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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the rules given in the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

IEEE Standards documents are developed within the IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Association (IEEE-SA) Standards Board. The IEEE develops its standards through a consensus development process, approved by the American National Standards Institute, which brings together volunteers representing varied viewpoints and interests to achieve the final product. Volunteers are not necessarily members of the Institute and serve without compensation. While the IEEE administers the process and establishes rules to promote fairness in the consensus development process, the IEEE does not independently evaluate, test, or verify the accuracy of any of the information contained in its standards.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents) or the IEC list of patent declarations received (see http://patents.iec.ch).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

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

This second edition cancels and replaces the first edition (ISO/IEC/IEEE 16326:2009), which has been technically revised.

The main changes compared to the previous edition are as follows:

a) re-ordered the original Clauses 2 and 4, and added a new Clause 2 to comply with the new ISO document fixed structure requirements;

b) moved the process guidelines up in front of the project management plan content requirements to put more emphasis on the process rather than the “product;”

c) changed the citation tables in the new Clause 6 to a single column so that the corresponding content is identical to both ISO/IEC/IEEE 15288:2015 and ISO/IEC/IEEE 12207:2017;

d) added references in the applicable guidance portions of the new Clause 6 that point to the more detailed process guidance information in ISO/IEC/IEEE 24748-4:2016 and ISO/IEC/IEEE 24748-5:2017;

e) removed the PMP format requirements from the new Clause 7;

f) re-ordered the Bibliography to list the citations in numerical order.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document provides normative content specifications for project management plans concerned with systems, and software systems.

This document also provides detailed discussion and advice on applying a set of technical management processes that are common to both the system and software life cycles as covered by ISO/IEC/IEEE 15288 and ISO/IEC/IEEE 12207 respectively. The discussion and advice are intended to aid in the preparation of the normative content of project management plans.

Systems and software engineering — Life cycle processes — Project management

1 Scope

1.1 Purpose

This document is intended to aid project managers in managing to successful conclusion those projects concerned with systems, including software systems.

This document specifies the required content of the project management plan (PMP). This document also quotes the extracted purpose and outcome statements from the technical management processes of ISO/IEC/IEEE 15288 and ISO/IEC/IEEE 12207, and adds detailed guidance for managing projects that use these processes for systems, including software systems.

1.2 Field of application

This document is written for those who use or plan to use ISO/IEC/IEEE 15288 and ISO/IEC/IEEE 12207 on projects dealing with systems, including software systems, regardless of project scope, products, methodology, size or complexity. The field of application of this document spans the whole system or software life cycle and addresses all project management roles, specifically:

— those responsible for establishing and continuously improving their organization's policies for implementing ISO/IEC/IEEE 15288 system life cycle processes and ISO/IEC/IEEE 12207 software life cycle processes;

— those responsible for executing any ISO/IEC/IEEE 15288 system life cycle process or ISO/IEC/IEEE 12207 software 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 document, the guidance, advice or normative requirement is taken as applying to the applicable role within the organization.

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

This document 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 PMPs and the guidance for application of the technical management processes have general application across the scope of ISO/IEC/IEEE 15288 and ISO/IEC/IEEE 12207, but are developed with a focus on projects dealing with systems with a significant software element, and software systems.

2 Normative References

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

No terms and definitions are listed in this document.

ISO, IEC and IEEE maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

— IEEE Standards Dictionary Online: available at http://ieeexplore.ieee.org/xpls/dictionary

3.2 Abbreviated terms

CDRL	contract data requirements list
ICWG	interface control working group
PERT	program evaluation review technique
PM	project management (or project manager)
PMP	project management plan
PPL	product parts list
SDP	software development plan
SEE	software engineering environment
SEMP	systems engineering management plan
SWEBoK	software engineering body of knowledge
WBS	work breakdown structure

4 Conformance

4.1 General

This document provides normative definition of the content of the PMP and provides guidance for the execution of the technical management processes of ISO/IEC/IEEE 15288 and ISO/IEC/IEEE 12207. Users of this document can claim conformance to the normative documentation content, to the process provisions, or both.

4.2 Conformance to the normative documentation content

A claim of conformance to the documentation provisions of this document means that the user demonstrates that the content of a PMP conforms to the content requirements specified in Clause 7.

4.3 Conformance to processes

A claim of conformance to the process provisions of this document is equivalent to claiming conformance to the technical management processes from ISO/IEC/IEEE 15288 and ISO/IEC/IEEE 12207 cited in Clause 6.

4.4 Full conformance

A claim of full conformance to this document is equivalent to claiming conformance to the PMP content requirements cited in Clause 7 and the technical management processes of ISO/IEC/IEEE 15288 and ISO/IEC/IEEE 12207 cited in Clause 6.

5 Application of this document

This document specifies the required content of the PMP such that the overall content of the plan, when executed successfully, fulfils the purposes and desired outcomes which are specified by the technical management processes of ISO/IEC/IEEE 15288 and ISO/IEC/IEEE 12207.

The technical management processes of ISO/IEC/IEEE 15288 and of ISO/IEC/IEEE 12207 contain the generic activities and tasks, which can be employed by any party that has to manage a project dealing with systems, including software systems. This document provides additional detailed guidance in Clause 6 to assist managers of these projects as they prepare and execute the PMP for a specific project.

NOTE 1 In the general case, any specific project exists within an organization's business program areas and project portfolios. The organization can have additional processes that are not directly related to project management, but that are essential to a project's successful execution. The organizational project-enabling processes in ISO/IEC/IEEE 15288 and the guidance in ISO 21500 provide useful information and guidance on how a project's technical management processes fit into the overall organization's process structure.

NOTE 2 Reference [2] also provides important information about managing projects.

The responsible people listed as actors for which guidance applies are those most often tasked with the listed preparation actions, but users of this document may agree to assign the actions to different people or organizations depending on a given program's organizational structure.

Project managers should also apply the guidance in this document 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.

6 Technical management processes

6.1 General

This clause examines the eight technical management processes of ISO/IEC/IEEE 15288 and ISO/IEC/IEEE 12207, i.e.:

— Project planning process;

— Project assessment and control process;

— Decision management process;

— Risk management process;

— Configuration management process;

— Information management process;

— Measurement process;

— Quality assurance process.

NOTE ISO/IEC/IEEE 15288 uses the identical process model for process purposes and outcomes as ISO/IEC/IEEE 12207, but its tasks and activities differ.

This clause provides detailed discussion and application advice as it applies to the management of projects dealing with systems, including software systems. The discussion and advice are intended

to aid project managers in managing a specific project (e.g., direct management and control of the work, management of the scope, management of the schedule, management of the budget and costs, management of resources, management of stakeholders, risk management, and procurement management).

Normative project process portions from both ISO/IEC/IEEE 15288 and ISO/IEC/IEEE 12207 are contained in boxed text, with discussion and advice for that portion immediately following. The purposes and outcomes from ISO/IEC/IEEE 15288 and ISO/IEC/IEEE 12207 are essentially the same, but may have minor editorial differences in verb tense and punctuation.

The advice given for systems projects also applies to projects undertaken to produce software systems. Any advice given specifically for software systems is further segregated below the advice for systems. The guidance provided for each process section in this document is designed to treat the combined purpose and outcome statements for that section from both ISO/IEC/IEEE 15288 and ISO/IEC/IEEE 12207.

The processes and activities for a given project can require iterative action to accomplish the requirements of a project. For instance, based upon the life cycle model being used, processes, activities and tasks can be employed at the same time; they can be interdependent; or they can be coordinated in an organized series of work breakdown structure (WBS) dependencies throughout a project life cycle. In addition, other more modern project development processes such as agile development can combine these processes and activities in different ways.

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 technical management processes with the organization's project-enabling processes. ISO/IEC/IEEE 15288:2015, 6.2 and ISO/IEC/IEEE 12207:2017, 6.2 provide guidance for the following organizational project-enabling processes:

— Life Cycle Model Management process;

— Infrastructure Management process;

— Portfolio Management process;

— Human Resource management process;

— Quality Management process;

— Knowledge Management process.

6.2 Project planning process

6.2.1 General

ISO/IEC/IEEE 15288:2015 and **ISO/IEC/IEEE 12207:2017**

6.3.1 Project planning process

6.3.1.1 Purpose

The purpose of the Project Planning process is to produce and coordinate effective and workable plans.

This process determines the scope of the project management and technical activities, identifies process outputs, tasks and deliverables, establishes schedules for task conduct, including achievement criteria, and required resources to accomplish tasks. This is an on-going process that continues throughout a project, with regular revisions to plans.

6.3.1.2 Outcomes

As a result of the successful implementation of the Project Planning process:

a) Objectives and plans are defined.

b) Roles, responsibilities, accountabilities, authorities are defined.

c) Resources and services necessary to achieve the objectives are formally requested and committed.

d) Plans for the execution of the project are activated.

6.2.2 Guidance

NOTE 1 ISO/IEC/IEEE 24748-4 and ISO/IEC/IEEE 24748-5 provide detailed guidance on the processes required for successful planning, execution and management of a project's systems and software engineering efforts, respectively.

a) The strategies defined in the guidance sections of each of the other Technical Management processes in this clause provide inputs and are integrated in the Project Planning process. The Project Assessment and Control process is used to assess whether the plans are integrated, aligned and feasible.

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

c) The project manager should plan the management of project requirements including their elicitation, documentation and analysis.

d) Project planning should include the following activities:

1. involving all stakeholders in the requirements definition of a project;
2. establishing a baseline of project requirements;
3. establishing a sequence of activities and events at a suitable level of detail that represents the full scope of work for the project;
4. managing change to the scope and requirements throughout a project's life cycle; all changes in scope and requirements should be carefully evaluated and documented;
5. reviewing the selection of processes made from a previously successful project when the scope and requirements are changed, to help ensure 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;

6. defining who is responsible for obtaining stakeholder agreement on project requirements;

7. establishing and maintaining traceability between requirements, between requirements and design, and between requirements and tests.

NOTE 2 "project requirements" can include process requirements (for the project activities) as well as product requirements (for the product of interest or enabling products).

e) Systems engineering efforts should be conducted with the required systems engineering resources and skills.

f) Software engineering efforts should be conducted with the required software engineering resources and skills.

g) Project planning should identify and document the activities required to translate stakeholder requirements into project deliverables and/or 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.

h) Project planning should include all aspects of process tailoring to 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 3 Refer to ISO/IEC/IEEE 15288:2015, Annex A and/or ISO/IEC/IEEE 12207:2017, Annex A for details of the tailoring process.

i) For iterative life cycle models, the scope of the project can be revised as understanding of requirements evolves, with agreement of the acquirer and supplier. 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. Project managers should also determine the feasibility of the planned technical management processes to help ensure personnel, materials, facilities, Systems/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 can be required to achieve a good fit between the project scope statement and the internal project plans and processes.

j) Planning the scope of the project can 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.

NOTE 4 ISO 10006 provides guidelines for project management to help ensure proper quality of their project's products and services.

k) Project managers should select a life cycle model appropriate to the project being undertaken. Incremental and evolutionary types of life cycle models typically have advantages over waterfall or 'Big Bang' models and can be less risky than other life cycle models, particularly for software systems.

l) The planning process should establish completion criteria for all project tasks. The intent, as supported by ISO 21500, is to determine if a project, activity or task has been completed successfully.

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

n) 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. Source code escrow should also be considered to ensure that the acquirer can continue to use the software in the event of the supplier going out of business.

o) A project should have one master schedule and all subordinate schedules should be integrated and consistent with the master schedule. A WBS should be used to define the total scope of work for 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. The WBS can be used as a basis of measuring project progress and to provide visibility into subordinate processes and products.

p) 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. changes to or creation of infrastructure and enabling systems such as an SEE;
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. work to be performed in each process and/or activity;
10. configuration management;
11. technical performance measures (e.g., response time, throughput, memory utilization, bandwidth).

q) 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 identified, planned and implemented. This can require the use of subcontracting to satisfy infrastructure deficiencies.

r) 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 PMP. Re-estimation can be done on a monthly basis and periodically as necessary. Re-estimation can also be required in a stepwise manner at major project phase points such as customer reviews. For information needed by a PMP but provided in other plans, the PMP may reference the other plans.

s) Plans should be updated and be consistent with Clause 7.

t) The project manager should place under project configuration management the PMP and all plans it references. The PMP and subordinate plans should then be managed as a baseline set of documents, with changes coordinated accordingly.

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

v) 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 can be more difficult under subcontract agreements and tasking, but can be aided by having one master plan.

w) The project should make use of historical project data when developing estimates and plans. In the absence of historical data, project risks are much higher, and planning requires careful considerations by all stakeholders. The project should 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.

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

y) 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.

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

aa) During project planning, the project management team should 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.

bb) In the project planning, the project management team should include contingency planning for both management and technical issues.

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

6.2.3 Software-specific guidance

NOTE ISO/IEC/IEEE 24748-5 provides detailed guidance on the processes required for successful planning and management of a project's software development effort, and ISO/IEC/IEEE 24748-5:2017, Annex B provides a sample outline for a software development plan.

a) ISO/IEC 25030 recommends that care be applied to defining and documenting quality requirements based on quality characteristics, 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) Project planning should 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 and source code escrow.

6.3 Project assessment and control process

6.3.1 General

ISO/IEC/IEEE 15288:2015 and ISO/IEC/IEEE 12207:2017

6.3.2 Project assessment and control process

6.3.2.1 Purpose

The purpose of the Project Assessment and Control process is to assess if the plans are aligned and feasible; determine the status of the project, technical and process performance; and direct execution to help ensure that the performance is 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 provided 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 technical management or technical processes. Redirection may include re-planning as appropriate.

6.3.2.2 Outcomes

As a result of the successful implementation of the Project Assessment and Control process:

a) Performance measures or assessment results are available.

b) Adequacy of roles, responsibilities, accountabilities, and authorities is assessed.

c) Adequacy of resources is assessed.

d) Technical progress reviews are performed.

e) Deviations in project performance from plans are investigated and analyzed.

f) Affected stakeholders are informed of project status.

g) Corrective action is defined and directed, when project achievement is not meeting targets.

h) Project replanning is initiated, as necessary.

i) Project action to progress (or not) from one scheduled milestone or event to the next is authorized.

j) Project objectives are achieved.

6.3.2 Guidance

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

b) Project tasks should include:

1. assessing the review results of project products, activities and tasks;
2. complying with PMPs, philosophy, methodology and technology;
3. documenting plans and commitments;
4. satisfying requirements;

5. assessing readiness for advancement to the next process, activity or task.

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

d) Supporting process activity for a project can 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.

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

f) For evaluation of work-in-progress, project managers should assign the evaluation task(s) to 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.

g) 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 report these achievements in an accurate and timely manner in accordance with approved plans. Since it is common for milestones to be contractually linked to the 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.

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

i) 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. All assumptions applicable to the specific assessment techniques and the reviews' results of schedule performance should be documented.

j) The project management team should undertake the overall management of interdependencies among technical management processes and should document these interdependencies.

k) 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.

l) 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.

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

n) As a result of software being difficult to visualize, 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.

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

6.4 Decision management process

6.4.1 General

ISO/IEC/IEEE 15288:2015 and ISO/IEC/IEEE 12207:2017

6.3.3 Decision management process

6.3.3.1 Purpose

The purpose of the Decision Management process is to provide a structured, analytical framework for objectively identifying, characterizing and evaluating a set of alternatives for a decision at any point in the life cycle and select the most beneficial course of action.

6.3.3.2 Outcomes

As a result of the successful implementation of the Decision Management process:

a) Decisions requiring alternative analysis are identified.

b) Alternative courses of action are identified and evaluated.

c) A preferred course of action is selected.

d) The resolution, decision rationale and assumptions are identified.

6.4.2 Guidance

a) When it is necessary to perform a detailed assessment of a parameter for one of the criteria, the System Analysis process can be employed to perform the assessment.

b) 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, schedule and quality 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.

c) 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 each project stakeholder is involved in the decision management process for the project. 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 cover one or more decision categories (examples are listed in item b) above).

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

e) 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.

f) Project managers should identify and document the circumstances that drive the need for a decision. Decisions can 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.

g) 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.

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

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

j) 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, that the consequences of the decision are fully addressed, that there are no unanticipated risks arising from the decision, and that the project has taken advantage of opportunities.

k) The project management team should maintain the records of decisions implemented due both to problems and to opportunities in a manner that supports auditing and learning from experience.

6.5 Risk management process

6.5.1 General

ISO/IEC/IEEE 15288:2015 and ISO/IEC/IEEE 12207:2017

6.3.4 Risk management process

6.3.4.1 Purpose

The purpose of the Risk Management process is to identify, analyze, treat and monitor the risks continually.

The Risk Management process is a continual process for systematically addressing risk throughout the life cycle 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

As a result of the successful implementation of the Risk Management process:

a) Risks are identified.

b) Risks are analyzed.

c) Risk treatment options are identified, prioritized, and selected.

d) Appropriate treatment is implemented.

e) Risks are evaluated to assess changes in status and progress in treatment.

6.5.2 Guidance

a) Project risks should be identified using the best available information and established techniques. In order to make decisions about whether further control is needed and what treatments would be effective, it can be necessary to analyze:

   1. uncertainties;
   2. the causes and sources of risk;
   3. the effectiveness of existing controls.

NOTE 1 IEC 31010 provides guidance on risk identification techniques.

NOTE 2 ISO Guide 73 defines risk as "the effect of uncertainty on objectives, where the effect can be positive or negative."

NOTE 3 ISO/IEC 16085 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 in case 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.

6.6 Configuration management process

6.6.1 General

ISO/IEC/IEEE 15288:2015 and ISO/IEC/IEEE 12207:2017

6.3.5 Configuration management process

6.3.5.1 Purpose

The purpose of Configuration Management is to manage and control system elements and configurations over the life cycle. Configuration Management (CM) also manages consistency between a product and its associated configuration definition.

6.3.5.2 Outcomes

As a result of the successful implementation of the Configuration Management process:

a) Items requiring configuration management are identified and managed.

b) Configuration baselines are established.

c) Changes to items under configuration management are controlled.

d) Configuration status information is available.

e) Required configuration audits are completed.

f) System releases and deliveries are controlled and approved.

6.6.2 Guidance

NOTE 1 IEEE Std 828, EIA-649C and ISO 10007 contain provisions for configuration management.

a) Interface control working groups (ICWGs) should be formed for the 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 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 the project's interface requirements and interface description documents.

b) In addition to any 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 help maximize the fidelity of process execution and to provide a basis for process improvement.

c) 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 2 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.

6.7 Information management process

6.7.1 General

ISO/IEC/IEEE 15288:2015 and ISO/IEC/IEEE 12207:2017

6.3.6 Information management process

6.3.6.1 Purpose

The purpose of the Information Management process is to generate, obtain, confirm, transform, retain, retrieve, disseminate and dispose of information, to designated stakeholders.

Information management plans, executes, and controls the provision of information to designated stakeholders that is unambiguous, complete, verifiable, consistent, modifiable, traceable, and presentable. Information includes technical, project, organizational, agreement, and user information. Information is often derived from data records of the organization, system, process, or project.

6.3.6.2 Outcomes

As a result of the successful implementation of the Information Management process:

a) Information to be managed is identified.

b) Information representations are defined.

c) Information is obtained, developed, transformed, stored, validated, presented, and disposed of.

d) The status of information is identified.

e) Information is available to designated stakeholders.

6.7.2 Guidance

a) Managed information has the following quality characteristics: unambiguous, adequate, fit for its intended purpose, verifiable, consistent, modifiable, traceable and presentable.

b) The project management team should provide timely progress reporting to stakeholders, promulgation of revisions to plans and work authorization, and deviation reporting and documenting, as necessary. Centralized, up-to-date information systems are useful to facilitate exchanges between people.

c) The project's information management process as defined in its information management plan should provide adequate protection of customer or third-party information in accordance with the stakeholder requirements (e.g. intellectual property or other limitations on use), taking any regulatory or statutory requirements (e.g. privacy) into consideration.

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

e) The project management team should determine the successful completion of a project and the satisfaction of project requirements, criteria and procedures. 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.

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

g) Project management should implement rigorous controls for the updating, backup and maintenance of all data, including requirements, design data, software, software configuration and configuration data, adaptation data, test data and data relating to supporting systems (e.g. test configurations and the test environment).

6.8 Measurement process

6.8.1 General

ISO/IEC/IEEE 15288:2015 and ISO/IEC/IEEE 12207:2017

6.3.7 Measurement process

6.3.7.1 Purpose

The purpose of the Measurement process is to collect, analyze, and report objective data and information to support effective management and demonstrate the quality of the products, services, and processes.

6.3.7.2 Outcomes

As a result of the successful implementation of the Measurement process:

a) Information needs are identified.

b) An appropriate set of measures, based on the information needs, is identified or developed.

c) Required data is collected, verified, and stored.

d) The data is analyzed and the results interpreted.

e) Information items provide objective information that supports decisions.

6.8.2 Guidance

a) Measures have the following quality characteristics: verifiable, meaningful, actionable, timely and cost-effective.

NOTE ISO/IEC/IEEE 15939 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/IEEE 15939 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.

b) The project's measurement process should enlist the participation of all relevant stakeholders in defining and reaching consensus on an appropriate set of measures.

6.9 Quality assurance process

6.9.1 General

ISO/IEC/IEEE 15288:2015 and ISO/IEC/IEEE 12207:2017

6.3.8 Quality assurance process

6.3.8.1 Purpose

The purpose of the Quality Assurance process is to help ensure the effective application of the organization's Quality Management process to the project.

Quality Assurance focuses on providing confidence that quality requirements will be fulfilled. Proactive analysis of the project life cycle processes and outputs is performed to assure that the product being produced will be of the desired quality and that organization and project policies and procedures are followed.

6.3.8.2 Outcomes

As a result of the successful implementation of the Quality Assurance process:

a) Project quality assurance procedures are defined and implemented.

b) Criteria and methods for quality assurance evaluations are defined.

c) Evaluations of the project's products, services, and processes are performed, consistent with quality management policies, procedures, and requirements.

d) Results of evaluations are provided to relevant stakeholders.

e) Incidents are resolved.

f) Prioritized problems are treated.

6.9.2 Guidance

a) The Quality Assurance process can be specified in the organization's or enterprise processes or can be defined specifically for the project or program. Often a section or sections in the PMP will be the project-specific definition of the quality assurance arrangements (quality assurance plan), but this can be a stand-alone document. In either case, the definition of quality assurance for the project should address the outcomes of the process as defined above.

b) As well as addressing the outcomes for the process, the quality assurance plan should define:

   1. the roles and responsibilities of those carrying out quality assurance tasks;
   2. specific standards to be applied to the project;
   3. provisions for vendor evaluation and control;
   4. specific verification and validation, joint reviews and audits to be carried out on the project if not specified elsewhere;
   5. how acceptance will be carried out (if not defined elsewhere);
   6. any process assessments or external evaluations to be performed during the project.

7 Elements of the project management plan

7.1 General

This clause specifies the content requirements for each of the elements of a PMP.

ISO/IEC/IEEE 15289 indicates that an information item is required to be consistent with an information item generic type. The key information item addressed in this document is of type "plan."

Detailed content descriptions of each section in a PMP are presented in 7.2 through 7.10. Additional plans are often required to satisfy product requirements and contractual terms. Additional plans are specified in 7.11. The various sections of the PMP may be included by direct incorporation or by reference to other project plans and additional information items, as applicable.

The grouping of elements in 7.2 through 7.11 corresponds to the general process flow of a new project start-up and does not imply any required order or format for a specific PMP. The PMP format is to be determined by the user of this document.

The contents of the PMP should explain how the project can fulfil the purpose and outcomes which are specified by ISO/IEC/IEEE 15288 and ISO/IEC/IEEE 12207, and which are cited in Clause 6.

The PMP can be updated as needed and authorized. A change history log shall be used to document PMP changes.

7.2 Front matter

Each version of a PMP based on this document shall contain front matter which includes at a minimum:

— identifying information, which shall contain the project name, the date of issue, a unique identifier (draft number, baseline version number) and identification of the issuing organization; this information may be presented on a title page;

— approval record, which shall contain the record of approvals by the authority(ies) responsible for reviewing and approving the PMP;

— a change history, which shall include or reference the changes, change rationale and previous revisions of the PMP;

— an introduction, which shall describe the scope and context of the PMP and identify the intended audience for the PMP;

— a table of contents, or list of bookmarks or hyperlinks to main sections and subsections;

— a list of figures that appear in the PMP;

— a list of tables that appear in the PMP.

7.3 Project overview

7.3.1 Project summary

7.3.1.1 Purpose, scope and objectives

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

This section 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

or activities to be performed to satisfy those objectives, and the methods by which satisfaction will be determined.

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

7.3.1.2 Assumptions and constraints

This section 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 section should also describe any considerations of scope or objectives to be excluded from the project or the resulting product.

7.3.1.3 Project deliverables

This section of the PMP shall list the work products that will be delivered to the acquirer, delivery locations and quantities required to satisfy the terms of the project agreement. In addition, this section 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 item such as a contract data requirements list (CDRL) or a product parts list (PPL). This section 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.

For projects which will output intangible deliverables and projects which are focused on decommissioning or disposal that will not result in any "deliverables," this section of the PMP shall list activity completion dates, methods of delivery, dissemination or disposal (where appropriate), locations (physical or logical) where dissemination, decommissioning or disposal will take place, and the means to demonstrate that the project is complete as required to satisfy the terms of the project agreement.

7.3.1.4 Schedule and budget summary

This section of the PMP shall provide a summary of the schedule, including delivery dates, 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 section shall also include payment details and schedules.

7.3.1.5 Evolution of the plan

This section 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 section 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.

7.4 References

This section of the PMP shall provide a complete list of all project information items and other sources of information referenced in the PMP. Each listed item should be identified by title, version number, date, author, path/name for electronic access and publishing organization. Any deviations from referenced standards or policies shall be identified and justifications shall be provided.

7.5 Definitions

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

7.6 Project context

7.6.1 Process model

This section 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 the 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 section.

7.6.2 Process improvement

This section 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. Process improvement planning should be closely related to problem resolution planning; for example, a root cause analysis of recurring problems can 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.

7.6.3 Infrastructure and enabling systems

This section of the PMP shall specify the plan for establishing and maintaining the project infrastructure and enabling systems (production systems, SEE, maintenance systems, project support systems including hardware, operating system, network and software), and the policies, procedures, standards and facilities required to conduct the project. These resources can 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.

7.6.4 Methods, tools and techniques

This section 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 non-deliverable work products.

7.6.5 Product acceptance

This section 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 if the project is fulfilling an agreement or contract. 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.

7.6.6 Project organization

7.6.6.1 General

This section 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.

7.6.6.2 External interfaces

This section 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.

7.6.6.3 Internal interfaces

This section of the PMP shall describe the internal structure of the project organization, including the interfaces between the development teams. 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 section. Graphical devices such as organizational charts or diagrams should be used to depict the lines of authority, responsibility and communication within the project.

7.6.6.4 Authorities and responsibilities

This section 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.

7.7 Project planning

7.7.1 General

This section of the PMP shall specify the project management processes for the project. This section 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.

7.7.2 Project initiation

7.7.2.1 General

This section 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.

7.7.2.2 Estimation

This section 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 section 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.

7.7.2.3 Staffing

This section 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 section 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 section 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.

7.7.2.4 Resource acquisition

This section 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 section may be expanded into additional sections as required to accommodate acquisition plans for various types of resources to be acquired.

7.7.2.5 Project staff training

This section of the PMP shall specify the training needed to help 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 section shall specify the training to be provided for them.

7.7.3 Project work plans

7.7.3.1 General

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

7.7.3.2 Work activities

This section 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 can be different depending on factors such as the quality of the requirements, familiarity with the work and novelty of the technology to be used.

7.7.3.3 Schedule allocation

This section 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 can include milestone charts, activity lists, activity Gantt charts, activity networks, critical path networks and PERT.

7.7.3.4 Resource allocation

This section 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 can include, as appropriate, personnel by skill level and factors such as computing resources, software tools, integration, 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.

7.7.3.5 Budget allocation

This section 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 can 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.

7.7.3.6 Procurement

This section 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 requests, the deadline for obtaining each good and service and the lead times needed to conduct the procurement process.

7.7.3.7 Disposal

This section of the PMP shall describe the Systems Engineering work products required prior to any decommissioning, demolition or disposal of software and/or systems, and shall provide a detailed breakdown of the decommissioning and/or disposal activities (as appropriate), which shall include roles, responsibilities and requirements for de-integrating the system/s from the operational environment, demolition or disposal work and removal of any waste. This shall include activities, responsibilities and Decommissioning Readiness Review (DRR) requirements. If any of the demolition or disposal is subcontracted, this section shall state the responsibilities and the criteria for determining successful completion.

7.8 Project assessment and control

7.8.1 General

This section of the PMP shall specify the procedures necessary to assess and control the product requirements, the project scope, schedule, budget, 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.

7.8.2 Requirements management

This section of the PMP shall specify the control mechanisms for measuring, reporting and controlling changes to the project and product requirements. This section 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 can be used for requirements control include traceability, prototyping and modelling, impact analysis and reviews.

7.8.3 Scope change control

This section 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 19759:2015, chapter 8, section 3.A.5.B.1 provides details on defining the project's scope.

7.8.4 Schedule control

This section 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.

7.8.5 Budget control

This section 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.

7.8.6 Quality assurance

This section of the PMP shall specify the quality goals and the resources and 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 can include quality assurance of work processes, verification and validation, joint reviews, audits and process assessment.

7.8.7 Subcontractor management

This section of the PMP shall contain plans for selecting and managing any subcontractors that can 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 document. Tailored plans should include the items necessary to help 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 help ensure successful completion of the subcontract. A reference to the official subcontract and prime contractor/subcontractor points of contact shall be specified.

7.8.8 Project closeout

This section of the PMP shall contain the plans necessary to help 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.

7.9 Product delivery

This section 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.

For a project which results in intangible deliverable(s), this section of the PMP shall detail how project completion is to be determined and how completion of the intangible deliverables will be demonstrated.

For projects focused on decommissioning and/or disposal, this section of the PMP shall detail how activity completion shall be satisfactorily demonstrated and any completion or disposal certificate(s) which can be provided.

7.10 Supporting processes

7.10.1 General

This section 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 sections and sections 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 can 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.

7.10.2 Project supervision and work environment

This section 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, encourage constructive differences of opinion and help resolve the resulting conflicts.

7.10.3 Decision management

This section 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 section shall also identify the desired outcomes of the strategies and shall specify measurable success criteria with which to assess the outcomes. This section 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 section. The need for decisions can 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.

7.10.4 Risk management

This section of the PMP shall specify the risk management plan for identifying, analyzing and prioritizing project risk factors. This section shall also describe the procedures for contingency planning and the methods to be used in tracking the various risk factors and evaluating changes in the levels of risk factors