BS ISO/IEC/IEEE 24748-4:2016

BSI Standards Publication

Systems and software engineering — Life cycle management

Part 4: Systems engineering planning

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National foreword

This British Standard is the UK implementation of ISO/IEC/IEEE 24748-4:2016. It supersedes BS ISO/IEC 26702:2007 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee IST/15, Software and systems engineering.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Systems and software engineering — Life cycle management —

Part 4: Systems engineering planning

Ingénierie des systèmes — Gestion du cycle de vie —

Partie 4: Ingénierie des systèmes

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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.

Attention is called to the possibility that implementation of this standard may require the use of subject matter covered by patent rights. By publication of this standard, no position is taken with respect to the existence or validity of any patent rights in connection therewith. ISO/IEEE is not responsible for identifying essential patents or patent claims for which a license may be required, for conducting inquiries into the legal validity or scope of patents or patent claims or determining whether any licensing terms or conditions provided in connection with submission of a Letter of Assurance or a Patent Statement and Licensing Declaration Form, if any, or in any licensing agreements are reasonable or non-discriminatory. Users of this standard are expressly advised that determination of the validity of any patent rights, and the risk of infringement of such rights, is entirely their own responsibility. Further information may be obtained from ISO or the IEEE Standards Association.

ISO/IEC/IEEE 24748-4 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 7, *Systems and software engineering*, in cooperation with the IEEE Computer Society Systems and Software Engineering Standards Committee, under the Partner Standards Development Organization cooperation agreement between ISO and IEEE.

This edition cancels and replaces the first edition of ISO/IEC 26702:2007 – IEEE Std 1220-2005, which has been technically revised.

ISO/IEC 24748 consists of the following parts, under the general title *Systems and software engineering — Life cycle management*:

— *Part 1: Guide for life cycle management*

— *Part 2: Guide to the application of ISO/IEC 15288 (System life cycle processes)*

— *Part 3: Guide to the application of ISO/IEC 12207 (Software life cycle processes)*

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— *Part 4: Systems engineering planning*

— *Part 5: Software development planning*

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Introduction

ISO/IEC/IEEE 15288, *Systems and software engineering – System life cycle processes*, provides a common process framework covering the life cycle of man-made systems. This life cycle spans the conception of ideas through to the retirement of a system. It provides the processes for acquiring and supplying systems. In addition, this framework provides for the assessment and improvement of the life cycle processes. This common framework improves communication and cooperation among the parties that create, utilize, and manage modern systems in order that they can work in an integrated, coherent fashion.

The acquisition or supply of a system is usually done within a project. A project prepares and implements the technical plans and schedules necessary to guide the project toward accomplishment of its objectives and proper conclusion. Given the project's authorization and objectives, the project should establish a Systems Engineering Management Plan (SEMP).

This part of ISO/IEC/IEEE 24748 replaces the former ISO/IEC 26702:2007 (IEEE Std 1220-2005), *Systems engineering — Application and management of the systems engineering process.* In preparation for harmonization, ISO/IEC 26702 provided explanations regarding key differences between IEEE Std 1220 and ISO/IEC/IEEE 15288 in areas such as terminology and structure.

The evolution of the harmonized set of ISO/IEC/IEEE 15288-12207 related standards and technical reports that are discussed in this part of ISO/IEC/IEEE 24748 provides detailed requirements and guidance on the application of system life cycle processes. This part of ISO/IEC/IEEE 24748 unifies technical and management requirements and guidance from several of these sources to specify the requirements for the content of a SEMP and to provide a common SEMP format. This part of ISO/IEC/IEEE 24748 also identifies the processes as defined in ISO/IEC/IEEE 15288 to perform the necessary project planning activities to accomplish the project's technical effort and to develop the project's SEMP. Due to close alignment with the content of ISO/IEC 24748, ISO/IEC 26702 is now Part 4 of the multi-part International Standard, ISO/IEC 24748 (*Systems and software engineering – Life cycle management*).

Taken together, the parts of ISO/IEC 24748 are intended to facilitate the joint usage of the process content of ISO/IEC/IEEE 15288 and ISO/IEC 12207, *Systems and software engineering – Software life cycle processes*, which in turn may be used together with related standards such as for service management, and various other lower-level process standards. In this way, ISO/IEC 24748 provides unified and consolidated guidance on the life cycle management of systems and software. Its purpose is to help ensure consistency in system concepts and life cycle concepts, models, stages, processes, process application, key points of view, adaptation, and use in various domains as the two International Standards (and others) are used in combination. It should help a project to design a life cycle model for managing progress on a project.

The five parts of ISO/IEC 24748 are:

— ISO/IEC TR 24748-1: *Systems and software engineering – Life cycle management – Part 1: Guide for life cycle management*

— ISO/IEC TR 24748-2: *Systems and software engineering – Life cycle management – Part 2: Guide for the application of ISO/IEC 15288 (System life cycle processes)*

— ISO/IEC TR 24748-3: *Systems and software engineering – Life cycle management – Part 3: Guide for the application of ISO/IEC 12207 (Software life cycle processes)*

— ISO/IEC/IEEE 24748-4: *Systems and software engineering – Life cycle management – Part 4: Systems engineering planning*

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— ISO/IEC/IEEE 24748-5: *Systems and software engineering – Life cycle management – Part 5: Software development planning*

Whereas Part 1 addresses in generic terms the purpose stated above of guidance for the life cycle management of systems and software, Part 2 focuses on and expands the coverage of those aspects for systems. Part 2 will also, in conjunction with Part 1, aid in identifying and planning the use of the life cycle processes described in ISO/IEC/IEEE 15288. The proper use of these processes will contribute to a project being completed successfully, meeting its objectives and requirements for each stage and for the overall project.

This part of ISO/IEC/IEEE 24748 focuses on the processes required for successful planning and management of the project's systems engineering effort. It calls for development of a SEMP as the key vehicle for representing a project's application of systems life cycle processes. The SEMP is a top level technical planning document for a project which addresses Technical Management processes established by three principal sources (the project's contract or agreement, applicable organizational processes, and the systems engineering project team) as necessary to successfully accomplish the systems engineering-related tasks of the project. The terms technical planning and systems engineering planning are used interchangeably in this part of ISO/IEC/IEEE 24748 to emphasize or differentiate technical contributions in the processes under discussion. This part of ISO/IEC/IEEE 24748 draws on key aspects of the former ISO/IEC 26702 (IEEE 1220) to highlight additional practices and provide normative content for a SEMP.

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Systems and software engineering — Life cycle management — Part 4: Systems engineering planning

1 Scope

This part of ISO/IEC/IEEE 24748

— specifies the Technical Management processes from ISO/IEC/IEEE 15288 that are required to be implemented for planning a systems engineering project,

— gives guidelines for applying the required processes,

— specifies a required information item, a plan for the technical management and execution of the project that is to be produced through the implementation of the Project Planning process,

— gives guidelines for the format and content of the required information item, and

— provides normative definition of the content of the information item that results from the application of these processes to that end. In this part of ISO/IEC/IEEE 24748 that plan for technical project management is termed the Systems Engineering Management Plan (SEMP).

This part of ISO/IEC/IEEE 24748 is applicable to

— those who use or plan to use ISO/IEC/IEEE 15288 on projects dealing with man-made systems including software-intensive systems, software products, and services related to those systems and products,

— those who are responsible for the technical management of projects concerned with the engineering of systems,

— those responsible for executing ISO/IEC/IEEE 15288 system life cycle processes at a project level,

— organizations and individuals who are subcontracting a project management effort,

— anyone developing engineering management documentation to complete technical planning aspects of their project's processes.

In many organizations, the various responsibilities of technical management are assigned to more than one person. Where the term "technical manager" or "systems engineering manager" is used in this part of ISO/IEC/IEEE 24748, the guidance, advice or normative requirement applies to the applicable role within the project or organization.

This part of ISO/IEC/IEEE 24748 is intended to provide guidance for two-party situations and may be equally applied where the two parties are from the same organization. This part of ISO/IEC/IEEE 24748 can also be used by a single party as self-imposed tasks.

This part of ISO/IEC/IEEE 24748 can also serve as guidance in multi-party situations, where high risks are inherent in the supply and integration of complex systems, and procurement can involve several suppliers, organizations or parties.

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2 Conformance

2.1 Intended usage

This part of ISO/IEC/IEEE 24748 provides guidance for the execution of the ISO/IEC/IEEE 15288 processes that are required for planning and managing a project to implement a significant systems engineering effort. This part of ISO/IEC/IEEE 24748 also provides normative definition of the content and recommendations for the format of the related information item, the project's SEMP.

Users of this part of ISO/IEC/IEEE 24748 can claim conformance to the process provisions or to the information item provisions, or both.

The requirements in this part of ISO/IEC/IEEE 24748 are contained in 6.1, Clauses 7 and 9 and in Annex C.

2.2 Conformance to processes

This part of ISO/IEC/IEEE 24748 identifies required processes for planning the technical management and execution of projects that implement considerable systems engineering efforts regarding the project's system products.

The requirements for these processes in this part of ISO/IEC/IEEE 24748 are contained in 6.1.

If a user of this part of ISO/IEC/IEEE 24748 claims full conformance to ISO/IEC/IEEE 15288:2015, then by implication the user may claim conformance to the processes in this part of ISO/IEC/IEEE 24748.

NOTE A claim to tailored conformance to ISO/IEC/IEEE 15288:2015, does not necessarily imply conformance to the processes in this part of ISO/IEC/IEEE 24748.

2.3 Conformance to information item content

This part of ISO/IEC/IEEE 24748 provides the requirements for an information item – the SEMP.

A claim of conformance to the information item provisions of this part of ISO/IEC/IEEE 24748 means that

— the user produces the required information item stated in this part of ISO/IEC/IEEE 24748, and

— the user demonstrates that the information item produced during the project planning activities conforms to the content requirements defined in this part of ISO/IEC/IEEE 24748.

The requirements for the information item in this part of ISO/IEC/IEEE 24748 are contained in Clause 7.

The requirements for the content of the information item in this part of ISO/IEC/IEEE 24748 are contained in Clause 9.

NOTE 1 If a user of this part of ISO/IEC/IEEE 24748 claims full conformance to ISO/IEC/IEEE 15289, it does not imply that the user may claim conformance to the information items and information item content in this part of ISO/IEC/IEEE 24748. The reason is that this part of ISO/IEC/IEEE 24748 adds additional information items and additional detail.

NOTE 2 In this part of ISO/IEC/IEEE 24748, for simplicity of reference, an information item is described as if it were published as a separate document. However, information items will be considered as conforming if they are unpublished but available in a repository for reference, or divided into separate documents or volumes.

2.4 Full conformance

A claim of full conformance to this part of ISO/IEC/IEEE 24748 is equivalent to claiming conformance

— to the processes of ISO/IEC/IEEE 15288, cited in subclause 6.1,

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— to the information item cited in Clause 7, and

— to content requirements of the information item in Clause 9.

2.5 Tailored conformance

A claim of tailored conformance to this part of ISO/IEC/IEEE 24748 is equivalent to claiming conformance in accordance with the tailoring direction provided in normative Annex C.

3 Normative references

The following document, in whole or in part, is normatively referenced in this document and is indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC/IEEE 15288:2015, *Systems and software engineering – System life cycle processes*

4 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC/IEEE 15288:2015 and the following apply.

NOTE 1 ISO/IEC TR 24748-1 provides guidance on the application of ISO/IEC/IEEE 15288, including definition or expansion of important organization, project, process, and life cycle model concepts and their adaptation for successful project implementation. ISO/IEC TR 24748-1 is a publicly available technical report; please see the ISO - Publicly Available Standards site: http://standards.iso.org/ittf/PubliclyAvailableStandards/index.html

NOTE 2 ISO/IEC TR 24748-1 also references and uses the terms and definitions from ISO/IEC/IEEE 15288.

4.1
document
uniquely identified unit of information for human use

EXAMPLE Report, specification, manual or book, in printed or electronic form.

[SOURCE: ISO/IEC/IEEE 15289:2015]

4.2
include [information]
having either the information or a reference to the information present in the document

[SOURCE: ISO/IEC/IEEE 15289:2015]

4.3
information item
separately identifiable body of information that is produced, stored, and delivered for human use

Note 1 to entry: Synonym: information product.

Note 2 to entry: An information item can be produced in several versions during a project life cycle.

[SOURCE: ISO/IEC/IEEE 15289:2015]

4.4
information item content
information included in an information item, associated with a system, product or service, to satisfy a requirement or need

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[SOURCE: ISO/IEC/IEEE 15289:2015]

4.5
information item type
group of information items consistent with a pre-arranged set of generic criteria

Note 1 to entry: Synonym: generic document type.

EXAMPLE A “plan” is the information item type for all plans and “report” is the information item type for all reports.

[SOURCE: ISO/IEC/IEEE 15289:2015]

4.6
integrated repository
planned and controlled storage of information pertinent to the systems engineering effort

Note 1 to entry: The integrated repository typically includes key data, e.g., schema, models, tools, technical management decisions, process analysis information, requirement changes, process and product metrics, trade-offs and other analyses.

4.7
measure of effectiveness
MOE
“operational” measure of success that is closely related to the achievement of the operational objective being evaluated in the intended operational environment under a specified set of conditions

[SOURCE: ISO/IEC TR 24748-2:2010, Table A.15 k)]

4.8
measure of performance
MOP
engineering parameter that provides critical performance requirements to satisfy a measure of effectiveness (MOE)

Note 1 to entry: An MOP typically characterizes physical or functional attributes relating to the system operation.

4.9
organization
group of people and facilities with an arrangement of responsibilities, authorities and relationships

Note 1 to entry: A body of persons organized for some specific purpose, such as a club, union, corporation, or society, is an organization.

Note 2 to entry: An identified part of an organization (even as small as a single individual) or an identified group of organizations can be regarded as an organization if it has responsibilities, authorities and relationships.

[SOURCE: ISO/IEC/IEEE 15288:2015]

4.10
plan
information item that presents a systematic course of action for achieving a declared purpose, including when, how, and by whom specific activities are to be performed

[SOURCE: ISO/IEC/IEEE 15289:2015]

4.11
project
endeavour with defined start and finish criteria undertaken to create a product or service in accordance with specified resources and requirements

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Note 1 to entry: A project is sometimes viewed as a unique process comprising co-coordinated and controlled activities and composed of activities from the Technical Management processes and Technical processes defined in ISO/IEC/IEEE 15288.

[SOURCE: ISO/IEC/IEEE 15288:2015, modified Note 1 to entry]

4.12
system breakdown structure
SBS
system hierarchy, with identified enabling systems, and personnel that is typically used to assign development teams, support technical reviews, and to partition the assigned work and associated resource allocations to each of the tasks necessary to accomplish the technical objectives of the project

Note 1 to entry: The SBS can be used as a basis for cost-tracking and control.

4.13
stakeholder
individual or organization having a right, share, claim, or interest in a system or in its possession of characteristics that meet their needs and expectations

[SOURCE: ISO/IEC/IEEE 15288:2015]

4.14
systems engineering management plan
SEMP
top level technical plan for managing the systems engineering effort which defines how the technical aspects of the project will be organized, structured, and conducted and how the systems engineering processes will be controlled to provide a product that satisfies stakeholder requirements

[SOURCE: ISO/IEC TR 29110-5-6-2:2014, modified to specify technical aspects of the project]

4.15
technical performance measure
TPM
measure used to assess design progress, compliance to performance requirements, and technical risks for critical performance parameters

Note 1 to entry: TPMs are derived from the MOPs focusing on the critical performance parameters of specific architectural elements of the system as it is designed and implemented.

[ISO/IEC 29148:2011, 6.3.3.1]

4.16
work breakdown structure
WBS
hierarchical decomposition of the total scope of work to be carried our by the project team to accomplish the project objectives and create the required deliverables

[SOURCE: PMBOK Guide – Fifth Edition]

5 Concepts

5.1 Introduction

This Clause presents concepts that apply to and are necessary to understand the systems engineering planning aspects of a project and for the development and content of a project's SEMP.

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The Agreement processes of ISO/IEC/IEEE 15288 specify the requirements for the establishment of agreements with organizational entities, both external and internal to the organization, for the acquisition and supply of products and services. The Organizational Project-Enabling processes of ISO/IEC/IEEE 15288 provide resources and infrastructure necessary to support projects and help ensure the satisfaction of organizational objectives and established agreements. The Technical Management processes of ISO/IEC/IEEE 15288 contain the generic activities and tasks, which may be employed by any party that has to manage a project dealing with systems or products. The Technical processes of ISO/IEC/IEEE 15288 transform the needs of stakeholders first into a product and then, by applying that product, provide a sustainable service, when and where needed in order to achieve customer satisfaction.

As discussed in this part of ISO/IEC/IEEE 24748, there are several standards that detail requirements and application guidance for use of ISO/IEC/IEEE 15288. Some of these standards further expand the requirements of ISO/IEC/IEEE 15288 to support its application and implementation in organizations and on projects. Their content includes pertinent requirements and guidance to support systems engineering planning activities and tasks; for the development of a SEMP for implementation on a project; or for a SEMP template for organizational use.

This part of ISO/IEC/IEEE 24748 unifies and supplements the extensive application information available in these standards to assist organizations and project management teams in performance of systems engineering planning activities and developing an engineering management plan to address a project's technical management needs. It must be noted that these referenced standards and other documents have been developed over different time spans and originated by different organizations, so the user may encounter some contradictions when applying these references.

Performance of systems engineering planning activities to manage the technical aspects of a project and for development of a SEMP presupposes an understanding of several key concepts. These include the concepts of: system, life cycle, process, organization, project, information item, and SEMP development. Foundational material that explains these concepts is discussed or identified in 5.2 to 5.7.

5.2 System concepts

System concepts for systems that are any mix of products and services are introduced in ISO/IEC/IEEE 15288, 5.2. Additional discussion is in ISO/IEC TR 24748-1, 3.1, which explains systems, system boundaries, structure in systems and projects, and enabling systems

5.3 Life cycle concepts

System life cycle concepts are introduced in ISO/IEC/IEEE 15288, 5.4. Additional discussion is in ISO/IEC TR 24748-1, 3.2.

Project life cycle concepts and application are addressed in ISO/IEC/IEEE 16326.

The INCOSE Systems Engineering Handbook discusses system life cycle concepts in terms of business, budget and technical aspects, and project cycles in terms of decision gates. Discussion of different methods, implementation strategies and case studies highlight some of the decisions facing organizations and projects in determining appropriate system and life cycle models to employ.

5.4 Process concepts

ISO/IEC TR 24774 provides foundational discussion of process concepts to encourage consistency in development of standard process reference models. It presents guidelines for the elements used most frequently in describing a process: the title, purpose, outcomes, activities, tasks and information items.

Process concepts are introduced in ISO/IEC/IEEE 15288, 5.5. Additional discussion for application is provided in ISO/IEC TR 24748-1, 3.3, and in ISO/IEC TR 24748-2, 4.4.

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ISO/IEC/IEEE 15288 establishes a top-level architecture of the life cycle of systems from conception through retirement. The architecture is constructed with a set of processes and interrelationships among these processes.

Process principles are introduced in ISO/IEC TR 24748-2, 4.4.2.

The process categories of ISO/IEC/IEEE 15288 are discussed in ISO/IEC TR 24748-2, 4.4.3.

The recursive and iterative application of processes is discussed in ISO/IEC TR 24748-2, 4.4.4.

5.5 Organizational concepts

Clause 4 provides a definition of organization as adapted from ISO/IEC/IEEE 15288. An identified part of an organization (even as small as a single individual) or an identified group of organizations can be regarded as an organization, if it has responsibilities, authorities and relationships. In ISO/IEC/IEEE 15288, when an organization, as a whole or a part, enters into an agreement, it is a party. Organizations are separate bodies, but the parties may be from the same organization or from separate organizations.

Organizational concepts, such as responsibility, organizational relationships and project organizational structure, are discussed in ISO/IEC TR 24748-2, 4.5.

5.6 Project concepts

Clause 4 provides a definition of project as adapted from ISO/IEC/IEEE 15288.

A project can be viewed as a single endeavour, unique in its purpose and consisting of various implemented lifecycle processes.

ISO/IEC TR 24748-1, 3.1.4, discusses system structure and implications in projects.

ISO/IEC TR 24748-1, 3.1.5, explains enabling systems in terms of the system-of-interest and its operational environment.

ISO/IEC TR 24748-2, 4.6, discusses project concepts, relationships among projects, project relationships with enabling systems and hierarchy of projects.

IEEE Std. 1490-2011, *IEEE Guide: Adoption of PMI Standard: A Guide to the Project Management Body of Knowledge*, provides more information on projects and project management.

ISO/IEC/IEEE 16326, *Systems and software engineering – Life cycle processes – Project management*, provides more information on project management and the information item, Project Management Plan (PMP).

5.7 Information items concepts

Clause 4 provides definitions of an information item and related terms as adapted from ISO/IEC/IEEE 15289.

ISO/IEC/IEEE 15289 provides more detail on information items and specifies how life cycle data is managed in information items.

ISO/IEC/IEEE 15289, 6.1, provides requirements for life cycle data characteristics of information items that are produced as documents.

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 part of ISO/IEC/IEEE 24748 is of type plan.

ISO/IEC/IEEE 15289, Clause 7, identifies several generic types of information items and provides generic content for each information item type.

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ISO/IEC/IEEE 15289, 7.3, provides generic content elements for plans.

ISO/IEC/IEEE 15289 makes a distinction between records and documents (which includes plans). Each information item produced as a document supports certain life cycle data characteristics. Documents are produced and communicated for human use and contain formal elements (such as purpose, scope, and summary), intended to make them usable by their intended audience.

ISO/IEC/IEEE 15289, 6.4, provides requirements for the management of information items through the application of ISO/IEC/IEEE 15288 and ISO/IEC 12207 processes. These include the Information Management process and select activities from the Knowledge Management process.

5.8 SEMP development concepts

The SEMP provides a plan for implementing the selected system life cycle processes across the full life cycle of the project. The SEMP should be developed in the earliest project planning stages. This is tightly coupled with Project Management Plan (PMP) development and content. Although sometimes combined, the SEMP is typically a subordinate document to the PMP and focuses on the technical management aspects of the project.

The SEMP should be a living document. A good SEMP provides a roadmap to the technical execution of a project. Project personnel should use the SEMP as a reference to understand the overall technical approach to a project. A SEMP should be periodically updated as plans are solidified or modified, activities move from plans to historical facts, known risks are mitigated or significantly changed, new risks are identified, new tools and technologies are adopted, and as a myriad of other factors cause an adjustment to the project's overall technical approach. Thus, it is expected that the SEMP will evolve over time and go through revisions when a new agreement is awarded, or as the project moves from stage to stage. The SEMP should reference or provide a link to the PMP, for direction on how the SEMP will be updated and controlled on the project.

The SEMP is the key technical management plan that integrates the system engineering effort. The following extract from ISO/IEC TR 24748-2, Table A.8 on Process Planning Notes, describes the engineering plan (which is referred to in this part of ISO/IEC/IEEE 24748 as a SEMP):

> The engineering plan provides an explanation of what needs to be done, how it will be done, who will do it, when it will be done and where it will be done; as well as how much of a resource is necessary to do the work for each technical process. The engineering plan explains the above within established constraints of resources and staff and in order to meet cost, schedule and performance requirements within acceptable risks.

ISO/IEC/IEEE 16326:2009 supplements the Technical Management processes of ISO/IEC/IEEE 15288, providing detailed guidance and normative content specifications for project management plans covering software projects and software-intensive system projects. ISO/IEC/IEEE 16326 notes that a SEMP is typically developed at a lower level of abstraction than the PMP to address and gather most of the other plans required to satisfy product requirements and agreement terms (e.g. specialty plans for safety, security, training, integration, transition). Technical plans such as the SEMP (also commonly called a Technical Management Plan or Engineering Plan) need to coordinate the technical and management aspects of a project (or many projects) across one or more organizations to help ensure successful achievement of organizational and agreement goals for the project. A SEMP will typically complete or supplement plan elements initiated at the PMP level. Organizational processes, agreement terms and project unique requirements contribute to the determination of PMP and SEMP content and their interfaces.

Informative Annex A notes the ISO/IEC/IEEE 16326 content specifications for key PMP elements. This annex also describes the relationship of the required SEMP content that is identified in Clause 9 to these informative descriptions of PMP elements.

Clause 8 contains guidance for SEMP development.

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6 Technical Management processes for systems engineering planning

6.1 General

To plan the project's technical effort and to develop the project's SEMP, the project shall implement the following processes as defined in ISO/IEC/IEEE 15288:2015 and listed in Table 1:

Table 1 — Technical Management processes of ISO/IEC/IEEE 15288 and ISO/IEC/IEEE 16326 guidance

Technical Management process	ISO/IEC/IEEE 15288 Clause	ISO/IEC/IEEE 16326 Guidance
Project planning	Clause 6.3.1	Clause 6.1
Project assessment and control	Clause 6.3.2	Clause 6.2
Decision management	Clause 6.3.3	Clause 6.3
Risk management	Clause 6.3.4	Clause 6.4
Configuration management	Clause 6.3.5	Clause 6.5
Information management	Clause 6.3.6	Clause 6.6
Measurement	Clause 6.3.7	Clause 6.7
Quality assurance	Clause 6.3.8	Not applicable

The related processes, activities, and tasks are found in the cited clauses of ISO/IEC/IEEE 15288. The process descriptions with outcomes and guidance for project management planning and development of project management plans are found in the cited clauses of ISO/IEC/IEEE 16326. The process descriptions with outcomes and supplemental guidance for technical planning and development of a project's SEMP are addressed in this part of ISO/IEC/IEEE 24748.

Clause 6 examines the eight Technical Management processes of ISO/IEC/IEEE 15288, providing detailed discussion and application advice as it applies to the management of projects dealing with systems. The guidance in Clause 8 and in Annex B support the analysis, selection, and adaptation of ISO/IEC/IEEE 15288 processes to populate a life cycle model for project application that is designed for the system life cycle stage or stages within the scope of the project. This combined guidance is intended to aid project and technical planners to produce the required technical planning contributions as specified in Clause 9 and allocate them to the SEMP, or other project plans, e.g. the PMP.

Normative process portions from ISO/IEC/IEEE 15288 are contained in boxed text, with discussion and advice for that portion immediately following.

ISO/IEC/IEEE 16326 explains these processes in terms of what the project manager should do to develop the project plans for the project. The SEMP is a specialization of one of these plans that focuses on the technical management aspects of the project to successfully manage and deliver the system products and services of the project. While many of the duties and activities of the project planning and technical or systems engineering planning are the same, the scope and focus can vary greatly – depending on project complexity and organizational influences.

NOTE The terms "technical planning" and "systems engineering planning" are used interchangeably in this part of ISO/IEC/IEEE 24748. Their use, especially in this Clause, is intended to emphasize or differentiate technical contributions in the processes under discussion. There is no intent to indicate that a particular person, group or organizational function should perform the activity.

If a project and its system products and services warrant separate project and technical management plans, such as creation of a SEMP, decisions need to be made early in the project's life cycle regarding the scoping and allocation of personnel responsibilities and the plans of the project. There needs to be direct and

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consistent communication between project and technical management. This helps to ensure that key technical stakeholders are identified with planned activities, and are involved as planned.

There are several prescriptive project management methodologies that support life cycle processes in the field of systems and software engineering, which are used in both government and the private sector. One example, the Project Management Body of Knowledge (PMBOK®)[1] Guide contains a comprehensive set of generic project management processes, which may be employed for implementing both general and technical project management tasks. One of the early project management and process planning activities will be to decide on the use and scope of methodologies, such as these, to support the project management and technical efforts of the project.

6.2 Project planning process

ISO/IEC/IEEE 15288:2015

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 project 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.

NOTE The strategies defined in each of the other processes 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.

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.

Guidance:

a) The responsibility for preparing, reviewing, and approving plans, including technical management plans, should be assigned and documented.

b) Systems engineering planning should help to ensure that requirements related to the technical effort are elicited, documented, analyzed, verified and managed. Technical project planning should include the following activities:

[1] 1) Project Management Body of Knowledge (PMBOK®) Guide is an example of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO or IEC of this product."

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1) Involve all identified stakeholders in the requirements definition, and related activities.

2) Establish verification strategy early and maintain verification activity as requirements evolve.

3) Manage change to the scope and requirements throughout a project's life cycle. Changes in scope and requirements should be carefully evaluated for impacts on stakeholder satisfaction, cost, schedule, risk, current scope and quality.

4) Review the selection of processes when the scope and requirements are changed, to confirm that the selected processes are still applicable after the changes in scope and requirements.

5) Define who is responsible for obtaining stakeholder agreement on requirements and for balancing opposing stakeholder views.

6) Establish and maintain requirements traceability.

c) System engineering efforts should be conducted with the required technical engineering resources and skills. When resources or skills are constrained, consider the criticality of the effort and the risk of failure on the effort in the allocation of limited resources or skills. Risk-driven scheduling provides one possible approach to address this. Although dynamically choosing the next task for implementation based on the current priority and risk rating, makes the schedule less predictable, it allows for better allocation of resources in a resource limited environment.

d) Systems engineering planning should supply the technical contributions to the description of the activities required to translate stakeholder requirements into project deliverables and activities to be carried out that will help ensure products are delivered as specified in an agreement, i.e., that a project includes all the work required, and only the work required, to complete the project and product successfully.

e) To support project scoping, systems engineering typically defines a hierarchy for the project's system-of-interest and establishes a related SBS.

f) All aspects of process tailoring and project planning should account for the type of project, systems, technologies, potential resources, and staffing that are expected to be encountered on the project.

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. Systems engineering planning should provide appropriate technical input to support determining the feasibility of the planned project processes to help ensure personnel, materials, facilities, System/Software Engineering Environment, and technology required to execute and manage the project are available, adequate and appropriate; and the predetermined times for completion are achievable, timely and economical. The results from these feasibility analyses 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 and technical 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 help 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. Often specialty engineering studies or activities are conducted to identify or help control project risks in unprecedented situations.

i) ISO 10006:2003 provides guidelines for project managers to help ensure proper quality of their project's products and services.

j) Project planning should include selection of a life cycle model that is appropriate to the project. The organization typically defines and provides potential life cycle policies, processes, models, and procedures to projects via the Life Cycle Model Management process. Technical planning should ensure that the system life cycle considerations and needs, which are within the project's purview, are addressed.

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Incremental and evolutionary types of life cycle models should be considered. 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 often preferable over a waterfall life cycle model.

k) The planning process should include the allocation of activities and tasks with established completion criteria to the program organizational elements. This facilitates determination if a project, an organizational element, an activity or task has reached successful completion.

l) A project should have one master plan. Subordinate plans should be integrated and consistent with the master plan. This is commonly called an Integrated Master Plan (IMP).

m) A project should have one master schedule. Subordinate schedules should be integrated and consistent with the master schedule. This is commonly called an Integrated Master Schedule (IMS). Often subordinate technical schedules are used to control the systems engineering effort and teams.

n) A Work Breakdown Structure (WBS) is commonly used to effectively measure project progress and to provide visibility into processes and products. The PMBOK® Guide 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 planning should make use of multiple cost estimation techniques, including system and software cost models. Project and technical planning should determine the complexity of the system and software products and should develop Measures of Effectiveness (MOEs) with the acquirer.

p) Project planning should determine if the existing organizational infrastructure resources, which are typically supplied through the organization's Infrastructure Management process, are sufficient for project needs, or whether a new or augmented infrastructure is needed. The Acquisition and Supply processes should be used if infrastructure systems need to be obtained.

q) Technical Plans, e.g. the SEMP and its subordinate plans, should be reviewed regularly and updated to be consistent with other project plans, e.g. the PMP. Traceability among key sections of technical plans, e.g. a Statement of Work, PMP, SEMP, IMP, and IMS, should be considered. Required content for a project's SEMP is described in Clause 9.

NOTE See 5.8 for additional guidance for updating Technical Plans.

r) The SEMP and subordinate plans should be placed under configuration control in accordance with the information management strategy determined for project documentation.

s) Project planning should include a mechanism for conflict resolution or escalation so an appropriately authorized level of organizational management is identified to resolve disagreements between the project management and supporting project stakeholders. Technical plans should reference this mechanism.

t) 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.

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u) The project should make use of historical project and technical data when developing estimates and plans. The organization should collect, analyze, archive and retrieve project and technical data for process improvement purposes and to support planning and analysis for future projects.

v) 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.

w) Systems engineering planning should include activities to resolve issues and resource needs for requirements, interfaces and design with relevant stakeholders.

x) Project planning should include contingency planning for both management and technical issues.

y) Project closeout strategy and planning should address the potential need for proper disposal, or continuing work, responsibilities, or support for project artifacts (including systems or enabling systems) after the project closeout.

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6.3 Project assessment and control process

ISO/IEC/IEEE 15288:2015

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 re-planning 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.

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