Chapter 5
Project Management

1 Project Management Overview

A project refers to fixed-term activities that are initiated irregularly in order to produce or provide a unique product or service. Project management refers to the management (i.e., control and administration) carried out in order to lead a project to its success.

1 - 1 Objective and Concept of Project Management

The purpose of project management is to meet the requirements of the project and lead it to its success. For this, in addition to knowledge, skills, and tools, techniques that make use of these are employed, and management is performed through a PDCA cycle that involves planning (Plan), proceeding (Do) with activities according to the plan, verifying the differences between the plan and actual result, and taking action (Act) against the cause of differences. Check

A project has the following constraints, and its characteristics are summarized as shown in the table below.

[Project constraints]

Quality	Quality standards that the project and the deliverables are required to meet
Cost	Budget that can be used in the project
Delivery	Date of delivering the deliverables

[Project characteristics]

Uniqueness	Unique deliverables are created.
Temporariness	The period from the initiation until the termination is decided.
Resource finiteness	The usable resources and the cost are decided.
Stepwise refinement	Uncertain elements are clearly identified by refining in a stepwise manner.

There are various types of projects including system development projects for developing a system, new product development projects for planning and producing a new product, and new business projects for planning and developing a new business. In all projects, in order to obtain the final deliverable (i.e., product), a shipment process for creating the product and a support process for supporting the creation of the product are implemented in addition to the project management process.

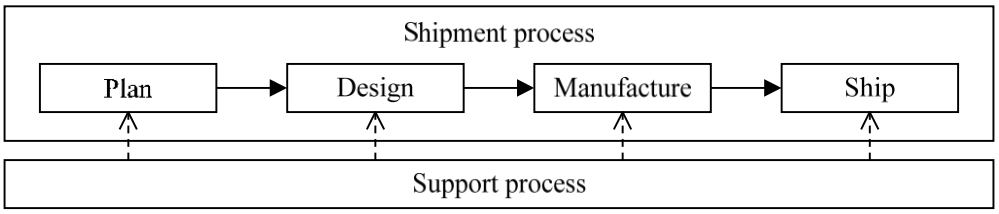


Figure 5-1 Shipment process and support process

(1) Project influence elements

The following elements influence the execution of a project. The project constraints are decided on the basis of these influence elements.

- Project environment

  This is the internal environment factors and external environment factors encompassing the project that may impact the success of the project. The project environment corresponds to such factors as the organization culture or system, national standards or industry standards, human resources or personnel management, and market situation or political situation.

- Stakeholder

  This is an organization or individual having interests in the activities of the project. The stakeholder corresponds to the organization/enterprise, employees, shareholders, creditors, customers, suppliers (or vendors), local community, and governmental agencies that form the main constituents of a project.

- Project life cycle

  This is the life cycle from the initiation of a project until its end, which includes the predictive type, iterative type, incremental type, and adaptive type.

  [Characteristics of a general project life cycle]

Starting the project	The cost is low and staff members are few.
Organizing and preparing	The cost and the staff members increase gradually.
Carrying out the project work	The cost and the staff members reach the peak.
Closing the project	The cost and the staff members fall rapidly.

- Project governance

  This is the governance (i.e., rule) of a project that is consistent with the governance of the organization. It is implemented through the project life cycle.

(2) Project team

The project team (i.e., team executing the project) consists of a project manager and project members.

- **Project manager**
  This is the leader who leads a project to its success. A project manager is required to have competency (i.e., behavioral characteristics) in terms of knowledge, practical ability (i.e., execution capability), and human qualities (i.e., leadership, communication, negotiation, conflict management, motivation).
- **Project members**
  This is the staff members engaged in a project. In the organizational structure of a project, the project members are required to have the self-management capabilities to appropriately perform activity planning, progress management, quality management, cost management, risk management, change management, problem discovery/problem reporting, measures planning, documentation, and communication.

(3) Organizational structure of project

The organizational structure of a project refers to the project organization system and the project management support system as shown below.

- **PBO (Project-Based Organization)**
  This is the project organization system. PBO is one of the management organizations and is classified into the following three types:

Functional organization	An organization formed within the affiliated department. The authority of the project manager is the weakest.
Matrix organization	An organization formed by members belonging to several departments. It is classified into a weak matrix organization, a balanced matrix organization, and a strong matrix organization.
Projectized organization	An organization initiated as a dedicated department of the project. The authority of the project manager is the strongest.

- **PMO (Project Management Office)**
  This is a department or group that supports (or performs direct management of) project management by performing consolidated management or coordination of several projects. It may be thought of as a PMO (Program Management Office) specialized as

a project.

Supportive	Project support is performed. The extent of control is low.
Controlling	Compliance is required along with project support. The extent of control is mid-level.
Directive	Direct management and control of the project are performed. The extent of control is high.

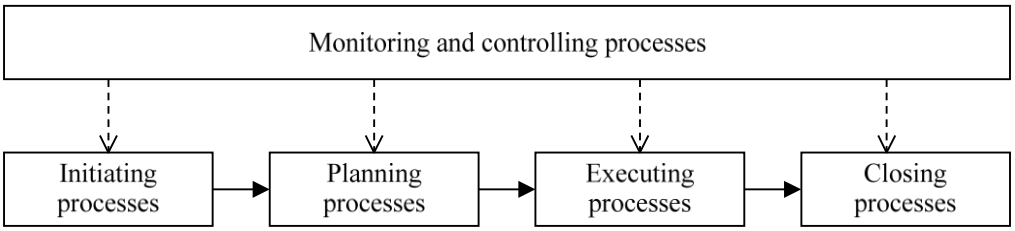
1 - 2 Project Management Implementation Method

In many cases, the following guidelines (i.e., international standards) are used as the standard for implementing project management. When these guidelines are applied, tailoring (i.e., corrections/adjustments) must be performed in response to the characteristics of the project.

- PMBOK (Project Management Body of Knowledge)
  This is a guide to the body of knowledge concerning project management that is issued by PMI (Project Management Institute).
- ISO 21500
  This is a comprehensive guideline on project management that is published by the ISO (International Organization for Standardization).

(1) Process groups

In PMBOK and ISO 21500, the project management processes (hereinafter, processes) that must be implemented in project management are classified into five process groups according to the flow of the project life cycle.



Process groups	Overview
Initiating process group	Definition of project outcome, deliverables, and range
Planning process group	Activity planning and scheduling for achieving the objectives

Implementing process group [Executing process group]	Implementation [or execution] of the projects or the processes
Controlling process group [Monitoring and controlling process group]	Progress management and monitoring, and evaluation/improvement
Closing process group	Arrangement of deliverables and closing of the project or contract

Note: The terms enclosed in brackets [ ] are used only in PMBOK.

(2) Subject groups (knowledge areas)

According to PMBOK and ISO 21500, a process is classified into the following 10 subject groups [knowledge areas] according to the applicable resources.

Subject group (Knowledge area)	Main objects to be managed
Project integration subject [Project integration management]	Overall project activities
Project scope subject [Project scope management]	Scope (e.g., deliverables)
Project time subject [Project time management]	Schedule
Project cost subject [Project cost management]	Budget/cost
Project quality subject [Project quality management]	Quality policies and quality objectives
Project risk subject [Project risk management]	Project risks
Project stakeholder subject [Project stakeholder management]	Interested parties
Project resource subject [Project human resource management]	Human resources/physical resources Note: PMBOK describes human resource only.
Project procurement subject [Project procurement management]	Procurement of external resources
Project communications subject [Project communications management]	Project information

Note: The terms enclosed in brackets [ ] are used only in PMBOK.

In PMBOK and ISO 21500, processes are compiled together on the basis of a table (i.e., process map) configured by process groups and subject groups. (For example, in the initiating process, the “project charter development” process is implemented for the project integration subject.)

In this textbook, the typical processes are explained in order from the viewpoint of management implemented in each subject group on the basis of PMBOK and ISO 21500.

2 Subject Group Management

This section describes the purposes and typical processes of the subject groups (knowledge areas) related to quality, cost, and delivery, which are the project constraints, while focusing on the subject group management.

2 - 1 Project Integration Management

The purpose of project integration management is to identify, define, combine, unify, and coordinate the processes and the project management activities of each subject group.
In order to define, control, and manage the overall project management activities, the following processes are implemented.

Process groups	Process to implement
Initiating	Develop project charter
Planning	Develop project plans [Develop project management plan]
Implementing [Executing]	Direct project work [Direct and manage project work]
Controlling [Monitoring and controlling]	Control project work [Monitor and control project work]
	Control changes [Perform integrated change control]
Closing	Close project phase or project [Close project or phase] Collect lessons learned

Note: The terms enclosed in brackets [ ] are used only in PMBOK.

(1) Development of a project charter

In this process, a project charter is developed on the basis of the project statement of work that describes the products expected from the project and the environmental factors or process assets of the organization body. The project charter is a document that declares the initiation of a project that is formally approved by the organization.

[Descriptions included in the project charter]
Purpose and validation of the project, objectives and success criteria of the project, needs and requirements (i.e., requirements concerning the outcome of the project) of

stakeholders, pre-requisites and constraints concerning the organization and related institutions, the overview and scope of the project, risks of the project, an overview of the overall schedule (i.e., summary milestone schedule), approximation of the overall budget (i.e., summary budget), responsibilities and authorities of the appointed project managers, a list of stakeholders, the approver and proponent (initiator) of the project charter, and so on.

In order to create the project charter, techniques such as feasibility study are used, in which investigation and verification are conducted to determine the execution possibility concerning the decision and facilitation of experts, and planning of a new business or a new project.

(2) Development of project management plan

From the project charter, subsidiary plans (i.e., basic rules such as planning, methods, and effective measurement methods) for management are developed, other than project integration management. The auxiliary plans are aggregated with the performance measurement baseline (i.e., scope baseline, schedule baseline, cost baseline) that are defined in the processes of other subject groups, and integrated into the project management plan.

[Descriptions included in the project management plan]
Project life cycle and applicable processes, tailoring items (e.g., clarification of processes, execution level of each process, techniques and tools to use), method of implementing change control (e.g., change management plan), method of communicating with stakeholders, method/content and scope/implementation period of problem resolution, and method of implementing activities for achievement of the objectives, and so on

(3) Integrated change control

This process performs centralized control of the change requests (corrective actions, preventive actions, and defect corrections) concerning the project and maintains the integrity of the project. The feasibility of a change request is decided on the basis of the decision of an expert or the reviews conducted in meetings, and it is approved by the project manager or CCB (Change Control Board). The approved change request is soon implemented, and the entire series of actions concerning the change request are described in a change directory. It must be noted that the project management plan and related project documents are also updated according to the change content.

(4) Closing of a project or a project phase

In order to close a project or a project phase (i.e., the project category controlled for acquiring important deliverables), all processes described in the project management plan is closed, and then the project or the project phase is formally completed.
The project that is completed because the objective of the project is accomplished, performs a transfer (e.g., a delivery) of the final deliverable (product) and project asset management (e.g., update of process assets). On the other hand, for a project that is closed (or aborted) because the objective of the project could not be accomplished, a material is developed in which the cause or reason of failure and the background details are described. In both cases, as the formal documents indicating the completion of the project, a project completion report and a closing report for the project or the project phase are developed.
Also, the lessons learned through the implemented project is compiled as a "Lessons learned document" for use in future projects and project phases, and is registered in the learning knowledge base.

2 - 2 Project Scope Management

The purpose of project scope management is to clarify of the activities necessary for the execution of the project without any deficiencies or excess, and to control them in order to make the project a success.
The following processes are implemented to define and control the items necessary to make the project a success.

Process groups	Process to implement
Initiating	–
Planning	Define activities [Plan scope management, Collect requirements]
	Define scope
	Create WBS (Work Breakdown Structure)
Implementing [Executing]	–
Controlling [Monitoring and controlling]	Control scope [Validate scope, Control scope]
Closing	–

Note: The terms enclosed in brackets [ ] are used only in PMBOK.

(1) Development of scope management plan

This process develops a scope management plan which describes the methods for performing scope definition, validation check, and control on the basis of the requirements that is described in the project charter, and the project management plan and the subsidiary plans. (Scope refers to the deliverables and the scope of work for obtaining the deliverables.) At the same time, the process develops a requirements management plan which describes the methods for performing analysis and documentation of the requirements. The scope management plan is a guideline for scope management, and is expected to have effect of reducing the risks that arise from the scope creep (i.e., changes made without performing control).

(2) Definition of a scope

This process clearly identifies the deliverables and the activities necessary for achieving the deliverables as the deliverable scope and the project scope.
In order to achieve this, first of all, the requirements of the stakeholders are collected according to the requirements management plan, and then the collected requirements are documented as a requirements document. (There is also a concept to make this activity independent as a requirements collection process.) By using the scope definition methods specified in the requirements document and the scope management plan, the project scope is defined and a project scope statement is developed.

> [Descriptions included in the project scope statement]
> Deliverable scope description, project deliverables and acceptance criteria, items excluded from the project, and project pre-requisites and constraints.

(3) Creation of WBS (Work Breakdown Structure)

WBS (Work Breakdown Structure) is a hierarchical structure diagram in which the activities necessary for achieving the purpose of the project are divided in a stepwise fashion with the deliverables as the main constituent. On the basis of the project scope statement, the project deliverables are subdivided (or decomposed) into the work package, which is the lowest component. The work package is divided into more detailed activities and used when the cost and schedule are estimated.

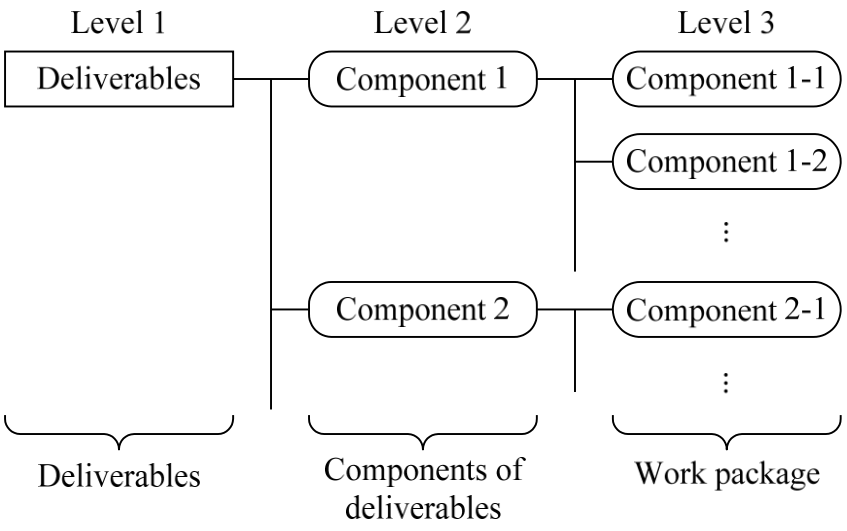


Figure 5-2　Example of WBS (WBS with three-level hierarchy)

The result of WBS creation is documented as the scope baseline. The scope defined as the baseline is used as the monitoring and controlling decision criteria in the project life cycle.

[Components of scope baseline]

- Project scope statement (output of scope definition)
- WBS
- WBS dictionary:

  A supplementary document describing the details of WBS components (e.g., the work package)

(4)　Scope control

This process monitors the status of the deliverable scope and the project scope on the basis of the scope baseline that is integrated into the project management plan, and controls the changes made to the scope (or the scope baseline). During monitoring, variance analysis is performed for the progress information (i.e., performance) of project activities and the scope baseline, and the cause and extent of the difference are checked. On the other hand, concerning the change requests for the scope (or the scope baseline), the integrated change control decides and approves the requests, and applies the changes.

2 - 3　Project Time Management

The purpose of project time management is to clarify and control the schedule for completing the project within the defined period.

The following processes are implemented for setting up and controlling the schedule.

Process groups	Process to implement
Initiating	–
Planning	[Plan schedule management]
	[Define activities]
	Sequence activities
	[Estimate activity resources]
	Estimate activity durations
	Develop schedule
Implementing [Executing]	–
Controlling [Monitoring and controlling]	Control schedule
Closing	–

Note: The terms enclosed in brackets [ ] are used only in PMBOK.

(1) Schedule management plan

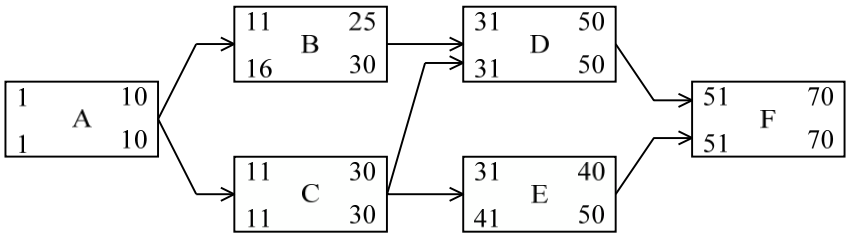
This process creates a schedule model (e.g., the scheduling method and the tools used) and a schedule management plan that describes the performance measurement method on the basis of the overview of the overall schedule (i.e., summary milestone schedule) described in the project charter and the project management plan and the auxiliary plan.

(2) Definition of activities / sequencing of activities

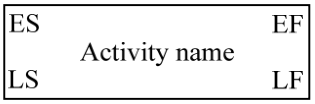
During activity definition, an activity, which is the unit obtained by further refinement of the work package that is the lowermost hierarchy of WBS, is clearly identified.
To achieve this, by using the activity definition level that is specified in the scope baseline (or WBS) and the schedule management plan, the work package is refined into activities, and an activity list is developed. At the same time, the milestones are identified, which act as important points of time in the work process (e.g., the start date/end date, or review date of the work process) that has an important meaning in the project, and then a milestone list is created.
The activities that are clearly identified through activity definition are arranged on the basis of a logical order relation with the help of an arrow diagram and PDM (Precedence Diagramming Method), and integrated into a project schedule network diagram. At this time, the following two dependencies are also decided: a lead during which a later activity can be started ahead of schedule without waiting for an earlier activity to complete, and a lag during which the start of a later activity is delayed even when an earlier activity is completed.

• PDM (Precedence Diagramming Method)

It is a technique used in CPM (Critical Path Method) according to which activities are represented through quadrangles and the logical order relation between activities is represented through arrows.



[Legend]:



ES : Earliest Start Date EF : Earliest Finish Date
LS : Latest Start Date LF : Latest Finish Date
Note: The duration and the lead time may also be specified.

(3) Estimate of activity resources

This process estimates the resources (e.g., staff members, devices, materials) that are required for executing each activity. On the basis of the resource calendar that is created through project human resource management and project procurement management or the activity cost estimate that is performed through project cost management, the type and quantity of the required resources are documented as an activity resource request list. Also, a RBS (Resource Breakdown Structure) is developed in which the resources to be used are classified hierarchically according to the category and the type.

(4) Estimate of activity durations

This process estimates the duration that is required for executing each activity when the expected resources are used. The basic concept of estimating the duration is "Duration = Man-hours ÷ Number of staff members," but in order to improve the accuracy, various estimation methods are combined together.

• Analogous estimate

This is a technique of relative estimate on the basis of the performance of a similar project in the past.

• Parametric estimate

This is a technique of estimate in which the past information is statistically analyzed and various coefficients are determined.

• Three-point estimate

This is a technique of estimate in which the optimistic value, the pessimistic value, and the mode (average) value are used.

- Reserve analysis

  This is a technique of estimate in which a reserve (i.e., buffer) is provided beforehand.

(5) Development of a schedule

This process creates a master schedule, an intermediate schedule (e.g., activity schedule by process), and a detailed schedule (e.g., weekly activity schedule) by using the scheduling method defined in the schedule management plan on the basis of the activity list, the activity resource requirements and resource calendar, and the estimate of activity durations.
During schedule development, schedule network analysis is performed by using the following techniques, and then various schedules are created.

- PERT (Program Evaluation and Review Technique)

  This is a technique that makes use of an arrow diagram. (Refer to p.59 for details.)
- CPM (Critical Path Method)

  This is a technique that makes use of an arrow diagram and PDM (Precedence Diagramming Method), and the basic concept is almost the same as PERT.
- Critical chain

  This is a technique by which schedule correction is enabled in order to meet the end date with limited resources by adding an activity (i.e., buffer) that does not involve actual work.
- Resource leveling

  This is a resource optimization technique by which the amount of usage of specific resources is maintained at a constant level.
- Schedule compression

  This includes techniques such as crashing in which the schedule is compressed by introducing resources such as staff members and cost, and fast-tracking in which the schedule is compressed through subdivision/parallel execution of specific activities and by proceeding with the succeeding process in parallel before the completion of the previous process.

The result of schedule development is documented as the schedule baseline. The schedule defined as the baseline is used as the decision criteria during monitoring and controlling. The schedule thus created is compiled in a Gantt chart that is used to manage the progress status by drawing horizontal bars representing the activity schedule (i.e., plan) and actual values on the upper and lower bars, and in a trend chart in which is used to perform the cost management

and the progress management by representing and comparing the schedule and actual result of milestones through a line graph.

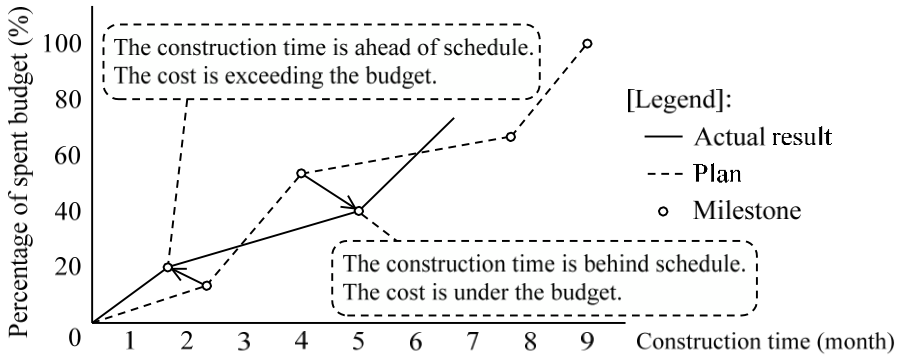


Figure 5-3 Example of a trend chart

(6) Control of the schedule

This process monitors and understands the progress status (i.e., schedule) of the project, and if there is a significant delay or an unexpected event has occurred, the changes are determined or approved through integrated change control, and the schedule is quickly readjusted (or the schedule baseline is changed).

The progress status of the schedule is understood by performing variance analysis of the activity performance data (e.g., the start status, work status, the completion status of an activity) created on the basis of the progress report that is submitted by the project members by using techniques such as EVM.

• EVM (Earned Value Management)

This is a technique of quantifying and evaluating the progress of a project and the productivity (i.e., performance) of activities on the basis of the value of the amount of work completed (normally converted to the amount of money).

[Basic indicators of EVM]

- PV (Planned Value)

  This is the amount (i.e., cost) assigned to each activity during planning.
- EV (Earned Value)

  This is the amount (i.e., cost) originally assigned to an activity completed at a recent point in time.
- AC (Actual Cost)

  This is the cost that was actually required for an activity completed at a recent point in time.

[Performance indicators of EVM]

(1) Performance indicators of progress

• SV (Schedule Variance)

This is an indicator of the difference as seen from the viewpoint of the schedule of each activity. If it is more than 0, the progress of the project is ahead of the schedule.

SV = EV − PV

• SPI (Schedule Performance Index)

This is an index of the efficiency as seen from the viewpoint of the schedule of each activity. If it is more than 1, the work efficiency is good; that is, the progress of the project is ahead of schedule.

SPI = EV ÷ PV

(2) Performance indicators of productivity

• CV (Cost Variance)

This is an indicator of the difference as seen from the viewpoint of the cost of each activity. If it is more than 0, the productivity is high.

CV = EV − AC

• CPI (Cost Performance Index)

This is an index of the efficiency as seen from the viewpoint of the cost of each activity. If it is more than 1, the cost efficiency is good; that is, the productivity is high.

CPI = EV ÷ AC

2 - 4 Project Cost Management

The purpose of project cost management is to clarify and control the budget spending plan for completing the project within the defined budget.
The following processes are implemented for setting up and controlling the budget spending plan.

Process groups	Process to implement
Initiating	–
Planning	[Plan cost management]
	Estimate costs
	Develop budget [Determine budget]
Implementing [Executing]	–
Controlling [Monitoring and controlling]	Control costs
Closing	–

Note: The terms enclosed in brackets [ ] are used only in PMBOK.

(1) Cost management plan

This process creates a cost data format (e.g., the effective number of digits, measurement unit, control threshold) and a cost management plan that describe the performance measurement method, on the basis of the overview of the overall budget that is described in the project charter (budget summary), and on the basis of the project management plan and the subsidiary plans.

(2) Cost estimate

The cost required for executing each activity is estimated. As compared with the approximation of the cost calculated initially, the accuracy of cost estimate improves with the progress of the project. (In PMBOK, the estimate accuracy during the initiating stage is between −25% and +75%, and the estimate accuracy during the stage when the detailed information is collected is between −5% and +10%.)

The main item of project cost management is the cost necessary for completing the project activities, but it is desirable to take into consideration the cost that arises after the project ends. For example, in the case of a system development project, not only the cost of development, but also the TCO (Total Cost of Ownership), including the cost of operations/maintenance after system installation and the cost of staff member training, must be taken into consideration.

Cost estimate involves the use of techniques, such as analogous estimate, parametric estimate, three-point estimate, and reserve analysis. In analogous estimate, the differences in the work package and activities that are refined stepwise are reflected on the basis of the performance of a similar project in the past. Therefore, it is also called top-down estimate. In contrast, there is bottom-up estimate, such as integration method in which the cost of the work package and activities keeps on adding up.

The other cost estimate techniques include the following. These techniques are also used in the activity duration estimate.

- COCOMO (COnstructive COst MOdel)
  It is a technique of estimating the development cost and the development man-hours by calculating the workload (i.e., development productivity) of the programmers through a statistical model on the basis of the software development size (e.g., the number of program steps). The statistical model includes elements such as the estimation target level (e.g., overview, regular, detailed) and the composition of work force (e.g., single experts group, common group, mixed group). Currently, there has been a shift to COCOMOII.
- FP (Function Point) method
  This is a technique of estimating the development cost and the development man-hours with the help of the software functions that are obtained from the number of screens

and the number of forms. The files or forms to be processed by the software that is to be developed are divided into the following five function types on the basis of the method of processing, then adjustments are made depending on the complexity and the characteristics, and the FPs (Function Points) are calculated. After that, the software size and the development man-hours are estimated.

Function type name	Overview
External input	Type and total amount of input data
External output	Type and total amount of output data
External inquiry	Type and total number of inquiries from outside
Internal logical file	Type and total number of files associated with access
External interface file	Type and total number of related interfaces

- LOC (Lines of Code) method

  This is a technique of estimating the development cost and the development man-hours on the basis of the number of lines of the source code of the software to be developed, the file size, and so on.
- Standard task method

  This is a technique of estimate in which the software development activities are broken down into standard activities, and the points (e.g., the man-hours and the cost) defined in each standard activity are integrated.
- Putnum model

  This is a model that takes into consideration the time series variation in the development man-hours, and is a technique of estimate in which the development cost and the development man-hours are estimated from the performance data of a past development project.

(3) Development of budget

This process creates a budget spending plan including the cost of resources as a cost baseline on the basis of the result of cost estimate. Since a cost baseline is represented as a graph in which the estimation cost is deployed in time series and built-up, the baseline generally results in an S-curve. During cost control, variance analysis is performed on the basis of EVM with the cost baseline as the reference, and the development productivity and the percentage of cost budget spent are managed. If the difference concerning the cost baseline is too great, it is necessary to consider changing the cost baseline to a realistic standard.

2 - 5 Project Quality Management

The purpose of project quality management is to clarify of the quality of the project and products, and to control the project in order to satisfy the quality. Use CMMI (Capability Maturity Model-Integrated) as the quality standard of the project and the software quality characteristics of ISO/IEC 9126 (JIS X 0129) as the quality standard of the products.
In order to achieve the purpose of the project and the quality desired by the stakeholders, the following processes are implemented in conformity to the ISO 9000 (JIS Q 9000) series (i.e., standard concerning the quality management system).

Process groups	Process to implement
Initiating	–
Planning	Plan quality [Plan quality management]
Implementing [Executing]	Perform quality assurance
Controlling [Monitoring and controlling]	Perform quality control [Control quality]
Closing	–

Note: The terms enclosed in brackets [ ] are used only in PMBOK.

(1) Quality management plan

On the basis of the project management plan, the subsidiary plans, and the requirements document, the quality requirements or quality standards concerning the project and the products are specified. Then, a quality management plan is developed which describes the quality policies, quality objectives, and quality plan for securing the quality level. The quality management plan also includes activities towards continuous process improvements.
The following techniques and tools are used in quality management planning.

- QFD (Quality Function Deployment)
  This is a technique used to clarify the requirements concerning the products and services, and deploy them in specifications needed to develop the products and services meeting those requirements.
- COQ (Cost of Quality)
  This is the total cost of quality. The cost of quality is on the basis of the concept called "Prevention over Inspection" according to which "The cost of preventive action for a defect is much less as compared with the cost of corrective actions." Moreover, in the case of the waterfall model, the cost of correcting a defect that occurs at an early stage (e.g., design process) is more than the cost of correcting a defect that occurs at a later

stage (e.g., the programming process).

- Seven QC Tools

  These are the quality control techniques and include Pareto chart, histogram, scatter diagram, control chart, stratification, check sheet, and cause-and-effect diagram. (Refer to p.77 for details.)

- Benchmark (benchmarking)

  This is a technique of identifying the best practice of a project that is being executed (or under planning), or examining an improvement plan by comparing it with a similar plan.

(2) Quality assurance

In order to achieve the quality requirements and quality standards that are defined during quality management plan, the quality assurance activities are implemented according to the quality management plan.

The quality assurance activities are also implemented in an integrated manner by setting up a specialized department. Moreover, in order to perform continuous process improvement by repeatedly performing quality improvement of all processes, comprehensive support is necessary.

In quality assurance, in addition to the techniques and tools that are used during quality management planning, the following techniques and tools are used.

- New Seven QC Tools

  These are the quality control techniques and include affinity diagram, association diagram, matrix diagram, matrix data analysis, arrow diagram, tree diagram (logic tree), and PDPC (Process Decision Program Chart). (Refer to p.77 for details.)

- Quality audit

  In this technique, a third party investigates and evaluates systematically whether the project conforms to the quality policies, the processes, and the procedures. During quality audit, the implementation status of already-approved change requests is checked, which includes corrective actions, preventive actions, and defect correction.

- Process analysis

  The process analysis examines the problems and contradictions, and worthless activities that occur during the execution of processes, and identifies the improvement plans necessary in the process.

(3) Quality control

This process monitors, according to the quality management plan, if the quality requirements and quality standards that are defined during quality management planning are achieved. In addition, the monitoring results are recorded, and if there is a quality defect in a process or a product, the action plans are made and implemented in order to identify and remove the cause. In quality control, the same techniques and tools as during quality management planning and quality assurance are used. Also, the inspection is performed to see if the result of activities conforms to the quality standards. The inspection is performed onto the activity results and final deliverable (e.g., product) of each activity unit. The results of inspection and the records of detected failures are documented as a failure report, and the failures are dealt by either corrective actions or defect correction. At this time, the result of the corrective action or defect correction is confirmed by an inspection.
In a software (or system) development project, a review (e.g., walk-through, inspection) and a test (e.g., a unit test, join test, qualification test) are included in the inspection. The review execution time and the number of tested items (or coverage rate), which are included in the results, are part of the quality management indexes or indicators of software. Also, it must not be forgotten that during quality management, not only the system and software, but also various documents need to be managed.

2 - 6 Project Risk Management

The purpose of project risk management is to clarify and control the risks (i.e., uncertain events that exert either a positive or negative influence) hidden in the project.
The following processes are implemented in order to increase the number of risks that exert a positive influence and reduce the number of risks that exert a negative influence.

Process groups	Process to implement
Initiating	–
Planning	[Plan risk management]
	Identify risks
	Assess risks [Perform qualitative risk analysis] [Perform quantitative risk analysis]
	[Plan risk responses]
Implementing [Executing]	Treat risks
Controlling [Monitoring and controlling]	Control risks

Closing	–

Note: The terms enclosed in brackets [ ] are used only in PMBOK.

(1) Risk management plan

This process specifies the risk management methods (e.g., techniques and tools) and the risk category in a project, and prepares a risk management plan, on the basis of the project risks (i.e., high-level risks) that are described in the project charter, the project management plan, and the subsidiary plans. In the risk category, a RBS (Risk Breakdown Structure) is prepared in which stepwise refinement of risks is performed in order to classify and organize the risks.

(2) Risk identification

This process identifies the risks that affect the project on the basis of the management plan and the project documents (e.g., various estimates, baselines) that are created in each process, and creates a risk register describing the characteristics of each risk. If an executable risk treatment can also be identified during risk identification, it must also be listed in the risk register.
The following techniques are available for collecting information for risk identification.

- Brainstorming
  This is a technique to uncover and reveals the project risks by exchanging opinions freely and openly with the project team and external expert groups.
- Delphi method
  This is a technique to identify (or create an agreement on) the project risks by repeatedly collecting, summarizing, and redistributing the opinions of several experts through questionnaires.

The following risk identification techniques are available.

- Checklist analysis
  The risks are identified by cross-checking against a checklist prepared by compiling together the expected risks on the basis of the information and knowledge accumulated from similar projects in the past.
- Monte Carlo method
  The risks are identified by performing several simulations or numerical analyses that make use of probability distribution and random numbers.
- Assumptions analysis
  The risks that occur as a result of inaccurate, incomplete, and unstable assumptions are

identified by checking the validation of the assumptions of the project.

(3) Qualitative risk analysis / quantitative risk analysis

In these analyses, the identified risks are analyzed, and each risk assessment is performed. (For example, the priority for risk response and the risk acceptance/permission are assessed.)
In qualitative risk analysis, a priority order is given to the risk on the basis of the occurrence probability (or the occurrence frequency) of the risk and the extent of impact during the time of risk being actualized, and thereafter, the risk is listed in the risk register.
In quantitative risk analysis, the accuracy is improved by performing a detailed analysis starting from the risk with a high priority order, the effect of the risk is quantified into amount of money, hours, and number of persons, and this is described in the risk register.

(4) Risk response plan (risk treatment plan)

A risk response plan is created to increase the number of risks that exert a positive influence (i.e., opportunities) and reduce the number of risks that exert a negative influence (i.e., threats). The response to risks that exert a positive influence includes “utilization, sharing, and enhancement” and the response to risks that exert a negative influence includes “avoidance, transfer, and mitigation.” However, a response called “risk acceptance” is applicable for both types of risks.
A contingency plan (emergency response plan) is also set up as a measure in cases where a threat with a particularly large impact has manifested itself.

(5) Control of risks

Risk response is implemented according to risk response planning. At this time, a follow-up check of the identified risks is performed, and the residual risks are monitored. If there is a possibility of intervention of new risks along with the progress of the project, the risks are identified and appropriate measures are taken. The series of activities are controlled and the effectiveness of risk management is evaluated.
Since the risk environment changes with time and situation, it is desirable to repeatedly perform risk management according to the PDCA cycle.

2 - 7 Management of Other Subject Groups

2-7-1 Project Stakeholder Management

The purpose of project stakeholder management is to clearly identify the stakeholders (i.e., interested parties: individuals, groups, and organizations affected by, or affecting the project) and to perform control so as to build and maintain a favorable relationship with the stakeholders. The following processes are implemented in order to proceed smoothly with the project while a favorable relationship is built and maintained with the stakeholders.

Process groups	Process to implement
Initiating	Identify stakeholders
Planning	[Plan stakeholder management]
Implementing [Executing]	Manage stakeholders [Manage stakeholder engagement]
Controlling [Monitoring and controlling]	[Control stakeholder engagement]
Closing	–

Note: The terms enclosed in brackets [ ] are used only in PMBOK.

(1) Identification of stakeholders

This process identifies the stakeholders and the impact that the stakeholders bring about on the basis of the project charter, and creates a stakeholder register. The identified stakeholders are classified on the basis of the authority and the interest level, the authority and the participation level, the participation level and influence, and the salience model (which classifies stakeholders by using three factors: power, urgency, and legitimacy).

(2) Stakeholder management plan

A plan is drafted for encouraging the identified stakeholders to effectively participate in the project, and a stakeholder management plan is developed. At this time, a stakeholder engagement (active participation in the project) is analyzed, which forms an important element for leading the project to its success, on the basis of five stages namely Unaware, Resistant, Neutral, Supportive, and Leading.

(3) Stakeholder engagement management

A favorable relationship with the stakeholders is built and maintained under the responsibility of the project manager according to the stakeholder management plan. At this time, the content of the information transmitted to the stakeholders and the transmission means conform to the communications management plan that is created in project communication management. By improving stakeholder engagement, it is expected that the project will be supported and the risks caused by the stakeholders will be reduced.

2-7-2 Project Resource Management

The purpose of project resource management is to clarify of the resources necessary for achieving the purpose of the project, and to control the resources. In addition to human resources such as staff members like the project manager and the project members, the project management team (team that performs management activities within the project), and organization systems such as PBO (Project-Based Organization) and PMO (Project Management Office), resources include physical resources such as devices, equipment, material, software, and hardware. In project resource management, these resources are estimated and arranged appropriately without any excess or deficiency.

In PMBOK, the following processes are implemented as project human resources management in order to perform control concerning human resources.

Process groups	Process to implement
Initiating	Establish project team
Planning	Estimate resources Define project organization [Plan human resource management]
Implementing [Executing]	[Acquire project team]
	Develop project team
	[Manage project team]
Controlling [Monitoring and controlling]	Control resources Manage project team
Closing	–

Note: The terms enclosed in brackets [ ] are used only in PMBOK.

(1) Human resource management plan

This process creates a human resource management plan (i.e., a subsidiary plan) that is composed of "roles and responsibilities," "project organization chart," and "staff members management plan" on the basis of the content that is described in the project management plan.

(2) Establishment of a project team / development of a project team

The members who are necessary for completing the project are collected according to the human resource management plan, and a project team is started. In order to enable the project team to exhibit sufficient performance, the ability of the project team is developed and enhanced.

[Project team organization]

- Chief programmer team

  Staff members such as programmers, backup programmers, and a librarian are assigned under the chief programmer, and the development work progresses under the guidance of the chief programmer.
- Specialist team

  Several technical specialists from specialized fields assist one chief programmer who creates all programs.

2-7-3 Project Procurement Management

The purpose of project procurement management is to acquire or purchase the resources necessary from outside of the project team for executing the project. In addition to outsourcing and system integrator, the methods of utilization of external resources include co-sourcing, which is a form of outsourcing in which the outsourcee and the outsourcer perform their work at equal positions and distribute the profits, and IDC (Internet Data Center), which is a data center specializing in Internet connections.

The following processes are implemented in project procurement management. As for the actual procurement procedures, the acquisition processes of Common Framework 2013 are commonly applied. (Refer to p.222 for details on the procurement procedures.)

Process groups	Process to implement
Initiating	–
Planning	Plan procurements [Plan procurement management]
Implementing [Executing]	Select suppliers

	[Conduct procurements]
Controlling [Monitoring and controlling]	Administer procurements [Control procurements]
Closing	[Close procurements]

Note: The terms enclosed in brackets [ ] are used only in PMBOK.

(1) Procurement management plan

This process specifies the procurement standard (i.e., supplier selection criteria) and procurement contract type, and create a procurement management plan. Also, it is necessary to prepare various procurement documents: the procurement statement of work that defines the scope of activities for procurement; RFI (Request For Information), RFP (Request For Proposal), and RFQ (Request For Quotation) that are used during procurement; and such other documents.

[Procurement contract type]

- Fixed price contract (lump-sum contract)

  The supplier provides products and services at a fixed remuneration up to the specified deadline. Since the amount is fixed, there is less risk to the acquirer.

- Cost-reimbursable contract

  The supplier adds a profit to the cost and charges the acquirer. Since the total cost is not clear at the time of the contract, the risk to the acquirer is high.

  - Cost plus fixed fee contract

    In this type of contract, a fixed profit (i.e., fixed fee) is added to the cost.

  - Cost plus incentive fee contract

    In this type of contract, an incentive that is in response to the objectives accomplishment level is added to the cost.

- T&M contract (Time and material contract)

  The supplier charges the acquirer an amount obtained by multiplying the actual work time and the amount of resources used with the unit value set for the time and the material. Since the total cost is not clear at the time of the contract, the risk to the acquirer is high.

2-7-4 Project Communications Management

The purpose of project communications management is to control the communication with the stakeholders and the communication within the project team by appropriately performing the tasks from generation of information up to its disposal in the project.

The following processes are implemented in project communications management.

Process groups	Process to implement
Initiating	–
Planning	Plan communications [Plan communications management]
Implementing [Executing]	Distribute information [Manage communications]
Controlling [Monitoring and controlling]	Manage communications [Control communications]
Closing	–

Note: The terms enclosed in brackets [ ] are used only in PMBOK.

(1) Communications management plan

This is the process of creating a communications management plan and setting the stakeholders' requirements, along with the information/language/format/content/detailing to be conveyed, and the communication methods.

[Communication methods]

- Interactive communication (bidirectional communication)
  This is a method in which information is exchanged mutually between two or more parties, such as meetings, conversations, and video conferences. Since this results in a feedback loop in which opinions are mutually exchanged, it is also called feedback communication.
- Push communication
  This is a method of distributing information to specific recipients who need to receive the information. Push communications include letters, e-mails, voice mails, reports, faxes, and such others.
- Pull communication
  This is a method of obtaining information at recipients' discretion from websites on the Internet or the Intranet and from printed materials such as newspapers and magazines. It is used when there are many unspecified recipients or a large amount of information.

(2) Communications management

Generation, collection, distribution, storage, and search of information is performed effectively in a project according to the communications management plan. In particular, when information

such as project performance and deliverables is distributed to stakeholders, it is necessary to make efforts to convert the scope, schedule, cost, and quality into an easy-to-understand format. The feedback of the stakeholders concerning information distribution is utilized in performance correction and process improvement of the project.

Chapter 5 Exercises

Q1

Which of the following is a characteristic that is common to many project life cycles and is the highest during the implementation of the activities of the project?

a) Extent of influence of stakeholders
b) Uncertainty of the project
c) Required number of staff members for the project
d) Risk of not being able to achieve the objectives

Q2

Which of the following is an appropriate item that is described in the project charter?

a) Performance measurement baseline
b) Causes and background of project discontinuation
c) Change requests concerning the project
d) Purpose and validation of the project

Q3

Which of the following is an appropriate purpose of using WBS (Work Breakdown Structure) in a project of software development?

a) To estimate the development cost and manage it intensively
b) To discover the critical path at an early stage and manage it intensively
c) To divide the activity into smaller segments by using the top-down method, and simplify the management of activities
d) To create an activity schedule in consideration of usable resources

Q4

In a project, an activity that an experienced employee can complete in one day, can be completed in two days by a general employee. When a new employee who is not yet familiar with the work performs the same activity, it takes six days to be completed. Which of the following is a technique to estimate the period that is required for the activity as three days by the expression that is described below?

Estimate of the duration that is required for the activity = (1 + 2 + 6) ÷ 3 = 3 days

a) Parametric estimate
b) Three-point estimate
c) Reserve analysis
d) Analogous estimate

Q5

In a project, the performance management is conducted through EVM. Which of the following is the expression of the condition where the progress of the project is behind schedule?

a) EV − AC > 0
b) EV − AC < 0
c) EV − PV > 0
d) EV − PV < 0

Q6

The following table shows the number of measurements and the weighting coefficient of each function type on the basis of the FP (Function Point) method of an application program. What is the number of function points of this application program? Here, the correction coefficient of complexity is 0.75.

Function type name	Number of measurements	Weighting coefficient
External input	1	4
External output	2	5
Internal logical file	1	10
External interface file	0	7
External inquiry	0	4

a) 18 b) 24 c) 30 d) 32

Q7

When the activities of project quality management are classified into quality plan, quality assurance, and quality control, which of the following is an appropriate activity of quality assurance?

a) Deciding on the method for removing the cause of occurrence of unsatisfactory results for the quality standards that is defined in the project
b) Performing planned and systematic activities to ensure the fulfillment of the quality standards that is defined in the project
c) Inspecting whether or not the performance results of the project conform to the defined quality standards
d) Setting appropriate quality standards for the performance results of the project, and defining the procedures to satisfy the standards

Q8

Which of the following is a technique to identify project risks by repeatedly collecting, summarizing, and redistributing opinions from several experts?

a) Qualitative risk analysis
b) Delphi method
c) Brainstorming
d) Monte Carlo method

Q9

The table below shows the relationship between preparation activities *A* through *E* for an event, the standard number of persons in charge for each activity, and the number of days required for each activity. On the basis of this table, preparation activities were started 35 days ago, but because of other activities only one staff member was assigned for the first 20 days. In order to perform the remaining preparation activities in time for the event, what is the minimum number of staff members that must be assigned per day? Here, each preparation activity has a manual, therefore, anyone can perform any activity and the activities can be performed in parallel.

Preparation activity	Standard number of staff members	Required number of days
A	2	5
B	2	5
C	3	10
D	2	5
E	5	10

a) 4 b) 5 c) 6 d) 7

Q10

In a project, the project manager sends a report that contains the project performance to specific stakeholders through e-mail. Which of the following is the communication method that is implemented by the project manager?

a) Interactive communication
b) Feedback communication
c) Push communication
d) Pull communication