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Systems and software engineering — Life cycle processes — Project management

Ingénierie du logiciel — Processus de cycle de vie — Gestion de projet

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of ISO/IEC JTC 1 is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

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ISO/IEC/IEEE 16326 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 7, *Software and systems engineering*, in cooperation with the Software and Systems Engineering Standards Committee of the IEEE, under the Partner Standards Development Organization cooperation agreement between ISO and IEEE.

This first edition of ISO/IEC/IEEE 16326 cancels and replaces ISO/IEC TR 16326, which has been technically revised and merged with content from IEEE Std 1058-1998.

Introduction

This International Standard provides normative content specifications for project management plans covering software projects, and software-intensive system projects.

This International Standard also provides detailed discussion and advice on applying a set of project processes that are common to both the software and system life cycle as covered by ISO/IEC 12207:2008 (IEEE Std 12207-2008), *Systems and software engineering – Software life cycle processes* [15], and ISO/IEC 15288:2008 (IEEE Std 15288-2008), *Systems and software engineering – System life cycle processes* [16], respectively. The discussion and advice are intended to aid in the preparation of the normative content of project management plans.

This International Standard is the result of the harmonization of ISO/IEC TR 16326:1999 and IEEE Std 1058-1998.

Systems and software engineering — Life cycle processes — Project management

1 Scope

1.1 Purpose

This International Standard is intended to aid project managers in managing to successful conclusion those projects concerned with software-intensive systems and software products.

This International Standard specifies the required content of the project management plan (PMP). This International Standard also quotes the extracted purpose and outcome statements from the project processes of ISO/IEC 12207:2008 (IEEE Std 12207-2008) and ISO/IEC 15288:2008 (IEEE Std 15288-2008), and adds detailed guidance for managing projects that use these processes for software products and software-intensive systems.

1.2 Field of application

This International Standard is written for those who use or plan to use ISO/IEC 15288:2008 (IEEE Std 15288-2008) and ISO/IEC 12207:2008 (IEEE Std 12207-2008) on projects dealing with software-intensive systems and software products, regardless of project scope, product, methodology, size or complexity. The field of application of this International Standard spans the whole software or system life cycle, and addresses everybody who plays a role in project management – project managers and others, specifically:

- those responsible for establishing and continuously improving ISO/IEC 12207:2008 (IEEE Std 12207-2008) software life cycle processes and ISO/IEC 15288:2008 (IEEE Std 15288-2008) system life cycle processes;
- those responsible for executing any ISO/IEC 12207:2008 (IEEE Std 12207-2008) software life cycle process or ISO/IEC 15288:2008 (IEEE Std 15288-2008) system life cycle process at a project level;
- organizations or individuals subcontracting a project management effort.

In many organizations, the various responsibilities of project management are assigned to more than one person. Where the term "project manager" is used in this International Standard, the guidance, advice or normative requirement applies to the applicable role within the organization.

This International Standard is intended to provide guidance for two-party situations and may be equally applied where the two parties are from the same organization. This International Standard can also be used by a single party as self-imposed tasks.

This International Standard can also serve as guidance in multi-party situations, where high risks are inherent in the supply and integration of complex software-based systems, and procurement can involve several vendors, organizations or contracting parties.

1.3 Limitations

The normative content specifications for project management plans and the guidance for management of the project processes are limited to projects dealing with software-intensive systems and software products.

2 Conformance

This International Standard provides normative definition of the content of the project management plan (PMP), and provides guidance for the execution of the project processes of ISO/IEC 15288:2008 (IEEE Std 15288-2008) and ISO/IEC 12207:2008 (IEEE Std 12207-2008). Users of this International Standard can claim conformance to the normative documentation content, to the process provisions, or both.

2.1 Conformance to normative documentation content

A claim of conformance to the documentation provisions of this International Standard means that the user demonstrates that the content of a PMP conforms to the content requirements specified in clause 5 of this International Standard.

2.2 Conformance to processes

A claim of conformance to the process provisions of this International Standard is equivalent to claiming conformance to the project processes from ISO/IEC 15288:2008 (IEEE Std 15288-2008) and ISO/IEC 12207:2008 (IEEE Std 12207-2008) cited in clause 6 of this International Standard.

2.3 Full conformance

A claim of full conformance to this International Standard is equivalent to claiming conformance to the PMP content requirements cited in clause 5 and the project processes of ISO/IEC 15288:2008 (IEEE Std 15288-2008) and ISO/IEC 12207:2008 (IEEE Std 12207-2008) cited in clause 6 of this International Standard.

3 Symbols and abbreviations

The following symbols and abbreviations are used in this International Standard:

ANSI	American National Standards Institute
CCB	Configuration/Change Control Board
CDRL	Contract Data Requirements List
GATES	Stage-Gate methodology
IBM	International Business Machines
ICWG	Interface Control Working Group
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Organization for Standardization
OGC	Office of Government Commerce (UK)
PERT	Program Evaluation Review Technique
PM	Project Management (or Project Manager)
PMBOK®	Project Management Body of Knowledge

PMI	Project Management Institute
PMP	Project Management Plan
PPL	Product Parts List
PRINCE2	Projects In Controlled Environments (version 2)
RUP	Rational Unified Process® (registered trademark of IBM)
SDP	Software Development Plan
SE	Software Engineering
SEE	Software Engineering Environment
SEMP	Systems Engineering Management Plan
SWEBOK	Software Engineering Body of Knowledge
UK	United Kingdom
USA	United States of America
WBS	Work Breakdown Structure

4 Application of this International Standard

This International Standard specifies the required content of a Project Management Plan (PMP) such that the overall content of the plan, when executed successfully, fulfils the purposes and desired outcomes which are specified by the project processes of ISO/IEC 15288:2008 (IEEE Std 15288-2008) and ISO/IEC 12207:2008 (IEEE Std 12207-2008).

The project processes of ISO/IEC 15288:2008 (IEEE Std 15288-2008) and of ISO/IEC 12207:2008 (IEEE Std 12207-2008) contain the generic activities and tasks, which may be employed by any party that has to manage a project dealing with software-intensive systems or software products. This International Standard provides additional detailed guidance in clause 5 to assist managers of these projects as they produce the PMP for a specific project.

ANSI/PMI 99-001-2004, *A Guide to the Project Management Body of Knowledge* [1] provides important information about managing projects, and ISO 10006:2003, Quality management systems - Guidelines for quality management in projects [2] provides guidance on the application of quality management in projects. Managers of projects dealing with software products or software-intensive systems may find the contents of the *PMBOK®*[1] *Guide* [1] and ISO 10006:2003 [2] helpful, along with the guidance in this International Standard, in managing their projects to a successful conclusion.

Project managers should also apply the guidance in this International Standard in an iterative manner to consider any systemic impact when undertaking an action, e.g., an action, or failure to act, in one area can affect other areas.

[1] *PMBOK®* is a registered trademark of the Project Management Institute, Incorporated. This information is given for the convenience of users of this standard and does not constitute an endorsement by ISO/IEC or the IEEE of these products. Equivalent products may be used if they can be shown to lead to the same results.

5 Elements of the project management plan

This clause specifies each of the elements of a PMP, as shown in Figure 1.

Title page
Signature page
Change history
Preface
Table of contents
List of figures
List of tables
1. Project overview
    Project summary
        Purpose, scope and objectives
        Assumptions and constraints
        Project deliverables
        Schedule and budget summary
    Evolution of the plan
2. References
3. Definitions
4. Project context
    Process model
    Process improvement plan
    Infrastructure plan
    Methods, tools and techniques
    Product acceptance plan
    Project organization
        External interfaces
        Internal interfaces
        Authorities and responsibilities
5. Project planning
    Project initiation
        Estimation plan
        Staffing plan
        Resource acquisition plan
        Project staff training plan
    Project work plans
        Work activities
        Schedule allocation
        Resource allocation
        Budget allocation
        Procurement plan
6. Project assessment and control
    Requirements management plan
    Scope change control plan
    Schedule control plan
    Budget control plan
    Quality assurance plan
    Subcontractor management plan
    Project closeout plan
7. Product delivery
8. Supporting process plans
    Project supervision and work environment
    Decision management
    Risk management
    Configuration management
    Information management
        Documentation
        Communication and publicity
    Quality assurance
    Measurement
    Reviews and audits
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Figure 1 – Format of a project management plan

The PMP shall contain all the items in Figure 1, ordered as shown in Figure 1. The order of the items is intended for ease of reading, for standardization of presentation, and use, and not as a guide to the order of preparation of the various elements of the PMP. The various clauses and subclauses of the PMP may be included by direct incorporation or by reference to other plans and documents.

Detailed descriptions of each clause and subclause in a PMP are presented in 6.1 through 6.8 of this standard. Additional plans are often required to satisfy product requirements and contractual terms. Additional plans are specified in 6.9.

Project managers should produce the contents of the plans specified below such that they fulfil the purpose and desired outcomes which are specified by ISO/IEC 12207:2008 (IEEE Std 12207-2008) and ISO/IEC 15288:2008 (IEEE Std 15288-2008), and which are cited in Clause 5 of this International Standard. Since the application and use of software products and services must by necessity be done in the larger context of systems in which they reside, project managers should, when producing these plans, strive when possible to harmonize the desired project outcomes cited for both ISO/IEC 12207:2008 (IEEE Std 12207-2008) and ISO/IEC 15288:2008 (IEEE Std 15288-2008).

The PMP shall be a living document that is continuously updated throughout the life of the project. A change history log shall be used to document PMP changes.

Each version of a PMP based on this standard shall contain front matter which includes:

- a title page, which shall contain the project name, the date of issue, a unique identifier (draft number, baseline version number), and identification of the issuing organization.
- a signature page, which shall contain the signature(s) of the person(s) responsible for reviewing and approving the PMP.
- a change history, which shall include the project name, revision status of the plan, date of release, a list of pages that have been changed in the current revision of the plan, a brief statement describing the nature of changes incorporated into this revision of the plan, and a list of all previous revisions of the plan which includes an identification of each revision and its release date.
- a preface, which shall describe the scope and context of the PMP and identify the intended audience for the PMP.
- a table of contents.
- a list of figures that appear in the PMP.
- a list of tables that appear in the PMP.

5.1 Project overview (Clause 1 of the PMP)

5.1.1 Project summary (Subclause 1.1 of the PMP)

5.1.1.1 Purpose, scope and objectives (Subclause 1.1.1 of the PMP)

This subclause of the PMP shall state the purpose, scope, and objectives of the project and the products to be delivered. The statement of scope shall be consistent with similar statements in the project agreement and other relevant system-level or business-level documents.

This subclause of the PMP shall also provide a brief statement of the business or system needs to be satisfied by the project, with a concise summary of the project objectives, the products to be delivered to satisfy those objectives, and the methods by which satisfaction will be determined. The project statement of purpose shall

describe the relationship of this project to other projects, and, as appropriate, how this project will be integrated with other projects or ongoing work processes.

A reference to the official statement of product requirements shall be provided in this subclause of the PMP.

5.1.1.2 Assumptions and constraints (Subclause 1.1.2 of the PMP)

This subclause of the PMP shall describe the assumptions on which the project is based and imposed constraints on project factors such as the scope, schedule, budget, resources, software to be reused, acquirer software to be incorporated, technology to be employed, project enabling facilities, product interfaces to other products, expected product user's environment and required integrity level. This subclause should also describe any considerations of scope or objectives to be excluded from the project or the resulting product.

5.1.1.3 Project deliverables (Subclause 1.1.3 of the PMP)

This subclause of the PMP shall list the work products that will be delivered to the acquirer, the delivery dates, delivery locations, and quantities required to satisfy the terms of the project agreement. In addition, this subclause shall specify the delivery media and any special instructions for packaging and handling. The list of project deliverables may be incorporated into the PMP directly or by reference to an external document such as a contract data requirements list (CDRL) or a product parts list (PPL). This subclause shall also include any work products that are deliverables internal to the project team, such as results from one project phase that are used by a subsequent phase, or organizational process metric data.

5.1.1.4 Schedule and budget summary (Subclause 1.1.4 of the PMP)

This subclause of the PMP shall provide a summary of the schedule and budget for the project. The level of detail should be 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. This subclause shall also include payment details and schedules.

5.1.2 Evolution of the plan (Subclause 1.2 of the PMP)

This subclause of the PMP shall specify the plans for producing both scheduled and unscheduled updates to the PMP. Methods of disseminating the updates shall be specified. This subclause shall also specify the mechanisms used to place the initial version of the PMP under configuration management and to control subsequent changes to the PMP.

5.2 References (Clause 2 of the PMP)

This clause of the PMP shall provide a complete list of all documents and other sources of information referenced in the PMP. Each document should be identified by title, report number, date, author, path/name for electronic access, and publishing organization. Other sources of information, such as electronic files, shall be identified using unique identifiers such as date and version number. Any deviations from referenced standards or policies shall be identified and justifications shall be provided.

5.3 Definitions (Clause 3 of the PMP)

This clause of the PMP shall define, or provide references to documents containing the definition of, all terms and acronyms required to properly understand the PMP.

5.4 Project context (Clause 4 of the PMP)

5.4.1 Process model (Clause 4.1 of the PMP)

This subclause of the PMP shall either reference the life cycle model management process or specify the relationships among major project work activities and supporting processes by specifying the flow of

information and work products among activities and functions, the timing of work products to be generated, reviews to be conducted, major milestones to be achieved, baselines to be established, project deliverables to be completed, and required approvals that span the duration of the project. In addition, the technical standards, policies, and procedures governing development and/or modification of the work products shall be specified. The process model for the project shall include project initiation and project termination activities. To describe the process model, a combination of graphical and textual notations may be used. Any tailoring of an organization's standard process model for a project shall be indicated in this subclause.

5.4.2 Process improvement plan (Clause 4.2 of the PMP)

This subclause of the PMP shall either reference the life cycle model management process or include plans for periodically assessing the project, determining areas for improvement, and implementing improvement plans. The process improvement plan should be closely related to the problem resolution plan; for example, root cause analysis of recurring problems may lead to simple process improvements that can significantly reduce rework during the remainder of the project. Implementation of improvement plans should be examined to identify those processes that can be improved without serious disruptions to an ongoing project and to identify those processes that can best be improved by process improvement initiatives at the organizational level.

5.4.3 Infrastructure plan (Clause 4.3 of the PMP)

This subclause of the PMP shall specify the plan for establishing and maintaining the development environment (hardware, operating system, network, and software), and the policies, procedures, standards, and facilities required to conduct the project. These resources may include workstations, local area networks, software tools for analysis, design, implementation, testing, and project management, desks, office space, and provisions for physical security, administrative personnel, and janitorial services.

5.4.4 Methods, tools and techniques (Clause 4.4 of the PMP)

This subclause of the PMP shall either reference the life cycle model management process or specify the development methodologies, programming languages and other notations, and the tools and techniques to be used to specify, design, build, test, integrate, document, deliver, modify and maintain the project deliverable and nondeliverable work products.

5.4.5 Product acceptance plan (Clause 4.5 of the PMP)

This subclause of the PMP shall specify the plan for acquirer acceptance of the deliverable work products generated by the project. Objective criteria for determining acceptability of the deliverable work products shall be specified in this plan and a formal agreement of the acceptance criteria shall be signed by representatives of the development organization and the acquiring organization. Any technical processes, methods, or tools required for product acceptance shall be specified in the product acceptance plan. Methods such as testing, demonstration, analysis and inspection should be specified in this plan.

5.4.6 Project organization (Clause 4.6 of the PMP)

This clause of the PMP shall identify interfaces to organizational entities external to the project, describe the project's internal organizational structure, and specify roles and responsibilities for the project.

5.4.6.1 External interfaces (Subclause 4.6.1 of the PMP)

This subclause of the PMP shall describe the organizational boundaries between the project and external entities. This should include, but is not limited to, the following: the parent organization, the acquiring organization, subcontracted organizations, and other organizational entities that interact with the project. Representations such as organizational charts and diagrams may be used to depict the project's external interfaces.

5.4.6.2 Internal interfaces (Subclause 4.6.2 of the PMP)

This subclause of the PMP shall describe the internal structure of the project organization to include the interfaces among the units of the software development team. In addition, the organizational interfaces between the project and organizational entities that provide supporting processes, such as configuration management, quality assurance, and verification and validation, shall be specified in this subclause. Graphical devices such as organizational charts or diagrams should be used to depict the lines of authority, responsibility, and communication within the project.

5.4.6.3 Authorities and responsibilities (Subclause 4.6.3 of the PMP)

This subclause of the PMP shall identify and state the nature of each major work activity and supporting process and identify the organizational units that are responsible for those processes and activities. A matrix of work activities and supporting processes vs. organizational units may be used to depict project authorities and responsibilities.

5.5 Project planning (Clause 5 of the PMP)

This clause of the PMP shall specify the project management processes for the project. This clause shall be consistent with the statement of project scope and shall include the project initiation plans, project work plans, project acquisition and supply plans, project assessment and control plans, and project closeout plan.

5.5.1 Project initiation (Subclause 5.1 of the PMP)

This subclause of the PMP shall specify the details for estimating project scope, the required staffing, the plan for acquiring the resources to support the project staff, and the plan for project staff training. Depending on the size and scope of the project, these plans may be incorporated directly or by reference to other plans.

5.5.1.1 Estimation plan (Subclause 5.1.1 of the PMP)

This subclause of the PMP shall specify the cost and schedule for conducting the project as well as methods, tools, and techniques used to estimate project cost, schedule, resource requirements, and associated confidence levels. In addition, the basis of estimation shall be specified. This subclause shall also specify the methods, tools, and techniques that will be used to periodically re-estimate the cost, schedule, and resources needed to complete the project. Re-estimation may be done on a monthly basis and periodically as necessary. Re-estimation may also be required in a stepwise manner at major project phase points such as customer reviews.

5.5.1.2 Staffing plan (Subclause 5.1.2 of the PMP)

This subclause of the PMP shall specify the number of staff required by skill level, the project phases in which the numbers of personnel and types of skills are needed, and the duration of need. This subclause shall also specify the sources of staff personnel; for example by internal transfer, new hire, or contracted. If personnel from other companies or from the customer are to be hosted along with the project team, this subclause shall also address the details of how the hosting will be accomplished. Resource Gantt charts, resource histograms, spreadsheets, and tables may be used to depict the staffing plan by skill level, by project phase, and by aggregations of skill levels and project phases.

5.5.1.3 Resource acquisition plan (Subclause 5.1.3 of the PMP)

This subclause of the PMP shall specify the plan for acquiring and releasing the resources in addition to personnel needed to successfully complete the project. The resource acquisition plan should include a description of the resource acquisition and release process, including assignment of responsibility for all aspects of resource acquisition. The plan should include, but not be limited to, acquisition and release plans for equipment, computer hardware and software, training, service contracts, transportation, facilities, and administrative and janitorial services. The plan should specify the points in the project schedule when the various acquisition and release activities will be required. Constraints on acquiring the necessary resources

shall be specified. This subclause may be expanded into additional subclauses of the form 5.1.3.x to accommodate acquisition plans for various types of resources to be acquired.

5.5.1.4 Project staff training plan (Subclause 5.1.4 of the PMP)

This subclause of the PMP shall specify the training needed to ensure that necessary skill levels in sufficient numbers are available to successfully conduct the project. The training schedule shall include the types of training to be provided, numbers of personnel to be trained, entry and exit criteria for training, and the training method; for example, lectures, consultations, mentoring, or computer-assisted training. The training plan should include training as needed in both technical and managerial skills. If personnel from other companies or from the customer are to be hosted as part of the project team, this subclause shall specify the training to be provided for them.

5.5.2 Project work plans (Subclause 5.2 of the PMP)

This clause of the PMP shall specify the work activities, schedule, resources, budget and procurement details for the project.

5.5.2.1 Work activities (Subclause 5.2.1 of the PMP)

This subclause of the PMP shall specify the various work activities to be performed in the project. A work breakdown structure should be used to depict the work activities and the relationships among work activities. Work activities shall be decomposed to a level that exposes all project risk factors and allows accurate estimate of resource requirements and schedule duration for each work activity. Work packages should be used to specify, for each work activity, factors such as the necessary resources, estimated duration, work products to be produced, acceptance criteria for the work products, and predecessor and successor work activities. The level of decomposition for different work activities in the work breakdown structure may be different depending on factors such as the quality of the requirements, familiarity with the work, and novelty of the technology to be used.

5.5.2.2 Schedule allocation (Subclause 5.2.2 of the PMP)

This subclause of the PMP shall provide scheduling relationships among work activities in a manner that depicts the time-sequencing constraints and illustrates opportunities for concurrent work activities. Any constraints on scheduling of particular work activities caused by factors external to the project shall be indicated in the work activity schedule. The schedule should include frequent milestones that can be assessed for achievement using objective indicators to assess the scope and quality of work products completed at those milestones. Techniques for depicting schedule relationships may include milestone charts, activity lists, activity Gantt charts, activity networks, critical path networks, and PERT.

5.5.2.3 Resource allocation (Subclause 5.2.3 of the PMP)

This subclause of the PMP shall provide a detailed itemization of the resources allocated to each major work activity in the project work breakdown structure. Resources shall include the numbers and required skill levels of personnel for each work activity. Resource allocation may include, as appropriate, personnel by skill level and factors such as computing resources, software tools, special testing and simulation facilities, and administrative support. A separate line item should be provided for each type of resource for each work activity. A summary of resource requirements for the various work activities should be collected from the work packages of the work breakdown structure and presented in tabular form.

5.5.2.4 Budget allocation (Subclause 5.2.4 of the PMP)

This subclause of the PMP shall provide a detailed breakdown of necessary resource budgets for each of the major work activities in the work breakdown structure. The activity budget shall include the estimated cost for activity personnel and may include, as appropriate, costs for factors such as travel, meetings, computing resources, software tools, special testing and simulation facilities, and administrative support. A separate line

item shall be provided for each type of resource in each activity budget. The work activity budget may be developed using a spreadsheet and presented in tabular form.

5.5.2.5 Procurement plan (Subclause 5.2.5 of the PMP)

This subclause of the PMP shall list the goods and services that will be purchased for the project and how they will be obtained. It shall specify the types of contracts to be used, who will conduct the procurement, sources of standard procurement documents, the deadline for obtaining each good and service and the lead times needed to conduct the procurement process.

5.6 Project assessment and control (Clause 6 of the PMP)

This subclause of the PMP shall specify the procedures necessary to assess and control the product requirements, the project scope, schedule, budget, and resources, the quality and timeliness of acquired products from subcontractors, and the quality of work processes and work products. All elements of the control plan should be consistent with the organization's standards, policies, and procedures for project control as well as with any contractual agreements for project control.

5.6.1 Requirements management plan (Subclause 6.1 of the PMP)

This subclause of the PMP shall specify the control mechanisms for measuring, reporting, and controlling changes to the product requirements. This subclause shall also specify the mechanisms to be used in assessing the impact of requirements changes on product scope and quality, and the impacts of requirements changes on project schedule, budget, resources, risk and performance throughout the project's life cycle. Techniques that may be used for requirements control include traceability, prototyping and modelling, impact analysis, and reviews.

5.6.2 Scope change control plan (Subclause 6.2 of the PMP)

This subclause of the PMP shall describe how to detect activities out of the project's scope and the actions that are to be taken if such activities are found or requested. ISO/IEC TR 19759:2005 [12], chapter 8, section 3.A.5.B.1 provides details on defining the project's scope.

5.6.3 Schedule control plan (Subclause 6.3 of the PMP)

This subclause of the PMP shall specify the control mechanisms to be used to measure the progress of work completed at the major and minor project milestones, to compare actual progress to planned progress, and to implement corrective action when actual progress does not conform to planned progress. The project manager should employ earned value techniques for these measures. The schedule control plan shall specify the methods and tools that will be used to measure and control schedule progress. Achievement of schedule milestones should be assessed using objective criteria to measure the scope and quality of work products completed at each milestone.

5.6.4 Budget control plan (Subclause 6.4 of the PMP)

This subclause of the PMP shall specify the control mechanisms to be used to measure the cost of work completed, to compare planned cost to budgeted cost, and to implement corrective action when actual cost does not conform to budgeted cost. The budget control plan shall specify the intervals at which cost reporting will be done and the methods and tools that will be used to manage the budget. The budget plan should include frequent milestones that can be assessed for achievement using objective indicators to assess the scope and quality of work products completed at those milestones. A technique such as earned value should be used to report the budget and schedule plan, schedule progress, and the cost of work completed.

5.6.5 Quality assurance plan (Subclause 6.5 of the PMP)

This subclause of the PMP shall specify the mechanisms to be used to measure and control the quality of the work processes and the resulting work products. The quality assurance plan shall include provisions for vendor evaluation and control. Quality control mechanisms may include quality assurance of work processes, verification and validation, joint reviews, audits, and process assessment.

5.6.6 Subcontractor management plans (Subclause 6.6 of the PMP)

This subclause of the PMP shall contain plans for selecting and managing any subcontractors that may contribute work products to the project. The criteria for selecting subcontractors shall be specified and the management plan for each subcontract shall be generated using a tailored version of this standard. Tailored plans should include the items necessary to ensure successful completion of each subcontract. In particular, requirements management, monitoring of technical progress, schedule and budget control, product acceptance criteria, quality assurance, and measurement and risk management processes shall be included in each subcontractor plan. Additional topics should be added as needed to ensure successful completion of the subcontract. A reference to the official subcontract and prime contractor/subcontractor points of contact shall be specified.

5.6.7 Project closeout plan (Subclause 6.7 of the PMP)

This subclause of the PMP shall contain the plans necessary to ensure orderly closeout of the project. Items in the closeout plan should include a staff reassignment plan, a plan for archiving project materials, a plan for post-mortem debriefings of project personnel, and preparation of a final report to include lessons learned and analysis of project objectives achieved.

5.7 Product delivery (Clause 7 of the PMP)

This clause of the PMP shall contain plans for delivery of the project's product(s), and shall specify the product delivery approach, the required information flow both internal to the project and to all external organizations required to support the delivery, the packaging and physical delivery plans, and all associated customer documentation such as operation manuals, maintenance manuals and training materials.

5.8 Supporting process plans (Clause 8 of the PMP)

This clause of the PMP shall contain plans for the supporting processes that span the duration of the project. These plans shall include, but are not limited to, project supervision and work environment, decision management, risk management, configuration management, information management, quality assurance and measurement. Plans for supporting processes shall be developed to a level of detail consistent with the other clauses and subclauses of the PMP. In particular, the roles, responsibilities, authorities, schedule, budgets, resource requirements, risk factors, and work products for each supporting process shall be specified. The nature and types of supporting processes required may vary from project to project; however, the absence of any of the plans listed above shall be explicitly justified in any PMP that does not include them. Plans for supporting processes may be incorporated directly into the PMP or incorporated by reference to other plans.

5.8.1 Project supervision and work environment (Subclause 8.1 of the PMP)

This clause of the PMP shall state how the project manager provides day-to-day instructions, guidance, and discipline to help project members fulfil their assigned duties. The project manager shall provide a work environment in which project personnel can work together toward common project goals which ensures a free flow of correct information among project members and allows project personnel to make decisions and expend resources within the limitations and constraints of their roles. The project manager shall also set performance goals for teams as well as for individuals, and encourage constructive differences of opinion and help resolve the resulting conflicts.

5.8.2 Decision management (Subclause 8.2 of the PMP)

This clause of the PMP shall specify decision categories based on circumstances and the need for decisions, and shall specify a scheme for their categorization. It shall specify a decision strategy for each decision category, and shall identify the method of involving all relevant parties in each decision strategy. This subclause shall also identify the desired outcomes of the strategies and shall specify measurable success criteria with which to assess the outcomes. This subclause shall also identify method(s) for tracking and evaluating the outcomes, and for supplying the required information for documenting and reporting in accordance with the information management subclause. The need for decisions may arise as a result of an effectiveness assessment, a technical trade-off, a reported software or hardware problem needing resolution, action needed in response to risk exceeding the acceptable threshold, a new opportunity or approval for project progression to the next life cycle stage.

5.8.3 Risk management (Subclause 8.3 of the PMP)

This subclause of the PMP shall specify the risk management plan for identifying, analyzing, and prioritizing project risk factors. This subclause shall also describe 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 risk management plan shall also specify plans for analyzing initial risk factors and the ongoing identification, analysis, and treatment of risk factors throughout the life cycle of the project. This plan should describe risk management work activities, procedures and schedules for performing those activities, documentation and reporting requirements, organizations and personnel responsible for performing specific activities, and procedures for communicating risks and risk status among the various acquirer, supplier, and subcontractor organizations. Risk factors that should be considered include risks in the acquirer-supplier relationship, contractual risks, technological risks, risks caused by the size and complexity of the product, risks in the development and target environments, risks in personnel acquisition, skill levels and retention, risks to schedule and budget, and risks in achieving acquirer acceptance of the product.

NOTE: ISO/IEC 16085:2006 (IEEE Std 16085-2006) [9] contains provisions for risk management and risk management plans.

5.8.4 Configuration management (Subclause 8.4 of the PMP)

This subclause of the PMP shall contain the configuration management plan for the project, to include the methods that will be used to provide configuration identification, control, status accounting, evaluation, and release management. In addition, this subclause shall specify the processes of configuration management to include procedures for initial baselining of work products, logging and analysis of change requests, change control board procedures, tracking of changes in progress, and procedures for notifying concerned parties when baselines are first established or later changed. The configuration management plan and procedures shall support the management and control of the software and/or system requirements. The configuration management process should be supported by one or more automated configuration management tools.

NOTE: IEEE Std 828-2005 [5], and ISO 10007:2003 [7] contain provisions for configuration management.

5.8.5 Information management (Subclause 8.5 of the PMP)

This subclause of the PMP shall contain the plans for identifying what project information is to be managed, the forms in which the information is to be represented, who is responsible for the various categories of project information, and how project information is to be recorded, stored, made available to designated parties, and disposed of as required. This subclause shall include the plans for protection of both customer and vendor information.

5.8.5.1 Documentation (Subclause 8.5.1 of the PMP)

This subclause of the PMP shall contain the documentation plan for the project, to include plans for generating nondeliverable and deliverable work products. Organizational entities responsible for providing input information, generating, and reviewing the various documents shall be specified in the documentation plan.

Nondeliverable work products may include items such as requirements specifications, design documentation, traceability matrices, test plans, meeting minutes and review reports. Deliverable work products may include source code, object code, a user's manual, an on-line help system, a regression test suite, a configuration library and configuration management tool, principles of operation, a maintenance guide, or other items specified in subclause 1.1.3 of the PMP. The documentation plan should include a list of documents to be prepared, the controlling template or standard for each document, who will prepare it, who will review it, due dates for review copy and initial baseline version, and a distribution list for review copies and baseline versions.

NOTE: ISO/IEC 15289:2006 [8] contains provisions for documentation.

5.8.5.2 Communication and publicity (Subclause 8.5.2 of the PMP)

This subclause of the PMP shall list the stakeholders that need to receive information about the project, the information to be communicated and the format, content and level of detail. Communication tools can include numerous types of publicity and marketing. The plan shall specify who is responsible for each element of communication, who will receive the communication, the methods and technologies that will be used, the frequency of communication, and how issues will be raised to higher levels of management if they are not resolved within specified timeframes. If the communication is to be by document distribution, this subclause shall list the documents and recipients both for distribution within the project team, and external to the team. It shall also describe how the plan will be updated, and it shall provide a glossary of terms and acronyms that are used on the project. If some aspects of communication, such as marketing, are outside the scope of the project, this should be stated and the plan should state how those aspects will be addressed.

5.8.6 Quality assurance (Subclause 8.6 of the PMP)

This subclause of the PMP shall provide the plans for assuring that the project fulfils its commitments to the software process and the software product as specified in the requirements specification, the PMP, supporting plans, and any standards, procedures, or guidelines to which the process or the product must adhere. Quality assurance procedures may include analysis, inspections, reviews, audits, and assessments. The quality assurance plan should indicate the relationships among the quality assurance, verification and validation, review, audit, configuration management, system engineering, and assessment processes.

NOTE: ISO 9001:2000 [10] contains provisions for quality assurance.

NOTE: ISO/IEC 90003:2004 (IEEE Std 90003-2009) [11] contains specific guidance for applying the quality assurance requirements in ISO 9001:2000 to computer software.

5.8.7 Measurement (Subclause 8.7 of the PMP)

This subclause of the PMP shall specify the methods, tools, and techniques to be used in collecting and retaining project measures. The measurement plan shall specify the identified information needs, the measures to be collected, the definitions of each measure, and the methods to be used in validating, analyzing, and reporting the measures.

NOTE: The specification of the measures includes the data in the measurement information model in ISO/IEC 15939:2007 (IEEE Std 15939-2007), frequency of data collection, sources of data, etc.

5.8.8 Reviews and audits (Subclause 8.8 of the PMP)

This subclause of the PMP shall specify the schedule, resources, and methods and procedures to be used in conducting project reviews and audits. The plan should specify plans for joint acquirer-supplier reviews, management progress reviews, developer peer reviews, quality assurance audits, and acquirer-conducted reviews and audits. The plan should list the external agencies that approve or regulate any product of the project.

5.8.9 Verification and validation (Subclause 8.9 of the PMP)

This subclause of the PMP shall contain the verification and validation plan for the project to include scope, tools, techniques, and responsibilities for the verification and validation work activities. The organizational relationships and degrees of independence between development activities and verification and validation activities shall be specified. Verification planning should result in specification of techniques such as traceability, milestone reviews, progress reviews, peer reviews, prototyping, simulation, and modelling. Validation planning should result in specification of techniques such as testing, demonstration, analysis, and inspection. Automated tools to be used in verification and validation should be specified.

NOTE: IEEE Std 1012-1998 [13] contains provisions for ensuring sufficient verification and validation of software.

5.9 Additional plans (Clause 9 of the PMP)

This clause of the PMP shall contain additional plans required to satisfy product requirements and contractual terms. Additional plans for a particular project may include plans for assuring that safety, privacy, and security requirements for the product are met, special facilities or equipment, product installation plans, user training plans, integration plans, data conversion plans, system transition plans, product maintenance plans, or product support plans. For projects dealing with software intensive systems or software products, these additional requirements are usually documented in two additional plans created at a lower level of abstraction than the PMP. These additional plans are the system engineering management plan (SEMP) and the software development plan (SDP).

5.10 End matter

The PMP may also include annexes and an index if applicable to aid in the use of the PMP.

- Annexes: Annexes may be included, either directly or by reference to other documents, to provide supporting details that could detract from the PMP if included in the body of the PMP.

- Index: An index to the key terms and acronyms used throughout the PMP is optional, but is recommended to improve the usability of the PMP.

6 Project processes

This clause examines the seven project processes of ISO/IEC 12207:2008 (IEEE Std 12207-2008) and ISO/IEC 15288:2008 (IEEE Std 15288-2008), providing detailed discussion and application advice as it applies to the management of projects dealing with software-intensive systems and software products. The discussion and advice are intended to aid project managers in producing the normative content of the project management plan (PMP) for a specific project as specified in clause 5 of this International Standard.

Normative project process portions from both ISO/IEC 12207:2008 (IEEE Std 12207-2008) and ISO/IEC 15288:2008 (IEEE Std 15288-2008) are contained in boxed text, with discussion and advice for that portion immediately following. Advice given for software-intensive systems projects also applies to projects undertaken to produce software products. Any advice given specifically for software products is further segregated below the advice for software-intensive systems.

The normative text from the corresponding portions of the ISO/IEC 12207:2008 (IEEE Std 12207-2008) and ISO/IEC 15288:2008 (IEEE Std 15288-2008) project processes cited in this International Standard highlights the fact that in some cases the text of a particular section is different between the citations from the two International Standards. In some cases this is due to the differing fields of application of the two international standards; e.g., whereas the life cycle process context of ISO/IEC 12207:2008 (IEEE Std 12207-2008) is focused on software products and services, the life cycle process focus of ISO/IEC 15288:2008 (IEEE Std 15288-2008) is on the broader treatment of complete systems. In other cases the differences may be due to certain purpose or outcome statements in ISO/IEC 15288:2008 (IEEE Std 15288-2008) assuming that a given specific item stated in ISO/IEC 12207:2008 (IEEE Std 12207-2008) must have occurred in order for the statement in ISO/IEC 15288:2008 (IEEE Std 15288-2008) to occur. However, the differences are not significant for the purposes of this standard. The guidance provided for each process section in this International Standard is designed to treat the combined purpose and outcome statements for that section from both ISO/IEC 12207:2008 (IEEE Std 12207-2008) and ISO/IEC 15288:2008 (IEEE Std 15288-2008).

There are several prescriptive PM methodologies that support life cycle processes in the field of systems and software engineering, used in both government and the private sector: The PMBOK® Guide [1] contains a comprehensive set of generic project management processes. OGC PRINCE2® Guide [17] provides guidance on PM processes for government information systems projects. RUP® [18] has been mapped [19] to PMBOK®, and applies PM and software development processes iteratively. (Each iteration occurs in any one of the phases of RUP, namely inception, elaboration, construction, transition. An iteration cannot span more than one phase, and an iteration covers the six core and three supporting disciplines of RUP). GATES methodology [20] supports PM governance by enforcing a Stage-Gate approach to control processes through inspection, review, approval, and sign-off of project baselines, artefacts and designated work products (or project deliverables), to ensure readiness for advancement to the next phase, stage, process, activity or task.

The identified processes, activities and tasks for any given project may require an iterative action to accomplish the requirements/goals of a project. For instance, based upon the software life cycle model being used, processes, activities and tasks may be employed at the same time; they may be interdependent; or they may be coordinated in an organized series of Work Breakdown Structure (WBS) dependencies throughout a project life cycle.

The project manager should communicate applicable project plans, deliverables and schedules to the organization's affected stakeholders. The project manager should enlist their commitment to support the project processes with the organization's project enabling processes. ISO/IEC 12207:2008 (IEEE Std 12207-2008), 6.2 and ISO/IEC 15288:2008 (IEEE Std 15288-2008), 6.2 provide guidance for the following organizational project enabling processes:

- Life cycle model management process
- Infrastructure management process
- Project portfolio management process
- Human resource management process
- Quality management process

6.1 Project planning process

ISO/IEC 12207	ISO/IEC 15288
6.3.1 Project Planning Process	**6.3.1 Project Planning Process**
6.3.1.1 Purpose	**6.3.1.1 Purpose**
The purpose of the Project Planning Process is to produce and communicate effective and workable project plans. This process determines the scope of the project management and technical activities, identifies process outputs, project tasks and deliverables, establishes schedules for project task conduct, including achievement criteria, and required resources to accomplish project tasks.	The purpose of the Project Planning Process is to produce and communicate effective and workable project plans. This process determines the scope of the project management and technical activities, identifies process outputs, project tasks and deliverables, establishes schedules for project task conduct, including achievement criteria, and required resources to accomplish project tasks.
6.3.1.2 Outcomes	**6.3.1.2 Outcomes**
As a result of successful implementation of the Project Planning Process: a) the scope of the work for the project is defined; b) the feasibility of achieving the goals of the project with available resources and constraints are evaluated; c) the tasks and resources necessary to complete the work are sized and estimated; d) interfaces between elements in the project, and with other project and organizational units, are identified; e) plans for the execution of the project are developed; and f) plans for the execution of the project are activated.	As a result of the successful implementation of the Project Planning Process: a) Project plans are available. b) Roles, responsibilities, accountabilities, and authorities are defined. c) Resources and services necessary to achieve the project objectives are formally requested and committed. d) Project staff are directed in accordance with the project plans. e) Plans for the execution of the project are activated.

Guidance:

a) The responsibility for preparing and approving plans should be assigned and documented.

b) The project manager should ensure that all project requirements are elicited, documented, analyzed and managed. Project planning should ensure the following activities are included:

1. Involving all stakeholders in the requirements definition of a project.
2. Managing change to the scope and requirements throughout a project's life cycle. All changes in scope and requirements should be carefully evaluated for the impact on cost, schedule, risk, current scope and quality.

3. Reviewing the selection of processes made from a previously successful project when the scope and requirements are changed, to assure that the selected processes are still applicable after the changes in scope and requirements. This review is iterative and occurs whenever changes in scope and requirements occur.
4. Defining who is responsible for obtaining stakeholder agreement on project requirements.
5. Establishing and maintaining traceability between system and software requirements, between software requirements and design, and between software requirements and tests.

c) Critical system engineering efforts should be conducted with the required software engineering resources and skills.

d) Critical software engineering efforts should be conducted with the required systems engineering resources and skills.

e) The project manager should describe the activities required to translate stakeholder requirements into project deliverables and activities to be carried out that will ensure products are delivered as specified in a contract, i.e., ensure a project includes all the work required, and only the work required, to complete the project and product successfully.

f) The project manager should ensure that all aspects of process tailoring and project planning account for the type of project: a new development, embedding in or integration with a larger system, modification of off-the-shelf software product, porting to different operating systems, etc. Process tailoring is fundamental for consistency of a project's activities within the organization, and includes tailoring of various levels of standardized processes from the organization's enterprise level down to the specific project level.

NOTE: Refer to Annex A of ISO/IEC 12207:2008 (IEEE Std 12207-2008) and/or ISO/IEC 15288:2008 (IEEE Std 15288-2008) for details of the tailoring process.

g) The development of the project scope statement should allow for an iterative agreement process to be employed throughout the project life cycle. An initial scope statement is usually based on stated or elicited customer/user requirements, but risks, changes in stakeholder requirements, environment, project budget and schedule, and an evolving design make it necessary to continually reassess and reaffirm agreements and commitments, and make appropriate changes to the project scope statement, as required. The project manager should also determine the feasibility of the planned project processes to ensure personnel, materials, facilities, System/Software Engineering Environment, and technology required to execute and manage a project are available, adequate and appropriate; and the predetermined times for completion are achievable, timely and economical. The results of this feasibility analysis could cause an adjustment to the initial project scope statement. Multiple iterations may be required to achieve a good fit between the project scope statement and the internal project plans and processes.

h) Planning the scope of the project may be difficult when a new project has unprecedented elements. For such a project care should be taken to ensure it is properly scoped and monitored. The organization's risk management process should identify detailed mitigation plans, if it is determined that additional risk exists due to the unfamiliar project.

i) ISO/IEC 10006:2003 [2] provides guidelines for project managers to ensure proper quality of their project’s products and services.

j) The project manager should ensure that a life cycle model appropriate to the project is selected. In general, incremental and evolutionary types of life cycle models should be chosen. Some type of evolutionary model is appropriate when the requirements are not well understood at project initiation. Even when the requirements are relatively well understood, an incremental life cycle model (with more than one iteration) is preferred over a waterfall life cycle model.

k) The planning process should establish completion criteria for all project tasks. The intent, as supported by the PMBOK® Guide [1], is to determine if a project, activity or task has been completed successfully.

l) Project plans should implement agreed-upon assignment of intellectual property ownership, and ensure agreements created or used in the project address this matter.

m) If not addressed as part of the terms and conditions of the agreement between the acquirer and supplier, the project manager should include in the project planning a task to identify with the acquirer at what point the acquirer gains ownership of the project's deliverable products, or, if ownership is not to be granted, what the licensing agreement will be.

n) A project should have one master schedule and all subordinate schedules should be integrated and consistent with the master schedule. A Work Breakdown Structure (WBS) should be used to effectively measure project progress and to provide visibility into processes and products. The PMBOK® Guide [1] strongly recommends a WBS technique because it organizes and specifies the total scope of the project. The WBS should be constructed to allow a project to be managed at the appropriate level of granularity consistent with the size, complexity, criticality and risk of the project.

o) Project estimates used in planning should include:

1. Costs associated with process execution.
2. Nonrecurring costs to produce products.
3. Recurring costs, per year, required of the organization as a result of project completion.
4. Infrastructure.
5. Need for resources, including related management and control.
6. Skill and experience level of personnel assigned to the project.
7. Quality assurance and control.
8. Risk management.
9. SEE provisions.
10. Work to be performed in each process and/or activity.
11. Configuration management.
12. Technical performance measures (e.g., response time, throughput, memory utilization, bandwidth)

p) Project managers should use existing organizational infrastructure whenever appropriate. When existing infrastructure is inappropriate or insufficient to support a project, then adaptation or additions to existing infrastructure should be handled judiciously. This may require the use of subcontracting to satisfy infrastructure deficiencies.

q) Project plans should describe the activities or tasks to facilitate re-planning and refinement of estimates throughout a project life cycle. There are many interdependencies on every project and several iterations of planning are usually required to obtain even an initial project management plan. For information needed by a project management plan but provided in other plans, the project management plan may reference the other plans.

r) Plans should be updated and be consistent with clause 5 of this International Standard.

s) The project manager should ensure that the project management plan and all plans it references are placed under project configuration management.

t) Project planning should describe a mechanism for conflict resolution or escalation so an appropriately authorized level of organizational management may resolve disagreements between the project manager and supporting process management.

u) Whenever supporting processes are performed by organizations outside the direct organizational control of the project manager, it is important to realize the existence of two sets of relationships between: 1) the project manager and the supporting process management, and 2) the supported and supporting organizational management. The project manager should recognize this when considering aspects of planning, implementation, control and reporting through clearly specified technical and management reporting,

information flow and dispute resolution. Synchronization of plans may be more difficult under subcontract agreements and tasking, but can be aided by having one master plan.

v) The project should make use of historical project data when developing estimates and plans. Plan for a mechanism to collect, analyze, archive and retrieve project data. These historical data may be used to improve life cycle processes and support planning and analysis for future projects.

w) When multiple teams from one or more organizations participate in a project, the project manager should integrate these teams by ensuring that each team establishes its charter and shared vision which are aligned with the project's objectives.

x) The number of people and teams on a project should be linked to the budget and schedule, and normal spans of control, i.e., 5 – 20, should not be exceeded.

y) The project manager should plan activities to resolve issues and resource needs for requirements, interfaces and design with relevant stakeholders.

z) During project planning make use of multiple cost estimation techniques, including system and software cost models. Most cost estimation techniques are based on estimated size of the end-product and/or work products. Thus, it is important to accurately estimate the product size.

aa) In the project planning, include contingency planning for both management and technical issues.

ab) The project manager should initiate the project commensurate with the authorization for expenditure (or the additional expenditure) of funds.

Software-specific guidance:

a) ISO/IEC 25030:2007 [14] recommends that care be applied to defining and documenting quality requirements based on quality characteristics such as described in ISO/IEC 9126-1:2001 [3]; for example, when software is to be embedded in a higher-level system, or functions are to be distributed between software and hardware, or between software and external interfacing software or systems.

b) In the planning, account for downstream activities in the life cycle of the system or software product, even if they are not part of the current project.

c) Determine the complexity of the system and software products and develop measures of effectiveness with the acquirer.

d) System, software and hardware plans should be integrated and managed together.

e) When procuring software resources the project manager should determine:

1. Requirements for maintenance, distribution of updates, version upgrades, and the costs of the services to be provided.
2. Ownership rights, e.g., warranty, intellectual rights, patents, licensing and copyrights.

6.2 Project assessment and control process

ISO/IEC 12207	ISO/IEC 15288
6.3.2 Project Assessment and Control Process	**6.3.2 Project Assessment and Control Process**
6.3.2.1 Purpose	**6.3.2.1 Purpose**
The purpose of the Project Assessment and Control Process is to determine the status of the project and ensure that the project performs according to plans and schedules, within projected budgets and it satisfies technical objectives. This process includes redirecting the project activities, as appropriate, to correct identified deviations and variations from other project management or technical processes. Redirection may include replanning as appropriate.	The purpose of the Project Assessment and Control Process is to determine the status of the project and direct project plan execution to ensure that the project performs according to plans and schedules, within projected budgets, to satisfy technical objectives. This process evaluates, periodically and at major events, the progress and achievements against requirements, plans and overall business objectives. Information is communicated for management action when significant variances are detected. This process also includes redirecting the project activities and tasks, as appropriate, to correct identified deviations and variations from other project management or technical processes. Redirection may include replanning as appropriate.
6.3.2.2 Outcomes	**6.3.2.2 Outcomes**
As a result of the successful implementation of the Project Assessment and Control Process: a) progress of the project is monitored and reported; b) interfaces between elements in the project, and with other project and organizational units, are monitored; c) actions to correct deviations from the plan and to prevent recurrence of problems identified in the project, are taken when project targets are not achieved; and d) project objectives are achieved and recorded.	As a result of the successful implementation of the Project Assessment and Control Process: a) Project performance measures or assessment results are available. b) Adequacy of roles, responsibilities, accountabilities, authorities and resources and services necessary to achieve the project is assessed. c) Deviations in project performance indicators are analyzed. d) Affected parties are informed of project status. e) Corrective action is defined and directed, when project achievement is not meeting planned targets. f) Project re-planning is initiated when project objectives or constraints have changed, or when planning assumptions are shown to be invalid. g) Project action to progress (or not) from one scheduled milestone or event to the next is authorized. h) Project objectives are achieved.

Guidance:

a) Interface Control Working Groups (ICWGs) should be formed for evaluation and successful implementation of interface constraints. ICWGs should consist of a representative from each organization affected by an interface. ICWGs provide a forum to discuss software and system interfaces, explore options and reach agreement on the best approach for implementing interfaces. ICWG recommendations requiring project changes should be submitted to whatever formal configuration management process the project has implemented (such as a configuration control board) for approval prior to implementation. Interfaces should be specified and controlled as an integral part of software specification and interface description documents.

b) The project manager should ensure that the project's assessment and control plans contain sufficient activities to provide evidence of departures from planned schedules and/or constraints in a timely manner that allows recovery.

c) The project manager should be responsible for ensuring that project tasks include:

1. Assessing the review results of project products, activities and tasks.
2. Complying with project management plans, philosophy, methodology and technology.
3. Documenting plans and commitments.
4. Satisfying requirements.
5. Readiness for advancement to the next process, activity or task.

d) The project manager should participate in critical reviews. The project management plan and associated plans should be the basis for tracking project processes and activities. A combination of event- and schedule-driven criteria may be used to manage review activities.

e) Supporting process activity for a project may occur at the enterprise level of the organization, or directly within the project team's tailored processes. In either case, the project manager should have local control of the supporting process activity that occurs in support of that manager's project. Problem or exception reports should be brought to the attention of the project manager for impact analysis on a project's cost, schedule, scope and quality.

f) The project manager should direct performance reviews of project teams and should provide periodic progress reviews to provide status for stakeholders.

g) Project managers should ensure that evaluation of work-in-progress is performed by personnel familiar with the project requirements, technologies involved, product requirements, and processes and infrastructure being used. Management reviews should cover project activities in support of a software and/or system life cycle. Top-level reviews should rely heavily on functional/technical level reviews and should be used to form an overall project assessment.

h) Where milestones are in place and achievement of milestones is dependent upon one or more reports and/or outcomes from any supporting process, the project manager should ensure that these achievements are reported in an accurate and timely manner in accordance with approved plans. Since it is common for milestones to be contractually linked to performance of supporting processes (for example achievement of a particular baseline), it is essential the plans be synchronized and the project manager be made aware (as soon as possible) of any difficulties experienced by supporting processes in completing assigned tasks.

i) Project managers should perform structured reviews of schedule performance that are based on realistic assessment techniques to support an accurate project assessment.

j) Documenting significant issues, action items and decisions resulting from reviews and evaluations should be required. Action items and significant issues should be tracked to closure and problems identified should be entered into a project corrective action system.

k) Project managers should undertake the overall management of interdependencies among project processes.

l) Management review of software schedule performance should pay particular attention to the software progress measures set up during project planning, and to the results from inspections, walkthroughs, and peer reviews in order to get meaningful software schedule assessments.

m) Recovery from a schedule slip needs to be carefully assessed and should not be expected without a negative impact on performance, cost, risk, or quality.

n) Adding personnel to a late software project makes it later[2].

o) In cooperation with stakeholders, review the software requirements baseline regularly throughout a project to ensure conformance with or adjustment to the objectives (cost, time and performance).

p) As a result of software being difficult to visualise, there are many difficulties with the evaluation of progress. Managers should specify and refine techniques to determine progress, so as to allow early detection of cost or schedule overruns.

q) Project managers should agree to schedule slippage prior to commencement of testing only with a corresponding slippage in delivery date, or the result may be the project being unable to complete testing according to plans.

[2] Brooks, Frederick P.; (1975, 2nd ed. 1995). *The Mythical Man Month: Essays on Software Engineering*. ISBN 0-201-83595-9

6.3 Decision management process

ISO/IEC 12207	ISO/IEC 15288
6.3.3 Decision Management Process	**6.3.3 Decision Management Process**
6.3.3.1 Purpose	**6.3.3.1 Purpose**
The purpose of the Decision Management Process is to select the most beneficial course of project action where alternatives exist. This process responds to a request for a decision encountered during the system life cycle, whatever its nature or source, in order to reach specified, desirable or optimized outcomes. Alternative actions are analyzed and a course of action selected and directed. Decisions and their rationale are recorded to support future decision-making.	The purpose of the Decision Management Process is to select the most beneficial course of project action where alternatives exist. This process responds to a request for a decision encountered during the system life cycle, whatever its nature or source, in order to reach specified, desirable or optimized outcomes. Alternative actions are analyzed and a course of action selected and directed. Decisions and their rationale are recorded to support future decision-making.
6.3.3.2 Outcomes	**6.3.3.2 Outcomes**
As a result of the successful implementation of the Decision Management Process: a) a decision-making strategy is defined; b) alternative courses of action are defined; c) a preferred course of action is selected; and d) the resolution, decision rationale and assumptions are captured and reported.	As a result of the successful implementation of the Decision Management Process: a) A decision management strategy is defined. b) Alternative courses of action are defined. c) A preferred course of action is selected. d) The resolution, decision rationale and assumptions are captured and reported.

Guidance:

a) The decision strategy should include identification of decision makers and authorities, decision categories and prioritization. Decision categories might include:

1. Implementation options for product functionality requirements.
2. Specific processes to be applied to the project to avoid excessive process specification.
3. Entry and exit points for life cycle stages.
4. Cost thresholds for alternatives at which formal trade studies are required to support a decision.
5. Make or buy decisions for components of the product or system to be delivered.
6. Issues affecting the organization's business objectives.
7. Categories of risk for which formal mitigation plans are required.

b) The decision strategy should ensure that all project stakeholders are involved in the decision management process in order to draw on their experience and knowledge. The decision strategy should specify how all project stakeholders are involved in the decision management process. The extent of involvement and

agreement of project stakeholders should depend on the priority or criticality of the decision, should be stated in the strategy documentation, and might include any or all of the categories listed in item b) above.

c) The decision management process stakeholders should include a board of company managers explicitly appointed in a support role to the project manager, to be called on as needed.

d) The decision strategy should specify the roles and responsibilities of the various stakeholders depending on the topic of a pending decision. Examples include:

1. The project's overall cost plan, as an output of the project planning stage, might have a stakeholder from the financial functional area in an approval role, but only include that stakeholder as a reviewer in a decision concerning a product's functionality implementation.
2. The project's schedule might have a stakeholder from the marketing functional area in a concurring, or even approval, role to ensure proper timing of product delivery, but only have that stakeholder as a reviewer for decisions on life cycle stage entry or exit points.
3. The project's overall technical feasibility might have a stakeholder from the company's enterprise-level product architecture board as a reviewer, but have that stakeholder in an approval role for the project's specific product designs.

e) The project manager should ensure that the circumstances and need for a decision are identified. Decisions may arise as a result of an effectiveness assessment, a technical trade-off, a problem needing to be solved, action needed as a response to risk exceeding the acceptable threshold, a new opportunity or approval for project progression to the next life cycle stage, among other things.

f) Problems or opportunities arising during project execution should be recorded, categorized, and promptly and objectively reported, along with the alternative courses of action that will resolve their outcome.

g) Each decision situation should be covered by the decision strategy, and should include desired outcomes and measurable success criteria.

h) For each identified decision situation, evaluate the balance of consequences of alternative actions in order to optimize the decision with respect to the criteria being evaluated.

i) The project manager should monitor the implementation of each decision to confirm that problems have been effectively resolved, that any adverse trends have been reversed, and that the project has taken advantage of opportunities.

j) The project manager should ensure that the records of decisions implemented due both to problems and to opportunities are maintained in a manner that supports auditing and learning from experience.

6.4 Risk management process

ISO/IEC 12207	ISO/IEC 15288
6.3.4 Risk Management Process	**6.3.4 Risk Management Process**
6.3.4.1 Purpose	**6.3.4.1 Purpose**
The purpose of the Risk Management Process is to identify, analyze, treat and monitor the risks continuously. The risk management process is a continuous process for systematically addressing risk throughout the lifecycle of a system or software product or service. It can be applied to risks related to the acquisition, development, maintenance or operation of a system.	The purpose of the Risk Management Process is to identify, analyze, treat and monitor the risks continuously. The risk management process is a continuous process for systematically addressing risk throughout the lifecycle of a system product or service. It can be applied to risks related to the acquisition, development, maintenance or operation of a system.
6.3.4.2 Outcomes	**6.3.4.2 Outcomes**
As a result of successful implementation of the Risk Management Process: a) the scope of risk management to be performed is determined; b) appropriate risk management strategies are defined and implemented; c) risks are identified as they develop and during the conduct of the project; d) risks are analyzed, and the priority in which to apply resources to treatment of these risks is determined; e) risk measures are defined, applied, and assessed to determine changes in the status of risk and the progress of the treatment activities; and f) appropriate treatment is taken to correct or avoid the impact of risk based on its priority, probability, and consequence or other defined risk threshold.	As a result of the successful implementation of the Risk Management Process: a) The scope of risk management to be performed is determined. b) Appropriate risk management strategies are defined and implemented. c) Risks are identified as they develop and during the conduct of the project. d) Risks are analyzed, and the priority in which to apply resources to treatment of these risks is determined. e) Risk measures are defined, applied, and assessed to determine changes in the status of risk and the progress of the treatment activities. f) Appropriate treatment is taken to correct or avoid the impact of risk based on its priority, probability, and consequence or other defined risk threshold.

Guidance:

a) Project managers should mitigate risk by ensuring a Failure Modes Effects Analysis (FMEA) is performed, and including any failure modes in the project's risk management process.

NOTE: ISO/IEC 16085:2006 (IEEE Std 16085-2006) [9] defines a process for the management of risk in the life cycle. Risk management is a key discipline for making effective decisions and communicating the results within organizations. The purpose of risk management is to identify potential managerial and technical problems before they occur so that actions can be taken that reduce or eliminate the probability and/or impact of these problems should they occur. It is a critical tool for continuously determining the feasibility of project plans, for improving the search for and identification of potential problems that can affect life cycle activities and the quality and performance of products, and for improving the active management of projects.

6.5 Configuration management process

ISO/IEC 12207	ISO/IEC 15288
6.3.5 Configuration Management Process	**6.3.5 Configuration Management Process**
6.3.5.1 Purpose	**6.3.5.1 Purpose**
The purpose of the Configuration Management Process is to establish and maintain the integrity of all identified outputs of a project or process and make them available to concerned parties.	The purpose of the Configuration Management Process is to establish and maintain the integrity of all identified outputs of a project or process and make them available to concerned parties.
6.3.5.2 Outcomes	**6.3.5.2 Outcomes**
As a result of the successful implementation of the Configuration Management Process:	As a result of the successful implementation of the Configuration Management Process:
a) a configuration management strategy is defined;	a) A configuration management strategy is defined.
b) items requiring configuration management are defined;	b) Items requiring configuration management are defined.
c) configuration baselines are established;	c) Configuration baselines are established.
d) changes to items under configuration management are controlled;	d) Changes to items under configuration management are controlled.
e) the configuration of released items is controlled; and	e) The configuration of released items is controlled.
f) the status of items under configuration management is made available throughout the life cycle.	f) The status of items under configuration management is made available throughout the life cycle.

Guidance:

NOTE: IEEE Std 828-2005 [5], ANSI/GEIA 649A [6], and ISO 10007:2003, Quality management systems – Guidelines for configuration management [7] contain provisions for configuration management.

a) In addition to the applicable product(s) that the project produces, the project manager should place under configuration control the plans, measures, and associated processes for a project in order to assure the fidelity of process execution and to provide a basis for process improvement.

b) Since a cost effective configuration management strategy is critical to projects, a graded configuration management approach, based on the importance of the system, should be used that specifies and controls only those artefacts that are essential to the project's cost, schedule, functionality and quality.

NOTE: The graded approach assumes no relaxation of whatever formal configuration management process the project has implemented (such as a configuration control board) to review, determine the impact of, and approve any proposed change to items under configuration control.

Software-specific guidance:

a) The Software Configuration Management Process presented in 7.2.2 of ISO/IEC 12207 is a specialization of the Configuration Management Process from the Project Process Group, and provides additional detail for the project manager's use in the configuration management of software products.

6.6 Information management process

ISO/IEC 12207	ISO/IEC 15288
6.3.6 Information Management Process	**6.3.6 Information Management Process**
6.3.6.1 Purpose	**6.3.6.1 Purpose**
The purpose of the Information Management Process is to provide relevant, timely, complete, valid and, if required, confidential information to designated parties during and, as appropriate, after the system life cycle.	The purpose of the Information Management Process is to provide relevant, timely, complete, valid and, if required, confidential information to designated parties during and, as appropriate, after the system life cycle.
This process generates, collects, transforms, retains, retrieves, disseminates and disposes of information. It manages designated information, including technical, project, organizational, agreement and user information.	This process generates, collects, transforms, retains, retrieves, disseminates and disposes of information. It manages designated information, including technical, project, organizational, agreement and user information.
6.3.6.2 Outcomes	**6.3.6.2 Outcomes**
As a result of the successful implementation of the Information Management Process:	As a result of the successful implementation of the Information Management Process:
a) information to be managed is identified;	a) Information to be managed is identified.
b) the forms of the information representations are defined;	b) The forms of the information representations are defined.
c) information is transformed and disposed of as required;	c) Information is transformed and disposed of as required.
d) the status of information is recorded;	d) The status of information is recorded.
e) information is current, complete and valid; and	e) Information is current, complete and valid.
f) information is made available to designated parties.	f) Information is made available to designated parties.

Guidance:

a) The project manager should be responsible for satisfying communication requirements, including timely progress reporting to stakeholders, promulgation of revisions to plans and work authorization, and deviation reporting and documenting, as necessary. Centralized, up-to-date databases are useful to facilitate exchanges between people.

b) The project manager should ensure that the project's information management process provides adequate protection of customer information in accordance with customer, and any regulatory or statutory requirements, and that the process addresses the deletion or destruction of the information upon the completion of the project.

c) If information provided by the customer or generated for the customer during project execution is classified, the project manager should ensure that the project's information management process includes the necessary physical protection of the information during both storage and use, and that it ensures the information is accessible only to those project personnel who have the required, documented approval(s) for access to the information. Access logs may be implemented to record the access history.

d) The project manager should be responsible for assessing completion of a project and for ensuring project requirements, criteria and procedures have been satisfied. This determination should be made when a project's products, processes, activities or tasks have been successfully completed. Upon the decision to close the project, the results and records of the products, processes, activities or tasks, including lessons learned and test cases and results used during product development, should be checked for completeness; and once deemed complete, should be archived per the contract and organizational requirements.

e) Early consideration should be given to maintaining baselines, documents and records after closure, e.g., location, media and how long to keep the information.

> *The conclusion of a project [stage] is generally marked by a review of both key deliverables and project performance in order to a) determine if the project should continue into its next phase and b) detect and correct errors cost effectively. (adapted from* the *PMBOK® Guide* [1].)

f) The project manager should ensure that rigorous controls are implemented for the registration, storage, updating, backup and maintenance of programs, test data and the test environment.

6.7 Measurement process

ISO/IEC 12207	ISO/IEC 15288
6.3.7 Measurement Process	**6.3.7 Measurement Process**
6.3.7.1 Purpose	**6.3.7.1 Purpose**
The purpose of the measurement process defined is to collect, analyze, and report data relating to the products developed and processes implemented within the organizational unit, to support effective management of the processes, and to objectively demonstrate the quality of the products.	The purpose of the measurement process is to collect, analyze, and report data relating to the products developed and processes implemented within the organization, to support effective management of the processes, and to objectively demonstrate the quality of the products.
6.3.7.2 Outcomes	**6.3.7.2 Outcomes**
As a result of successful implementation of the measurement process: a) the information needs of technical and management processes are identified; b) an appropriate set of measures, driven by the information needs are identified and/or developed; c) measurement activities are identified and planned; d) the required data are collected, stored, analyzed, and the results interpreted; e) information products are used to support decisions and provide an objective basis for communication; f) the measurement process and measures are evaluated; and g) improvements are communicated to the measurement process owner.	As a result of successful implementation of the Measurement Process: a) The information needs of technical and management processes are identified. b) An appropriate set of measures, driven by the information needs are identified and/or developed. c) Measurement activities are identified and planned. d) The required data is collected, stored, analyzed, and the results interpreted. e) Information products are used to support decisions and provide an objective basis for communication. f) The measurement process and measures are evaluated. g) Improvements are communicated to the measurement process owner.

Guidance:

NOTE: ISO/IEC 15939:2007 (IEEE Std 15939-2007) [4] contains provisions for measurement. Measurement supports the management and improvement of processes and products. Measurement is a primary tool for managing system and software life cycle activities, assessing the feasibility of project plans, and monitoring the adherence of project activities to those plans. System and software measurement is also a key discipline in evaluating the quality of products and the capability of organizational processes. ISO/IEC 15939:2007 (IEEE Std 15939-2007) identifies the activities and tasks that are necessary to successfully identify, define, select, apply, and improve measurement within an overall project or organizational measurement structure. It also provides definitions for measurement terms commonly used within the system and software industries.

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Abstract: ISO/IEC/IEEE 16326:2009 provides normative content specifications for project management plans covering software projects, and software-intensive system projects. It also provides detailed discussion and advice on applying a set of project processes that are common to both the software and system life cycle as covered by ISO/IEC 12207:2008 (IEEE Std 12207-2008) and ISO/IEC 15288:2008 (IEEE Std 15288-2008), respectively. The discussion and advice are intended to aid in the preparation of the normative content of project management plans. ISO/IEC/IEEE 16326:2009 is the result of the harmonization of ISO/IEC TR 16326:1999 and IEEE Std 1058-1998.

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