, you need to ask the following questions:

* What happens early in the process that could cause problems later on?
* Which activities are out of your control?
* Are there logical inconsistencies, bottlenecks, or complexities that could create delays, errors, or confusion?

The two types of factors that are likely to represent the greatest project risks are those that are out of the organization's control, and any complexities, bottlenecks, or inefficiencies in the flow of the project.

Consider a flowchart outlining a project's activities. You consult the flowchart as part of the Identify Risks process and first ask what happens earlier in the process that could result in problems later on.

From the flowchart, you're able to determine that the project may run behind schedule. Delays could result if the project's design or the data gathering process take longer than expected, or if external reviewers find the initial results unacceptable. In addition, there's a risk that, owing to inconsistencies during data collection, your team may find a large number of errors in the analyzed data.

You then assess the activities in the flowchart that are out of your team's control. These activities include approving the design and the document review findings. Because your team has little influence over these two activities, they represent a particular risk to the project schedule.

Finally, you check the flowchart for any logical inconsistencies, bottlenecks, and complexities. You see that the person responsible for the design wouldn't know exactly what to do if it wasn't approved. This would cause a delay as questions go back and forth between you and that person. The risk of missing deadlines would increase.

The flowchart enables you to assess each step in the process, as well as the relationships among the steps. This makes it much easier to identify possible project risks and their causes.

Creating and assessing system or process flowcharts is a useful diagramming technique for identifying project risks and their causes.

To use a flowchart to identify risks and their causes, you should ask questions such as what could go wrong, what happens earlier in the process that could cause problems, and which activities are out of your control. You should also check the flowchart for any logical inconsistencies, bottlenecks, or complexities that could contribute to risks.

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**Topic:** Process Flowcharts

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# SkillBrief

# The SWOT Analysis Grid

SWOT analysis is one of the tools and techniques used to identify risks and classify them into different types. SWOT stands for Strengths, Weaknesses, Opportunities, and Threats. Identifying risks within these categories gives you a broad view of the types of risks a project faces.

A project's strengths and weaknesses are internal factors that may influence the project team's ability to meet its objectives. The performing organization is often able to exert some control over a project's strengths and weaknesses.

Opportunities and threats come from outside the performing organization – they are external factors that could help or harm a project.

The best way to set up a SWOT analysis is to create a simple grid with a square for

* **strengths** – you list the advantages or strong points that you and your organization have, as well as you and your team's unique abilities, opportunities, or wisdom
* **weaknesses** – you list the things about you, your team, or your organization that are disadvantages, such as areas that could be improved upon or that may compromise the success of a project
* **opportunities** – you list positive external factors that could benefit the project, such as opportunities that arise from particular external events, new technology, changes in societal attitudes, or policy changes
* **threats** – you list external factors that may disrupt, damage, or hinder the project in any way

To perform a SWOT analysis, you brainstorm with team members or a specially assigned risk identification team.

A SWOT analysis can be fairly simple or complex and detailed. Generally, it's best to keep it as simple as possible, listing only factors that may have a definite impact on the project.

It's important to remember that a SWOT analysis is usually highly subjective. So although it can provide good insights about the risks involved in a project, it shouldn't be the only technique you use to identify risks.

#### The USED strategy

Once you and your team have brainstormed and filled in the sections of a SWOT analysis grid, you should refine it.

To do this, you apply the USED strategy.

The letters in USED stand for four questions:

* How can we Use each strength?
* How can we Stop each weakness?
* How can we Exploit each opportunity?
* How can we Defend against each threat?

Answering these questions will help you create strategies for dealing with each risk. You would do this in preparation for the Plan Risk Responses process.

You can use a SWOT analysis to help identify and categorize project risks. SWOT is an acronym for strengths, weaknesses, opportunities, and threats. Strengths and weaknesses are internal factors, whereas opportunities and threats are external factors.

To assess the factors you identify, you use the USED strategy – a set of four questions for analyzing how to deal with risks.

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**Topic:** SWOT Analysis

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# SkillBrief

# Questions Relevant to an Assumption Analysis

Most actions are based on assumptions, which are often similar to educated guesses. For instance, in project management, you make assumptions about the availability of facilities, the skills of your workers, and that equipment will work properly.

If you don't make assumptions in a project, it's likely you'll become bogged down with all the possible events and outcomes that could occur.

So assumptions are necessary. By nature, though, any assumption has an associated risk as it may prove to be untrue.

Assumptions analysis is one of the techniques you use during the Identify Risks process. It involves identifying potential risks to a project by examining the validity of the assumptions on which it's based. It also involves assessing the potential impact that false assumptions could have on the project.

So during an assumptions analysis, you subject each recorded project assumption to two questions:

* Is the assumption valid?
* What impact could the assumption have on the project if it proves false?

Assumptions analysis should be an ongoing process. You'll continue having to make assumptions throughout a project, and it's important that you record these and regularly have them reviewed by a risk identification team.

This helps ensure any associated risks are identified so that plans for protecting a project against them can be developed.

Generally, it's better if the individuals assessing assumptions are not those who identified the risks originally. That way they can remain as objective as possible. People often don't recognize their own assumptions.

During assumptions analysis, you should assess whether each project assumption is valid by checking it for possible

* **inaccuracy** – When reviewing an assumption, determine whether it is based on accurate information. An assumption might prove to be false for various reasons. Perhaps it was true at one stage but circumstances have changed, perhaps it is only partially true, or perhaps it's even completely false. You must ensure that assumptions are always based on fact.
* **inconsistency** – It's important to check that basic assumptions not only seem to be accurate but are also consistent with the other facts in your possession. You might not actually be able to spot a specific inaccuracy, but if several facts or assumptions don't quite seem to add up, it likely indicates a problem.
* **incompleteness** – Even if a recorded assumption seems accurate and consistent with the other information you have, it may not tell you everything you need to know. For example, it may prove valid only under specific circumstances or at particular times.

Once a team has verified assumptions, identifying the associated risks involves determining how each assumption could impact the project if it proves false.

False assumptions can have several negative impacts:

* budget overruns, as a result of incurring expenses not initially anticipated
* unanticipated schedule delays
* a lack of resources, due to false assumptions about resource availability or the resources required to complete tasks
* a lack of supplies when they're needed, due to false assumptions about how quickly the supplies could be obtained

Once a team has identified the risks associated with project assumptions, it's in a position to manage these risks.

Bear in mind that it is not only the direct impact on the project you should be concerned with.

A false assumption – particularly one that has a significant impact on the budget or schedule – can shake stakeholders' confidence and make them lose faith in the project management team.

Analyzing assumptions carefully during the Identify Risks process can help prevent this from occurring.

Assumptions analysis is a useful technique during the Identify Risks process. It involves verifying the accuracy of assumptions and determining the impacts they may have on a project if they prove false, and identifying associated risks. Throughout a project, new assumptions should be documented and analyzed.

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**Topic:** Assumptions Analysis

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# SkillBrief

# Compiling a Checklist Analysis

In the context of the Identify Risks process, checklist analysis is the technique of

* creating a list of project risks
* assessing whether the risks apply to the current project

#### Risk registers

The entries in a risk checklist for a project are generally based on historical information from similar past projects, such as old risk registers and lessons learned documentation. You then assess whether those risks apply to the current project.

Looking at risk registers from similar past projects is a good way to learn about potential risks that you should add to a risk checklist. It can also give you greater insight into risks you have already identified.

#### Risk breakdown structure

Another source of risks for the checklist is the lowest level of the project's risk breakdown structure. It includes the potential risks that have already been identified for the project.

Examining how a problem was dealt with in the past can be as important as identifying a risk in the first place.

As a project unfolds, new information about potential risks will become available and the risk checklist should be updated and refined.

Similarly, the risk checklist should be reviewed and updated during project closure to incorporate lessons learned during the project. It then becomes a useful resource for future projects.

Checklist analysis involves identifying project risks and compiling them into a list that can be quickly and easily assessed by members of the project team. The two main types of project documents that contribute to a risk analysis checklist are the risk breakdown structure and risk registers from similar, previous projects.

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**Topic:** Checklist Analysis

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# Follow-on Activity

# Using a Cause-and-effect Diagram

**Purpose:** Use this follow-on activity to review a template and instructions for using cause-and-effect diagrams in your own projects.

**Instructions for use:** To use this tool, follow the instructions and use the cause-and-effect diagram template provided to identify potential causes of risks in your own projects.

## Using the cause-and-effect diagram

Included in the diagram are four examples of main cause categories, as well as space for you to add causes in each category.

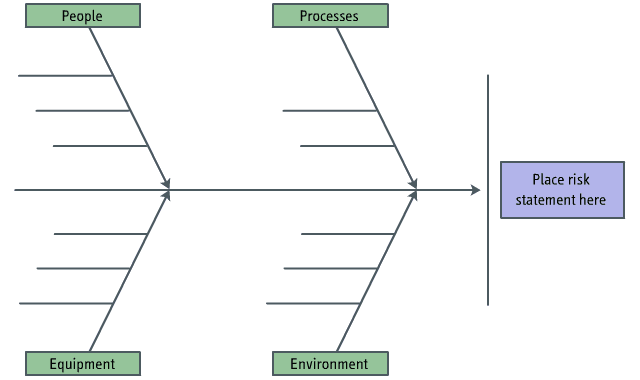
You can replace the main categories and add further lines for sub-causes as needed.

An example of a completed diagram is provided below the template.

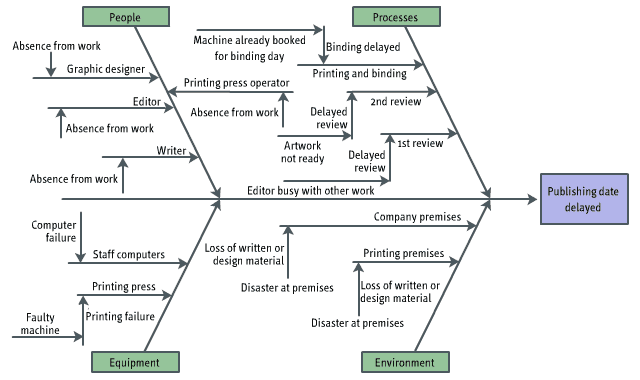
### Instructions for drawing the diagram

1. In the head section, write down the risk that you want to deal with in the diagram. Then draw a draw a horizontal line – a spine – running from the head to the other side of the page.
2. Draw the main cause categories on either side of the spine, and connect them to the spine as branches – or the "bones" of the fishbone diagram. Examples of categories are people, processes, and equipment. Then use brainstorming or other methods to identify the possible factors contributing to the risk, and record these factors as offshoots of the categories they fall into.
3. Take each of the factors identified in the previous step and brainstorm what could possibly cause problems in each area. For each factor, continue asking "why?" or "how?" to drill down into the causes, until you find the root cause. Record your findings for each cause as smaller offshoots in the diagram.

With the diagram now completed, you should have identified all possible causes of the risk you identified in the first step. You can now analyze the diagram to find the most likely causes of that risk.



Cause-and-effect diagram template



Completed cause-and-effect diagram

**Course:** Identifying Project Risks  
**Topic:** Cause-and-effect Diagrams

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# Follow-on Activity

# Completing a Risk Register

**Purpose:** Use this follow-on activity to identify and then record information you obtain during the Identify Risks process in the risk register.

**Instructions for use:** To use this tool, gather the risk information for a project you're working on using the appropriate techniques. Then add the information into the risk register.

| **Risk register template** | | | | |
| --- | --- | --- | --- | --- |
|  | **Risk 1** | **Risk 2** | **Risk 3** | **Risk 4** |
| **Tracking** | Row 2 Column 3 | Row 2 Column 4 | Row 2 Column 5 | Row 2 Column 6 |
| **RBS** | Row 3 Column 3 | Row 3 Column 4 | Row 3 Column 5 | Row 3 Column 6 |
| **WBS** | Row 4 Column 3 | Row 4 Column 4 | Row 4 Column 5 | Row 4 Column 6 |
| **Date** | Row 5 Column 3 | Row 5 Column 4 | Row 5 Column 5 | Row 5 Column 6 |
| **Description** | Row 6 Column 3 | Row 6 Column 4 | Row 6 Column 5 | Row 6 Column 6 |
| **Cause** | Row 7 Column 3 | Row 7 Column 4 | Row 7 Column 5 | Row 7 Column 6 |
| **Impact** | Row 8 Column 3 | Row 8 Column 4 | Row 8 Column 5 | Row 8 Column 6 |
| **Severity** | Row 9 Column 3 | Row 9 Column 4 | Row 9 Column 5 | Row 9 Column 6 |
| **Likelihood** | Row 10 Column 3 | Row 10 Column 4 | Row 10 Column 5 | Row 10 Column 6 |
| **Risk response** | Row 11 Column 3 | Row 11 Column 4 | Row 11 Column 5 | Row 11 Column 6 |

****For online use, complete each row as described in the instructions. If you would like to work with the page as hard copy, simply print it out using the Print link at the top of this page.****

**Course:** Identifying Project Risks  
**Topic:** Risk Register

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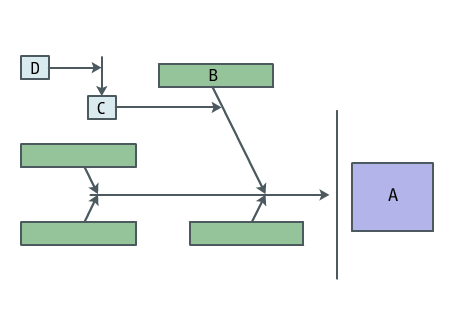
# Learning Aid

# Cause-and-effect Labeling

**Purpose:** Use this learning aid to review a labeled cause-and-effect diagram.

The standard structure for a cause-and-effect diagram consists of:

* a box at the head of the diagram – labeled "A" in this case
* main branches shooting off from the spine – labeled "B" in this case
* sub-branches shooting off the main branches – labeled "C" in this case
* further sub-branches shooting off the initial sub-branches – labeled "D" in this case



Labeled cause-and-effect diagram

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**Topic:** Cause-and-effect Diagrams

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# Job Aid

# Performing a SWOT Analysis

**Purpose:** Use this job aid to guide you in completing a SWOT analysis to identify risks.

| **SWOT analysis** | |
| --- | --- |
| **Strengths and opportunities** | **Weaknesses and threats** |
| **Strengths** – List the advantages you, your team, and your organization have that will help you reach project objectives. Include activities you do well, special skills you may have, or resources that can boost productivity or quality. | **Weaknesses** – List anything internal to your organization or team that could prevent you from meeting objectives, such as resources or skills you lack. These are factors that can be improved on. |
| **Opportunities** – List anything external to your organization that could lead to a positive outcome in meeting objectives. Opportunities can arise, for example, from particular events, new technology, changes in societal attitudes, or policy changes. | **Threats** – List anything external to your organization that could disrupt, damage, or hinder project objectives. Look for obstacles such as supplier failure, environmental factors, competition, changes in market demands, or late deliveries. |

**Course:** Identifying Project Risks  
**Topic:** SWOT Analysis

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# Job Aid

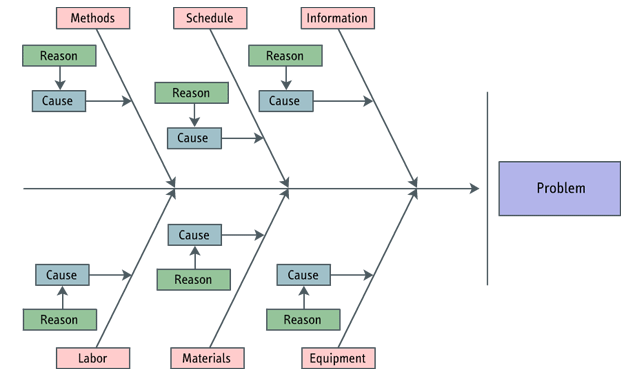
# Diagrams Used in Root Cause Analysis

**Purpose:** Use this job aid to review three diagramming techniques that can assist you in conducting a root cause analysis.

## Cause-and-effect diagrams

Cause-and-effect diagrams identify the various factors that contribute to a problem or risk. You use these diagrams to identify the main categories of causes for a risk, and then to drill down into specific causes. Further analysis of each of the causes – through questions like "why?" and "how?" – is used to uncover the underlying reasons for them.

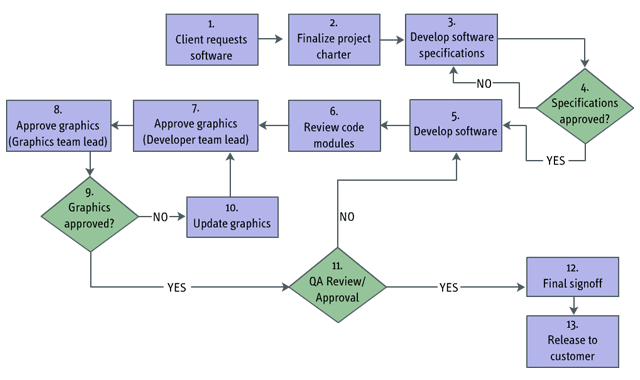
Cause-and-effect diagrams are also known as Ishikawa diagrams or fishbone diagrams.



A simple cause-and-effect diagram

## Flowcharts

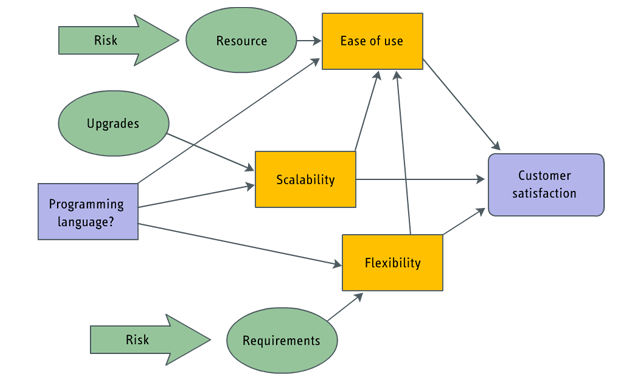
A system or process flowchart is a graphical representation of a system or process that shows the sequence of steps it includes and how its different components link. In root cause analysis, flowcharts can be used to identify risks between the different components of a system or process.



A software development process flowchart

## Influence diagrams

Influence diagrams graphically map out a situation, showing how the factors of the situation may influence each other. This is useful for root cause analysis – especially where a problem is due to a bad decision – because it helps the project manager identify which factors influenced a decision.



Influence diagram: Decisions and influences

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**Topic:** Introduction to Root Cause Analysis

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# Job Aid

# Documentation Review Inputs

**Purpose:** Use this job aid to revise the list of inputs to include in a documentation review as part of the Identify Risks process.

#### Risk management plan

* roles and responsibilities
* provision for risk management activities in the budget and schedule
* categories of risk (risk breakdown structure)

#### The stakeholder register

* provides a list of people that can be used in soliciting inputs for identifying risks

#### Estimates

* activity cost estimates
* activity duration estimates

#### Baselines and management plans

* scope baseline - project assumptions, work breakdown structure
* cost management plan
* schedule management plan
* quality management plan

#### Other sources of information

* enterprise environmental factors – external to the project environment – such as academic studies, benchmarking, industry studies, and risk attitudes
* organizational process assets, such as project files, risk statement templates, and lessons learned

#### Project documents for ongoing risk identification

* work performance reports
* earned value reports
* updated baselines

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**Topic:** Documentation Review

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Performing risk analysis

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# SkillBrief

# Risk Probability and Impact Assessment

One of the main techniques for the Perform Qualitative Risk Analysis process is performing a risk probability and impact assessment. The purpose of this is to assign a combined probability-impact rating to each risk identified for a project. You can then prioritize all risks based on the relative levels of threat or opportunity they represent.

To conduct a risk probability and impact assessment, the risk planning team assesses risks either in brainstorming sessions, interviews, or using the Delphi technique. The team is typically comprised of people who are familiar with the risk categories on the agenda. These individuals should either have experience with recent, similar projects, or be responsible for planning and managing specific project areas that may be impacted by the risk.

During the assessment, the team should record explanatory details and the assumptions behind each risk probability and impact rating it assigns. This information will be useful either to justify ratings later in the same project, or as historical information for similar projects in the future.

When you perform the assessment, you do the risk probability assessment separately from the risk impact assessment. It doesn't matter which you do first.

During the probability assessment, the team uses expert judgment to estimate how likely it is that each identified risk will occur. To ensure standard measures of probability are used across all risks, the team uses a scale defined in the risk management plan or one that is already available in the organization. This scale may be either

* an **ordinal scale** – uses adjectives such as low, medium, high, and very high. Each of these ratings must be described in detail to ensure a shared understanding of its meaning.
* a **cardinal scale** – uses numbers to denote probability. This may be on a scale of 0 to 10, with 0 being very low and 10 representing a certainty of a risk occurring. However, a common cardinal scale uses 0 through 1.0, with 1.0 representing a certainty. The meaning of each value on the scale should be clearly defined.

In an impact assessment, the team determines the potential effect of each risk on a project, typically in relation to schedule, cost, or performance objectives. The impact of a risk may be negative – a threat – or positive, in the case of an opportunity.

Impact is rated according to the same scale used for probability – either ordinal or cardinal.

To arrive at an overall risk score, you multiply its probability by its impact. To help do this and to determine what priority level a risk's overall score represents, the team uses a probability and impact matrix. This matrix is a look-up table developed as part of the risk management plan. It contains possible probability scores down one side and possible impact ratings – for both threats and opportunities – along the bottom. The connecting cells show the combined scores, and their shading identifies the associated priority level.

The specific combinations of probability and impact that lead to a risk being rated as high, moderate, or low priority are decided by the organization. In this matrix, a dark gray area with the largest numbers represents high risk; a light gray area with the smallest numbers represents low risk; and a medium gray area with the in-between numbers represents moderate risk.

You can also use an ordinal probability and impact matrix to determine a risk's priority rating:

* when a risk has a low probability and a low impact, it is given a low priority rating.
* when a risk has a low probability and a medium impact, it is assigned the low priority rating.
* when a risk has a low probability and a high impact, it is assigned the medium priority rating.
* when a risk has a medium probability and a low impact, it is assigned the low priority rating.
* when a risk has a medium probability and a medium impact, it is assigned the medium priority rating.
* when a risk has a medium probability and a high impact, it is assigned the high priority rating.
* when a risk has a high probability and a low impact, it is assigned the medium priority rating.
* when a risk has a high probability and a medium impact, it is assigned the high priority rating.
* when a risk has a high probability and a high impact, it is assigned the high priority rating.

Whether you use an ordinal or a cardinal scale will depend on your organization's conventions. If these conventions haven't been established, you can choose the type of scale that best suits your own preference or the nature of a project.

### Prioritizing risks

You've assigned ordinal values to all identified risks based on their probabilities and impacts. Now you can order the risks based on their associated priorities. The risks with the highest priorities are listed first.

If the risk assessment team uses a cardinal scale, each risk score has a numeric value. This makes it even easier to place the risks in order of priority. Note, however, that some risk scores may be high, but are assigned a medium or lower priority depending on their placement within the matrix. Remember that the table is shaded so you can quickly confirm visually which priority level the risk is; low, medium, or high.

Prioritizing risks helps guide the planning of risk responses. For example, high-priority threats may require aggressive response strategies, whereas threats with low priority may simply be monitored. Similarly, high-priority opportunities should be targeted first.

To prioritize risks, you need to combine the probability rating and the impact rating of each risk. The results are then assessed using a cardinal or ordinal matrix, which determines the risk's priority level. Once you have assigned a priority level or number to each risk, you place the risks in sequence according to those priorities, from highest to lowest.

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**Topic:** Risk Probability and Impact Assessment

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# SkillBrief

# Categorizing Risk and Assessing Risk Data and Urgency

Although probability and impact are key indicators for risk priority, preparing for the unknown is highly complex and more tools and techniques are needed to prepare the team against potential risks. It's useful to rate identified risks based on their probability and impact, and group risks based on their type and urgency. It's also important to check the accuracy of the data on which you base risk assessment, and to determine which risks require the earliest responses.

So additional tools and techniques for the Perform Qualitative Risk Analysis process include risk categorization, risk data quality assessment, and risk urgency assessment.

### Risk categorization

Risk categorization involves grouping sets of risks. This can reveal the areas of the project most exposed to risk and inform risk response planning. There are three main risk categories:

* **sources of risk** – Categorizing risks based on their sources enables you to group them according to their root causes. This can help you plan effective risk responses. A useful tool for doing this is the risk breakdown structure.
* **project areas** – Risks could be categorized by project area for analysis. The project's work breakdown structure contains project areas, so it is helpful to categorize risks according to the areas of the project they affect. Each risk is linked to a specific work package.
* **project phases** – If you choose to categorize risks according to a project's phases – such as planning, development, monitoring, and closing phases, you link each risk to the project phase in which it is most likely to occur.

Risk categories are developed and refined during the Plan Risk Management and Identify Risks processes. During the Perform Qualitative Risk Analysis process, it may be useful to re-categorize the risks according to a different scheme. This may help the team identify new risks that weren't apparent before.

### Risk data quality assessment

If the information you and your team gather about identified risks is inaccurate, biased, or incomplete, the results of qualitative analysis will be unreliable. To ensure the quality of the information gathered, the risk team uses risk data quality assessment.

This involves evaluating the accuracy, reliability, and integrity of the data about identified risks. It also involves determining which data is relevant. If you determine that the quality of the data you have on hand is not sufficient to perform a thorough analysis, you may need to gather better quality data.

The team assesses the level of understanding shown for each risk. It then reviews the risk data quality by assessing the availability, quality, and reliability of the data about each risk.

### Risk urgency assessment

To assess how quickly each risk should be dealt with, the risk team uses the risk urgency assessment technique. This involves prioritizing risks based primarily on timing – risks that could occur soon are seen as more urgent than those that may occur later on. Other factors considered are the risks' probability and impact ratings, and any warning signs that particular risks are likely to occur.

A risk's priority according to the probability and impact matrix can influence the urgency of a particular risk. Those risks with high priority generally have higher urgency than those with low ratings. You can categorize risks as near-term, mid-term, or far-term risks based on how soon into a project they're likely to occur.

In addition to probability and impact assessment, tools and techniques for the Perform Qualitative Risk Analysis process include risk categorization, risk data quality assessment, and risk urgency assessment. These can help a risk management team organize risks based on the types of responses they may require, ensure the accuracy of analysis results, and prioritize risks according to how urgently they require attention.

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**Topic:** Risk Quality and Urgency Assessment

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# SkillBrief

# Risk Register Updates

The risk register is first created during the Identify Risks process. Once it's updated with the results of the Perform Qualitative Risk Analysis process, it becomes an input to the Perform Quantitative Risk Analysis and Plan Risk Response processes. It then continues to be updated and adjusted throughout the project life cycle, as new information becomes available.

During the Identify Risks process, the risk register is populated with a list of identified risks. Generally, a description, category, cause, impact, and probability or likelihood rating are provided for each risk at this stage.

After the Perform Qualitative Risk Analysis process, risk causes and categories may be updated.

You categorize the risks in the register and then

* **order by priority** – After qualitative analysis, risks in the register are grouped by category, based on their sources or the project areas or phases they're likely to affect. This can help identify common root causes of risks and simplifies the management of risks and risk responses. Within each category, the risks are listed according to their priority ratings as determined during the probability and impact assessment.
* **mark near-term risks as urgent** – The risk urgency assessment you conduct during the Perform Qualitative Risk Analysis process provides new information about which risks require the most immediate attention. So you update the risk register by marking near-term risks as urgent.
* **flag risks requiring further analysis** – These risks should be flagged in the register with symbols or color coding. For example, specific risks may be marked as requiring quantitative analysis after qualitative analysis has been completed.

The risk register should already contain descriptions of risks and their causes. These can be refined if more information becomes available during qualitative analysis. Additionally, new risk categories or newly identified risks may be added to the register.

The causes of each risk are entered into the risk register during the Identify Risks process. However, if new details arise during qualitative analysis, these can be added to the existing descriptions.

### Risk register appendices

Some information that results from a qualitative risk analysis can't be added directly to the risk register table. This information is added in the form of appendices or notes. These typically include any risk trends identified during the analysis and a watchlist of low-priority risks.

Examples of risk trends a team may identify during qualitative analysis include changes in goods and fuel costs, regulatory changes, or problems with communication strategies. These issues should be documented and added to the risk register.

Any risks that have low priority are added to the watchlist. This identifies risks the team must monitor as the project progresses, but that don't require specific responses. If there's an increase in the urgency or priority of risks on this list, the risks must be added to the risk register.

Updates to the risk register are the only output of the Perform Qualitative Risk Analysis process. The identified risks in the register are categorized and listed in order of priority, information about the urgency of risks is added, and risks that require further analysis are marked. Additional components that may be included with the risk register at this stage include a watchlist of low-priority risks and documentation of any trends associated with the identified risks.

**Course:** Performing Risk Analysis  
**Topic:** Updating the Risk Register with Qualitative Data

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# Inputs to the Perform Qualitative Risk Analysis Process

Risks discovered in the Identify Risks process are analyzed during the Perform Qualitative Risk Analysis process. The results determine whether further, quantitative risk analysis is needed or whether the team can move directly to planning risk responses.

The objective of qualitative risk analysis is to prioritize risks according to their probability and impact, and to compare the results against risk tolerance levels. These levels are related to project constraints and time frames.

Qualitative risk analysis relies on the subjective judgment of stakeholders and so is open to bias. Bias may cause you to overlook critical risks or focus on improbable risks. To help prevent bias in analysis, you need to ensure that the risk management plan clearly defines probability and impact scales. These provide a consistent approach for measuring probability and impact. You can also interview experts and review historical information to gain a better perspective on the potential for risks occurring and their probable impact on the project.

There are four inputs to the Perform Qualitative Risk Analysis process.

#### Risk register

The risk register lists and describes identified risks. It's expanded and refined throughout the risk planning processes. It is also updated throughout the project as risks are monitored and controlled and new risks are identified. The role of the risk register in qualitative risk analysis is to provide information about the risks that are to be analyzed. The risk register contains the following columns:

* **RBS and WBS** – The risk breakdown structure (RBS) column links each identified risk to its category within the risk breakdown structure. The work breakdown structure (WBS) column links each risk to one or more work packages within the project's work breakdown structure.
* **description** – This column should contain a clear and concise description of each identified risk.
* **cause** – This column should identify the cause – or causes – of each risk.
* **impact** – This column should detail the potential impact of each risk on the project. This section of the register may be further divided to detail each risk's impact on specific project objective
* **likelihood** – This column indicates the probability of each risk occurring. Likelihood could be classified, for example, as none, very low, low, medium, high, and very high.

#### Risk management plan

Elements of the risk management plan that inform the process include

* **roles and responsibilities** – The risk management plan identifies the roles and responsibilities of specific team members for managing risk. Generally, these individuals have the most knowledge about risks in their particular areas. So you use this information when you compile the list of attendees to the risk analysis meetings.
* **risk analysis budget and schedule** – The risk management budget states how much money is approved for risk management activities. The risk management schedule informs you of the amount of time available for risk management. You use the budget and the schedule to track the time and money spent on risk analysis.
* **risk categories** – These identify risk types, such as technical, external, organizational, and those related to project management. Grouping risks like this enables you to determine where project risks are concentrated so you can focus on those areas when you develop risk responses.
* **definitions of probability and impact** – Definitions of what constitutes low, medium, and high probability and impact are included in the risk management plan. These definitions help to minimize bias when prioritizing risks.
* **revised stakeholders' risk tolerances** – The less tolerance stakeholders have for risk, the more vigilant and aggressive you must be in analyzing and responding to risk. It's important to keep your stakeholders' risk tolerance in mind as you analyze risks and make associated decisions. This helps ensure that risks are prioritized appropriately.

#### Project scope statement

You can use the project scope statement to determine if there is a large amount of uncertainty surrounding project deliverables. If the project is of a common or recurrent type, the deliverables and scope of the work tend to be well understood. Therefore, the project's risks will also be well understood. In projects that are the first of their kind or involve state-of-the art technology, there are broader areas of uncertainty. So these projects carry greater inherent risks that are not well understood by the project team.

When evaluating the project scope statement, you should check if there are clear and proven procedures for exactly how to create deliverables. Also, are the deliverables clearly defined in terms of what they should look like or how they should function?

To eliminate uncertainty, the deliverable description should be expanded and provide enough information so that the project team can plan and carry out the work to the customer's expectations.

#### Organizational process assets

Typically, organizational process assets include

* **historical information** – refers to information from previous, similar projects which can help determine how to prioritize particular risks
* **studies of similar projects** – by risk specialists, are useful in determining the probability and potential impacts of particular risks
* **risk databases** – from industry or proprietary sources, can be a good source of historical information about risks that you have identified for your own project

You use the Perform Qualitative Risk Analysis process to prioritize risks according to their probability and impact. The inputs to this process include the risk register, the risk management plan, the project scope statement, and organizational process assets.

**Course:** Performing Risk Analysis  
**Topic:** Introduction to Qualitative Risk Analysis

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# SkillBrief

# Perform Quantitative Risk Analysis Inputs

During the Qualitative Risk Analysis process, you assess project risks based on their probability and likely impact. In the Quantitative Risk Analysis process, you take this a step further. You evaluate the risks in more detail and using more objective methods, so you can rate them numerically based on how they could affect overall project objectives.

It's important to remember that quantifying risks doesn't reduce the potential damage they can cause in any way. However, it can be more useful to know that a risk could cause a loss of between $620,000 and $840,000 than just to know that it's "highly significant." You can use quantitative risk analysis to assign numerical ratings to individual risks or to evaluate the combined effect of all risks affecting the project.

Processes for both qualitative and quantitative risk analysis form part of the Project Risk Management knowledge area and fall into the Planning process group. Typically, you perform quantitative analysis on the risks you've already prioritized during a qualitative analysis.

The Perform Quantitative Risk Analysis process may occur again after the Plan Risk Responses process, and periodically throughout a project as part of the Monitor and Control Risks process. At these points, you use it to determine if the team's risk management activities have succeeded in reducing overall project risk.

The budget and time at the team's disposal will help determine if quantitative risk analysis is performed and what form it takes. Depending on the complexity of a project, the management team may decide to use quantitative analysis to assess all project risks, or only risks assigned high priorities during qualitative analysis. Or perhaps the team has worked on a similar project before and has a high level of familiarity with the relevant risks. In this case, the team may choose to skip the process and use qualitative analysis only.

The Perform Quantitative Risk Analysis process relies on information from several sources. These include

* **the risk register** – identifies the project risks you need to analyze and assign numeric values during quantitative analysis. It also identifies risk categories and priorities. Often quantitative analysis is performed only for risks that have been assigned priorities above a certain threshold value in the risk register.
* **the risk management plan** – details how project risk must be managed throughout a project. This information helps determine whether quantitative analysis must occur, when it must occur, and what form it must take. It also identifies the budget available for risk analysis.
* **the cost management plan** – details how project costs must be planned, structured, estimated, budgeted, and controlled throughout a project. The controls that will be used to manage costs must be analyzed because many project risks are related to cost estimates and budget overruns. One way to measure the impact of a risk is in terms of how it will affect project costs. For these reasons, the cost management plan is an important input during quantitative risk analysis.
* **the schedule management plan** – determines how the project schedule must be developed, formatted, and controlled. The controls that will be used to manage the schedule must be analyzed because many project risks are related to activity duration estimates and schedule overruns. Often the impact of risk is measured in terms of how it will affect the schedule, so this plan must be used during quantitative risk analysis.
* **organizational process assets** – can include risk-related information about previous, similar projects; studies of similar projects by risk specialists; and risk databases from industry or proprietary sources. These can provide information that improves the accuracy of quantitative risk analysis for a particular project.

The Perform Quantitative Risk Analysis process involves analyzing the effects of identified risks on project objectives, and assigning numerical ratings to these risks based on their probability and impact. As inputs, the process relies on information from the risk register, the risk management plan, the cost and schedule management plans, and organizational process assets.

**Course:** Performing Risk Analysis  
**Topic:** Introduction to Quantitative Risk Analysis

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# SkillBrief

# Different Methods of Quantitative Risk Analysis

The first step in quantitative risk analysis is gathering and representing data about the estimated probabilities of risks and their impacts on project objectives.

To report quantitative data about project risks, you use specific quantitative risk analysis and modeling techniques. Quantitative risk analysis involves using mathematical or statistical methods to quantify and rank the relative impacts of risks on project objectives. Modeling and simulation techniques involve using representations of real systems to test the effects of changes.

Quantitative risk analysis can take one of two forms:

* **event-oriented analysis** – You assess how a specific risk event could impact a particular project objective.
* **project-oriented analysis** – You assess how all identified risks could impact the overall success of a project. This typically involves identifying how much each risk is likely to cost the project – financially or in terms of schedule delays. You can then prioritize the risks based on quantifiable data.

Two methods of quantitative risk analysis often used in project management are sensitivity analysis and expected monetary value (EMV) analysis. You can use each of these methods to perform either event-oriented or project-oriented risk analysis.

### Sensitivity analysis

Sensitivity analysis involves testing how changes in one variable affect an outcome when all other variables are kept the same. By repeating the process for each variable, you can determine which of them has the greatest impact.

During risk data gathering interviews, you collect data about the probability and impact of risks. You determine the best case, worst case, and most likely case of each cost in your budget. You can change the cost figure in the budget while keeping all other figures the same. This enables you to check the minimum, most likely, and maximum effect of the change on total costs.

You can repeat the process to test how changes to each type of expense will affect total costs.

A tornado diagram is a useful way to represent the results of a sensitivity analysis. In this type of diagram, a bar represents each risk and the range of the impact it could have, from negative to positive impact. The length of each bar represents the relative impact of each risk. The bars are ordered in sequence giving the diagram its characteristic "tornado" shape.

Many risks have potentially positive and negative impacts. A tornado diagram lets you determine whether the potential positive impact of a risk outweighs its potential negative impact. It also identifies risks in order of impact so the team knows which risks pose the greatest threats or opportunities, and so require the most focus.

### EMV analysis

The importance of a risk to a project depends on both the damage it can cause and its likelihood of occurring. This principle lies at the heart of EMV analysis. You use EMV during quantitative analysis to determine the relative significance of risks, given both their possible impacts and their probabilities of occurring.

To calculate a risk's EMV, you multiply its potential impact by its probability. Once you have calculated the EMV for each risk, you can then prioritize risks by using the EMV values to rank the particular risks from highest to lowest

You can use EMV analysis to evaluate the most likely impacts of risks on the schedule, as well as on project costs. You can add up the potential costs of all the risks in the project. But this assumes that every risk will occur and will have the worst possible impact. Statistically, this might be possible – but it's extremely unlikely. You can add the EMV for each risk – which will give you a more plausible figure to consider when you draft a contingency budget.

Although EMV analysis can be extremely useful, it has some weaknesses. The results of the analysis depend completely on how accurately you've predicted the probability and impacts of the given risks. Also, it's important to remember that EMV analysis deals with uncertainty. It can help you prioritize risks, but it can't tell you exactly which risks will occur or what their total cost to a project will really be.

### Decision tree analysis

This is a common application of EMV that involves representing the choice between two or more options in the form of a diagram, and using quantitative data to compare the possible outcomes of each of the options.

A decision tree includes three types of nodes. A decision node represents the question you want to answer. Chance nodes – often represented as circles – lead to quantitative data about the different possible outcomes of each option. And end nodes, usually marked as triangles, show the results of analyzing the possibilities of each option.

You can use decision tree analysis in many different ways as part of quantitative risk analysis. For example, you can use it to compare the risks associated with different choices.

One of the ways you can represent the values of possible outcomes in a decision tree is using EMV analysis.

To perform decision tree analysis using EMV, you perform three steps:

1. determine the best-case and worst-case EMVs for the first path and add them to get a total EMV
2. determine the expected market value of each possible outcome
3. compare the two total EMVs to determine which option is best

Each of the quantitative risk analysis techniques – sensitivity and EMV analysis – is useful for different reasons, and in different circumstances. Also, decision tree analysis - as a specific application of EMV analysis - also has its uses.

Commonly used quantitative risk analysis techniques include sensitivity analysis and EMV analysis. Sensitivity analysis involves testing the sensitivity of outcomes to one risk factor at a time. You can use it to rank project risks according to their potential impacts. EMV analysis involves assessing risks in terms of both their estimated impact and probability. Decision tree analysis is often used as a specific application of EMV analysis. This involves representing the choice between two or more options, and comparing the most probable outcomes of the options based on their total EMVs.

**Course:** Performing Risk Analysis  
**Topic:** Quantitative Risk Analysis

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# SkillBrief

# The Perform Quantitative Risk Analysis Output

The single output of the Perform Quantitative Risk Analysis process is risk register updates. You add the results of quantitative risk analysis to the register so they can be used during the planning of appropriate risk responses.

Consider the processes through which the risk register passes during a project:

* The risk register is first created during the Identify Risks process, when relevant risks to the project are identified and recorded.
* Through the Perform Qualitative Risk Analysis process, general judgments are added about the cause, impact, severity, and likelihood of each identified risk.
* Through the Perform Quantitative Risk Analysis process, the details in the risk register are fleshed out to include statistics about the impact and likelihood of each assessed risk. Severity ratings may be adjusted accordingly.
* All the information in the risk register becomes an input for the Plan Risk Responses process. In turn, the register is updated with planned responses for managing the risks.
* The risk register continues to be updated throughout the course of the project as new information about risks emerges or further risk analysis is completed.

You should add specific outputs of quantitative risk analysis to the risk register.

#### Probabilistic analysis of the project

Upper managers in your organization who authorize contingency reserves will be interested in the probabilistic analysis of the project. You can use a cumulative cost chart to illustrate what the budget contingencies will need to be. The same type of chart could be used to display probable schedule outcomes and finish dates with associated levels of confidence.

#### Probability of achieving cost and time objectives

Through quantitative risk analysis, you can quantify the likelihood of achieving specific cost and schedule objectives. You do this based on identified risks, their possible impacts, and the probability of the risks occurring. For instance, analysis may determine a 35% chance of a project finishing by its planned completion date, or a 68% chance of the project completing within its planned budget.

#### Prioritized list of quantified risks

Based on the results of quantitative risk analysis, you prioritize the identified risks in each risk category based on which poses the greatest threats or opportunities for a project. Each risk is ranked based on both its possible impacts and their probabilities of occurring. Ranking risks in this way tells the management team which risks it should prioritize when it plans risk responses.

#### Any trends in analysis results over time

You can repeat quantitative analysis several times at different points in a project. Trends – or patterns – that emerge in the results can guide the risk management team in prioritizing and addressing specific risks, or point to the need for further risk analysis.

A probabilistic analysis of a project provides statistics about the project's possible outcomes, in terms of costs and time.

Typically, you represent the probable total costs or duration of a project using a cumulative distribution. This type of graph lets you represent the probabilities of all possible outcomes using a single curve.

Similarly, you can use a probability distribution to represent the likelihood of achieving a specific project objective, in terms of costs or the schedule.

The information in a cumulative distribution is an important input for planning appropriate contingency reserves. Stakeholders' levels of risk tolerance will help determine the extent to which contingency reserves must cover possible risks.

During qualitative risk analysis, the team prioritizes the identified risks in each category. The team then adds the resulting list to the risk register. After quantitative risk analysis, the risks are prioritized a second time, based on their possible impacts and statistical probabilities.

A final component you should add to the risk register is information about any trends in the results of quantitative risk analysis.

The output of the Perform Quantitative Risk Analysis process is risk register updates. These updates should include a probabilistic analysis of the overall success of a project, the probability of achieving cost and time objectives, a prioritized list of quantified risks, and any trends in quantitative risk analysis results over time.

**Course:** Performing Risk Analysis  
**Topic:** Updating the Risk Register with Quantitative Data

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# SkillBrief

# Perform Quantitative Risk Analysis Techniques

Through the Perform Quantitative Risk Analysis process, you convert general information about project risks into concrete statistics. But a good adage to remember is "garbage in, garbage out." The results of the process are valuable only if the information you start with is good.

The tools and techniques for the Perform Quantitative Risk Analysis process can be divided into two main categories. You use data gathering and representation techniques to collect and record risk-related data. And you use quantitative risk analysis and modeling techniques to convert the data you've gathered into meaningful results.

### Gathering data

The primary technique you use to gather data about risks is interviewing experts and relevant stakeholders. These people may be members of the project team who have already played a role in qualitative risk analysis. Alternatively, the project manager may have to bring in experts who have in-depth or specialized knowledge about the risks under consideration.

The main goal of the interviews is to collect data about the probability of achieving specific project objectives, given the impacts of risks. For the purpose of quantitative analysis, the kind of information you'll be looking for to answer these questions is statistical in nature, and usually expressed as percentages. For example, there may be a 50% chance of remaining within budget.

Usually, the basic information you need to obtain from experts is a three-point estimate of how each risk or risk category could affect a particular project objective.

A three-point estimate is one that incorporates an optimistic – or best – view, an estimate of what's most likely, and a pessimistic – or worst – view of how events may unfold. As well as these estimates, it's important to record the rationale for them and any assumptions on which they're based. These provide insight about the reliability and accuracy of the estimates.

Most commonly, a three-point estimate is the most useful starting point for quantitative risk analysis. However, the information you need to gather during interviews will depend on the nature of specific objectives and risks, and on how you plan to represent and analyze this data. For an in-depth analysis, you might need to gather more detailed statistical data about a wide range of possible outcomes.

### Data representation

Once you've gathered data about the statistical probabilities of risks, you need to represent this information in a way that will enable you to analyze it. A probability distribution is a graph that shows where the probabilities lie. The advantage of this type of graph is that it can depict a lot of information in one place and in a format that's easy to interpret.

There are two main types of probability distributions:

* a **discrete distribution** includes the probabilities of a fixed number of outcomes – for example, represented in a bar chart
* a **continuous distribution** includes the probabilities of a full range of possible outcomes, usually represented as a curve

There are five types of continuous distribution, each with specific characteristics.

#### Normal

The highest point in a normal distribution is the average value. All other values fall symmetrically on either side of this point to create a bell shape. A simple way of explaining this is that the further values move away from an average, the less likely they are to occur. The type of data you're dealing with will determine whether a normal distribution applies.

#### Uniform

In a uniform distribution, all the possible outcomes between known upper and lower limits have the same probability. This occurs if you know the range between which values can fall but none of these values is more probable than the other, or if you don't yet have enough information to determine what's most probable.

#### Beta

The beta distribution represents the probabilities of all values between specified minimum and maximum values. The most likely value is at the top of the curve. You determine the shape of the curve using mathematical methods.

#### Triangular

In the triangular distribution, you plot only three values – typically representing the best-case, most likely, and worst-case scenarios. It's important to remember that the highest point in a triangular distribution isn't the same as the average value. It represents an expert's best guess. The average of the possible values may lie to the left or right of this point.

#### Lognormal

The lognormal distribution results if the logarithm of a variable has a normal distribution. In this case, values are skewed to the right side of an average – or median – value. This type of distribution occurs in specific cases where the factors that affect a variable have a multiplicative effect on its value.

Each type of probability distribution is useful in particular circumstances. But the two types of distributions used most often in project risk analysis are beta and triangular distributions. Both are useful for representing the three-point estimates – or best-case, most likely, and worst-case values – that you establish during interviews.

The tools and techniques for the Perform Quantitative Risk Analysis process can be divided into two main categories – those for gathering and representing risk-related data, and those for analyzing and modeling this data. The main technique you use to gather data is interviewing experts. During interviews, you need to obtain estimates of the probabilities of achieving project objectives, given the impacts of risks. You should also record the rationale and assumptions on which the estimates are based. To represent the probability data you've obtained, you use probability distributions. These may be discrete or continuous. Types of continuous distributions include normal, uniform, beta, triangular, and lognormal.

**Course:** Performing Risk Analysis  
**Topic:** Risk Data Gathering and Representation Techniques

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# SkillBrief

# Quantitative Risk Modeling

Like building physical models, using quantitative risk modeling techniques enables you to represent the behavior of real systems. If you can model a situation or a system, you can test how it will react given different conditions. This includes testing how project costs or the schedule will be affected by risks.

You can think of a model as a set of rules representing real behavior. You can feed data into the model and it will return predictions of how a real system or scenario would respond.

Simulations are also used in quantitative risk assessment. Whereas other types of models represent expected behavior, a simulation involves actually imitating a real system so you can test how the system is likely to react, given various conditions.

There are two basic types of models:

* **iterative** – the same "what if" scenario is played out repeatedly, each time with a different, randomly chosen set of possible values for the variables that may affect its outcome. In theory, repeating the process many times gives this type of model the characteristic of accuracy. The more times random values are chosen and used, the closer the model is to simulating random probability in real life.
* **non-iterative** – a single set of values representing the possible impacts and probabilities of each factor in an outcome is used to determine a result.

A widely used example of iterative modeling is **Monte Carlo** simulation. Named after the famous Monte Carlo Casino, it involves feeding data about the range of possible outcomes into a computer application. You can also weight this information – for example, by specifying that values below an average are 20% more likely than values above the average.

The system then repeatedly recalculates results, each time using values it chooses randomly from within the range you've specified. Once the system has completed a very large number of calculations, it can provide statistics based on all the possible outcomes it has calculated.

If you were to perform a simulation-based risk analysis on the costs for a project, the inputs for the Monte Carlo simulation are the cost estimates. When schedule risks are the focus, you will have two inputs. One is the schedule network precedence diagram, which shows the tasks that must be completed, their sequence, and various estimates of their durations. The other input is the duration estimates. The output of the simulation is a prediction of how risks may impact cost or schedule objectives, usually in the form of a probability distribution.

The output of a simulation illustrates the likelihood of achieving specific targets. For example, in a cost risk simulation where the project's target budget is $41 million, the results are mapped out on a cumulative chart. The probability that a project will meet its target cost displays in percentages on the chart.

Results charts, such as the cumulative chart, indicate how much you must add to the estimated budget in order to give the project a good chance of succeeding within its expected budget. You can use this method of charting results when you determine the results of a project's schedule.

Quantitative risk modeling techniques enable you to represent or imitate real situations so you can analyze the possible effects of risks. Iterative techniques, such as a Monte Carlo simulation, take a large number of possible risk values into account and repeat calculations to imitate random probability.

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**Topic:** Quantitative Risk Modeling Techniques

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# Job Aid

# Quantitative Risk Analysis Techniques

**Purpose:** Use this job aid to review the types of quantitative risk analysis techniques.

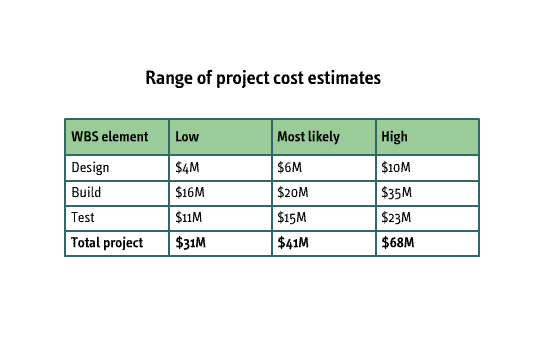
By using quantitative risk analysis techniques, you reduce uncertainty on a project. These techniques assign definite numeric values to risks based on their probability and impact on project objectives. This makes it possible to assess, compare, and prioritize the risks objectively.

## Interviews

The primary technique used to gather data about risks is interviewing experts and relevant stakeholders. Interviews aim to collect data about the probability of achieving specific project objectives, given the impacts of risks. These project objectives can include the likeliness that the project will finish on time or within budget.

In quantitative analysis, the results of these interviews are statistical, giving you a three-point estimate of how each risk, or risk category, affects a particular project objective. Each point represents the probability of the risk occurring.

These three points are low, most likely, and high.



Range of project cost estimates collected during the risk interview

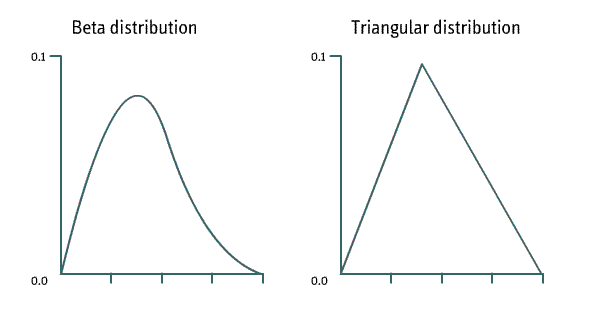
Fig. 11-13; PMBOK® Guide – Fourth Edition

## Probability distributions

Once you've gathered data about the statistical probabilities of risks, you can represent this information in probability distribution graphs. These graphs can depict a lot of information in one place. They show where an expert has determined that the probabilities lie.

There are two main types of probability distributions. **Discrete** distributions include the probabilities of a fixed number of outcomes – for example, represented in a bar chart.

**Continuous** distributions include the probabilities of a full range of possible outcomes, usually represented as a curve. Two examples of continuous distributions are beta and triangular distributions.



Examples of commonly used probability distributions

Fig. 11-14; PMBOK® Guide - Fourth Edition

## Sensitivity analysis

Sensitivity analysis involves testing how changes in one variable affect an outcome when all other variables are kept the same. By repeating the process for each of the variables one at a time, you can determine which of them has the greatest impact.

You can use sensitivity analysis to evaluate the impacts of particular risk events, or the relative overall impacts of all identified risks on a project.

## Expected monetary value analysis (EMV)

EMV is used to determine the relative significance of risks, given both their possible impacts and probabilities of occurring.

Using the EMV formula, you calculate the average outcome when the future includes scenarios that may or may not happen (i.e. analysis under uncertainty).

To calculate the EMV of a risk, you use this formula:

EMV of a risk = Potential impact of risk × Probability of risk occurring

The effectiveness of EMV depends on how accurately you've predicted the probability and impacts of the given risks.

EMV is useful in drafting your contingency budget, as you can use it to rank particular risks and assess the most probable total impact of all identified risks on a project. You do this by adding the EMV for each identified risk.

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**Topic:** Quantitative Risk Analysis

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# Job Aid

# Probability and Impact Matrices

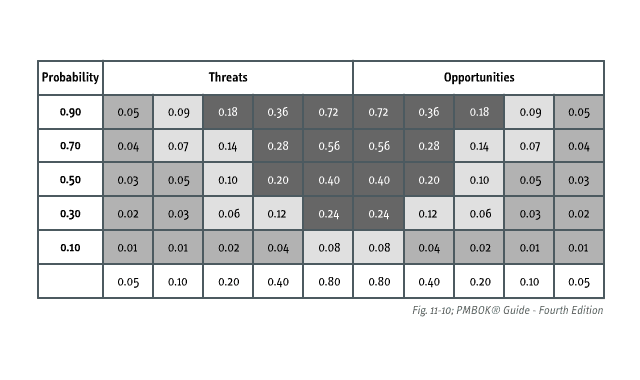
**Purpose:** Use this job aid to review the types of priority matrices and how to use them to assign priorities to risks.

To determine the priority of a risk, you need to factor in the risk's probability and impact scores and then locate the resulting score in a priority matrix.

A probability and impact matrix that uses an ordinal scale identifies risk priority based on descriptions of combined impact and probability, such as medium/low or high/medium.

| **Nominal priority matrix** | |
| --- | --- |
| **Probability-impact combination** | **Priority rating** |
| Low/Low | Low |
| Low/Medium | Low |
| Low/High | Medium |
| Medium/Low | Low |
| Medium/Medium | Medium |
| Medium/High | High |
| High/Low | Medium |
| High/Medium | High |
| High/High | High |

A cardinal probability and impact matrix identifies risk priority based on a numeric score. To determine the priority of a risk, you find the cell in the matrix that contains the result of multiplying the risk's numeric probability and impact ratings. The color or shading in the cell identifies the risk's priority level.



Probability and impact matrix

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**Topic:** Risk Probability and Impact Assessment

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# Job Aid

# Probability and Impact Matrices

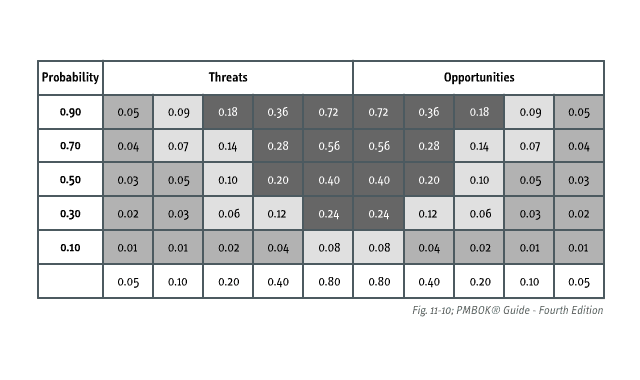
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| **Nominal priority matrix** | |
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| Medium/Low | Low |
| Medium/Medium | Medium |
| Medium/High | High |
| High/Low | Medium |
| High/Medium | High |
| High/High | High |

A cardinal probability and impact matrix identifies risk priority based on a numeric score. To determine the priority of a risk, you find the cell in the matrix that contains the result of multiplying the risk's numeric probability and impact ratings. The color or shading in the cell identifies the risk's priority level.



Probability and impact matrix

**Course:** Performing Risk Analysis  
**Topic:** Risk Probability and Impact Assessment

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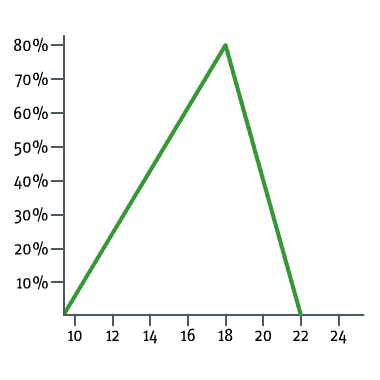
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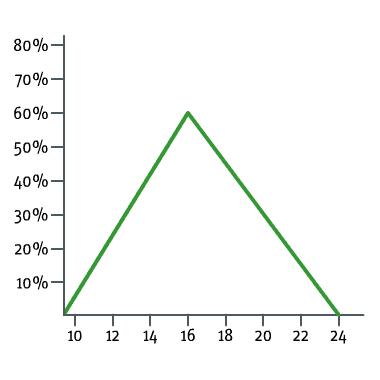
# Learning Aid

# Schedule Triangular Distributions

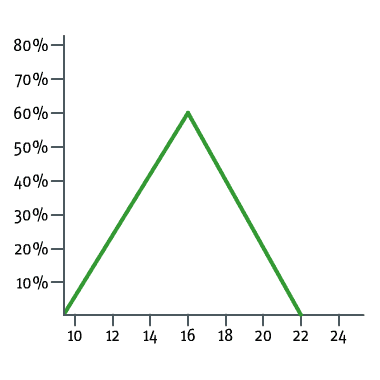
**Purpose:** Use this learning aid to answer the test question on predicting the probability distribution of a set of risk data.



Triangular distribution A



Triangular distribution B



Triangular distribution C

**Course:** Performing Risk Analysis  
**Topic:** Risk Data Gathering and Representation Techniques

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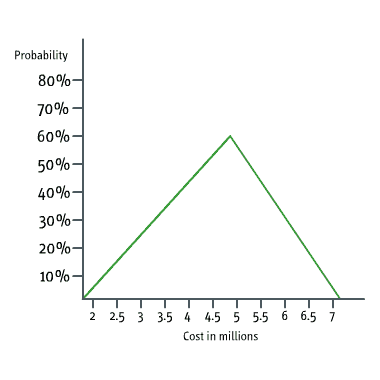
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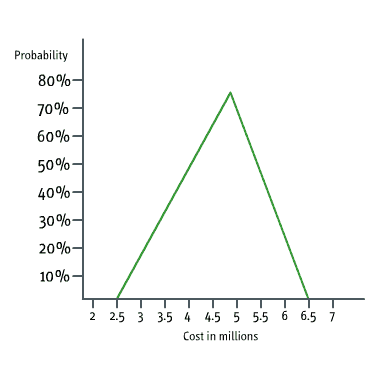
# Learning Aid

# Triangular Distributions of Costs

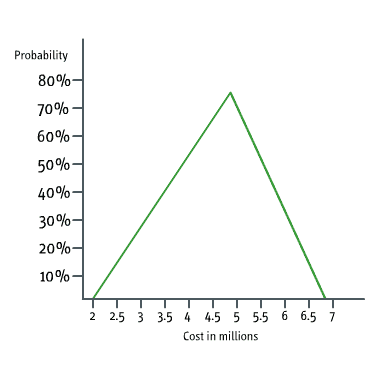
**Purpose:** Use this learning aid to answer the test question on predicting the probability distribution of a set of risk data.



Triangular distribution A



Triangular distribution B



Triangular distribution C

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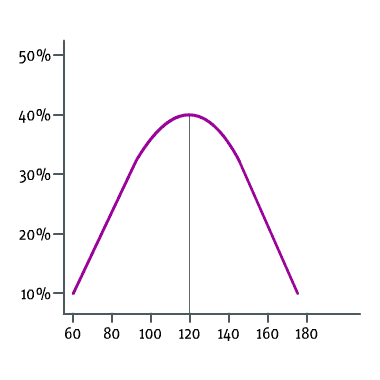
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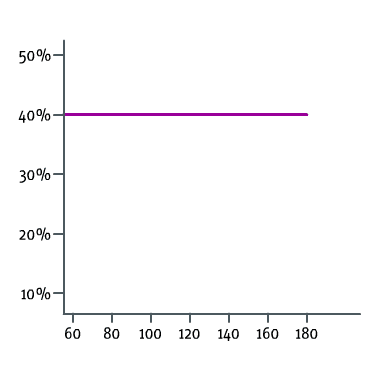
# Learning Aid

# Duration Probability Distributions

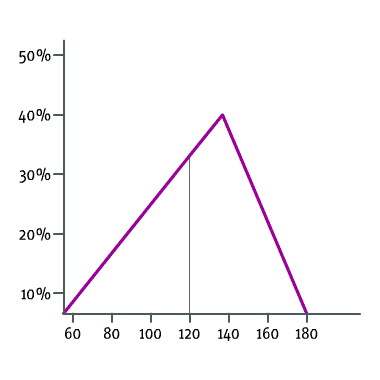
**Purpose:** Use this learning aid to answer the practice question on predicting the probability distribution of a set of risk data.



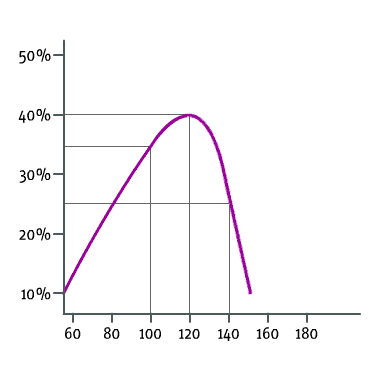
Distribution A



Distribution B



Distribution C



Distribution D

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# Learning Aid

# Internal Risks

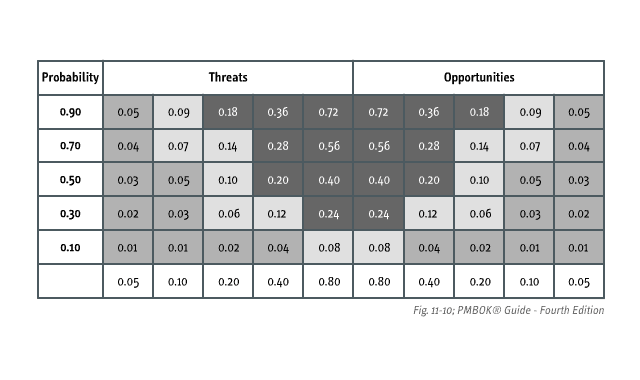
**Purpose:** Use this learning aid to answer the practice question on prioritizing risks.

The identified risks with their probability and impact ratings are displayed in the table. Enter the priority for each risk in the column provided and use the figures to list the risks sequentially, from highest to lowest priority.

| **Internal risks** | | | |
| --- | --- | --- | --- |
| **Risk** | **Probability** | **Impact** | **Priority rating** |
| Funding shortages | 0.30 | 0.20 | Row 2 Column 4 |
| Staffing shortages | 0.50 | 0.10 | Row 3 Column 4 |
| Quality procedures inadequate | 0.30 | 0.40 | Row 4 Column 4 |
| Loss of key personnel | 0.50 | 0.40 | Row 5 Column 4 |
| Resource problems | 0.70 | 0.40 | Row 6 Column 4 |

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Now assess each priority using the matrix to determine how it should be prioritized.



Probability and impact matrix

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**Topic:** Risk Probability and Impact Assessment

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# Learning Aid

# External Risks

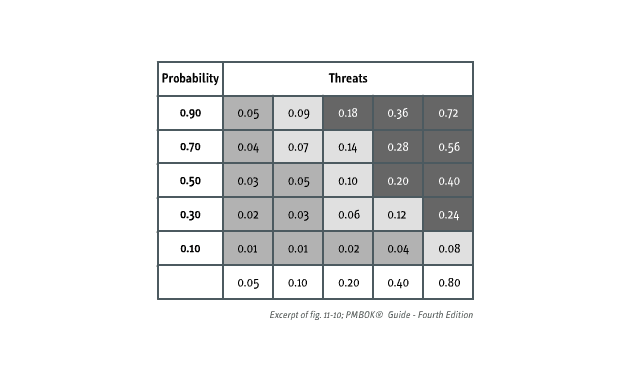
**Purpose:** Use this learning aid to answer the test question on prioritizing risks.

The identified risks with their probability and impact ratings are displayed in the table. Enter the priority for each risk in the column provided and use the figures to list the risks sequentially with the highest risk first.

| **External risks** | | | |
| --- | --- | --- | --- |
| **Risk** | **Probability** | **Impact** | **Priority rating** |
| Changes in regulations | 0.30 | 0.40 | Row 2 Column 4 |
| Competitor releases product first | 0.50 | 0.40 | Row 3 Column 4 |
| Supplier's business fails | 0.10 | 0.10 | Row 4 Column 4 |
| Transport costs increase | 0.70 | 0.20 | Row 5 Column 4 |
| Marketing campaign fails | 0.10 | 0.40 | Row 6 Column 4 |

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Now assess each priority using the matrix to determine how it will be prioritized.



Probability and impact matrix

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**Topic:** Risk Probability and Impact Assessment

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# Learning Aid

# Technical Risks

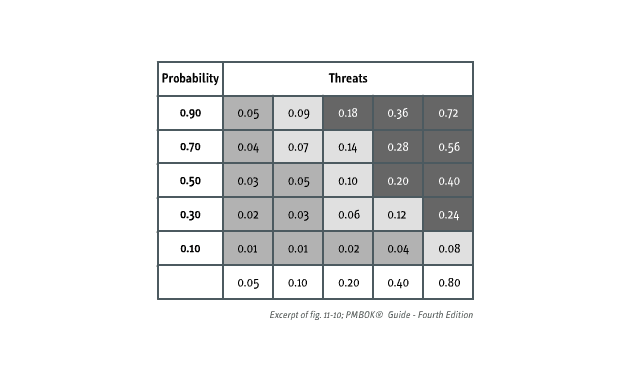
**Purpose:** Use this learning aid to answer the test question on prioritizing risks.

The identified risks with their probability and impact ratings are displayed in the table. Enter the priority for each risk in the column provided and use the figures to list the risks sequentially with the highest risk first.

| **Technical risks** | | | |
| --- | --- | --- | --- |
| **Risk** | **Probability** | **Impact** | **Priority rating** |
| Errors in calculations | 0.70 | 0.20 | Row 2 Column 4 |
| Sub-standard materials supplied | 0.30 | 0.80 | Row 3 Column 4 |
| Toxic waste spill | 0.50 | 0.40 | Row 4 Column 4 |
| Safety procedures inadequate | 0.10 | 0.80 | Row 5 Column 4 |
| Requirements estimates larger than needed | 0.50 | 0.05 | Row 6 Column 4 |

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Now assess each priority using the matrix to determine how it will be prioritized.



Probability and impact matrix

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# Follow-on Activity

# Performing Decision Tree Analysis

**Purpose:** Use this follow-on activity to practice performing decision tree analysis.

Focus on two or more possible outcomes you need to analyze in greater depth.

For example, you may want to

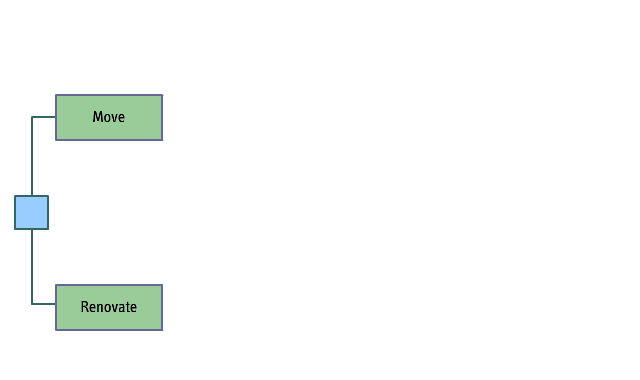
* compare the risks associated with different choices
* compare the possible gains and losses associated with a particular opportunity
* determine the best of two possible decisions, given relevant risks

Then, to create a decision tree, perform these steps:

#### Step 1

First draw a decision node – which you typically represent as a square – on the left side of a sheet of paper or whiteboard. From this square, draw a branch to each alternative for which you need to evaluate the possible outcomes. It's a good idea to keep the lines as far apart as possible to give you room to expand the tree.

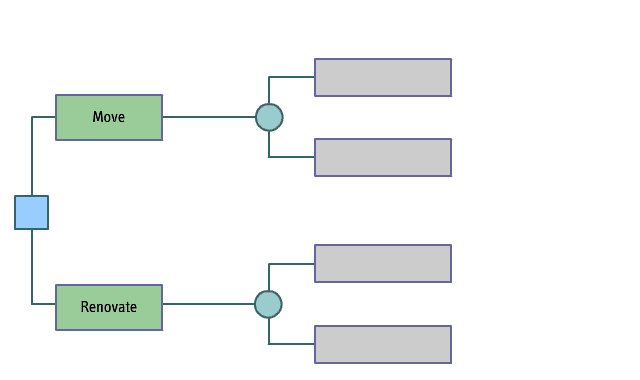
In this example, the decision tree will be used to compare the possible costs of two alternatives – renovating existing office space or moving to new premises.



#### Step 2

If the result of an alternative is uncertain, connect a line from it to a chance node, represented by a circle. If the result is another decision that must be made, draw a square. In this example, the outcomes of both alternatives in terms of costs are uncertain.

Next draw branches from each circle to represent the possible outcomes of each alternative. For instance, you may choose to compare estimates of the best-case and worst-case outcomes. This will mean connecting each circle to two squares, representing two possible outcomes.

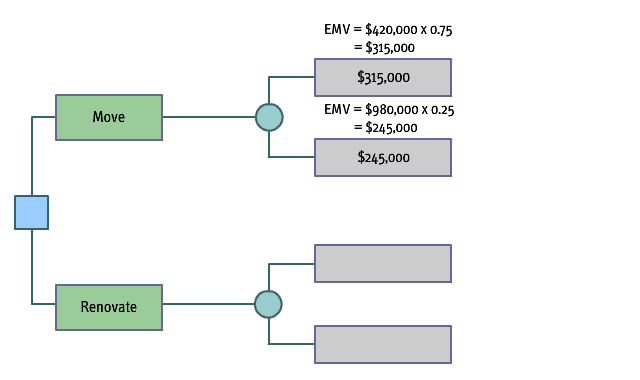


#### Step 3

Estimate the impact and probability of each possible outcome for the first path in the decision tree. Use market research, expert opinion, and historical data for help. Lacking those resources, use your best judgment.

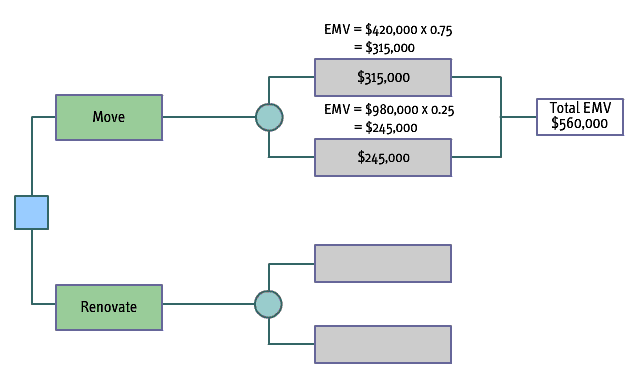
In this example, you estimate that moving to new premises has a 0.75 – or 75% – probability of costing $420,000, and a 0.25 – or 25% – probability of costing $980,000.

Using the values you've estimated, calculate the expected monetary value (EMV) for each alternative in the first path. To do this, you multiply the estimated impact for an alternative by its probability. Record the results in the squares representing the relevant outcomes.



#### Step 4

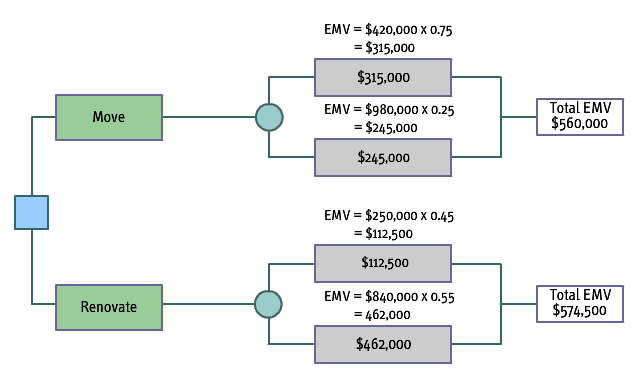
Next add the EMVs you've calculated for each of the alternatives to determine the total EMV for the first path, and record this value at an end node.



#### Step 5

Repeat this process for the second path. Calculate and record the EMV for each possible outcome, and then add the EMVs to determine a total.

In this example, renovating the existing office space has an estimated 0.45 probability of costing $250,000 – which gives an EMV of $112,500 – and a 0.55 probability of costing as much as $840,000 – which gives an EMV of $462,000. The total EMV for the path is therefore $574,500.



The results of the decision tree analysis identify the alternative that has the lowest risk or offers the highest benefit.

In this example, the alternative of moving has a lower EMV than the alternative of renovating existing office space, so it has a lower probable cost and represents a lower risk.

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**Topic:** Quantitative Risk Analysis

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# Follow-on Activity

# Qualitative Risk Analysis

**Purpose:** Use this follow-on activity to perform a data quality assessment with data of previous projects.

**Instructions for use:** To use this tool, gather historical and lessons-learned risk data from past projects. Then review its accuracy and relevance by evaluating it against a set of listed criteria. Does the data fulfill the criteria or not? Provide a reason. Finally, conclude whether your findings give you confidence in the data. Document your answers in the tables provided.

### Evaluate how complete the data is

| **Completeness** | | | |
| --- | --- | --- | --- |
| **Question** | **Yes/No** | **Reasons** | **Conclusions** |
| Is the data complete? | Row 2 Column 2 | Row 2 Column 3 | Row 2 Column 4 |
| Are charts graphics, and tables completely filled in? | Row 3 Column 2 | Row 3 Column 3 | Row 3 Column 4 |

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### Evaluate the data's clarity

| **Clarity** | | | |
| --- | --- | --- | --- |
| **Question** | **Yes/No** | **Reasons** | **Conclusions** |
| Is the data easy to interpret? | Row 2 Column 2 | Row 2 Column 3 | Row 2 Column 4 |
| Is the data clear and understandable? | Row 3 Column 2 | Row 3 Column 3 | Row 3 Column 4 |

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### Evaluate the data's sources

| **Sources** | | | |
| --- | --- | --- | --- |
| **Question** | **Yes/No** | **Reasons** | **Conclusions** |
| Are sources identified? | Row 2 Column 2 | Row 2 Column 3 | Row 2 Column 4 |
| Do you trust the sources? | Row 3 Column 2 | Row 3 Column 3 | Row 3 Column 4 |

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### Assess the data's believability

| **Believability** | | | |
| --- | --- | --- | --- |
| **Question** | **Yes/No** | **Reasons** | **Conclusions** |
| How believable is the data? | Row 2 Column 2 | Row 2 Column 3 | Row 2 Column 4 |
| Do you trust it? | Row 3 Column 2 | Row 3 Column 3 | Row 3 Column 4 |

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### Evaluate the data's objectivity

| **Objectivity** | | | |
| --- | --- | --- | --- |
| **Question** | **Yes/No** | **Reasons** | **Conclusions** |
| Is the data objective? | Row 2 Column 2 | Row 2 Column 3 | Row 2 Column 4 |
| Does it show bias? | Row 3 Column 2 | Row 3 Column 3 | Row 3 Column 4 |

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**Topic:** Risk Quality and Urgency Assessment

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Risk Response monitor and control

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# SkillBrief

# Inputs and Tools of Risk Response Planning

The Plan Risk Responses process involves determining the best possible responses to identified risks. It relies on outputs from all the project risk management processes that precede it. Chief among these outputs are the risk management plan and the risk register.

## Inputs to the Plan Risks Responses process

### Risk register

The risk register records all identified risks and, based on analysis, their severity and probability ratings. It also includes information such as the root causes of risks and their likely impact on the project. All of this information is required during the planning of suitable risk responses.

To assist in planning risk responses, you include additional information in the risk register, which you record in paragraph form. For example, you may identify **risks that require a response soon**. Identifying these risks helps ensure that the team focuses on these risks early on in the Plan Risk Responses process.

Also, you may record **trends identified in qualitative analysis results**. These help the team identify patterns, such as relationships between risks and their association with specific events, which help in the development of suitable responses. Compiling a **watchlist of low-priority risks** helps ensure that if the priority of a risk increases, the team will know that an active response is required.

Lastly, you may also develop a list of **risks for additional analysis**. This helps ensure the risks aren't forgotten. Once further analysis is complete, risk responses can be developed or those already planned can be improved.

### Risk management plan

The risk management plan, which you create during the Plan Risk Management process, introduces risk management and its purpose specific to the project at hand. It contains the assumptions, constraints, and policies that relate to risk management.

It mentions related documents and standards. It gives an overview of the risk management approaches, tools, and sources of information that the management team must use to manage risk over the project life cycle.

The four components of the risk management plan are

* **roles and responsibilities** – are outlined for specific team members for managing risks. They help identify team members with the most knowledge about particular risks. These people can then be consulted during the planning of suitable risk responses.
* **risk analysis definitions** – specify what criteria must be used to rate the probability, impact, and urgency of risks. This helps ensure that the ratings, which will inform the planned risk responses, are consistent and reliable.
* **timing for reviews** – outlines a schedule for risk management activities, including reviews of identified risks and their status. Planned risk responses may be altered based on these reviews.
* **risk thresholds** – define the limits above which planned risk responses must be implemented. The risk management plan defines risk thresholds for low, moderate, and high-priority risks. During risk response planning, these thresholds help the team design specific responses for risks in each category.

## Plan Risk Responses tools and techniques

Once a team has gathered the required information about project risks, it has to develop suitable risk responses. Tools and techniques for doing this include

* **strategies for negative risks or threats** – involve avoiding, transferring, mitigating, or accepting the risks
* **strategies for positive risks, or opportunities –** involve exploiting, sharing, enhancing, or accepting the risks
* **contingent response strategies –** are plans for addressing risks only once the risks occur, if they do
* **expert judgment** – required to determining appropriate responses to given risks. It may come from anyone with skills or knowledge related to a particular risk

To plan risk responses effectively, you need to choose the best mix of strategies for managing each risk. For instance, an effective response to a financial threat might be to transfer some of the risk to a third party by purchasing insurance and to accept the rest of the risk. It's also important to focus planning on high-priority risks, which have a high potential impact and probability of occurring.

Low-priority risks require less attention. For example, consider a risk that's unlikely to occur and that could cost a project only $300. Planning and implementing a response for this risk will probably cost more than simply accepting the risk and monitoring its status.

Each risk response should define a specific plan of action for managing a risk. It should also outline alternative plans – or fallback plans – to be used if the primary strategy selected isn't fully effective.

It's important to assign each risk response to a particular person, who is then known as the risk owner. This ensures it's clear who must take responsibility for managing each risk and the planned response.

Planners should also take secondary risks into account. These are new risks that may arise because of planned risk responses.

Inputs to the Plan Risk Responses process include the risk register and the risk management plan. These provide information about project risks and agreed approaches for managing them.

Effective risk response planning involves choosing the best mix of strategies for handling each risk, outlining clear plans of action and fallback plans, identifying and planning for secondary risks, and assigning risk owners.

**Course:** Risk Response, Monitor, and Control  
**Topic:** Introduction to Risk Response Planning

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# SkillBrief

# Positive and Negative Risk Response Strategies

The main goal of the Plan Risk Responses process is to identify the best strategies for managing project risks. Several types of strategies can be used. Generally, these fall into two categories – strategies for responding to negative risks, or threats, and those for responding to positive risks, or opportunities.

### Response strategies for negative risks

The four main strategies for managing negative risks are to avoid, transfer, mitigate, and accept.

#### Avoid

Sometimes risks are so costly or unpredictable that they should not be incurred at any cost. In this case, they must be avoided. In other words, planned risk responses must prevent the risks from affecting a project at all.

Avoiding a risk can involve eliminating the cause of the risk. Or it may involve changing the project management plan so that the risk isn't encountered. In some cases, it can be appropriate to go as far as changing or relaxing a project objective that's in jeopardy.

#### Transfer risk

This involves shifting some or all of a negative risk to a third party. This doesn't remove the risk – it simply transfers responsibility for it to a party outside of the project.

The strategy of transferring risk is most often used to manage financial risks. Most companies to which you can transfer financial risk have fairly high rates or fees for providing this service. So you should always consult the budget and perform a cost estimate before deciding to use this strategy.

Examples of tools a project team may use to transfer negative risks are

* **insurance** – The most common form of risk transference, where one pays a premium for protection against financial loss. It typically protects against loss due to property or vehicle damage, business interruption – through power failures, for instance, or employee injury.
* **contracts** – Designed to transfer specific risks to contractors, or sellers of products or services. In these cases, a vendor accepts responsibility for the cost of failure.
* **performance bonds** – A type of insurance that a contractor supplies to an organization. It specifies an amount of money to be paid over to the organization if the contractor fails to deliver the promised results. This protects the organization against financial loss if work is not completed.
* **guarantees** – An assurance of the quality or lifespan of a product, accompanied by a promise of reimbursement or replacement if the product doesn't live up to the specified standards.
* **warranties** – A written guarantee of the integrity of a product and of the manufacturer's responsibility for the repair or replacement of defective parts. Electrical appliances, for instance televisions and computers, typically come with warranties.

#### Mitigate

This involves reducing the probability that risks will occur and the impact they'll have if they do to acceptable levels.

Techniques for mitigating risks include

* adopting less complex processes
* conducting more tests on a product or service
* choosing more stable suppliers
* building redundancy into a system so that if one part fails, another part takes over its function

Project managers often use the strategy of mitigating risks – and taking early action to reduce risks is much more effective than trying to repair the damage after they occur. However, mitigating risks doesn't eliminate them altogether.

#### Accept

A fourth strategy for approaching negative risks is simply to accept the risks and their possible consequences.

Active or passive acceptance is an appropriate strategy when a risk is small, unavoidable, unknown, and can't be transferred, shared, or mitigated. In this case, a project team may simply hope for the best and plan to respond appropriately to any consequences or benefits that arise.

Passive acceptance involves doing nothing unless a risk event occurs, and then dealing with the consequences. Active risk acceptance involves accepting a risk but planning beforehand how to deal with the consequences if the risk occurs.

As well as planning, active risk acceptance involves making sure enough reserves are set aside to put the plans in motion if they're needed. These are known as contingency reserves. They can include money and time.

### Response strategies for positive risks

There are four main types of strategies for responding to positive risks are to exploit, share, enhance, and accept.

#### Exploit

To exploit a positive risk is to make the most of an opportunity by eliminating uncertainty in the project to ensure that it happens. This may involve changing a project's objectives, schedule, or budget.

The project manager might achieve this by reducing the time period to complete a project by bringing in more qualified resources or by improving on the level of quality that was originally planned.

Exploiting an opportunity can be expensive in terms of costs, time, and other resources. So it's important to assess the benefits of exploiting an opportunity in relation to the expense of obtaining it.

#### Share

Sharing involves joining with an external party to increase the chance of securing benefits, and agreeing to share the rewards.

#### Enhance

This involves taking steps to increase the likelihood or positive impact of the opportunity on a project.

#### Accept

In the case of an opportunity, the best plan of action simply to accept the risk and move on with the project.

Flowcharts can help a team determine the best responses for positive risks.

### Expert judgment

In addition to risk response strategies, expert judgment is an important tool during the Plan Risk Response process. Expert judgment about a risk and the best way for managing it should inform the response that's planned. It may be provided by any group or person with specialized knowledge, skill, experience, or training in establishing risk responses.

During risk response planning, a team may choose to avoid, transfer, mitigate, or accept negative risks, or to use a combination of these strategies.

And it may choose to exploit, share, enhance, or accept positive risks. In all cases, expert judgment should inform the choice of risk response strategies.

**Course:** Risk Response, Monitor, and Control  
**Topic:** Risk Response Strategies

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# SkillBrief

# Contingency Planning

The use of contingent response strategies is an important technique for the Plan Risk Responses process. Also known as contingency planning, contingent response strategies involve planning responses in case risk events actually occur. This also involves assigning reserves so that the responses can be implemented when necessary.

Reserves are usually project funds, but can include time, materials, and staff. They're any resources needed to offset the impact a risk event has on a project's scope, schedule, cost, or quality.

Sometimes it's not possible or cost-effective to respond to a risk until the risk actually occurs. This is where contingency planning comes in.

Contingency planning doesn't involve mitigating risks by reducing the likelihood that they'll occur. But it also doesn't mean just accepting the risks. Instead it involves ensuring plans and resources are in place if the risks occur. Where appropriate, it's used for both negative and positive risks.

The level of risk for which you create contingency plans should depend largely on stakeholders' risk tolerance. Suppose a customer will lose a key contract if a certain risk event occurs. This means the customer's risk tolerance is low. You would create solid contingency plans for this risk event. But in a project with a very flexible schedule, you might think twice before applying contingency planning to a risk that would delay the project only by a few days.

It's important to monitor a project for impending risk events so you can implement contingency plans in time. To assist with monitoring, you can identify warning signs – or triggers – to watch out for. A trigger might be a threshold value of a performance metric such as cost performance, or a threshold defect rate. Or it could be missing a milestone or a change in a business relationship.

### Calculating contingency reserves

#### EMV analysis

An important part of contingency planning is setting aside enough reserves to put the planned responses in motion when risk events occur. But how big should the reserves you set aside be? A statistical method for determining this is expected monetary value (EMV) analysis.

To calculate the EMV for a risk, you multiply its probability by its estimated impact, in terms of cost or time.

If a positive risk event, or opportunity, has a 9% probability of occurring and would result in a gain of $15,000, its EMV would be $1,350. This will then be recorded as a positive EMV.

A risk's impact is a negative value if it will cost a project time or money. Thus if a risk, or threat, is 5% likely to cost your project $20,000, you multiply 0.05 by 20,000, and obtain a negative EMV of -$1,000.

The net EMV is the sum of the EMVs for all the risks you've identified. It will be negative if the threats outweigh the opportunities, or positive if opportunities outweigh the threats.

#### Time-based contingency plans

Some threats and opportunities require time-based contingency plans. For instance, the impacts of network failures are usually measured in terms of the downtime they cause, rather than in direct financial costs.

Including a contingency reserve in the schedule for a project helps ensure delays associated with risk events can be absorbed. To calculate the required schedule contingency reserve for a project, you use the EMV analysis method but use time values rather than monetary values.

Contingent response strategies, or contingency planning, is a technique for the Plan Risk Responses process. It involves planning responses in case risk events occur and assigning reserves for implementing the responses.

To calculate the financial or schedule contingency reserve required for a project, you can use expected monetary value (EMV) analysis. The EMV of a risk is its probability multiplied by its estimated impact, measured as a cost or using time. Adding the EMV values for identified risks, and taking the absolute value of the net EMV, identifies an appropriate contingency reserve.

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**Topic:** Contingent Response Strategies

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# SkillBrief

# Outputs of the Plan Risk Responses Process

Outputs of the Plan Risk Responses are

* risk register updates, including changes to the planned risk responses, and information about residual and secondary risks
* risk-related contract decisions, such as insurance contracts
* project management plan updates, in any of the project management knowledge areas
* project document updates, particularly to the assumption log and technical documentation

#### Risk register

The level of detail in the risk register should depend on a risk's type and priority, and on the nature of the response. For example, high and moderate-impact risks should be addressed in detail. Lower-priority risks should also be listed, but only for monitoring purposes.

In the risk register, you would typically include tracking numbers for relating the risk to other information, a description of each risk, and its causes, impacts, severity, and probability. This information is usually recorded during the Identify Risks process. Then during the Plan Risk Responses process, you record the appropriate planned risk responses.

The risk register can contain various types of information to describe risks:

* tracking codes to associate each risk with the relevant components in the risk breakdown structure
* the date of each entry
* the category to which each risk belongs
* a description of each risk
* the causes
* the impacts
* the severity
* the probability of the risk

You add risk responses to the risk register as an output of the Plan Risk Responses process. For instance, you can plan to avoid, accept, mitigate, or transfer a risk, or use a contingent response strategy. You also record any action that will facilitate the response or that will become necessary.

As well as adding planned responses to identified risks, it's important to update the risk register with residual and secondary risks, and responses for managing them.

Residual risk is what remains after you've used a planned response to mitigate an identified risk as much as you can. The residual risk has a lower impact and priority than the original risk your response is designed to address.

A secondary risk is a new risk that arises because of the planned response. Any risk response strategy can lead to one or more secondary risks.

#### Risk-related contract decisions

Decisions about how risks must be shared or transferred, and how benefits will be shared among stakeholders, are known as risk-related contract decisions. These decisions and associated documents are the next output of the Plan Risk Responses process. Typical examples are

* **contracts** – result from the risk planning process and are legally-binding agreements between buyers and sellers. They protect both parties against a variety of risks by making each party's obligations and responsibilities clear. A contract can also identify penalties that will apply if these responsibilities are not met. Project risks are shared differently depending on the type of contract you use.
* **insurance policies** – transfer the risk of losses to the insurer. In construction projects, for example, developers typically insure building sites against the risk of fire. Other risks you might insure against are worker injury and the breakdown of expensive machinery.
* **performance bonds** – are specialized insurance policies that contractors or suppliers use to protect themselves from extra loss if they can't meet all the terms and conditions of a contract. If this happens, the performance bond will pay out a specified sum to the contracting organization. Performance bonds are obtained through banks, insurance companies, or specialist financial institutions.
* **guarantees** – are a commitment by a manufacturer or supplier, usually with a set expiry date, about the quality and durability of a product. A guarantee might include a reimbursement of cost if a product is faulty.
* **warranties** – are written guarantees of the integrity and quality of products. They also describe the manufacturer's commitment to repair or replace defective products and parts.

Any risk-related contract decisions that result from planning risk responses become inputs for the Plan Procurements process. This is because they relate to what must be acquired for a project.

Most risks and responses have implications for a number of project management knowledge areas. So the next output of the Plan Risk Responses process is updates to the various documents that make up the project management plan.

#### Project management plan updates

Updates are typically necessary to the schedule baseline, cost performance baseline, work breakdown structure, human resources management plan, and procurement management plan. Updating these documents can be time-consuming, but is essential for keeping track of decisions throughout a project.

#### Project document updates

Planning risk responses can also lead to updates to other project documents, especially the assumption log and technical information.

All the project risk management processes, including Plan Risk Responses, are iterative in nature. This means that as new risks are identified, the processes are repeated. Sometimes, planning, identifying, prioritizing, quantifying, and developing responses to risks may also happen simultaneously.

The Plan Risk Responses process includes four main outputs. These are updates to the risk register, risk-related contract decisions, and updates to both the project management plan and other project documents.

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**Topic:** Updating Plans and Risk Documentation

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# SkillBrief

# Techniques of the Monitor and Control Risks Process

### Risk assessments

Risk reassessment occurs as project work progresses. It involves evaluating project risks and, if necessary, re-rating and reprioritizing them. Additionally, it involves identifying any new risks and risks that are no longer relevant. Risk reassessment should be scheduled to occur regularly – for example, during regular project team status meetings.

As events unfold, new risks may arise and earlier risks may cease to apply. The depth and frequency of risk reassessment depends on a project's progress relative to its objectives. If the project is meeting its objectives, risk reassessment doesn't need to be as vigorous as it would if the project was in trouble.

### Risk audits

During risk audits, either the project risk management team or an external auditor evaluates and documents the effectiveness of risk responses and risk management processes. The risk management plan specifies how often these audits should occur, their objectives, and the format they must take.

Audits may also be triggered whenever risk thresholds are exceeded.

The findings of the risk audit are then added to the lessons learned database, which can be used to prevent the problem in future projects.

### Variance and trend analysis

Variance analysis evaluates the differences between planned and actual performance in terms of costs, the schedule, or other performance criteria. Trend analysis also looks at performance, but focuses on identifying patterns over time. Trends suggest future performance patterns – if no action is taken to disrupt them – and can help identify risks that have come to fruition.

Earned value analysis is one kind of variance analysis. This technique enables you to compare the planned value of project work to the earned value and actual cost to identify variances. Earned value analysis can provide an early warning that the budget or schedule is in trouble, while there's still time and money available to get a project back on track.

Based on what all three types of analysis reveal about current performance, you can forecast whether and by how far a project will have deviated from cost and schedule targets by its completion. This deviation from the baseline plan may indicate the potential impact of threats or opportunities.

### Technical performance measurement

Technical performance measurement focuses on product-related risks, such as scope, functionality, and quality. Total performance measurement compares actual and planned technical achievements in key performance areas.

The success of technical performance measurement depends on the team identifying the correct key performance parameters at the outset of a project.

Examples of technical performance parameters include any quantifiable measures of its attributes, such as the product's features, size, speed, or output capacity. The project manager monitors the product's performance over time by comparing actual performance to the product's schedule of technical achievement. Any variances point to a risk of the project failing to achieve its quality, scope, schedule, and budget objectives.

### Reserve analysis

Reserve analysis involves comparing the remaining contingency reserves for a project with the remaining risks. This is to determine whether the reserves are sufficient to see you through to the end of the project.

Throughout the execution of the project, some risks may occur, with positive or negative impacts on the budget or schedule.

Reserve analysis protects the budget and schedule by ensuring contingency reserves are adequate to cover these impacts.

Periodically, the project manager should analyze contingency reserves to determine that adequate reserves remain to cover the estimated amount of remaining risk. Reserves that are too low could signify that a higher than expected number of risks have already occurred to drain reserves.

Tools and techniques used to monitor and control risk include risk reassessment and risk audits. In status meetings, risks are reassessed and new risks are identified. Through risk audits, the effectiveness of risk response strategies and risk management processes is assessed.

Variance analysis and trend analysis are used to monitor overall project performance. The results of these analyses can be used to forecast potential cost, schedule, and scope deviations.

Technical performance measurement focuses on product-related risks, touching on scope and quality risks. Reserve analysis involves determining whether sufficient reserves are available, given the remaining risks for a project.

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**Topic:** Techniques for Monitoring and Controlling Risks

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# SkillBrief

# The Outputs of the Monitor and Control Risks Process

Most of the outputs of the Monitor and Control Risks process consist of updates to documents to ensure they are complete and available to guide ongoing risk management.

## Risk register

The risk register is updated when new information about any risk becomes available. There are two common triggers for this type of update during the Monitor and Control Risks process. The first trigger is outcomes of risk reassessments and audits. The second is outcomes of actualized risks or implemented risk responses.

#### Outcomes of risk reassessments and audits

Whenever risks are reassessed, you need to update the risk register with any changes to the impact, probability, and priority ratings of identified risks. You also need to update the risk responses outlined in the register whenever audits or other issues indicate that the existing responses are inadequate. If a risk audit reveals a risk is no longer applicable, you update the risk register to indicate that the risk has been closed. In that case, you would also release the risk's associated reserves.

#### Outcomes of actualized risks

If a risk event occurs, you should record this and the effectiveness of the planned response in the risk register. Once a risk has passed, its status and any lessons learned about it should also be recorded.

## Organizational process assets

Certain organizational process assets may be updated during the Monitor and Control Risk process or at project closure:

* **templates for risk planning documents** – include the risk management plan, probability and impact matrix, risk breakdown structure, and risk register
* **finalized risk management documents** – include the finalized risk management plan, checklists, risk breakdown structure, and risk register
* **lessons learned** – include risk audit results, changes to assumptions, and identified risks and their priorities

## Project document updates

Project document updates include updates to the assumption log and technical documentation.

The Perform Integrated Change Control process is used to manage and coordinate changes in a project. Various control and monitoring processes lead to recommendations for corrective or preventive measures, which are passed to the change control board as change requests. Approved change requests then trigger changes in the execution and management of the project.

The Monitor and Control Risks process may result in change requests if risk control activities involve changes to the project management plan or project baselines. For example, a new risk is identified part way through your project. Altering a certain process will allow you to avoid the risk. You draw up a change request to revise the work instructions for the activity and the corresponding sections of the scope statement and WBS dictionary.

Change requests generated during the Monitor and Control Risks process take the form of either corrective action for a risk that has occurred or preventive action for a risk that is likely to occur. The requests then become inputs to the Perform Integrated Change Control process.

#### Corrective actions

Corrective actions include implementing contingency plans and workaround plans.

A contingency plan is a provision in the project management plan that specifies how a risk will be handled if that risk occurs. Specific money or time reserves may be allocated for implementing the plan.

A workaround is an unplanned and quick response to a negative risk that has occurred.

#### Preventive actions

Preventive actions are steps taken to prevent risks from threatening project objectives.

Contingency plans are planned responses to risks.

Workarounds are unplanned, rapid responses.

When change requests are granted, you need to update the project management plan with the new information. The approved change requests may have an effect on risk management processes and this must be recorded.

## Project management plan updates

Every authorized change may affect many components of the project management plan. For instance, you may update the schedule to include longer deadlines because of a threat.

A risk response may also result in new activities. This would affect the work breakdown structure, and could impact cost, staff assignments, quality control and assurance, and procurements decisions.

Whenever plans change, the project manager needs to update the appropriate documents.

The outputs of the Monitor and Control Risks process include updates to the risk register, organizational process assets, the project management plan, and project documents such as the assumptions log and technical documentation.

They also include change requests for either corrective or preventive action.

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**Topic:** Risk Document Updates and Change Requests

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# SkillBrief

# The Monitor and Control Risks Process

During the Monitor and Control Risks process, you monitor warning signs that specific risks may occur, control risks using specified responses, and identify and analyze new risks as they arise. You also update process assets with information gained during this process.

Unlike other risk management processes, Monitor and Control Risks is not a planning process, but part of the Monitoring and Controlling process group. It is the last process in the Project Risk Management knowledge area. It receives inputs from Risk Response Planning and from processes in other knowledge areas. And it generates outputs used in the Close Project process.

Project managers monitor and control risks for four main reasons:

* **to evaluate the effectiveness of responses** – Over time, some risks may become more serious and others may disappear. To maintain an accurate picture of risk exposure, the project manager must track risks and the effectiveness of the planned responses in mitigating their impacts.
* **to identify and plan for new risks** – A project must be monitored so that new risks can be identified, analyzed, and planned for.
* **to monitor residual risks** – risks that remain after planned responses that have been implemented – must be monitored to ensure they don't grow into more significant risks.
* **to activate contingency plans** – Monitoring may indicate that the planned response for a risk isn't effective. In this case, contingency plans formulated during risk response planning should be implemented to control the risk.

In addition, monitoring and controlling risks involves ensuring project assumptions are still valid and assessing the current status of identified risks.

The process ensures that the correct risk management policies and procedures are being followed, and that cost or schedule contingency reserves are modified as needed.

It also involves taking corrective action and modifying the project management plan when necessary.

## Inputs to the Monitor and Control Risks process

### Risk register

The risk register is the main input to the process. It provides a wealth of information that's useful for both monitoring and controlling risks.

The risk register lists the identified risks you need to monitor, in order of their priority. It identifies risk causes, which should be carefully monitored for change, and the symptoms or warning signs that should alert you to the occurrence of risks. In addition, the register identifies risk owners – the team members responsible for monitoring each of the identified risks.

The following risk register components inform how you control risks:

* planned risk responses and specific actions for implementing them, to minimize threats and capitalize on opportunities
* the triggers, symptoms, and warning signs that risk events have occurred or are about to occur
* residual and secondary risks, which may result from risk control activities and which require monitoring and control themselves
* time and cost contingency reserves

The risk register also contains the impact thresholds for risks. If impacts exceed the stated thresholds, you activate the contingency plans. Thresholds may be set in terms of dollars, time, or resource limits, based on stakeholders' tolerance for risk.

### Project management plan

It contains the risk management plan, which is created during the Plan Risk Management process. It identifies the risk tolerances of project stakeholders, outlines the methodology used to manage risk, and assigns risk monitoring and control responsibilities to specific team members.

The risk management plan also contains the budget and schedule activities planned for monitoring and controlling risk throughout the life of the project.

### Work performance information

Work performance information used to monitor and control risks includes

* deliverable status
* schedule process
* costs incurred

Each of these types of information can act as a warning signal that a risk is about to occur or has already occurred. Work performance information signals the occurrence of threats and of opportunities. The associated risks can be positive or negative.

### Performance reports

The final input, performance reports, is closely related to work performance information. These reports present performance information in various formats to convey project status, and provide information on variances, earned value, and forecasts.

#### Bar charts

Bar charts display statistics, timelines, and other information on performance that can assist the project manager with monitoring project risks.

#### S-curve

An S-curve is a graph that displays the time-phased cost performance baseline. It has time as its X-axis and cost as its Y-axis. The data entered traces earned, planned, and actual values. This can help the project manager monitor given risks by comparing planned to actual values and costs. S-curves can also help determine when to kick off a round of risk identification and analysis.

#### Summary table

A summary table acts as a form of performance report. For example it can outline planned and actual cost performance for each work package in a project. This helps project managers in monitoring risks and points to new risks that need analysis.

The Monitor and Control Risks process is part of the Monitoring and Controlling process group. It is also the last process in the Project Risk Management knowledge area.

During this process, you monitor warning signs, activate risk responses, and identify new risks as they arise. You also update process assets with information gained during this process.

Inputs into this process include the risk register, the project management plan, work performance information, and performance reports.

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**Topic:** Introduction to Monitoring and Controlling Risks

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# Job Aid

# Strategies for Positive and Negative Risks

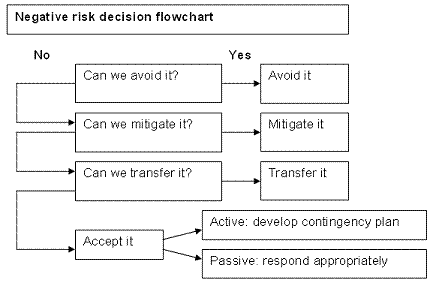
**Purpose:** Use this job aid as a reference to assist you in selecting the most appropriate risk response strategies.

### Strategies for negative risks

There are four risk response strategies for dealing with negative risks, or threats:

* avoid
* transfer
* mitigate
* accept

Project managers often make use of decision trees, such as the one below, to determine which risk response strategy is the most appropriate.



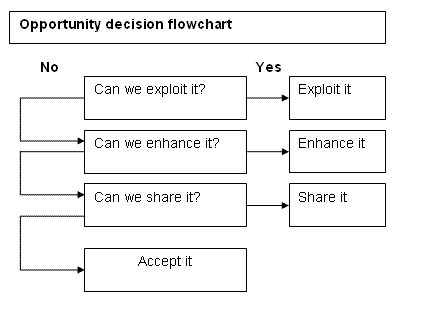
Flowchart of risk responses for negative risks

### Strategies for positive risks

There are four risk response strategies for dealing with positive risks, or opportunities:

* exploit
* share
* enhance
* accept

As for negative risks, a flowchart can help a team determine the most appropriate responses to positive risks.



Flowchart of risk responses for positive risks

For both positive and negative risks, project managers should call on individuals who can provide expert judgment about the best possible risk response strategies.

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# Job Aid

# Calculating Contingency Reserves

**Purpose:** Use this job aid to review calculating contingency reserves.

To calculate the size of the contingency reserve, in money or time, you take the absolute value of the net expected monetary value (EMV) for the project. The contingency reserve is always a positive value.

The EMV is the probability of a risk times its impact. The net EMV is the sum of EMVs for all risks and opportunities.

This is summarized as follows:

EMV = probability × impact

Net EMV = sum of all EMVs

Contingency reserve = positive value of net EMV

#### Monetary example

Consider a phase in a mining project. You've identified certain risks and opportunities for this phase that require a contingent response strategy.

| **Monetary contingency reserve calculations** | | | |
| --- | --- | --- | --- |
| **Risk** | **Probability** | **Impact** | **EMV** |
| Negative risk of losing senior engineers during this phase | 10% | - $110,000 | - $11,000 |
| Negative risk of reduced operations from severe weather | 25% | - $275,000 | - $68,750 |
| Negative risk if environmental law is passed | 50% | - $105,000 | - $52,500 |
| Positive risk if environmental law is passed | 50% | $200,000 | $100,000 |
| Net EMV |  |  | - $32,250 |
| Contingency reserve |  |  | $32,250 |

#### Time-based example

You're working out the time reserve needed in an IT project to develop a database.

| **Time-based contingency reserve calculations** | | | |
| --- | --- | --- | --- |
| **Risk** | **Probability** | **Impact (days)** | **EMV (days)** |
| Risk of under-estimating complexity of development | 30% | - 40 | - 12 |
| Risk of downtime from IT failure | 20% | - 10 | - 2 |
| Net EMV |  |  | - 14 |
| Contingency reserve |  |  | 14 |

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**Topic:** Contingent Response Strategies

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Planning project procurements

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# SkillBrief

# Buyers, Sellers, and Contract Terms

### Buyers and sellers

To procure something means to acquire it. In the context of a project, the process of procurement entails buying or getting resources needed to perform the project work. These may be products, services, or results. Procurement involves the extensive use of contracts between buyer and seller. So procurement management is the process of creating or selecting, managing, and controlling those contracts.

Procurement management involves two important kinds of activities – managing contracts with suppliers and clients by developing and controlling any changes, and ensuring the project team fulfills its contractual obligations. Some examples of procurement activities include the following:

* reviewing activity resource requirements to determine what goods and services are required
* determining which goods and services need to be sourced externally
* examining the schedule and ascertaining when goods and services are needed throughout the project
* overseeing the creation of contracts with suppliers
* ensuring all contractual obligations of suppliers are met

There are a number of names that are given to both buyers and sellers, depending on the type of project, the work being done, or the kind of contract:

* a **buyer** can be known as a client, customer, prime contractor, contractor, acquiring organization, governmental agency, service requestor, or purchaser. Simply put, the buyer is the party that provides monetary compensation for a product or service.
* a **seller** can also be known as a contractor, subcontractor, vendor, service provider, or supplier. The basic rule is that the seller is the party providing a service or product. In exchange, the seller receives monetary compensation.

A project team isn't limited to one of these roles, though. More than likely, the team will be engaged in a number of agreements, which means that the team can be buyer for one agreement and seller for another.

### Contract terms

The contract is the legal document used in project procurements. Contracts can go by a number of names, depending on the context or situation in which they are used. Some names include agreement, understanding, subcontract, and purchase order.

Whatever name a contract goes by, it's important to remember that it's a legally-binding document. If one of the parties defaults or fails to perform according to the contract, the consequences could be severe. For this reason, contracts are often subject to a much stricter review process than other project documentation. This is to ensure that the contract clearly describes the products, services, or results required, so parties know exactly what's expected of them and each other.

A contract goes through its own life cycle, from its creation to its closure. However, a contract may be required during any phase of a project and may be closed at any phase too. So a project will typically have many contracts running at the same time and these contracts may start and end at different points during the project's life cycle.

If the performing organization is the seller, a contract is an important input to a project. The contract may pose some limitations on the project and the team. The terms and conditions, in particular, may become inputs to the seller's management processes.

Typically, a contract may contain key milestones, deliverables, and cost objectives. These are examples of terms and conditions that may represent key inputs for the project.

Terms and conditions, or the entire contract, may affect a project manager's decision–making powers. Product specifications in a contract may relate back to the scope requirements in a project. Or a contract may state that a project should not have more than ten team members, which would be specified in the project scope.

There's an important link between contracts and risk management. A buyer or seller can set conditions that reduce the risk of incorrect scope or quality requirements. They can also tailor contract terms to reduce many project risks that are foreseeable.

More than likely, a contract will set standards and constraints for both contracting parties, and so reduce the risk for both the buyer and the seller at once. A contract may also require that certain quality specifications are met.

Procurement management is the process of managing contracts with suppliers and clients, and ensuring contractual obligations are fulfilled by the project team. In procurement contracts, parties are either buyers or sellers. Because numerous contracts are often required in a project, the project team may find themselves in both roles. Contracts are legally-binding documents, so they are usually subject to strict review processes. The terms of a contract may be tailored to reduce the risk for the buyer, the seller, or both.

**Course:** Planning Project Procurement  
**Topic:** Introduction to Project Procurement

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# SkillBrief

# Project Procurement Management

Project Procurement Management is all about getting the resources you need from external parties in order to carry out the project. This creates relationships with the external parties, which also have to be managed and maintained.

There are four processes in the Project Procurement Management knowledge area.

#### Plan Procurements

The Plan Procurements process falls into the Planning process group. During the planning stages of a project, the Plan Procurements process is concerned with predicting what procurements are needed for the project. This is based on analyzing what the project team can accomplish itself and what external acquisitions are required. You record those predictions and decide on a logical approach to take for those procurements.

Likewise, you identify potential sellers during this process. All the considerations of risks involved with contracting out are also ascertained during planning.

This process should ideally be carried out early in the planning processes. But all planning processes are iterative by nature, so as the project develops and changes, new needs may arise or changes might be required. This means that the Plan Procurements process will have to be revisited as often as needed.

#### Conduct Procurements

The Conduct Procurements process falls into the Executing process group. It is a process during which you interact heavily with sellers. You get responses from sellers, select the ones you want to use, and enter into procurement contracts with them.

While interacting with potential sellers in the Conduct Procurements process, you use evaluation criteria you've already documented and planned during the Plan Procurements process to select the sellers you want to use.

* Some of the factors you'd evaluate include but are not limited to the following:
* whether the seller understands what's needed by the procurement
* whether the risk is acceptable to both you and the seller
* whether the seller's proposal is cost efficient and technically sound
* whether the seller has the capacity, experience, resources, and management skills to carry out the work

Once you've selected the sellers, you draw up a contract with them. The contract should contain all the essential terms and conditions. You also negotiate specific terms and conditions that reduce risk for you and the seller.

#### Administer Procurements

The Administer Procurements process falls into the Monitoring and Controlling process group and is concerned with managing the procurement relationships, monitoring contracts, and making any changes or corrections when they're needed.

The Administer Procurements process applies to both the buyer and the seller. So you and the party you've contracted with will ensure that contractual obligations are met and that all legal rights of both parties are protected. It also involves making changes where needed.

#### Close Procurements

The Close Procurements process falls into the Closing process group.

When a contract comes to the end of its life cycle, the Close Procurements process comes into play. This process ensures that all the terms of the contract are acceptable, accurate, and concluded.

Finally, the Close Procurements process completes each project procurement. When carrying out the Close Procurements process, it's important to ensure that the work that was stated in the contract has been completed accurately and satisfactorily. Both parties should have performed according to the contract.

The four processes occur more or less sequentially during a project. They also build on each other in that many of the outputs from one process form the inputs for another.

The **Plan Procurements** process produces two important outputs, among others. They are the procurement management plan, which forms part of the project management plan, and procurement documents, which are used to attract potential sellers. These become inputs to the **Conduct Procurements** process. The outputs of this process are a list of selected sellers and project management plan updates.

The list of selected sellers, which is an output from the Conduct Procurement process, flows into the **Administer Procurements** process. You can only make procurements from companies on this list.

The project management plan is an important input to the Administer Procurements process. The result of this process is an updated project management plan and procurement documentation. These documents are important for the **Close Procurements** process because they're compared against the project records to make sure all plans and contractual obligations have been met by all parties.

The processes of the Project Procurement Management knowledge area are iterative by nature. This is due to the nature of procurements and contracts. As the project progresses, new needs may arise. This means that new procurement relationships need to be developed. So the Plan Procurements process could kick off at any stage of the project, even very late into a project.

Project Procurement Management is concerned with getting specific resources you need from external parties in order to carry out a project. There are four processes in this knowledge area – Plan Procurements, Conduct Procurements, Administer Procurements, and Close Procurements. Each of these corresponds to a project management process group. The four processes occur more or less sequentially in a project. They are linked in that most of the outputs from one will form the inputs for another. These processes are also iterative by nature because they are triggered whenever there is a need for procurements during a project.

**Course:** Planning Project Procurement  
**Topic:** Procurement Management and the Process Groups

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# SkillBrief

# Inputs to the Plan Procurements Process

If the required materials, consultants, training, components, equipment, or services aren't available when they're needed, a project won't be completed on time and within the specified budget. So it's important that procurements are carefully planned and managed.

The Plan Procurements process involves planning how to obtain all the products, materials, and services that are required from outside the project organization to achieve project objectives. So the process involves identifying the products, materials, and services that the performing organization can't perform. This involves determining what resources a project needs from external sources, how to get them, how much of each resource is needed, and when it's needed.

The starting point for planning procurements is gathering information from a variety of inputs.

#### Scope baseline

The scope baseline forms part of the project management plan. It justifies the need for a project and describes its requirements and current boundaries. The components that make up the scope baseline are the

* **scope statement** – identifies the project and product scope, the deliverables the project must create and criteria for their acceptance, and important information regarding technical issues or concerns that could impact cost estimating. So the scope statement includes a section on the project's objectives, boundaries, and scope description. The scope statement is important when planning procurements because it clarifies what work is required and what isn't required to complete a project. It also enables him to consider the availability of resources.
* **work breakdown structure (WBS)** – provides a detailed breakdown of all the work components required to create each of a project's key deliverables. The components range from high-level phases and tasks down to work packages. Assessing each component helps identify the types of services and goods that are required, and whether these must be purchased externally.
* **WBS dictionary** – provides more detailed descriptions of the components in the WBS, including work packages and control accounts. During the Plan Procurements process, it helps identify the goods and services that are required for a project.

#### Requirements documentation

Requirements documentation may outline a variety of project requirements that affect procurement planning. These might include any resource needs associated with contractual and legal requirements regarding health, safety, and security, project performance, or environmental practices. They may also relate to insurance, intellectual property rights, equal employment opportunity, and licenses or permits.

#### Teaming agreements

These are legal, contractual agreements between buyers and sellers. They define the roles and responsibilities of each party. So if teaming agreements already exist for a project, the roles of the parties involved and other elements such as the scope of work will have already been predefined.

#### Risk register

The risk register includes all available information about the risks identified for a project, including the probability and priority of each risk, the risk owner, and the risk response. During procurement planning, high-priority risks – or risks that pose the greatest threats or opportunities – can often be managed effectively through procurement contracts.

Risk registers identify

* **high-priority threats** – Organizations may use contracts to transfer some or all of the risk associated with high-priority threats to third parties. This involves shifting the negative impact of a threat, as well as ownership of the response, to an external party. Tools like insurance, performance bonds, warranties, and guarantees also enable risk transference. Bear in mind that if a risk has been transferred, it doesn't necessarily mean it has been eliminated.
* **high-priority opportunities** – Contracts that involve joint ventures or risk-sharing partnerships may improve an organization's ability to capitalize on high-priority opportunities.

#### Risk-related contract decisions

These decisions also relate to risk management and risk responses. They include decisions related to insurance, bonding, service provision agreements, or other agreements in which each party's responsibility for specific risks is specified. These decisions may determine the nature of procurements, such as the type of insurance that must be purchased.

#### Activity resource requirements

The activity resource requirements identify the people, equipment, and venues that must be procured to complete scheduled project activities. They simplify procurement planning by making it clear exactly what quantity or amount of each resource is required. As a result, they also enable you to identify any constraints on the availability of needed resources.

#### Project schedule

The required timelines and mandated deliverable dates in the project schedule can have a significant influence on procurement decisions by allowing you to determine when specific resources will be required.

#### Activity cost estimates

These estimates are another input for the Plan Procurements process. During procurement planning, these are used to assess the bids or proposals received from potential sellers.

#### The cost performance baseline

The cost performance baseline tells the project manager what the planned project budget is over time. This is useful in procurements planning because it indicates the available funds for procuring resources at particular times.

#### Enterprise environmental factors

These are all the external circumstances and conditions that may influence the success of a project. Factors that can influence procurement planning include marketplace conditions, product and service availability, previous relationships with suppliers, the typical terms and conditions for products, services, and results, and any unique local requirements.

#### Organizational process assets

This includes assets that may inform or simplify the process such as formal procurement policies, procedures, and guidelines; management systems; and any pre-existing seller lists.

The Plan Procurements process involves planning how to obtain the products, materials, and services that the organization requires from external sources to achieve a project's objectives. The starting point for making purchasing decisions is gathering information. Inputs to the Plan Procurements process include the scope baseline, requirements documentation, teaming agreements, the risk register, and all risk-related contract decisions. They also include activity resource requirements, the project schedule, activity cost estimates, the cost performance baseline, enterprise environmental factors, and organizational process assets.

**Course:** Planning Project Procurement  
**Topic:** Gathering Procurement Information

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# SkillBrief

# Using Make-or-Buy Analysis

Make-or-buy analysis is one of three tools and techniques you use during the Plan Procurements process. It involves determining whether it's best for the project team to complete particular work within the project organization or to purchase services or products from outside sources.

Goods and services purchased for a project often relate to the following business functions:

* information technology
* facilities management
* payroll management
* logistics
* procurement

It's common today for manufacturers to use outsourcing. Some outsource entire production functions to companies that specialize in procuring materials, assembly, and testing. Although outsourcing has potential benefits, it doesn't come without disadvantages. These include loss of control over the work that's outsourced and a less flexible schedule.

The two most important factors in a make-or-buy decision are the availability of

* **resources** – An organization is likely to "make" rather than "buy" if required skills and materials are already available internally, or are difficult to obtain elsewhere.
* **cost** – A make-or-buy decision is often based simply on which option will be less expensive – developing goods or services in-house or purchasing these from external organizations.

If the budget is a project's key constraint, a make-or-buy decision will be based largely on which option is less expensive. Otherwise, availability will drive the decision.

Less critical factors that influence make-or-buy decisions include

* **time** – It may be important to determine which option – in-house development or outsourcing – will be better for the schedule. For projects that have time as their key constraint, this may be a deciding factor.
* **risk** – Different levels of risk may be associated with completing work in-house and with outsourcing. It's also relevant to consider whether stakeholders will be more comfortable accepting the risk of creating a product or service in-house or with transferring risk to a third party.
* **business strategy** – Typically, it's best to outsource processes or products that fall outside your organization's core competencies. These core competencies depend on the organization's business strategy.
* **control** – If it's important to maintain control of quality or intellectual property, it's probably preferable to complete work in-house.

### Comparing costs

The general steps of assessing costs when conducting a make-or-buy analysis are to

* define the product, service, or result that's required
* calculate the costs of in-house production
* calculate the costs of outsourcing
* compare the in-house and outsourcing costs

When you calculate the costs of in-house production and the costs of purchasing, it's important not to overlook any of the associated expenses.

The costs of in-house production include materials and staffing costs, as well as overhead costs.

The costs of purchasing include the price of the product or service, and the administrative costs associated with the purchasing or contracting process.

### Buy-or-lease decisions

If you decide to buy a product rather than making it in-house, there's often a second decision to make. Should you buy or lease? The main factor to consider in a buy-or-lease decision is for how long you will use the product or equipment. If you'll use it just for a specific project or for a short period only, it's probably better to lease. Also, leasing is used primarily when acquiring capital equipment.

Project managers often ask themselves this question, "If the equipment is used more than once, will leasing it cost more than purchasing and then maintaining it over the required time?" The amount of time after which leasing and purchasing costs will be equal is called the break-even point. Say a project manager in a graphic direction firm is deciding whether to buy or lease an expensive printer. It will take a year before the total leasing costs add up to the full purchase price. So one year marks the break-even point.

Companies often factor in hidden costs of ownership when making the decision to buy or lease. This is because there will always be inventory costs and other types of maintenance costs associated with having unused equipment just lying around.

### Expert judgment

Expert judgment is another important tool that project managers use during the Plan Procurements process. Planning procurements may rely on the following types of expertise:

* **technical** – Technical experts can help the project team determine what procurements must be made.
* **purchasing** – For the purposes of expanding or adjusting the decisive factor that is utilized to judge seller proposals, expert judgment is necessary.
* **legal** – Expert legal judgment may be required to assist with the preparation and handling of procurement contracts. It can also help ensure that procurement processes are legally sound.

Two of the tools and techniques for the Plan Procurements process are make-or-buy analysis and expert judgment. Make-or-buy analysis involves determining whether developing a product or service in-house is preferable to sourcing it externally. Key factors in a make-or-buy analysis are costs and the availability of resources. Less critical considerations relate to time, level of risk, business strategy, and required level of control. Once a decision is taken to source a product or service externally, you need to determine whether it's better to buy or lease. The types of expert judgment that are typically required during procurement planning are technical, purchasing, and legal.

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**Topic:** Make-or-Buy Analysis

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# SkillBrief

# Working with Different Contract Types

A valid procurement contract is a legally-binding document that protects the rights of both the buyer and the seller. For a contract to be valid, it must

* contain an offer
* provide payment
* be accepted by the contracting parties
* be properly executed

There are three main types of procurement.

## Fixed-price contract

This contract describes precisely what product or service will be supplied and at what price.

There are three types of fixed-price contracts.

**Firm fixed-price** contract are the simplest and most common. The seller offers a product or service at a price, and the buyer agrees to pay the price. A seller's profits are equal to this fixed price minus any costs. So a seller bound by a firm fixed-price contract is vulnerable to changing market forces.

The variations on the fixed-price contract each suit different seller and buyer requirements:

* **fixed price plus incentive fee** – suits a seller who is able to improve performance, and earn an incentive by doing so.
* **fixed price with economic price adjustment** – suits a seller who is contracting to a project for a very long period over which prices are likely to change. These contracts protect the buyer and seller from changes in the costs of labor, materials, and transport.

## Cost-reimbursable contracts

The buyer agrees to refund a sellers' costs as well as paying a fixed fee. This assures the seller of a profit margin.

The contracts are suitable for large developments and in industries where costs are well known. They enable sellers to compete on price alone by cutting their profit margins. The buyer takes on the risk of cost increases.

There are three kinds of cost-reimbursable contracts.

#### Cost plus fixed fee contracts

These contracts shift most of the risk of cost increases to the buyer. The buyer agrees to pay the seller's real costs, often based only on an estimate of these costs from the seller. The buyer also agrees to pay a fixed fee or a fixed percentage of costs, which represents the seller's profit.

They are common in projects that involve high levels of risk.

#### Cost plus incentive fee contracts

The buyer agrees to pay allowable seller costs and a performance fee based on meeting certain objectives outlined in the contract. The incentive fee might be fixed or calculated as a proportion of cost savings.

#### Cost plus award fee contracts

The buyer agrees to pay the seller's costs and an award portion of the fee that is based on achieving performance criteria outlined in the contract. The award portion may be a percentage of the seller's fees.

This is useful if the scope of work is not clear beforehand and costs can be submitted only as they are incurred.

These contracts are generally paid only at the discretion of the buyer, if the work meets every requirement.

## Time-and-materials contracts

In a time-and-materials contract, the buyer agrees to pay the seller a time-based rate and a published price for each item or unit of material that's used. This is useful when the final quantity of materials or the duration of required services isn't known up front.

This is similar to a cost-reimbursable contract in that the final contract value is left open in the contract, increasing risk for the buyer. This value will only be known once the work is finished.

It is also similar to fixed-price contracts in that the labor, equipment, and materials can be added to the contract as fixed unit rates.

These contracts typically include a "not-to-exceed" clause, which protects the buyer.

If the rates are fixed, the seller carries the risk of cost increases. If the rates are flexible, the seller may change the rates and the buyer carries most of the risk. The buyer also carries risks of overruns if the scope and duration of work is not limited properly. But if the seller and buyer have planned properly, this type of contract is beneficial to both.

Time-and-materials contracts demand strict cost control from the buyer.

Contracts used in project procurements differ mostly in how costs and risks are structured. In the **fixed-price** contract, the buyer pays an agreed price and the seller carries the risk of cost increases. When an incentive is included in the contract, the buyer pays and agreed price and an incentive for exceptional performance by the seller. The seller carries the risk of cost overruns and both the buyer and seller carry risk regarding the incentive.

With **economic price adjustment** contracts, the buyer pays an agreed price that is linked to economic or market-related factors. The seller and buyer are protected from these factors, but both are still subject to other risks that might affect costs.

With **cost-reimbursable** contracts, the buyer carries most of the risk. In a cost plus fixed fee contract, the buyer pays the seller's actual costs plus a fixed fee as a profit margin and carries all the risk.

In a **cost plus incentive fee** contract, the buyer pays actual costs, a fixed fee, and an incentive to reward exceptional performance.

In **cost plus award fee** contract, the seller's costs are reimbursed if he meets the performance criteria which the buyer sets. The buyer carries a high risk of cost overruns because the award depends on the costs. The buyer can mitigate this risk by withholding payment until the work is perfect.

With **time-and-materials** contracts, the buyer pays the agreed rates for the time, labor, and materials that are used. The rates may be are either fixed or flexible. If rates are fixed, the seller carries the risk of cost increases. If they are flexible, the buyer carries the risk of rate increases. The buyer also carries the risk of schedule and budget overruns resulting from poor planning.

For a procurement contract to be legally valid, it must contain an offer and terms of payment. It must also be accepted by the contracting parties and executed properly. The main types of contracts are fixed-price, cost-reimbursable, and time-and-materials contracts.

**Course:** Planning Project Procurement  
**Topic:** Contract Types

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# SkillBrief

# Outputs of the Plan Procurements Process

The Plan Procurements process generates the following documents as outputs:

* the procurement management plan
* the procurement statement of work (SOW)
* the make-or-buy decisions
* change requests
* procurement documents
* source selection criteria

The **procurement management plan** is a subsidiary of the project management plan. It describes how procurements for a project must be managed from developing procurement documents through to contract closure.

The structure and level of detail of the procurement management plan depends on the type of project. An informal and broadly defined procurement management plan is often sufficient for a small or internal project. Depending on your needs, you can group the information in a procurement management plan into these categories:

* **procurement documents** – describes the main types of documents to be used during the project, such as requests for quotation or requests for tender.
* **seller selection policies and criteria** – gives an overview of the requirements for choosing suppliers
* **supplier management methods** – plans the procedures for locating suppliers and for negotiating contracts with them
* **risk management and mitigation methods** – describes how the project will use insurance policies and performance bonds to protect against supplier failures
* **assumptions and constraints** – describes any assumptions or constraints that are relevant to procurements, in particular to seller selection criteria and policies

Another category that the procurement management plan can contain is responsibilities regarding procurements. The procurement management plan can also contain information about project integration activities. Specifically, you can include methods for coordinating procurements with the other components of the project management plan.

The **procurement SOW** is a description of the product, service, or result that will be procured under a specific contract. The purpose of the procurement SOW is to enable prospective sellers to prepare and submit appropriate offers.

The procurement SOW should describe the buyer's requirements clearly, completely, and concisely, and includes:

* **product requirements** – The procurement SOW describes the product, service, or result in the most suitable way for prospective sellers. This means listing the mandatory product specifications and features, as well as any optional features.
* **supply requirements** –Supply information should include the quantity required, and the location and timing of delivery. For this reason, you include activity descriptions and scheduling information from the project's schedule. Another supply requirement is the type of procurement contract that will be used to manage the supply process.

The actual level of detail in the procurement SOW will vary depending on the needs of the project and the type of product or service being procured. It will also vary depending on the type of procurement contract being used. If the product is a service or result, the procurement SOW also contains performance data,

As with the other project planning processes, the Plan Procurements process is iterative.

**Make-or-buy decisions** refer to decisions about whether you need to acquire resources for your project internally or whether you need to buy them from external sources. To justify each decision, you considered the costs, benefits, and risks of all options. These justifications are then recorded in the make-or-buy decisions document. You update this document throughout the project as you make further decisions about procurements.

A simple make-or-buy decision document may simply record the activities, the decisions to make or buy, and the justifications for the decisions.

The Plan Procurements process can also result in **change requests**. A change request is also needed if you find that purchasing a specified product or service is too expensive.

If change requests that result from procurement processes are approved, the project manager must ensure the changes are integrated through the processes of the Project Integration Management knowledge area. You may also need to update the risk register because any change may have an impact on project risks.

To buy anything, you need to communicate your requirements to prospective sellers. **Procurement documents**, the next output of the Plan Procurements process, serve this purpose. You should structure procurement documents to facilitate accurate and complete seller responses, and easy evaluation of these responses.

Procurement documents include

* **a request for information (RFI)** – you use it to solicit information about the capabilities of prospective sellers
* **an invitation for bid (IFB)** – you use it to solicit competitive prices from prospective sellers who compete mainly on price
* **a request for quotation (RFQ)** – the buyer asks the seller to supply the price for a simple commercial product or service
* **a request for tender (RFT) or tender notice** – the buyer's requirements are more complicated but still clearly defined and a price is a sufficient response
* **a request for proposal (RFP)** – the buyer invites the seller to submit a proposal for completing the specified work
* **an invitation for negotiation (IFN**) – the buyer calls on prospective sellers to join in price and solution negotiations
* **a seller initial response (SIR)** – the prospective seller states their intentions to respond to a buyer's request or invitation
* **a purchase order (PO)** – a type of unilateral contract from the buyer to the seller, indicating to the seller that the purchase has been approved

The level of detail in a procurement document is usually proportional to the value of the required product or service and the risk associated with it. So for higher value procurements, procurement documents usually have more detailed specifications to ensure that what is supplied is precisely what you require.

Procurement documents, especially requests for jobs carrying a high value, are often made public.

**Source selection criteria** are the measures you use to rate or score seller proposals in terms of their suitability. For simple purchases and when a number of sellers are equally acceptable, purchase price is generally used to select a supplier. In other cases, you will rate criteria like reputation and reliability as more important than price.

The outputs of the Plan Procurements process include the procurement management plan, the procurement SOW, make-or-buy decisions, and change requests. They also include various procurement documents, such as requests for proposals and purchase orders, and seller selection criteria.

**Course:** Planning Project Procurement  
**Topic:** Outputs from Planning Procurements

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# Follow-on Activity

# Make-or-Buy

**Purpose:** Use this follow-on activity to explore the make-or-buy decisions that your company makes.

**Instructions:** Print out the questions and then answer them in your own time.

1. Have any make-or-buy decisions recently been made in your company?
2. Was it decided to make or buy the product or service?
3. What were the key considerations used to make the decision?
4. What were the advantages of the decision made?
5. What were the disadvantages of the decision made?

**Course:** Planning Project Procurement  
**Topic:** Make-or-Buy Analysis

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# Follow-on Activity

# Exploring your Company's Contract Types

**Purpose:** Use this follow-on activity to explore your organization's use of contracts in project procurements.

**Instructions for use:** To use this tool, consider the types of contracts that your organization has used to procure materials and services for two large projects.

1. Why was a particular contract type used for procuring each type of product or service, and was there an incentive or reward included in the fee?
2. Was each type of contract the best choice for that product or service, or would you now choose a different one? If so, why?
3. Who carried most of the risk in each contract type, and was this optimal for your organization?

Once you've answered these questions, complete the entries in the table.

| **Procurement contracts that your organization uses** | | |
| --- | --- | --- |
| **Contract type** | **Description of products or services procured** | **Your notes about your organization's use of the contract** |
| **Project 1** |  |  |
| **Fixed-price** | Row 3 Column 3 | Row 3 Column 4 |
| **Cost-reimbursable** | Row 4 Column 3 | Row 4 Column 4 |
| **Time-and-materials** | Row 5 Column 3 | Row 5 Column 4 |
| **Project 2** |  |  |
| **Fixed-price** | Row 7 Column 3 | Row 7 Column 4 |
| **Cost-reimbursable** | Row 8 Column 3 | Row 8 Column 4 |
| **Time-and-materials** | Row 9 Column 3 | Row 9 Column 4 |

****For online use, complete each row as described in the instructions. If you would like to work with the page as hard copy, simply print it out using the Print link at the top of this page.****

Keep this follow-on activity so you can refer to it when you're considering which types of procurement contracts to use in future projects.

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**Topic:** Contract Types

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# Learning Aid

# Catering Company: Make or Buy Decision

**Purpose:** Use this learning aid to answer the practice question on determining the best course of action between making or buying a product, given cost data.

### Costs of producing in-house

Material costs, including the costs of the cake ingrediants = $15

Staffing costs for the in-house baker = $5

Indirect costs such as project management, and electricity = $5

### Costs of buying

Price of using an external cake expert = $30

Administrative costs = $5

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**Topic:** Make-or-Buy Analysis

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# Learning Aid

# Interior Decorating: Make, Buy, or Lease Decision

**Purpose:** Use this learning aid to answer the practice question on determining the best course of action between making, buying, or leasing a product, given cost data.

### Company Details

The company provides consultation, design, decorating, and quality assurance services for both residential and commercial projects. Services include room planning, design conceptualization, computerized furniture placement, color palette design, custom lighting design, window treatments, carpet and floor installation, the design and manufacture of upholstery, soft furnishings, and curtains, and liaison with subcontractors for the the manufacture and renovation of furniture and fittings.

### Costs of buying

Price of the cement mixer = $4,000

Administrative costs = $350

### Costs of leasing

Principle amount = $3,000

Interest = $300

Tax write-off to deduct = -$20

### Cost of making

The company does not have the scope for making a cement mixer.

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**Topic:** Make-or-Buy Analysis

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# Learning Aid

# Direct Mail Campaign: Make, Buy, or Lease Decision

**Purpose:** Use this learning aid to answer the test question on determining the best course of action between making, buying, or leasing a product, given cost data.

The services of the product expert will be required for a two-month period. For the company, the direct mail campaign is a once-off project.

The in-house product expert is available for the duration of the project. The in-house product expert has 50% availability during the time frame this project would take place.

### Costs of using the in-house product expert

* Material costs = $0
* Pro-rata salary = $2,000
* Indirect costs, such as office overhead and project management costs = $100

### Costs of outsourcing

* Cost of the external expert's services = $3,500
* Administrative costs = $50

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**Topic:** Make-or-Buy Analysis

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# Learning Aid

# Door Factory: Make, Buy, or Lease Decision

**Purpose:** Use this learning aid to answer the test question on determining the best course of action between making, buying, or leasing a product, given cost data.

Cost is the main priority during decision making.

### Costs of buying

* Price of the product = $15,000
* Administrative costs = $70

### Costs of leasing

* Principal amount = $20,500
* Interest = $2,000
* Tax write-off for deduction = -$900

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**Topic:** Make-or-Buy Analysis

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# Learning Aid

# Satellite Transportation Project

**Purpose:** Use this learning aid to answer the practice question on whether the contract is valid or not.

Contract

entered into between Hortalez Holdings

and

Interswift Communications

Offer:

Hortalez Holdings, a freight logistics agent, will collect the AXAX01 Communications Satellite from 228 Merchants Rd, Salem, NH 03080, on January 20 and deliver it to the premises of Interswift Communications, at 3995 Arundel Square, Detroit, MI 48231-7904, on January 25.

The contract has been accepted by persons with the authority to do so – the director of Hortalez Holdings, and the board members of Interswift Communications.

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**Topic:** Contract Types

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# Job Aid

# Contract Types

**Purpose:** Use this job aid to review the different contract types.

| **Contract types** | | |
| --- | --- | --- |
| ***Contract type*** | **How it works** | **Risk issues** |
| **Cost plus award fee** | The seller is reimbursed for their costs but the profit comes via an award which is earned by meeting subjective performance criteria set by the buyer. | The buyer carries a high risk of cost overruns because the award depends on the costs. |
| **Cost plus fixed fee** | The buyer pays actual costs plus a fixed fee as a profit margin. | The buyer carries all the risk. |
| **Cost plus incentive fee** | The buyer pays the actual costs, and offers a pre-determined incentive to reward exceptional performance thus motivating the seller to reduce costs. Cost variances from original estimates are shared based on a pre-negotiated formula. | The buyer carries most of the risk, but the seller risks losing the incentive fee. |
| **Firm fixed-price** | The buyer pays an agreed price. | The seller carries all the risk. |
| **Fixed price plus incentive fee** | The buyer pays an agreed price and offers an incentive for exceptional performance. Some price variance is allowed and is based on a pre-established profit formula. Cost overruns beyond a ceiling amount are the responsibility of the seller. | The buyer and seller share some of the risk but the seller carries the risk of cost overruns beyond a ceiling amount. Risk is usually higher for the seller. |
| **Fixed price with economic price adjustment** | The buyer pays an agreed price, but the price is linked to economic or market-related factors. | Both the seller and buyer are protected from economic or market-related factors. Both are still subject to other risks that might affect cost. |
| **Time-and-materials** | The buyer pays the agreed rates – which can be fixed or flexible – for the time, labor, and materials that are used. | If rates are fixed, the seller carries the risk of cost increases. If they are flexible, the buyer carries the risk of rate increases. The buyer also carries the risk of schedule and budget overruns resulting from poor planning. |

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**Topic:** Contract Types

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# Job Aid

# Seller Selection Criteria Questions

**Purpose:** Use this job aid to review examples of seller selection criteria.

You can use the following examples of questions to help rate and select sellers and their proposals:

* How well does the seller's proposal address the procurement statement of work (SOW)?
* Does the selected seller provide the lowest total cost, including purchase cost plus operating cost?
* Does the seller have the required technical skills and knowledge, or can the seller reasonably be expected to acquire these?
* How much risk is embedded in the SOW, and how much risk will be assigned to the selected seller?
* Do the seller's proposed technical methodologies, techniques, solutions, and services meet or surpass the requirements outlined in the procurement documents?
* What does the seller propose as warrantee for the final product or service, and through what time period does this extend?
* Does the seller have the necessary financial resources, or can the seller reasonably be expected to obtain them?
* Does the seller's enterprise fall within a specific type or category of business, such as small business, as defined by the buyer or an established governmental agency and set forth as a condition of contract award?
* What have your or your organization's past experiences been with the selected seller?
* What references can the seller provide?
* Does the seller assert intellectual property rights over the work processes or services that will be used to meet contract requirements?

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**Topic:** Outputs from Planning Procurements

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# Job Aid

# Procurement Management Plan Template

**Purpose:** Use this job aid as a reference for the contents of a procurement management plan.

#### Procurement documents

In this section, you describe the kinds of contracts to be used, and the form and structure of the procurement contract statements of work. You also identify any standardized procurement documents or templates, if necessary.

#### Seller selection

Here you state whether independent estimates, such as quotations, bids, or tenders, will be used and if they are needed as evaluation criteria. You identify any prequalified or preferred sellers, if available. You also define the procurement metrics to be used to manage contracts and evaluate sellers.

#### Supplier management

In a section on supplier management, you describe how you'll handle multiple suppliers. You establish the type of direction to be provided to the sellers on developing and maintaining a work breakdown structure (WBS).

#### Risk management

Under risk management, you clarify known risk issues and identify requirements for measures – such as performance bonds or insurance contracts – that will mitigate specific risks.

#### Assumptions and constraints

Here you describe any constraints and assumptions – limiting factors or unproven beliefs – that could affect planned procurements.

#### Responsibilities

In a section on responsibilities, you describe the actions the project management team is authorized to take. For instance, if the performing organization has an existing department that handles procurements, contracting, or purchasing, the project management team might not be responsible for procurements.

#### Project integration

Under project integration, you plan how to coordinate procurements with other project areas such as scheduling and performance reporting. You plan how to coordinate purchasing lead times with the project schedule development. You plan how to manage make-or-buy decisions and how to link them to the Estimate Activity Resource and Develop Schedule processes. You set the scheduled dates in each contract for the contract deliverables. You also plan how to coordinate the schedule development and schedule control processes.

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Managing procurements

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# SkillBrief

# Conduct Procurements Techniques

When it comes to the Conduct Procurements process, the choice of seller is all-important. The buyer needs to ensure that the seller it chooses can deliver to the requirements of the project.

There are several tools and techniques for selecting sellers during the Conduct Procurements process. These will be used during the

* invitation stage
* evaluation and selection stage
* contract signing stage.

## Invitation stage

During the invitation stage, the project team must find potential sellers suited to help outsource the work required for the project.

This can be done in one of two ways. The performing organization may extend a general invitation to sellers by advertising the opportunity in the media. Or it may contact targeted sellers directly.

The invitation stage of the process is sometimes also known as seller solicitation. The three major tools and techniques for this process are

* advertising
* bidder conferences
* Internet searches

**Advertising**

Advertising is one way to quickly generate a wide selection of potential sellers or expand the list you already have. Ads can be placed in selected newspapers or trade magazines that sellers in the desired industry are likely to read.

They may also be placed on the buyer's corporate web site or even on web sites dedicated to industry networking.

**Bidder conferences**

After receiving sellers' responses to their ads, some buyers hold bidder conferences – also known as contractor conferences, vendor conferences, or prebid conferences. These are meetings between the buyer and prospective seller organizations.

This method is typically used to obtain non-standardized, custom-developed goods or services. The aim is to ensure that all prospective sellers understand the procurement process and that every bidder is given an equal chance to bid on the contract.

**Internet searches**

The last method for finding potential sellers that might be employed during the invitation stage would be Internet searches for the goods and services required.

The buyer might consult various sources, for example online trade journals, directories, and industrial guides. The buyer can also conduct his or her own search using search engines and selected keywords.

An Internet search is particularly useful when obtaining fixed price goods or services, such as basic building materials or computer hardware.

## Evaluation and selection stage

There are three techniques the buyer will use to distinguish between the various bids.

**Independent estimates**

Independent estimates can be prepared within the performing organization or outsourced to a professional external organization that specializing in evaluating contract suppliers.

Independent estimates are known as "should cost" estimates because they indicate what the required goods or services should reasonably cost. Whoever is responsible for choosing a seller can use this information to inform their decision.

An independent estimate is used as a benchmark against which to measure the costs proposed in each seller's bid. Any bid that significantly higher or lower than the costs predicted is likely to be less desirable.

Sometimes, all the proposals may be generally consistent with each other but differ from the independent estimate. In this case, the buyer should examine the possibility that the independent estimate may be inaccurate.

If a bid is significantly different from the other bids and the estimate, it is likely that the seller did not understand the requirements or overlooked some aspect of them.

If all the bids received differ from the independent estimate and each other, this indicates that requirements might not have been clearly communicated and that sellers may not have interpreted the requirements as intended.

**Expert judgment**

When selecting sellers, most companies rely on a panel of people with experience or specific knowledge in one or more fields of relevance to the project. Areas of knowledge may include contracting, legal, finance, accounting, engineering, design, research, development, sales, and manufacturing.

**Proposal evaluation techniques**

These techniques are used to select bidders for more complex procurements. They use a combination of evaluation techniques, including estimates and expert judgment, to gauge each proposal on pre-established criteria. Each result is then assigned a significance or weight to find the most suitable candidate.

The use of a scoring system ensures precise and unbiased decisions based on an overall view of important factors, rather than simply estimates of cost or subjective judgments.

## Contract signing stage

The final stage in the seller-selection process is the contract signing stage. Having evaluated all prospective sellers, it is time to make an offer to the successful candidate and finalize contract details. The technique used to do this is procurement negotiation.

Procurement negotiations clarify the details of the contract and finalize the terms of agreement so that the contract is acceptable and achievable for both the seller and the procuring organization.

These negotiations should take the contract from a state in which it outlines the buyer's expectations and the work to be done to a mutually agreeable document that details both parties' stipulations for a working relationship.

The contract should address and accurately reflect all agreements reached. And it should document the responsibilities of all parties, such as who has the authority to make changes. It should also cover

* applicable terms and conditions
* legal ramifications
* technical specifications
* financing
* property rights
* schedule
* price

The tools and techniques for the Conduct Procurements process are advertising, bidder conferences, Internet searches, independent estimates, expert judgment, proposal evaluation techniques, and procurement negotiation.

These techniques are used during the three stages of the Conduct Procurements process. The first three techniques are used to find potential sellers and solicit proposals for project contracts. The next three are used during the evaluation and selection stage to identify the best seller to handle the project's needs.

At the last stage of the process – contract signing – the buyer and the seller will have to negotiate the final details to be included in the contract.

**Course:** Managing Procurements  
**Topic:** Techniques for Selecting Sellers

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# SkillBrief

# Outputs of the Conduct Procurements Process

There are six outputs of the Conduct Procurements process.

## Selected sellers

Selected sellers are bidders adjudged to be in a competitive range, based on the outcome of the evaluation and selection process, and they have already negotiated a draft contract with the procuring organization.

The final approval of selected sellers will generally be made by senior management.

## Procurement contract award

A contract can be in the form of a simple purchase order or a more complex document (SOW).

Whatever its detail, a contract is a binding legal document that sets out the buyer's and seller's obligations. The information listed may vary, but all contracts have several basic elements in common. Six key components include

* **a statement of work, or deliverables** – describes the work or products that the seller is contractually bound to complete. Contracts should specify what is expected of the seller.
* **a schedule baseline** – records dates for the deliverables or milestones delivered by the seller. Every contract should define the time frame in which obligations should be fulfilled.
* **roles and responsibilities** – define the relationship between parties bound by a contract. This establishes who is expected to do the work, approve it, manage contract processes, and administer the contract itself.
* **pricing** – stipulates the agreed costs for the contract's various deliverables
* **payment terms** – stipulate how a seller will be compensated. They also specify at what stages the seller can expect to receive payment. Many contracts specify payment will be made within 30 days of being invoiced.
* **inspection and acceptance criteria** – detail how a product will be tested and the technical specifications it must achieve. Determining whether or not a product or service has fulfilled the project's needs is a possible cause of contention. It's vital to lay out a deliverable's requirements in advance

## Resource calendar updates

Resource calendars detail when material or human resources will be available to the project. If the project acquires more resources through the procurement process, the calendar must be updated.

## Change requests

The process of integrating outside organizations into the project and modifying requirements during contract negotiations may prompt changes to the project management plan. Changes caused by procurement will generally relate to

* **budget** – Conduct Procurements may cause changes in the budget if, for example, it is decided to outsource part of the work that the organization planned to handle inhouse. This would affect the cost of outsourcing and how the organization utilizes its inhouse resources.
* **schedule** – A seller negotiating more time in which to complete its part of the project would affect the project schedule. A change would need to be made to the schedule to reflect newly agreed timeframes.
* **scope** – Hiring a specialized organization for a task might allow the buyer to do more than had initially been hoped. Alternatively, the buyer might have overestimated what could be achieved. In other words, the final contract could widen or narrow the project scope.
* **quality** – The buyer may be offered a product of better quality than it had anticipated or it may have to settle for a sub-standard product. Either way, this will have implications for the project's quality management plan.

## Project management plan updates

Four elements of the project management plan are most likely to be updated:

* **the cost baseline –** A discrepancy between an independent cost estimate and the sellers' proposals will affect the cost baseline, increasing or decreasing it.
* **the scope baseline** – The project team may agree to scrap a project feature to contract a seller unable or unwilling to provide it. This will lead to a change in the scope baseline for the project because less work will now have to be competed.
* **the schedule baseline** – If an organization contracted to do work completes it in less than the anticipated time, this will affect the schedule baseline.
* **the procurement management plan** – If a seller negotiates a new change management system for work formerly done inhouse, it would prompt an update to the procurement management plan.

## Project document updates

Documents most likely to be affected by the outcomes of the Conduct Procurements process are the

* requirements documentation
* requirements traceability matrix
* risk register

#### Requirements documentation

Requirements documentation describes everything the project team will do to meet stakeholder expectations and the project's business needs. If an outside contractor is contracted to meet these needs, this should be reflected in the documentation.

Should requirements documentation be affected during negotiation by, for example, changed materials, this would need to be reflected in the buyer's requirements documentation as it would change the acceptance criteria.

#### Requirements traceability matrix

The requirements traceability matrix links each project requirement to its origin and traces its status throughout the project. If conducting procurements changes any project requirements, this will have implications to the requirements traceability matrix.

#### Risk register

The risk register is also likely to be updated. When the buyer allows another company to take on some of the requirements of a project, the buyer also inherits some of the seller's risk. If the seller was engaged in several other projects, thereby diminishing its capacity to put enough resources into the buyer's requirements, this inherited risk would need to be recorded and mitigated.

The Conduct Procurements process has six outputs: the final list of selected sellers, the contract that is awarded, updates to the resource calendars, change requests that may arise due to the selection process and negotiations with sellers, project management plan updates, and project document updates.

**Course:** Managing Procurements  
**Topic:** The Contract and Other Procurement Documents

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# SkillBrief

# Inputs to the Conduct Procurements Process

The Conduct Procurements process is a part of the Project Procurement Management knowledge area, which consists of Plan Procurements, Conduct Procurements, Administer Procurements, and Close Procurements.

The Conduct Procurements process comprises two main tasks:

* to solicit bids from sellers offering to supply the project
* to apply the criteria established during the Plan Procurements process in evaluating and selecting appropriate recipients for project contracts

A shortlist of qualified prospective sellers is usually established by examining the preliminary proposals of various organizations bidding for a project contract. It is then up to the organization tendering the contract to examine the organizations most likely to be able to fulfill the project's schedule, cost, and quality requirements.

Relevant issues – like the risk involved in using certain suppliers and the compatibility between organizational policies – should also be evaluated against the procurement plan.

There are nine inputs to the Conduct Procurements process.

#### Project management plan

The project management plan – or more specifically the procurement management plan – is developed during the Plan Procurement process. It provides guidelines for managing the procurement process. The plan also provides details about who will perform the procurement activities. For example, the task might be assigned to members of the project team or it may be assigned to a group within the performing organization but external to the project – the accounting department, for instance.

Four elements of the procurement management plan will impact the Conduct Procurements process:

* guidelines for the types of contracts to be used
* procedures for managing multiple suppliers
* how procurement activities will be coordinated with other processes – scheduling or performance reporting, for example
* constraints and assumptions that might affect procurements

#### Procurement documents

Procurement documents are used to solicit proposals from sellers. These documents provide a description of the requested format that seller responses are to take, a relevant procurement Statement Of Work (SOW), and any contractual provisions. Buyers provide sufficient detail in the procurement documents to facilitate accurate and complete prospective seller responses and to facilitate their evaluation and comparison.

Procurement documents may include a request for information, known as the RFI, an invitation for bid, or IFB, a request for proposal, or RFP, and a request for quotation, or RFQ.

All these documents should be aligned to the SOW, in which the buyer lays out the basic requirements for the contract being tendered.

#### Source selection criteria

Source selection criteria are the established criteria used to rate the seller organizations proposing to supply the project. The criteria may be used to evaluate how closely the seller's purchase price matches the requirements of the SOW. Or they may be the basis of a more detailed analysis evaluating the seller's required capabilities, capacity, delivery dates, product cost, life-cycle costs, technical expertise, and approach to the contract.

#### Qualified seller list

The qualified seller list is derived from a shortlist of sellers whose preliminary proposals suggest that they will be able to fulfill contractual obligations. A more detailed evaluation can then be performed on these shortlisted candidates by asking them to provide more specific and comprehensive responses to the requirements document.

The list is the first place a project manager will look when attempting to outsource a required product or service because it allows him to easily narrow down his choices.

#### Make-or-buy decisions

The list of make-or-buy decisions specifies the required goods and services for the project and whether they will be handled internally or procured externally. The project manager will consult this list – usually a document or table – to establish which procurements need to be made for the project.

#### Seller proposals

Seller proposals are produced by sellers in response to issued RFP documents issued by the buyer. During the Conduct Procurements process, these proposals are used to judge the suitability of a seller.

#### Teaming agreements

Teaming agreements are short-term agreements between companies that allow them to work together to fulfill a contract they jointly enter into with a third company.

Sometimes you may need to collaborate with another company to complete the contract. For example, suppose you are creating a television ad for a large corporation. Your company has the creative expertise, but you team up with another company that has the production equipment to create the finished product.

The two organizations might take on equal shares of the work, which is known as a horizontal team arrangement. Or one company might be subcontracted to the other, which is known as vertical teaming.

Whichever way the two organizations choose to set up the agreement, the sellers must inform the buyer about the roles that each company will be playing in the project.

The terms of the teaming agreement will dictate how the procurement is carried out. That is why it is an input to the Conduct Procurements process.

#### Organizational process assets

Organizational process assets include any general documents that provide guidelines about how to select sellers and manage contracts within your company. There may also be reports on past sellers that contain past positive or negative experiences.

#### Project documents

The most commonly consulted project documents are the risk register and risk-related contract decisions. Both the completed risk register and risk-related contract decisions are key outputs of the Plan Risk Responses process.

These project documents will affect the Conduct Procurements process because, having identified risks, the buyer will choose its sellers in such a way that will mitigate the risks.

All in all, there are nine inputs to the Conduct Procurements process: the procurement management plan – part of the project management plan, procurement documents, source selection criteria, qualified seller list, make-or-buy decisions, seller proposals, teaming agreements, organizational process assets, and project documents. Each of these inputs is used to select the most appropriate prospective seller, taking into account capacity, cost, and risk.

**Course:** Managing Procurements  
**Topic:** Introduction to Project Procurements

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# SkillBrief

# Inputs to the Administer Procurements Process

The Administer Procurements process, which prevents budget and schedule overruns, involves the following activities:

* managing procurement relationships
* monitoring contract performance
* making changes and corrections when required

Procurement contracts are legally binding agreements between a buyer and seller.

**Buyers** must administer contracts to ensure they fulfill their contractual obligations – such as paying the agreed amount for procured products or services at the appropriate time. They should also monitor contracts to protect their legal rights. This involves ensuring procured items or work meets the agreed specifications.

**Sellers** must also administer contracts to ensure they meet their contractual obligations and to protect their rights. They need to deliver the correct goods or services within the agreed timeframes and need to hold buyers responsible for paying and supporting them.

Project managers on both sides should make their teams aware of allowed and prohibited procurement-related actions, so that they do not violate contract terms.

The Administer Procurements process falls in the Monitoring and Controlling process group. It integrates with several other project management processes in this group and in the Executing process group, including:

* **Direct and Manage Project Execution** – provides work performance information used to monitor the progress of contracted work or supplies to meet deliverables and dependencies
* **Report Performance** – uses performance reports to ensure that contracted work meets the agreed terms with regard to scope, cost, schedule, technical performance, and risk management
* **Perform Quality Control** – uses the results of quality tests to verify that procured goods or services meet the agreed-upon quality standards
* **Perform Integrated Change Control** – generates approved change requests which are used in the Administer Procurements process to ensure that procurement or contract-related changes are properly implemented; that the relevant parties are informed, and that the overall project plan is adjusted accordingly
* **Monitor and Control Risks** – uses its results to indicate whether procurements are effectively mitigating these risks

In a complex project involving many sellers, products, and services, integrating the related processes effectively is a major task. As a project manager, you will need to be organized and have good systems in place to stay on top of things and administer all project contracts effectively.

## Inputs to the Administer Procurements process

The inputs provide the information you need to manage procurement relationships and monitor and control contract performance.

**Procurement documents**

Procurement documents include statements of work and the associated request for information (RFIs), requests for proposals (RFPs), initial quotes, and any other solicitation documents. These provide a baseline against which you can measure contractors' actual work results and performance. The project team may also need to retrospectively evaluate initially stated requirements and expectations throughout the project.

**Project management plan**

The procurement management plan, which forms part of the overall project management plan, describes how procurements must be monitored and how necessary changes will be made.

**Contract**

The contracts contain the names and contact information for sellers selected through the Conduct Procurements process. This information is used in administering the contracts – and particularly in managing procurement relationships.

**Performance reports**

The project manager uses performance reports to monitor the actual progress and performance of contracted sellers. These reports are prepared by the seller and contain information about how the seller is doing, what their status is regarding deliverables, and similar information.

**Approved change requests**

Approved changes may be made to the terms of the contract or to the project management plan, including baselines and subsidiary plans. The revised contracts or plans then replace those originally used to administer procurements.

**Work performance information**

Work performance information about the actual results of contracted work is important in measuring whether actual results meet contractual requirements. This information, which can be found in performance reports from the project team, is more general and from the buyer's perspective.

Work performance information could include issues like actual costs and schedule performance. It may also identify any quality issues the internal team is having with the supplier's products.

Seller-developed technical documentation is another type of performance report used in administering procurements.

Typically, suppliers are contractually required to provide these kinds of documents to their buyers.

The Administer Procurements process ensures the effective administration of relationships with sellers and contractors. It integrates with several other project management processes in the Executing process group and the Monitoring and Controlling process group.

Inputs to the process include procurement documents, the project management plan, and the contract. They also include performance reports, work performance information, and approved change requests.

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**Topic:** Overview of Administering Procurements

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# Outputs of the Administer Procurements

The success of any administrative process relies on keeping good records. It often depends on the use of clear and concise procedures. Both these principles apply as you manage a project's procurements during the Administer Procurements process.

The Administer Procurements process has four main outputs.

#### Procurement documentation

Procurement documentation includes a broad category of documents, such as procurement contracts, project schedules related to buyer and seller performance, and seller-developed technical documentation.

Also included is work performance information, like procurement inspection results, payment-related documents such as invoices and payment records, warrantees, and seller performance reports.

#### Change requests

During the Administer Procurements process, change requests can have an impact on the following documents:

* the cost baseline
* project schedule
* procurement management plan
* project management plan
* other related project documents

Changes to a procurement agreement may be initiated by either the buyer or seller. If either party feels a proposed change affects the substance of the original procurement contract, it should be handled through a formal change control process.

Change requests are not instantly granted – they must be reviewed and approved by the project manager or, in some cases, by the Change Control board. This occurs through the Perform Integrated Change Control process.

When contract changes are on the horizon, correspondence is very important. Both the buyer and seller should document their communication so that each has records of this in the event of a dispute.

#### Updates to organizational process assets

Updating organizational process assets can include updates to

* **procurement-related correspondence** – Correspondence between the buyer and seller regarding contractual terms and conditions should be recorded and kept. This provides a written record of important issues discussed, decisions made, and actions taken.
* **payment schedules and requests** – Payment schedules and requests detail the timing of deliveries and of payments made to a seller. These should be added to organizational process assets so records are available in the case of disputes.
* **seller performance evaluation documentation** – Seller performance evaluation documentation is the buyer's formal assessment of the seller's performance with regard to contractual obligations. This documentation should be added to organizational process assets because it indicates the reliability of a seller for possible future use.

#### Project management plan updates

With changes that occur while administering various contracts, elements of the project management plan may need to be adjusted. For example, affected sections could include the

* **procurement management plan** – Any approved change requests that affect procurements must be reflected in the procurement management plan.
* **baseline schedule** – Because procurements don't always go according to schedule, the baseline schedule may have to be updated to reflect changes to the project's expected overall schedule performance.

The outputs of the Administer Procurements process include procurement documentation, change requests, and changes to organizational process assets and the project management plan.

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**Topic:** Documentation from Procurement Administration

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# SkillBrief

# Administer Procurements Techniques

Administering project procurements relies heavily on using the right tools and techniques. These help a project manager monitor and control procurement relationships and contracts.

You can group the tools and techniques for the Administer Procurements process into two categories:

* those appropriate for when procurements and relationships are ongoing and running smoothly – procurement performance reviews, inspections and audits, performance reporting, and payment systems.
* those to use when disputes arise or changes to procurement agreements are required – contract change control system, claims administration, and the records management system.

#### Procurement performance reviews

Procurement performance reviews are performed by the buyer to assess a seller's performance and progress in relation to contractual agreements. For example, they're used to assess whether a seller is meeting the agreed scope, quality, budget, and contracted requirements.

Procurement performance reviews are structured. They may involve inspections of a product or of seller-prepared documents, or quality audits conducted while the seller is performing its tasks.

The reviews may take place during the contract period – such as in project status reviews – or at the end of the contract.

#### Inspections and audits

Inspections and audits are carried out to check whether both the buyer and seller are meeting their contractual obligations. Generally, inspections and audits are required by the buyer and supported by the seller.

#### Performance reporting

The focus of performance reporting is to inform the buyer about the seller's effectiveness in achieving the contractual objectives. There are three types of performance reports, each aimed at a different audience:

* **reports from the seller to the project manager** – cover the status of deliverables and any issues that require attention for resolution
* **reports from the project team to the project manager** – contain information about the status of deliverables and may identify any issues the team is having with sellers
* **reports from the project manager to upper management or the company's procurement officer** – include information about the overall performance of contractors and suppliers

#### Payment systems

The buying organization uses payment systems to pay sellers for the products or services they provide. Payments are usually made after the buyer has confirmed that procured items meet contractual requirements.

It's important that the buyer abides by the payment terms in a procurement contract and documents the payments that are made.

In this way, the payment system ensures that both buyer and seller fulfill their contractual obligations. The seller provides items meeting the quality requirements of the contract and the buyer pays the seller according to the terms of the contract.

#### Contract change control system

The contract change control system defines the procedures for changing procurement contracts. Buyers and sellers may use this tool, which includes the paperwork, tracking systems, dispute resolution procedures, and approval levels necessary for authorizing changes.

The contract change control system forms part of the integrated change control system for an organization or project. The process for handling requests to change contracts is similar to the one for handling other types of change requests.

The contract change control system is first used to process, document, and approve or reject a change request. The output is a change request status update. If the change is approved, it is then passed into the Administer Procurements process. The project manager notifies relevant stakeholders and enters the updated contract into the configuration management system.

A change request may originate from either the buyer or the seller. The project manager should always document the change request before passing it on to the control board.

#### Claims administration

"Claims" are also known as "disputes" or "appeals." They are changes that are contested by parties to an agreement. Claims may result if, for instance, the parties holding a contract can't agree whether

* requested changes should be approved
* changes have occurred
* compensation for general changes, such as changes to product scope, is required or fair
* either party's practices, products, or services are in compliance with government regulations

Claims should always be resolved quickly in a mutually agreed manner. The claim resolution process is usually documented in a section of the procurement contract. If the parties themselves are not able to come to an agreement based on simple methods an alternate dispute resolution (ADR) method – such as arbitration – may be required.

Negotiation and resolution is the preferred method for managing claims. If this fails, a dispute may have to be settled by the courts.

Claims administration involves the following tasks:

* documenting the claim or dispute
* processing the claim as per the agreed dispute resolution method
* monitoring the results
* managing the buyer-seller relationship

#### Records management system

Project managers use a records management system to keep the documents, contracts, and other information involved in the Administer Procurements process in order. It helps them manage contract and procurement records, and related correspondence.

Records management systems make it easy to file and retrieve documents and records. These systems are made up of

* processes
* related control functions
* automation tools

The Administer Procurements process uses several tools and techniques for monitoring and controlling procurement contracts and managing relationships. Important tools when things are running smoothly are procurement performance reviews, inspections and audits, performance reporting, and payment systems.

However, when disputes arise or changes to procurement agreements are needed, another set of tools becomes significant. This includes the contract change control system, claims administration, and the records management system.

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**Topic:** Tools and Techniques for Administering Procurements

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# SkillBrief

# Inputs to the Close Procurements Process

Through the Close Procurements process, the project manager finalizes procurements and associated contracts. This process forms part of the Closing process group. Because it entails verifying that all procured project work and deliverables are acceptable, it supports the Close Project or Phase process.

The Close Procurements process involves the activities required to close any contract agreements established for the project. This includes ensuring that contract terms have been met and that any claims against contracts have been resolved.

The Close Procurements process involves the activities required to close any contract agreements established for the project. This includes ensuring that contract terms have been met and that any claims against contracts have been resolved.

It may also contain a terminations clause, outlining when the contract can be terminated early and the responsibilities of both parties in this case.

The Close Procurements process also involves tidying up and finalizing project documentation. This includes the following activities:

* finalizing open claims against contracts
* updating records to reflect final results
* archiving the information so that it can be used at a later date

Closing procurements requires two inputs.

#### Project management plan

The project management plan contains the procurement management plan. And the procurement management plan contains the procurement metrics for the project.

Procurement metrics are the planned measures for evaluating the success of project contracts and the performance of sellers. They represent the benefits you expect to achieve for the project by procuring goods or services externally as opposed to creating them inhouse.

During procurement closure, you use these metrics to establish where the procurement goals for a project have been met, and where they haven't.

#### Procurement documentation

The next input for closing procurements is all procurement documentation. This includes information on the schedule, scope, quality, and cost performance of each contract. It also includes all contract change documentation, payment records, and inspection results. These must be collected, indexed, and filed as part of closing procurement contracts.

Finalizing and storing procurement documentation ensures lessons learned from procurement processes are available for future projects. Information about the performance of specific contractors can also be useful in evaluating and selecting contractors for later projects.

The following types of procurement documents are especially important inputs during the Close Procurements process:

* **procurement contracts** – You check that both parties have met the terms and conditions in procurement contracts. A contract may also specify whether you must provide a formal written notice that you've accepted products or services from the contractor.
* **contract schedules** – This is the baseline you use to check whether procured products or services were delivered on time. It may also indicate proposed payment dates.
* **contract-related technical documents** – You compare technical documents like product specifications to the results of quality control inspections. This lets you determine whether contractors have met the agreed performance requirements.
* **approved change requests** – Approved change requests may result in changes to the terms of procurement contracts. In these cases, it's important to verify that the agreed changes were implemented. Also, actual results and seller performance must then be checked against the updated contract terms.
* **correspondence between buyers and sellers** – Tracking correspondence between the buyer and seller in a procurement agreement can alert the project manager to outstanding claims or any issues that have not yet been resolved.

The Close Procurements process involves ensuring that all procurement contract terms have been met, tidying up and finalizing associated documentation, and ensuring all outstanding claims against contracts are dealt with. Doing this requires the use of two inputs – the project management plan and procurement documentation.

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**Topic:** Overview of Procurement Closure

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# SkillBrief

# Techniques and Outputs of the Close Procurements Process

## Tools and techniques

The tools and techniques of the Close Procurements process help you wrap up project procurements.

### Procurement audits

A procurement audit is a structured analysis of procurement processes, from the Plan Procurements process through to Administer Procurements. During Close Procurements, these reviews determine whether project procurements were performed correctly and whether they met the right needs.

The primary purpose of procurement audits is to identify the successes and failures of the procurement processes used for a project.

They identify lessons learned, which can help later projects avoid repeating mistakes and capitalize on procurement strategies that have already proved effective.

The five main areas to assess as part of conducting a procurement audit are

* activities related to determining resource requirements, which help determine what must be procured for a project
* the tendering – or advertising and seller solicitation – process, through which potential sellers are identified
* the process for bid evaluation, which informs the selection of sellers
* the process for awarding contracts
* the process for administering contracts

### Negotiated settlements

Negotiation is a technique for resolving contract claims and disputes. It's important during the Close Procurements process, in which one of the goals is the final equitable settlement of all outstanding issues and claims.

Negotiated settlements can be reached through

* **direct communication between the buyer and seller** – If a claim or dispute arises, direct negotiation between the buyer and seller is usually the first course of action.
* **alternative dispute resolution method** – An alternative dispute resolution method is used if a settlement cannot be achieved through direct negotiation. This may involve mediation, in which an impartial third party guides the buyer and seller in reaching a settlement. It can also involve arbitration, in which a third party decides what the settlement will be and both parties are bound to accept it.
* **litigation** – If direct negotiations and alternative dispute resolution methods fail, either party may take legal action to settle a claim. This is the least desirable option because it's potentially time-consuming, costly, and confrontational.

### Records management system

A records management system is a set of processes, related control functions, and automation tools that form part of the overall project management information system. During Close Procurements, it is used to manage contract documentation and records.

A project manager uses a records management system to organize, index, and store procurement documentation, such as contracts and correspondence between buyers and sellers. Archiving this documentation in the system ensures it can be easily retrieved for future reference.

## Outputs

Two outputs result from the Close Procurements process.

### Closed procurements

Once the terms of a contract have been met and the contracted products or services have been accepted, a procurement contract can be closed. This should be handled through a formal, written notification to the seller.

The formal closure process may vary according to the scale of a procurement agreement, but should be documented in the contract.

### Updates to organizational process assets

There are three organizational process assets that are typically updated as a result of the Close Procurements process.

#### The procurement file

The procurement file, also known as the contract file, for a project should be updated to include all procurement documentation. This includes closed contracts, as well as records of payment, seller performance, correspondence between the buyer and seller, and acceptance notifications.

Filing this documentation using an organized records management system ensures it can be retrieved easily when necessary. A procurement file also provides documentation in the case of unresolved disputes. Ensuring it's properly updated may protect your organization in the case of litigation.

#### Deliverable acceptance forms

The deliverable acceptance form is a formal notification that contracted products or services have been accepted and approved. Typically, the form notes that deliverables conform to contractual requirements. This may be based on the results of quality assurance and testing activities, and checks that any deficiencies have been corrected.

#### Lessons learned documentation

Among lessons learned recorded for the project, you would document all the knowledge gained during procurements management for the project. This is useful for future projects. Referring to this document may save your organization a lot of time and money. It helps ensure that the same mistakes aren't made again and that practices that proved successful are re-used.

The inputs to the Close Procurements process are the project management plan and procurement documentation. Tools and techniques for the process include procurement audits, negotiated settlements, and the records management system.

These result in two main outputs – closed procurements and updates to organizational process assets, such as the procurement file, the deliverable acceptance form, and lessons learned.

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**Topic:** Closing Procurements Techniques and Outputs

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# Follow-on Activity

# Using Tools and Techniques for Administering Procurements

**Purpose:** Use this follow-on activity to determine how using the tools and techniques can enhance your project's Administer Procurements process.

## Reviewing the tools and techniques

First review the tools and techniques for the Administer Procurements process.

| **Administer Procurements tools and techniques** | |
| --- | --- |
| **Tool and technique** | **Used to:** |
| Procurement performance reviews | Detail the seller's progress in delivering a product or service within the cost and schedule specified in the contract and to quality specifications. |
| Inspections and audits | Identify whether both the buyer and seller are meeting their contractual obligations. |
| Performance reporting | Used to gather sellers' performance information and distribute it to stakeholders on the buyers' side. |
| Payment systems | Processes and tools used in compensating sellers according to the terms of their contracts. |
| Contract change control system | Defines the procedures for changing a contract, product specifications, or scope of the agreement. |
| Claims administration | Resolves claims using agreed dispute resolution procedures, which should be outlined in the contract. |
| Records management system | Used to manage contracts, procurement records, and any other related correspondence. |

Now answer the following questions.

| **Questions** | |
| --- | --- |
| **Question** | **Answer** |
| For a current project, which of the tools and techniques can you use for the Administer Procurements process? List them in the text box provided. | Row 2 Column 2 |
| Provide specific examples of how using these tools or techniques can make your Administer Procurements process more effective. | Row 3 Column 2 |

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# Follow-on Activity

# Reviewing the Seller Selection Process

**Purpose:** Use this follow-on activity to help you review the seller selection process in a current or recent project.

**Instructions for use:** To use this tool, print and complete the table using the details of a current or recent project's seller selection process.

| **Details of a seller selection process** | |
| --- | --- |
| **Process** | **Comments** |
| How did the purchasing organization go about soliciting seller proposals? | Row 2 Column 2 |
| Was a qualified sellers list compiled? | Row 3 Column 2 |
| Did the qualified sellers list accurately represent the capabilities of potential sellers? | Row 4 Column 2 |
| Were all sellers listed able to supply to your organization's requirements? | Row 5 Column 2 |
| Did all sellers provide information in the required format? If not, how could the procurement document package have been improved? | Row 6 Column 2 |
| Did sellers request additional information from you? | Row 7 Column 2 |
| Was sufficient information provided to enable you to evaluate sellers' capabilities? | Row 8 Column 2 |
| Did the purchasing organization prepare an independent estimate? | Row 9 Column 2 |
| Did the purchasing organization seek advice from individuals with specialized knowledge when assessing the prospective sellers? | Row 10 Column 2 |
| Was a weighting system used to distinguish between potential sellers? | Row 11 Column 2 |
| Did sellers' capabilities match your expectations as described in the qualified sellers list? | Row 12 Column 2 |
| How closely did the contract agreed to by the seller and the buyer resemble the project's initial SOW? | Row 13 Column 2 |

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**Topic:** Techniques for Selecting Sellers

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# Job Aid

# Elements of a Procurement Contract

**Purpose:** Use this job aid to examine the elements of a procurement contract.

Procurement contracts may vary depending on the requirements of the work involved but all contract will have some basic elements.

|  |  |
| --- | --- |
| **Basic elements of a procurement contract** | |
| **Statement of work or deliverables** | This is a description of the work or products that the seller is contractually bound to complete. Every contract should clearly state exactly what is expected from the seller. |
| **Schedule baseline** | The contract will use this information to record dates for the deliverables or milestones being delivered by the seller. Every contract should define the time frame in which obligations should be fulfilled. |
| **Performance reporting** | This section defines how and when reports will be issued concerning the contracted work. For example, the contract might stipulate a weekly or monthly hardcopy performance update from the contractor to the project team. |
| **Period of performance** | A contract might stipulate the time during which a certain service would be performed. |
| **Roles and responsibilities** | This is where you define the relationships between parties bound to the contract. This information will establish who is expected to do the work, who will approve it, and who will manage contract processes and administer the contract its self. |
| **Seller's place of performance** | A contract might stipulate where work must take place. |
| **Pricing** | This stipulates the agreed costs of the various deliverables in the contract. |
| **Payment terms** | These terms stipulate how a seller will be compensated and at what stages of the work the seller can expect to receive payment. |
| **Place of delivery** | A contract may state where the buyer will take receipt of the finished product. |
| **Inspection and acceptance criteria** | This will detail how a product will be tested and the technical specifications that must be met. Determining whether or not a product or service has fulfilled all the needs of the project is a likely cause for contention, so it is vital to lay out all the requirements for a deliverable to be defined in advance. |
| **Warranty** | The contract may stipulate how long the seller will guarantee the functioning or performance of the product. This section contains the details the conditions and provisions of the warranty. |
| **Product support** | This section outlines the seller's responsibility when it comes to servicing, maintaining, or troubleshooting the product. |
| **Limitation of liability** | A contract may outline a limit to either the seller's or buyer's legal liability for damages arising from the performance of work detailed in the contract. |
| **Fees and retainage** | It might be part of the contract that a certain percentage of the contract fee is held back to provide the buyer with the funds necessary to complete the work in the event that the contractor fails to do so. |
| **Penalties** | The contract may lay out various penalties that a contractor would have to pay for failing to fulfill various stipulations of the contract. |
| **Incentives** | The contract may lay out various rewards that a contractor would receive for fulfilling various stipulations of the contract. |
| **Insurance and performance bonds** | A contract may detail business insurance policies taken out against the failure of the contract. A performance bond is a guarantee of a contractor's performance of his contractual obligations. Liabilities of the various parties for the failure of the contract would be laid out in this portion of the contract. |
| **Subordinate subcontractor approvals** | If a contractor has subcontracted some of the work to another organization, the details of this agreement and their relationship should be reflected in the contract. |
| **Change request handling** | The contract might formally outline how change requests arising from the contracted work would be processed. |
| **Termination and alternative dispute resolution mechanisms** | A contract may state upfront the conditions that might mean the termination of the contract and the mechanisms that would come into play should a dispute arise over whether the contract has been satisfactorily performed. |
| **Definitions** | This section contains any technical definitions or terms used in the contract. |
| **Statement of laws and regulation governing project activity** | The contract records any legal requirements or regulations that are particularly relevant to the performance of the work. |

**Course:** Managing Procurements  
**Topic:** The Contract and Other Procurement Documents

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# Job Aid

# Sample Contract Extract and Purchase Order

**Purpose:** Use this job aid to examine an extract from a sample contract and purchase order.

## Extract from a procurement agreement

PROCUREMENT AGREEMENT

BETWEEN

Vanessa's Deli

AND

Earth Farm PROCUREMENT GROUP, INC.

May 15

This Agreement, effective May 15, is entered into between Vanessa's Deli, ("VD") and Earth Farm ("Provisions").

WHEREAS, VD is in the business of developing, owning and franchising restaurants

WHEREAS, Provisions is in the business of negotiating and contracting for the procurement of food and beverages, supplies, uniforms, furniture, fixtures and equipment for restaurants and other hospitality industry establishments; and

WHEREAS, VD and Provisions have done business with each other in the past and wish to continue doing business with each other;

NOW, THEREFORE, the parties hereto agree as follows:

1. SCOPE OF ENGAGEMENT. VD, for VD owned and operated restaurants, and franchised restaurants that choose to be included in this Agreement, ("Sites"), agrees to hire Provisions to source for each Site substantially all food, beverages, supplies, packaging, selected pieces of the uniforms for staff and other operating supplies used in the day to day operation of the Site (sometimes hereinafter referred to as "Food Product"), as well as furniture, fixtures and equipment used by a Site in its operations, including non-food items used in daily operations, kitchen equipment and utensils, and decor used at the Site (sometimes hereinafter referred to as "FFE"). Collectively, Food Product and FFE may hereinafter be referred to as "Goods". Food Product does not currently include produce (including fruits and vegetables), milk, half and half, alcoholic beverages, eggs and certain breads, and any other exceptions set forth in the Exhibit A attached hereto, which may be amended throughout the term by the parties. Other than as set forth below, during the term of this Agreement, neither VD nor any individual Site will, outside of the scope of this Agreement, purchase Goods from a supplier under contract with Provisions. Provisions agrees to provide such sourcing of Goods for each Site.

2. SOURCING OF GOODS.

(a) Provisions will negotiate contracts with supplies of Goods to ensure Goods and shall use commercially reasonable efforts to obtain the lowest available pricing for such Goods that is reasonably available in the market. Suppliers may be international, national, regional or local and, with respect to source Goods for Sites outside of the United States, Goods may be exported to the Site country or they may be sourced locally. Provisions will take all reasonable steps to ensure that suppliers comply with all pertinent national and local...

**Course:** Managing Procurements  
**Topic:** Techniques for Selecting Sellers

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# Job Aid

# Sample Invitation to a Bidder Conference

**Purpose:** Use this job aid to examine a sample invitation to a bidder conference.

ID:

Title:

Date:

Status:

A bidders' conference will be held at \_\_\_\_\_ on \_\_\_\_\_. The conference will begin at \_\_:\_\_\_ in \_\_\_\_\_ room. Bidders that do not attend are not precluded from submitting a bid.

Bidders are requested to confirm attendance with the Contracting Authority prior to the bidders' conference. Bidders are to provide the Contracting Authority, in writing, with the names of its representatives who will be attending and a list of issues that it wishes to table no later than \_\_\_\_\_ days prior to the scheduled bidders' conference.

Bidders or a representative of the bidder are requested to attend this conference during which the requirements outlined in this bid solicitation document will be reviewed and any questions will be answered. In order to fully understand the scope of the requirement, it is recommended that bidders who intend submitting a bid attend or send a representative.

Bidders are advised that any clarifications or changes resulting from the bidders' conference shall be included as an amendment to the bid solicitation document.

**Course:** Managing Procurements  
**Topic:** Techniques for Selecting Sellers

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# Job Aid

# Procurements File Documents

**Purpose:** Use this job aid to review a list of the types of documents that may be included in a procurements file.

| **Procurements file documents** | |
| --- | --- |
| **Document** | **Description** |
| Make-or-buy decisions document | Documents the rationale for decisions either to acquire products or services externally or to create them internally. |
| Statement of work | Defines the portion of the project scope that is to be included within a related contract. |
| Contract | Defines a mutually binding legal agreement between the buyer and seller. |
| Solicitation documents | Includes documents used to invite bids, proposals, and quotes from sellers. |
| Advertisements inviting seller responses | Includes advertisements inviting bids, proposals, or quotes from sellers. |
| Sellers' bids, proposals, or quotes | Form the basic information used by an evaluation body to select one or more sellers from those available. |
| Documented procurement negotiations | Clarify the structure, requirements, and other terms of purchases so that mutual agreements can be reached prior to the signing of a contract. |
| Contract schedules | Define the delivery dates outlined in procurement contract terms. |
| Seller-developed technical documentation | Includes seller-developed product specifications or manuals, as well as performance reports. |
| Warranties | Identify guarantees that sellers provide on their products or services. |
| Financial documents | Includes invoices and records of payment. |
| Change requests | Includes procurement-related change requests initiated by the buyer or seller. |
| Teaming agreements | Legal contractual agreements between two or more parties to form a partnership. For example, a company may partner with a particular supplier when bidding on a large contract. |
| Seller performance reports | Indicate how well sellers met contractual obligations. Identify the "fit" or strategic alignment of a particular buyer and seller. |
| Significant correspondence between buyer and seller | Contains information about adjusted expectations, misunderstandings, disagreements, and the relationship in general between the buyer and seller. Can also be a source of commendations and "kudos" to the project team when the buyer is pleased with the seller. |
| Formal notification of contract closure | Officially notifies a seller that a contract has been concluded. |
| Deliverable acceptance notification | Officially notifies a seller that the buyer has accepted and approved deliverables. |
| Procurement lessons learned document | Records knowledge and insights gained through procurements management, for use in future projects. |

**Course:** Managing Procurements  
**Topic:** Closing Procurements Techniques and Outputs

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