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Systems and software engineering — Software life cycle processes

Ingénierie des systèmes et du logiciel — Processus du cycle de vie du logiciel

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ISO/IEC 12207:2008(E)
IEEE Std 12207™-2008
(Revision of
IEEE/EIA 12207.0-1996)

Systems and software engineering — Software life cycle processes

Sponsor

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Abstract: This International Standard establishes a common framework for software life cycle processes, with well-defined terminology, that can be referenced by the software industry. It applies to the acquisition of systems and software products and services, to the supply, development, operation, maintenance, and disposal of software products and the software portion of a system, whether performed internally or externally to an organization. Those aspects of system definition needed to provide the context for software products and services are included. Software includes the software portion of firmware. This revision integrates ISO/IEC 12207:1995 with its two amendments and was coordinated with the parallel revision of ISO/IEC 15288:2002 (System life cycle processes) to align structure, terms, and corresponding organizational and project processes. This standard may be used stand alone or jointly with ISO/IEC 15288, and supplies a process reference model that supports process capability assessment in accordance with ISO/IEC 15504-2 (Process assessment). An annex provides support for IEEE users and describes relationships of this International Standard to IEEE standards.

Keywords: acquisition, agreement, assessment, audit, configuration management, development, maintenance, disposal, operation, process reference model, process improvement, quality assurance, retirement, supply, validation, verification

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International Standard ISO/IEC 12207:2008(E)

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

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ISO/IEC 12207 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 7, *Software and systems engineering*.

This second edition cancels and replaces the first edition (ISO/IEC 12207:1995), which has been technically revised. It also incorporates the Amendments ISO/IEC 12207:1995/Amd.1:2002 and ISO/IEC 12207:1995/Amd.2:2004.

Changes in this revision of ISO/IEC 12207 were developed in conjunction with a corresponding revision of ISO/IEC 15288. The purpose of these revisions is to better align the two International Standards to facilitate their joint use. This alignment is the first step toward harmonization of the structures and contents of the two International Standards, while supporting the requirements of the assessment community. This alignment provides the foundation to facilitate evolution to an integrated and fully harmonized treatment of life cycle processes. This International Standard was developed with the following goals:

— incorporate and rationalize both Amendments;

— provide a common terminology between the revision of ISO/IEC 15288 and ISO/IEC 12207;

— where applicable, provide common process names and process structure between the revision of the ISO/IEC 15288 and this International Standard;

— enable the user community to evolve towards fully harmonized standards and to provide a stable standard, while maximizing backward compatibility; and

— leverage ten years of experience with the development and use of ISO/IEC 12207 and ISO/IEC 15288.

A subsequent revision is intended to achieve a fully harmonized view of the system and software life cycle processes. Identified areas to address in the future include: common process purposes and outcomes, architecture of the standards, level of prescription of activities and tasks, life cycle treatments, treatment of products and services, common verification and validation concepts, common configuration management concepts, deferred recommendations and alignment with other applicable standards.

The IEEE Computer Society collaborated with ISO/IEC JTC 1 in the development of this International Standard. *IEEE/EIA 12207.0-1996, Industry Implementation of International Standard ISO/IEC 12207:1995 Standard for Information Technology – Software Life Cycle Processes*, was one of the base documents used in the development of this International Standard.

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Introduction

ISO/IEC 12207 was published on 1 August 1995 and was the first International Standard to provide a comprehensive set of life cycle processes, activities and tasks for software that is part of a larger system, and for stand alone software products and services. That International Standard was followed in November 2002 by ISO/IEC 15288 which addressed system life cycle processes. The ubiquity of the software meant that the software and its design processes should not be considered separately from those systems, but be considered as an integral part of the system and system design processes. The ISO/IEC 12207 Amendments in 2002 and 2004 added process purpose and outcomes to the International Standard and established a Process Reference Model in accordance with the requirements of ISO/IEC 15504-2.

This International Standard, a revision of the amended ISO/IEC 12207, is an initial step in the SC7 harmonization strategy to achieve a fully integrated suite of system and software life cycle processes and guidance for their application.

This revision integrates ISO/IEC 12207:1995 with its two Amendments and applies SC7 guidelines for process definition to support consistency and improved usability. Project execution was carefully coordinated with the parallel revision of ISO/IEC 15288:2002 to align structure, terms, and corresponding organizational and project processes.

This International Standard can be used in one or more of the following modes:

— By an organization — to help establish an environment of desired processes. These processes can be supported by an infrastructure of methods, procedures, techniques, tools and trained personnel. The organization may then employ this environment to perform and manage its projects and progress systems through their life cycle stages. In this mode this International Standard is used to assess conformance of a declared, established set of life cycle processes to its provisions.

— By a project — to help select, structure and employ the elements of an established set of life cycle processes to provide products and services. In this mode this International Standard is used in the assessment of conformance of the project to the declared and established environment.

— By an acquirer and a supplier — to help develop an agreement concerning processes and activities. Via the agreement, the processes and activities in this International Standard are selected, negotiated, agreed to and performed. In this mode this International Standard is used for guidance in developing the agreement.

— By organizations and assessors — to perform assessments that may be used to support organizational process improvement.

This International Standard contains requirements in four Clauses: Clause 6, which defines the requirements for the system life cycle processes, Clause 7, which defines the requirements for specific software life cycle processes, clauses of Annex A, which provides requirements for tailoring of this International Standard and clauses of Annex B, which provides a Process Reference Model (PRM) which may be used for assessment purposes.

Five informative annexes support the harmonization strategy initiated by this revision.

— Annex C expands on history and rationale for the changes, and provides high-level traceability among the International Standards which were used as the inputs to this revision.

— Annex D describes the alignment of the processes of ISO/IEC 15288 and ISO/IEC 12207 — a key focus of this revision.

— Annex E provides an example of a process view for Usability, intended to illustrate how a project might assemble processes, activities and tasks of ISO/IEC 12207 to provide focused attention to the achievement of product characteristics that have been selected as being of special interest.

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— Annex F contains some example process descriptions that are considered useful to some readers of this International Standard.

— Annex G provides support for IEEE users and describes relationships of this International Standard to IEEE standards.

Readers of this International Standard are advised to consult Clause 5 to gain understanding of the key concepts used.

NOTE A future Technical Report (ISO/IEC TR 24748) will describe the relations between this International Standard and ISO/IEC 15288:2008.

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IEEE Introduction

This introduction is not part of IEEE Std 12207™-2008, Systems and Software Engineering—Software Life Cycle Processes.

IEEE Std 12207™-2008 and IEEE Std 15288™-2008 are identical to ISO/IEC 12207:2008 and ISO/IEC 15288:2008. Therefore, all references to ISO/IEC 12207 or ISO/IEC 15288 apply equally well to their IEEE counterparts. Further details regarding relationships to IEEE standards can be found in Annex G.

This standard replaces IEEE/EIA 12207.0-1996, *Industry Implementation of International Standard ISO/IEC 12207: 1995 Standard for Information Technology – Software Life Cycle Processes*, which was an adoption with changes of ISO/IEC 12207:1995. Users of the earlier standard may be interested to know what will happen to its companions, IEEE/EIA 12207.1-1996 and IEEE/EIA 12207.2-1997. There is currently a project underway to replace IEEE/EIA 12207.1 with an adoption of ISO/IEC 15289. Completion of the current project will render IEEE/EIA 12207.2 obsolete; it will probably be withdrawn unless there is a demonstration of interest to revise it.

The original ISO/IEC 12207 was published on 1 August 1995 and was the first international standard to provide a comprehensive set of life cycle processes, activities and tasks for software that is part of a larger system, and for stand alone software products and services. That international standard was followed in November 2002 by ISO/IEC 15288 which addressed system life cycle processes.

IEEE cooperated with the Electronic Industries Alliance (EIA) in adopting ISO/IEC with changes to become IEEE/EIA 12207-1996. In 2004, IEEE performed an identical adoption of ISO/IEC 15288:2002.

The ISO/IEC 12207 amendments in 2002 and 2004 added process purpose and outcomes to the International Standard and established a Process Reference Model in accordance with the requirements of ISO/IEC 15504-2. IEEE did not pick up these amendments, preferring a stable base for the users of its standard.

This new revision of ISO/IEC 12207 is the product of a coordinated effort by IEEE and ISO/IEC JTC 1/SC 7. The base documents for the revision included the ISO/IEC standard and its amendments, and the IEEE/EIA standard and its unique material.

This revision integrates ISO/IEC 12207:1995 with its two Amendments and applies SC7 guidelines for process definition to support consistency and improved usability. Project execution was carefully coordinated with the parallel revision of ISO/IEC 15288:2002 to align structure, terms, and corresponding organizational and project processes.

This revised standard is a step in the SC7 harmonization strategy to achieve a fully integrated suite of system and software life cycle processes and guidance for their application. It is also an important step in the shared strategy of ISO/IEC JTC 1/SC 7 and the IEEE to harmonize their respective collections of standards. The new editions of ISO/IEC 12207 and ISO/IEC 15288, and their identical IEEE editions, will provide a single, shared baseline of systems and software life cycle processes applicable to both ISO/IEC and the IEEE standards collections.

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Errata, if any, for this and all other standards can be accessed at the following URL: http://standards.ieee.org/reading/ieee/updates/errata/index.html. Users are encouraged to check this URL for errata periodically.

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Systems and software engineering — Software life cycle processes

1 Overview

1.1 Scope

This International Standard establishes a common framework for software life cycle processes, with well-defined terminology, that can be referenced by the software industry. It contains processes, activities, and tasks that are to be applied during the acquisition of a software product or service and during the supply, development, operation, maintenance and disposal of software products. Software includes the software portion of firmware.

This International Standard applies to the acquisition of systems and software products and services, to the supply, development, operation, maintenance, and disposal of software products and the software portion of a system, whether performed internally or externally to an organization. Those aspects of system definition needed to provide the context for software products and services are included.

This International Standard also provides a process that can be employed for defining, controlling, and improving software life cycle processes.

The processes, activities and tasks of this International Standard—either alone or in conjunction with ISO/IEC 15288—may also be applied during the acquisition of a system that contains software.

1.2 Purpose

The purpose of this International Standard is to provide a defined set of processes to facilitate communication among acquirers, suppliers and other stakeholders in the life cycle of a software product.

This International Standard is written for acquirers of systems and software products and services and for suppliers, developers, operators, maintainers, managers, quality assurance managers, and users of software products.

This International Standard is intended for use in a two-party situation and may be equally applied where the two parties are from the same organization. The situation may range from an informal agreement up to a legally binding contract. The International Standard may be used by a single party through a self-imposed set of processes. This clause does not prevent the use of ISO/IEC 12207 by suppliers or developers of off-the-shelf software.

1.3 Limitations

This International Standard does not detail the life cycle processes in terms of methods or procedures required to meet the requirements and outcomes of a process.

This International Standard does not detail documentation in terms of name, format, explicit content and recording media. The International Standard may require development of documents of similar class or type; various plans are an example. The International Standard, however, does not imply that such documents be developed or packaged separately or combined in some fashion. These decisions are left to the user of the International Standard.

NOTE ISO/IEC 15289 addresses the content for life cycle process information items (documentation).

This International Standard does not prescribe a specific system or software life cycle model, development methodology, method, model or technique. The parties of the International Standard are responsible for

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selecting a life cycle model for the software project and mapping the processes, activities, and tasks in this International Standard onto that model. The parties are also responsible for selecting and applying the software development methods and for performing the activities and tasks suitable for the software project.

This International Standard is not intended to be in conflict with any organization's policies, procedures, and standards or with any national laws and regulations. Any such conflict should be resolved before using this International Standard.

2 Conformance

2.1 Intended usage

The requirements in this International Standard are contained in Clauses 6 and 7 and Annex A. This International Standard provides requirements for a number of processes suitable for usage during the life cycle of a software product or service. It is recognized that particular projects or organizations may not need to use all of the processes provided by this International Standard. Therefore, implementation of this International Standard typically involves selecting a set of processes suitable to the organization or project. There are two ways that an implementation can be claimed to conform with the provisions of this International Standard. Any claim of conformance is cited in only one of the two forms below.

2.2 Full conformance

A claim of full conformance declares the set of processes for which conformance is claimed. Full conformance is achieved by demonstrating that all of the requirements of the declared set of processes have been satisfied using the outcomes as evidence.

2.3 Tailored conformance

When this International Standard is used as a basis for establishing a set of processes that do not qualify for full conformance, the clauses of this International Standard are selected or modified in accordance with the tailoring process prescribed in Annex A. The tailored text, for which tailored conformance is claimed, is declared. Tailored conformance is achieved by demonstrating that requirements for the processes, as tailored, have been satisfied using the outcomes as evidence.

NOTE 1 When this International Standard is used to help develop an agreement between an acquirer and a supplier, clauses of this International Standard can be selected for incorporation in the agreement with or without modification. In this case, it is more appropriate for the acquirer and supplier to claim compliance with the agreement than conformance with this International Standard.

NOTE 2 Any organization (for example, national, industrial association, company) imposing this International Standard, as a condition of trade, should specify and make public the minimum set of required processes, activities, and tasks, which constitute suppliers' conformance with this International Standard.

NOTE 3 Requirements of this International Standard are marked by the use of the verb "shall." Recommendations are marked by the use of the verb "should". Permissions are marked by the use of the verb "may".

3 Normative references

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4 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

4.1
acquirer
stakeholder that acquires or procures a product or service from a supplier

NOTE The acquirer could be one of the following: buyer, customer, owner, purchaser.

4.2
acquisition
process of obtaining a system, software product or software service

4.3
activity
set of cohesive tasks of a process

4.4
agreement
mutual acknowledgement of terms and conditions under which a working relationship is conducted

4.5
audit
independent assessment of software products and processes conducted by an authorized person in order to assess compliance with requirements

4.6
baseline
specification or product that has been formally reviewed and agreed upon, that thereafter serves as the basis for further development, and that can be changed only through formal change control procedures

4.7
configuration item
entity within a configuration that satisfies an end use function and that can be uniquely identified at a given reference point

4.8
contract
binding agreement between two parties, especially enforceable by law, or a similar internal agreement wholly within an organization

4.9
customer
organization or person that receives a product or service

NOTE 1 A customer can be internal or external to the organization.

NOTE 2 Adapted from ISO 9000: 2005.

NOTE 3 Other terms commonly used for customer are acquirer, buyer, and purchaser.

4.10
developer
organization that performs development tasks (including requirements analysis, design, testing through acceptance) during a life cycle process

NOTE In this International Standard, the terms developer and implementer are synonymous.

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4.11
enabling system
system that supports a system-of-interest during its life cycle stages but does not necessarily contribute directly to its function during operation

NOTE 1 For example, when a system-of-interest enters the production stage, a production-enabling system is required.

NOTE 2 Each enabling system has a life cycle of its own. This International Standard is applicable to each enabling system when, in its own right, it is treated as a system-of-interest.

4.12
evaluation
systematic determination of the extent to which an entity meets its specified criteria

4.13
facility
physical means or equipment for facilitating the performance of an action, e.g. buildings, instruments, tools

4.14
firmware
combination of a hardware device and computer instructions or computer data that reside as read-only software on the hardware device

NOTE The software cannot be readily modified under program control.

4.15
implementer
organization that performs implementation tasks

NOTE In this International Standard, the terms developer and implementer are synonymous.

4.16
life cycle
evolution of a system, product, service, project or other human-made entity from conception through retirement

4.17
life cycle model
framework of processes and activities concerned with the life cycle that may be organized into stages, which also acts as a common reference for communication and understanding

4.18
maintainer
organization that performs maintenance activities

4.19
monitoring
examination of the status of the activities of a supplier and of their results by the acquirer or a third party

4.20
non-deliverable item
hardware or software product that is not required to be delivered under the contract but may be employed in the development of a software product

4.21
off-the-shelf
<product> already developed and available

4.22
operator
entity that performs the operation of a system

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NOTE 1 The role of operator and the role of user may be vested, simultaneously or sequentially, in the same individual or organization.

NOTE 2 In the context of this specific definition, the term entity means an individual or an organization.

4.23
organization
person or a group of people and facilities with an arrangement of responsibilities, authorities and relationships

NOTE 1 Adapted from ISO 9000:2005.

NOTE 2 A body of persons organized for some specific purpose, such as a club, union, corporation, or society is an organization.

NOTE 3 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.

NOTE 4 A form of an organizational entity is often called an enterprise, so the organizational aspects of this International Standard would apply to an enterprise as well.

4.24
party
organization entering into a contract

NOTE In this International Standard, the agreeing parties are called the acquirer and the supplier.

4.25
process
set of interrelated or interacting activities which transforms inputs into outputs

[ISO 9000:2005]

4.26
process purpose
high level objective of performing the process and the likely outcomes of effective implementation of the process

NOTE The implementation of the process should provide tangible benefits to the stakeholders.

4.27
process outcome
observable result of the successful achievement of the process purpose

NOTE An outcome statement describes one of the following:

- production of an artefact;
- a significant change in state;
- meeting of specified constraints, e.g., requirements, goals, etc.

4.28
product
result of a process

[ISO 9000:2005]

4.29
project
endeavour with defined start and finish dates undertaken to create a product or service in accordance with specified resources and requirements

NOTE 1 Adapted from ISO 9000:2005.

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NOTE 2 A project may be viewed as a unique process comprising coordinated and controlled activities and may be composed of activities from the Project Processes and Technical Processes defined in this International Standard.

4.30
project portfolio
collection of projects that addresses the strategic objectives of the organization

4.31
qualification
process of demonstrating whether an entity is capable of fulfilling specified requirements

4.32
qualification requirement
set of criteria or conditions that have to be met in order to qualify a software product as complying with its specifications and being ready for use in its target environment or integration with its containing system

4.33
qualification testing
testing, conducted by the developer and witnessed by the acquirer (as appropriate), to demonstrate that a software product meets its specifications and is ready for use in its target environment or integration with its containing system

4.34
quality assurance
all the planned and systematic activities implemented within the quality system, and demonstrated as needed, to provide adequate confidence that an entity will fulfil requirements for quality

NOTE 1 There are both internal and external purposes for quality assurance:

a) Internal quality assurance: within an organization, quality assurance provides confidence to management;

b) External quality assurance: in contractual situations, quality assurance provides confidence to the customer or others.

NOTE 2 Some quality control and quality assurance actions are interrelated.

NOTE 3 Unless requirements for quality fully reflect the needs of the user, quality assurance may not provide adequate confidence.

4.35
release
particular version of a configuration item that is made available for a specific purpose (for example, test release)

4.36
request for proposal
tender
document used by the acquirer as the means to announce its intention to potential bidders to acquire a specified system, software product or software service

4.37
resource
asset that is utilized or consumed during the execution of a process

4.38
retirement
withdrawal of active support by the operation and maintenance organization, partial or total replacement by a new system, or installation of an upgraded system

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4.39
security
protection of information and data so that unauthorized persons or systems cannot read or modify them and authorized persons or systems are not denied access to them

4.40
service
performance of activities, work, or duties associated with a product

4.41
software item
item
source code, object code, control code, control data, or a collection of these items

NOTE A software item can be viewed as a system element of ISO/IEC 15288:2008.

4.42
software product
set of computer programs, procedures, and possibly associated documentation and data

4.43
software unit
separately compilable piece of code

4.44
stage
period within the life cycle of an entity that relates to the state of its description or realization

NOTE 1 As used in this International Standard, stages relate to major progress and achievement milestones of the entity through its life cycle.

NOTE 2 Stages may be overlapping.

4.45
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

4.46
statement of work
document used by the acquirer as the means to describe and specify the tasks to be performed under the contract

4.47
supplier
organization or individual that enters into an agreement with the acquirer for the supply of a product or service

NOTE 1 The "supplier" could be a contractor, producer, seller, or vendor.

NOTE 2 Sometimes the acquirer and the supplier are part of the same organization.

4.48
system
combination of interacting elements organized to achieve one or more stated purposes

NOTE 1 A system may be considered as a product or as the services it provides.

NOTE 2 In practice, the interpretation of its meaning is frequently clarified by the use of an associative noun, e.g., aircraft system. Alternatively, the word “system” may be substituted simply by a context-dependent synonym, e.g., aircraft, though this may then obscure a system principles perspective.

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4.49
system element
member of a set of elements that constitutes a system

NOTE A system element is a discrete part of a system that can be implemented to fulfil specified requirements. A system element can be hardware, software, data, humans, processes (e.g. processes for providing service to users), procedures (e.g., operator instructions), facilities, materials, and naturally occurring entities (e.g., water, organisms, minerals), or any combination.

4.50
task
requirement, recommendation, or permissible action, intended to contribute to the achievement of one or more outcomes of a process

4.51
test coverage
extent to which the test cases test the requirements for the system or software product

4.52
testability
extent to which an objective and feasible test can be designed to determine whether a requirement is met

4.53
user
individual or group that benefits from a system during its utilization

NOTE The role of user and the role of operator may be vested, simultaneously or sequentially, in the same individual or organization.

4.54
validation
confirmation, through the provision of objective evidence, that the requirements for a specific intended use or application have been fulfilled

[ISO 9000:2005]

NOTE Validation in a life cycle context is the set of activities ensuring and gaining confidence that a system is able to accomplish its intended use, goals and objectives.

4.55
verification
confirmation, through the provision of objective evidence, that specified requirements have been fulfilled

[ISO 9000:2005]

NOTE Verification in a life cycle context is a set of activities that compares a product of the life cycle against the required characteristics for that product. This may include, but is not limited to, specified requirements, design description and the system itself.

4.56
version
identified instance of an item

NOTE Modification to a version of a software product, resulting in a new version, requires configuration management action.

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5 Application of this International Standard

This clause presents an overview of the software life cycle processes that can be employed to acquire, supply, develop, operate, maintain, and dispose of software products and services. The objective is to provide a road map for the users of this International Standard so that they can orient themselves in it and apply it judiciously.

5.1 Key concepts of this International Standard

This subclause introduces key concepts useful in reading and applying this International Standard. In a few cases, commonly used words are used in a special way in this International Standard. This subclause will also describe those special usages. Further elaboration of these concepts can be found in ISO/IEC TR 15271, *A Guide for the application of ISO/IEC 12207 Software life cycle processes*.

NOTE A future Technical Report (ISO/IEC TR 24748, *Guide for life cycle management*) will also provide further elaboration.

5.1.1 Relationship of software products and software services

In general, this International Standard applies to both software products and software services. The provisions of specific processes state their applicability.

NOTE ISO/IEC 20000 provides processes, requirements, and guidance to service providers for the delivery of managed services.

5.1.2 Relationship between systems and software

This International Standard establishes a strong link between a system and its software. It is based upon the general principles of systems engineering. Software is treated as an integral part of the total system and performs certain functions in that system. This is implemented by extracting the software requirements from the system requirements and design, producing the software, and integrating it into the system. It is a fundamental premise of this standard that software always exists in the context of a system, even if the system consists of only the processor upon which the software is executed. Therefore, a software product or service is always treated as one item in a system. For example, the standard makes a distinction between system requirements analysis and software requirements analysis, because, in the general case, system architectural design will allocate the system requirements to various items of the system and software requirements analysis will derive software requirements from the system requirements allocated to each software item. Of course, in some cases, the non-software items of a system may be so minimal that it may not be necessary to perform distinct system and software analyses.

This standard has a strong relationship with ISO/IEC 15288:2008, *System Life Cycle Processes*, and may be used in conjunction with it. In many cases, the processes of this International Standard directly correspond to processes of ISO/IEC 15288 but with some specialization for software products and services. A notable example is that the Software Implementation process of this standard is a specialization — a detailed specialization — of the Implementation Process of ISO/IEC 15288.

In the case where the system has important non-software elements, an organization may wish to apply ISO/IEC 15288 to provide the appropriate life cycle processes. For each software element of the system, the organization would apply the Software Implementation Process of this standard to create the software element.

In the case where the non-software portions of the system are minimal, an organization may wish to apply this standard without reference to ISO/IEC 15288. This standard contains the additional system-level process — albeit specialized to the needs of software — to provide the minimum appropriate system context for the software.

When applying this standard in conjunction with ISO/IEC 15288, one minor mismatch in terminology must be considered. ISO/IEC 15288 decomposes a system into a set of system "elements". Some of those elements may be determined to be software products to be implemented using this standard. This standard uses the term "item" to refer to a major element of the system. In short, this standard uses the term "item" where ISO/IEC 15288 would use the term "element of software".

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Some of the items may eventually be designated as being subject to configuration management; they are then called "configuration items". The Software Architectural Design Process transforms items into "components" and the Software Detailed Design Process refines components into "units".

5.1.3 Organizations and parties

In this standard, the terms "organization" and "party" are closely related. An organization is a body of persons with identified responsibilities and authorities organized for some specific purpose, such as a club, union, corporation, or society. When an organization, as a whole or a part, enters into a contract, it is a party. Parties may be from the same organization or from separate organizations. An individual is an example of an organization, if the individual is assigned responsibilities and authorities.

An organization or a party derives its name from the process for which it is responsible. For example, it is called an acquirer when it performs the Acquisition Process. So, when the following terms are used in this standard, they do not have their generic meaning, but instead, refer to the organization or party responsible for executing the process with a similar name: acquirer, supplier, implementer, maintainer, and operator.

A few other terms are applied to organizations in this standard: "user" can be the organization that benefits from the utilization of the software product or service; "customer" refers to the user and acquirer collectively; and "stakeholder" refers to an organization with an interest in the success of the project.

The processes and organizations (or parties) are only related functionally. The standard does not dictate or imply a structure for an organization (or a party).

The processes in this standard form a comprehensive set to serve various organizations. An organization, small or large, depending on its business purpose or its acquisition strategy, can select an appropriate set of the processes (and associated activities and tasks) to fulfil that purpose. An organization may perform one process or more than one process. Under one contract or application of this standard, a given party should not perform both the Acquisition Process and the Supply Process, but it can perform other processes. A process may be performed by one organization or more than one organization. An example of a process performed by more than one organization is the Software Review process.

This standard is intended to be applied by an organization internally or externally by two or more organizations. When applied internally, the two agreeing parties typically act under the terms of an agreement that may vary in formality under different circumstances. When applied externally, the two agreeing parties typically act under the terms of a contract. In order to facilitate application of this standard either internally or contractually, the tasks are expressed in contractual language. When applied internally, the contractual language is to be interpreted as self-imposed discipline.

For the purpose of this standard, any project is assumed to be conducted within the context of an organization. This is important because a software project is dependent upon various outcomes produced by the business processes of the organization, e.g., employees to staff the project and facilities to house the project. For this purpose, this standard provides a set of “Organizational Project-Enabling” processes. These processes are not assumed to be adequate to operate a business, nor is any individual Project Process assumed to be completely defined. Instead, the processes, considered as a collection, are intended to state the minimum set of dependencies that the project places upon the organization

5.1.4 Organization-level and project-level adoption

Modern software businesses strive to develop a robust set of software life cycle processes that are applied repeatedly to the software projects of the business. Therefore, this standard is intended to be useful for adoption at either the organization level or at the project level. An organization would adopt the standard and supplement it with appropriate procedures, practices, tools and policies. A software project of the organization would typically conform to the organization's processes rather than conform directly to this standard.

In some cases, projects may be executed by an organization that does not have an appropriate set of processes adopted at the organizational level. Such a project may apply the provisions of this standard directly to the project.

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5.1.5 Tailoring

Annex A, which is normative, defines the basic activities needed to perform tailoring of this International Standard.

It should be noted that tailoring may diminish the perceived value of a claim of conformance to this standard. This is because it is difficult for other organizations to understand the extent to which tailoring may have deleted desirable provisions. An organization asserting a single-party claim of conformance to this standard may find it advantageous to claim absolute conformance to a smaller list of processes rather than tailored conformance to a larger list of processes.

5.1.6 Temporal relationships among the processes

In this standard, the processes and their activities and tasks are arranged in a sequence suitable for exposition. This positional sequence does not prescribe or dictate any time-dependent sequence. For lack of consensus on or use of a universal time-dependent sequence, the user of this standard may select and order the processes, activities, and tasks as appropriate and effective. This standard encourages iteration among the activities and recursion within an activity to offset the effects of any implied sequence of activities and tasks. The parties of this standard are responsible for selecting a life cycle model for the project and mapping the processes, activities, and tasks onto that model.

5.1.7 Evaluation versus verification, and validation

Organizations that are involved in any process of the life cycle conduct evaluations of the products of that task. The Software Verification and Software Validation processes provide the opportunity for additional evaluations. These processes are conducted by the acquirer, the supplier, or an independent party to verify and validate the products in varying depth depending on the project. These evaluations do not duplicate or replace other evaluations, but supplement them. Additional opportunities for evaluation are provided by the Software Review, Software Audit, Software Quality Assurance and the Life Cycle Model Management Processes.

5.1.8 Criteria for processes

This standard establishes a framework for the life cycle of software. The life cycle begins with an idea or a need that can be satisfied wholly or partly by software and ends with the retirement of the software. The architecture is built with a set of processes and interrelationships among these processes. The determination of the life cycle processes is based upon two basic principles: cohesion and responsibility.

> Cohesion: The life cycle processes are cohesive and coupled to the optimum extent deemed practical and feasible.
>
> Responsibility: A process is placed under the responsibility of an organization or a party in the software life cycle.

5.1.9 Description of processes

The processes of this standard are described in a manner that is similar to ISO/IEC 15288 in order to facilitate the use of both standards in a single organization or project.

Each process of this standard is described in terms of the following attributes:

— The title conveys the scope of the process as a whole

— The purpose describes the goals of performing the process

— The outcomes express the observable results expected from the successful performance of the process

— The activities are a list of actions that are used to achieve the outcomes

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— The tasks are requirements, recommendations, or permissible actions intended to support the achievement of the outcomes.

Additional detail regarding this form of description can be found in ISO/IEC 24774, *System and Software Engineering — Life Cycle Management — Guidelines for process definition*.

5.1.10 General Characteristics of processes

The attributes described in subclause 5.1.9 characterize the specificity of each process. When an implemented process conforms to these attributes, the process' specifically defined purpose and outcomes are achieved through the implementation of its defined activities.

In addition to these basic attributes, processes may be characterized by other attributes common to all processes. ISO/IEC 15504-2 identifies common process attributes which characterize 6 levels of achievement within a measurement framework for process capability. Annex B of this International Standard includes the list of process attributes which contribute to the achievement of higher levels of process capability as defined in ISO/IEC 15504-2.

5.1.11 Decomposition of processes

Each process of this standard satisfies the criteria described above. For the purpose of clear description, processes are sometimes decomposed into smaller pieces. Some processes are decomposed into activities and/or lower-level processes. A lower-level process is described when the decomposed portion of the process itself satisfies the criteria to be a process. An activity is used when the decomposed unit does not qualify as a process. An activity can be considered as simply a collection of tasks (see below).

It is sometimes useful to decompose processes into lower-level processes at a finer level of detail. Some lower-level processes are described solely for the purpose of assessment. These lower-level processes are not described in the body of the standard, but are provided in an annex. In each case, the lower-level assessment process described in the annex is an elaboration of one activity of the associated process in the body of the standard.

A task is expressed in the form of a requirement, recommendation, or permissible action, intended to support the achievement of the outcomes of a process. For this purpose, this standard carefully employs certain auxiliary verbs (shall, should, and may) to differentiate between the distinct forms of a task. "Shall" is used to express a provision required for conformance, "should" to express a recommendation among other possibilities, and "may" to indicate a course of action permissible within the limits of this standard.

Additional informative material is provided in the form of non-normative notes or non-normative annexes.

5.1.12 Life cycle models and stages

The life of a system or a software product can be modelled by a life cycle model consisting of stages. Models may be used to represent the entire life from concept to disposal or to represent the portion of the life corresponding to the current project. The life cycle model is comprised of a sequence of stages that may overlap and/or iterate, as appropriate for the project's scope, magnitude, complexity, changing needs and opportunities. Each stage is described with a statement of purpose and outcomes. The life cycle processes and activities are selected and employed in a stage to fulfil the purpose and outcomes of that stage. Different organizations may undertake different stages in the life cycle. However, each stage is conducted by the organization responsible for that stage with due consideration of the available information on life cycle plans and decisions made in preceding stages. Similarly, the organization responsible for that stage records the decisions made and records the assumptions regarding subsequent stages in the life cycle.

This International Standard does not require the use of any particular life cycle model. However, it does require that each project define a suitable life cycle model, preferably one that has been defined by the organization for use on a variety of projects. Application of a life cycle model provides the means to establish the time-dependent sequence necessary for project management.

Furthermore, this International Standard does not require the use of any particular set of stages. An example set of stages for the life cycle of a system includes: concept, development, production, utilization, support and

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retirement. An example set of stages for the life cycle of a software product is development, operation and maintenance.

Various types or classes of life cycle models have been described. Examples of these types are known by names such as waterfall, incremental development, evolutionary development, and spiral. It should be noted that simply selecting the name of a type of model does not satisfy the requirement to define a model comprised of stages with defined purpose and outcomes accomplished via the processes of this International Standard.

NOTE A future Technical Report (ISO/IEC TR 24748) provides additional detail regarding life cycle models and stages.

5.2 Organization of this International Standard

5.2.1 Categories of Life Cycle Processes

This International Standard groups the activities that may be performed during the life cycle of a software system into seven process groups. Each of the life cycle processes within those groups is described in terms of its purpose and desired outcomes and lists activities and tasks which need to be performed to achieve those outcomes.

a) Agreement Processes — two processes (subclauses 5.2.2.1.1 and 6.1)

b) Organizational Project-Enabling Processes — five processes (subclauses 5.2.2.1.2 and 6.2)

c) Project Processes — seven processes (subclauses 5.2.2.1.3 and 6.3)

d) Technical Processes — eleven processes (subclauses 5.2.2.1.4 and 6.4)

e) Software Implementation Processes — seven processes (subclauses 5.2.2.2.1and 7.1)

f) Software Support Processes — eight processes (subclauses 5.2.2.2.2 and 7.2)

g) Software Reuse Processes — three processes (subclauses 5.2.2.2.3 and 7.3)

The purposes and outcomes of the life cycle processes constitute a Process Reference Model.

Within this International Standard clauses numbering:

— 6.a and 7.a denote a process group

— 6.a.b and 7.a.b denote a process (or lower-level process) within that group

— 6.a.b.1 and 7.a.b.1 describe the purpose of the process

— 6.a.b.2 and 7.a.b.2 describe the outcome of the process

— 6.a.b.3.c and 7.a.b.3.c list activities of the process and clauses

— 6.a.b.3.c.d and 7.a.b.3.c.d list tasks of the activity 'c'

These life cycle process groups are introduced below and depicted in Figure 1.

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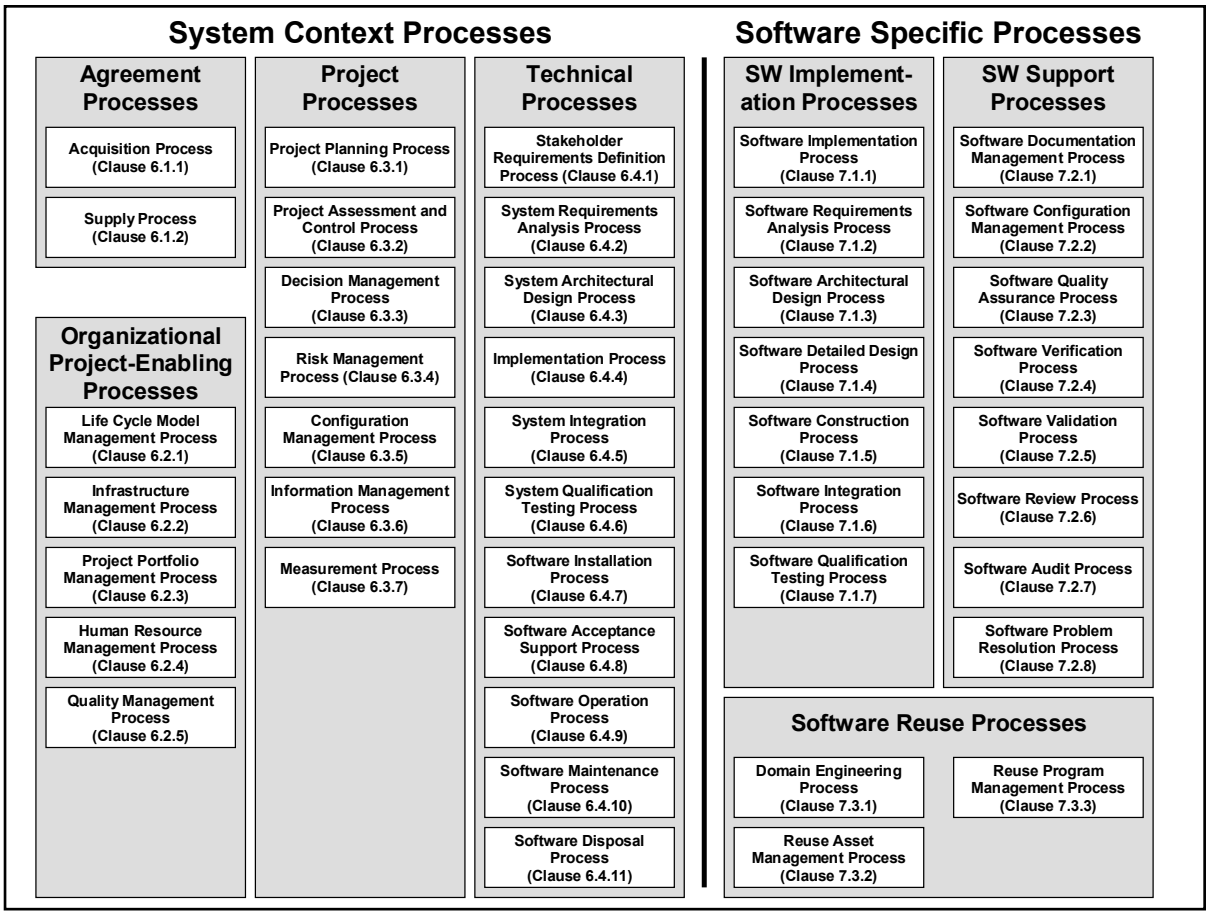

Figure 1 — Life Cycle Process groups

The Process Reference Model does not represent a particular process implementation approach nor does it prescribe a system/software life cycle model, methodology or technique. Instead the reference model is intended to be adopted by an organization based on its business needs and application domain. The organization's defined process is adopted by the organization's projects in the context of the customer requirements.

Process outcomes are used to demonstrate successful achievement of the purpose of a process. This helps process assessors to determine the capability of the organization's implemented process and to provide source material to plan organizational process improvement.

5.2.2 Summary of Life Cycle Processes

There are two major sub-divisions of process in this International Standard. Clause 6 provides a system context for dealing with a standalone software product or service or a software system. Clause 7 contains the software-specific processes for use in implementing a software product or service that is an element of a larger system.

To aid the concurrent use of ISO/IEC 15288 and ISO/IEC 12207, corresponding processes of Clause 6 have the same subclause number (at the 6.x.x level).

In general, the collection of processes provided in this International Standard are software-appropriate specializations, or contributions to the outcomes of the processes provided in ISO/IEC 15288. Many of the ISO/IEC 15288 processes seem similar to software-specific process implementations, but they preserve crucial distinctions based on the purpose, outcomes and audiences. Users of both ISO/IEC 15288 and ISO/IEC 12207 should be sure to consider the distinct explanations and notes in each specific process.

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5.2.2.1 System Context Processes

5.2.2.1.1 Agreement Processes

These processes define the activities necessary to establish an agreement between two organizations. If the Acquisition Process is invoked, it provides the means for conducting business with a supplier of products that are supplied for use as an operational system, of services in support of an operational system, or of elements of a system being developed by a project. If the Supply Process is invoked, it provides the means for conducting a project in which the result is a product or service that is delivered to the acquirer.

In general, the Agreement Processes provided in this International Standard are software-appropriate specializations of the Agreement Processes provided in ISO/IEC 15288.

5.2.2.1.2 Organizational Project-Enabling Processes

The Organizational Project-Enabling Processes manage the organization's capability to acquire and supply products or services through the initiation, support and control of projects. They provide resources and infrastructure necessary to support projects and ensure the satisfaction of organizational objectives and established agreements. They are not intended to be a comprehensive set of business processes that enable management of the organization's business.

The Organizational Project-Enabling Processes consist of the following:

a) Life Cycle Model Management Process;

b) Infrastructure Management Process;

c) Project Portfolio Management Process;

d) Human Resource Management Process;

e) Quality Management Process.

In general, the Organizational Project-Enabling Processes provided in this International Standard are software-appropriate specializations of the corresponding set of processes provided in ISO/IEC 15288.

5.2.2.1.3 Project Processes

In this International Standard, the project has been chosen as the context for describing processes concerned with planning, assessment and control. The principles related to these processes can be applied in any area of an organization's management.

There are two categories of Project Processes. The Project Management Processes are used to plan, execute, assess and control the progress of a project. The Project Support Processes support specialized management objectives. Both are described below.

The Project Management Processes are used to establish and evolve project plans, to assess actual achievement and progress against the plans and to control execution of the project through to fulfilment. Individual Project Management Processes may be invoked at any time in the life cycle and at any level in a hierarchy of projects, as required by project plans or unforeseen events. The Project Management Processes are applied with a level of rigor and formality that depends on the risk and complexity of the project.

a) Project Planning Process

b) Project Assessment and Control Process

The Project Support Processes provide a specific focused set of tasks for performing a specialized management objective. They are all evident in the management of any undertaking, ranging from a complete organization down to a single life cycle process and its tasks.

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a) Decision Management Process;

b) Risk Management Process;

c) Configuration Management Process;

d) Information Management Process;

e) Measurement Process.

In general, the Project Support Processes provided in this International Standard are identical to the Project Support Processes provided in ISO/IEC 15288, aside from some differences in formatting. In several cases, Software Supporting Processes may have a relationship to Project Supporting Processes.

5.2.2.1.4 Technical Processes

The Technical Processes are used to define the requirements for a system, to transform the requirements into an effective product, to permit consistent reproduction of the product where necessary, to use the product, to provide the required services, to sustain the provision of those services and to dispose of the product when it is retired from service.

The Technical Processes define the activities that enable organizational and project functions to optimize the benefits and reduce the risks that arise from technical decisions and actions. These activities enable products and services to possess the timeliness and availability, the cost effectiveness, and the functionality, reliability, maintainability, producibility, usability and other qualities required by acquiring and supplying organizations. They also enable products and services to conform to the expectations or legislated requirements of society, including health, safety, security and environmental factors.

The Technical Processes consist of the following processes:

a) Stakeholder Requirements Definition (a specialization of the Stakeholder Requirements Definition Process of ISO/IEC 15288);

b) System Requirements Analysis (a specialization of the Requirements Analysis Process of ISO/IEC 15288);

c) System Architectural Design (a specialization of the Architectural Design Process of ISO/IEC 15288);

d) Implementation Process (a specialization of the Implementation Process of ISO/IEC 15288 and further elaborated in Clause 7 of this International Standard as the Software Implementation Process);

e) System Integration Process (a specialization of the Integration Process of ISO/IEC 15288);

f) System Qualification Testing Process (a process that contributes to achieving the outcomes of the Verification Process of ISO/IEC 15288);

g) Software Installation Process (a process that contributes to achieving the outcomes of the Transition Process of ISO/IEC 15288);

h) Software Acceptance Support Process (a process that contributes to achieving the outcomes of the Transition Process of ISO/IEC 15288);

i) Software Operation Process (a specialization of the Operation Process of ISO/IEC 15288);

j) Software Maintenance Process (a specialization of the Maintenance Process of ISO/IEC 15288);

k) Software Disposal Process (a specialization of the Disposal Process of ISO/IEC 15288).

In general, the Technical Processes provided in this International Standard are software-appropriate specializations or contributions to the outcomes of the Technical Processes provided in ISO/IEC 15288. Many

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seem similar to Software Implementation Processes but preserve crucial distinctions, e.g., System Requirements Analysis and Software Requirements Analysis start from different points and have different audiences.

5.2.2.2 Software-Specific Processes

5.2.2.2.1 Software Implementation Processes

The Software Implementation Processes are used to produce a specified system element (software item) implemented in software. Those processes transform specified behaviour, interfaces and implementation constraints into implementation actions resulting in a system element that satisfies the requirements derived from the system requirements.

The umbrella process is the Software Implementation Process, a software-specific specialization of the Implementation Process of ISO/IEC 15288.

The Software Implementation Process has several software-specific lower-level processes:

a) Software Requirements Analysis Process;

b) Software Architectural Design Process;

c) Software Detailed Design Process;

d) Software Construction Process;

e) Software Integration Process;

f) Software Qualification Testing Process.

5.2.2.2.2 Software Support Processes

The Software Support Processes provide a specific focused set of activities for performing a specialized software process. A supporting process assists the Software Implementation Process as an integral part with a distinct purpose, contributing to the success and quality of the software project. There are eight of these processes:

a) Software Documentation Management Process;

b) Software Configuration Management Process;

c) Software Quality Assurance Process;

d) Software Verification Process;

e) Software Validation Process;

f) Software Review Process;

g) Software Audit Process;

h) Software Problem Resolution Process.

5.2.2.2.3 Software Reuse Processes

The Software Reuse Process Group consists of three processes that support an organization’s ability to reuse software items across project boundaries. These processes are unique because, by their nature, they operate outside the bounds of any particular project.

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The Software Reuse Processes are:

a) Domain Engineering Process;

b) Reuse Asset Management Process;

c) Reuse Program Management Process.

5.2.3 Process Reference Model

Annex B defines a Process Reference Model (PRM) at a level of abstraction higher than that of the detailed requirements contained in the main text of this International Standard. The PRM is applicable to an organization that is assessing its processes in order to determine the capability of these processes. The purpose and outcomes are a statement of the goals of the performance of each process. This statement of goals permits assessment of the effectiveness of the processes in ways other than simple conformity evaluation. For example, novel process definitions can be evaluated against the statements of Purpose and Outcomes in Annex B rather than against the detailed provisions in the main text of this International Standard.

NOTE 1 In this International Standard, the term “Process Reference Model” is used with the same meaning as ISO/IEC 15504-2.

NOTE 2 The PRM is intended to be used to develop assessment model(s) for assessing processes using ISO/IEC 15504-2.

6 System Life Cycle Processes

6.1 Agreement Processes

6.1.1 Acquisition Process

6.1.1.1 Purpose

The purpose of the Acquisition Process is to obtain the product and/or service that satisfies the need expressed by the acquirer. The process begins with the identification of customer needs and ends with the acceptance of the product and/or service needed by the acquirer.

6.1.1.2 Outcomes

As a result of successful implementation of the Acquisition Process:

a) acquisition needs, goals, product and/or service acceptance criteria and acquisition strategies are defined;

b) an agreement is developed that clearly expresses the expectation, responsibilities and liabilities of both the acquirer and the supplier;

c) one or more suppliers is selected;

d) a product and/or service is acquired that satisfies the acquirer’s stated need;

e) the acquisition is monitored so that specified constraints such as cost, schedule and quality are met;

f) supplier deliverables are accepted; and

g) any identified open items have a satisfactory conclusion as agreed to by the acquirer and the supplier.

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6.1.1.3 Activities and tasks

The acquirer shall implement the following activities in accordance with applicable organizational policies and procedures with respect to the Acquisition Process.

NOTE The activities and tasks in this process can apply to one or more suppliers.

6.1.1.3.1 Acquisition preparation. This activity consists of the following tasks:

6.1.1.3.1.1 The acquirer begins the acquisition process by describing a concept or a need to acquire, develop, or enhance a system, software product or software service.

6.1.1.3.1.2 The acquirer shall define and analyze the system requirements. The system requirements should include business, organizational and user as well as safety, security, and other criticality requirements along with related design, testing, and compliance standards and procedures.

6.1.1.3.1.3 The acquirer may perform the definition and analysis of software requirements by itself or may retain a supplier to perform this task.

6.1.1.3.1.4 If the acquirer retains a supplier to perform system or software requirements analysis, the acquirer shall retain approval authority for the analyzed requirements.

6.1.1.3.1.5 The Technical Processes (subclause 6.4) should be used to perform the tasks in subclauses 6.1.1.3.1.2 and 6.1.1.3.1.4. The acquirer may use the Stakeholder Requirements Definition Process to establish the customer requirements.

6.1.1.3.1.6 The acquirer shall consider options for acquisition against analysis of appropriate criteria to include risk, cost and benefits for each option. Options include:

a) Purchase an off-the-shelf software product that satisfies the requirements.

b) Develop the software product or obtain the software service internally.

c) Develop the software product or obtain the software service through contract.

d) A combination of a, b, and c above.

e) Enhance an existing software product or service.

6.1.1.3.1.7 When an off-the-shelf software product is to be acquired, the acquirer shall ensure the following conditions are satisfied:

a) The requirements for the software product are satisfied.

b) The required documentation is available.

c) Proprietary, usage, ownership, warranty and licensing rights are satisfied.

d) Future support for the software product is planned.

6.1.1.3.1.8 The acquirer should prepare, document and execute an acquisition plan. The plan should contain the following:

a) Requirements for the system.

b) Planned employment of the system.

c) Type of contract to be employed.

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d) Responsibilities of the organizations involved.

e) Support concept to be used.

f) Risks considered as well as methods to manage the risks.

6.1.1.3.1.9 The acquirer shall define and document the acceptance strategy and conditions (criteria).

6.1.1.3.1.10 The acquirer should document the acquisition requirements (e.g., request for proposal), the content of which depends upon the acquisition option selected in subclause 6.1.1.3.1.6. The acquisition documentation should include, as appropriate:

a) System requirements.

b) Scope statement.

c) Instructions for bidders.

d) List of software products.

e) Terms and conditions.

f) Control of subcontracts.

g) Technical constraints (e.g., target environment).

6.1.1.3.1.11 The acquirer should determine which processes of this International Standard are appropriate for the acquisition and specify any acquirer requirements for tailoring those processes. The acquirer should specify if any of the processes are to be performed by parties other than the supplier, so that suppliers may, in their proposals, define their approach to supporting the work of other parties. The acquirer shall define the scope of those tasks that reference the contract.

6.1.1.3.1.12 The acquisition documentation shall also define the contract milestones at which the supplier's progress shall be reviewed and audited as part of monitoring the acquisition (see subclauses 7.2.6 and 7.2.7).

6.1.1.3.1.13 The acquisition requirements should be given to the organization selected for performing the acquisition activities.

6.1.1.3.2 Acquisition advertisement. This activity consists of the following task:

6.1.1.3.2.1 The acquirer shall communicate the request for the supply of a product or service to identified suppliers.

NOTE This may include supply chain management partnering which exchanges information with related suppliers and acquirers to achieve a harmonized or collective approach to common technical and commercial issues.

6.1.1.3.3 Supplier selection. This activity consists of the following tasks:

6.1.1.3.3.1 The acquirer should establish a procedure for supplier selection including proposal evaluation criteria and requirements compliance weighting.

6.1.1.3.3.2 The acquirer should select a supplier based upon the evaluation of the suppliers' proposals, capabilities, and in accordance with the acquirer's acceptance strategy and conditions.

6.1.1.3.4 Contract agreement. This activity consists of the following tasks:

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6.1.1.3.4.1 The acquirer may involve other parties, including potential suppliers or any necessary third parties (such as regulators), before contract award, in determining the acquirer's requirements for tailoring of this International Standard for the project. In making this determination, the acquirer shall consider the effect of the tailoring requirements upon the supplier's organizationally-adopted processes. The acquirer shall include or reference the tailoring requirements in the contract.

6.1.1.3.4.2 The acquirer shall then prepare and negotiate a contract with the supplier that addresses the acquisition requirements, including the cost and schedule, of the software product or service to be delivered. The contract shall address proprietary, usage, ownership, warranty and licensing rights associated with the reusable off-the-shelf software products.

6.1.1.3.4.3 Once the contract is underway, the acquirer shall control changes to the contract through negotiation with the supplier as part of a change control mechanism. Changes to the contract shall be investigated for impact on project plans, costs, benefits, quality, and schedule.

NOTE 1 The acquirer determines whether the term "contract" or "agreement" is to be used in the application of this International Standard.

NOTE 2 The agreement between the acquirer and the supplier should clearly express the expectation, responsibilities and liabilities of both.

NOTE 3 The contract change control mechanism should address the change management roles and responsibilities, level of formality of the proposed change requests and contract renegotiation, and communication to the affected stakeholders. An informative Annex F contains a sample contract change management process that may be utilized to support this.

6.1.1.3.5 Agreement monitoring. This activity consists of the following tasks:

6.1.1.3.5.1 The acquirer shall monitor the supplier's activities in accordance with the Software Review Process (subclause 7.2.6) and the Software Audit Process (subclause 7.2.7). The acquirer should supplement the monitoring with the Software Verification Process (subclause 7.2.4) and the Software Validation Process (subclause 7.2.5) as needed.

6.1.1.3.5.2 The acquirer shall cooperate with the supplier to provide all necessary information in a timely manner and resolve all pending items.

6.1.1.3.6 Acquirer acceptance. This activity consists of the following tasks:

6.1.1.3.6.1 The acquirer should prepare for acceptance based on the defined acceptance strategy and criteria. The preparation of test cases, test data, test procedures, and test environment should be included. The extent of supplier involvement should be defined.

6.1.1.3.6.2 The acquirer shall conduct acceptance review and acceptance testing of the deliverable software product or service and shall accept it from the supplier when all acceptance conditions are satisfied. The acceptance procedure should comply with the provisions of subclause 6.1.1.3.1.9.

6.1.1.3.6.3 After acceptance, the acquirer should take the responsibility for the configuration management of the delivered software product (see subclause 7.2.2).

NOTE The acquirer may install the software product or perform the software service in accordance with instructions defined by the supplier.

6.1.1.3.7 Closure. This activity consists of the following tasks:

6.1.1.3.7.1 The acquirer shall make payment or provide other agreed consideration to the supplier for the product or service rendered.

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NOTE 1 When the supplied product or service has satisfied the conditions of the agreement and identified open items have been satisfactorily closed, the acquirer concludes the agreement by rendering payment or other agreed consideration and notification of conclusion of the agreement.

NOTE 2 A product or service may be supplied incrementally and payment or other agreed consideration may be provided in increments.

6.1.2 Supply Process

6.1.2.1 Purpose

The purpose of the Supply Process is to provide a product or service to the acquirer that meets the agreed requirements.

6.1.2.2 Outcomes

As a result of successful implementation of the Supply Process:

a) an acquirer for a product or service is identified;

b) a response to an acquirer's request is produced;

c) an agreement is established between the acquirer and the supplier for developing, maintaining, operating, packaging, delivering, and installing the product and/or service;

d) a product and/or service that meets the agreed requirements are developed by the supplier;

e) the product and/or service is delivered to the acquirer in accordance with the agreed requirements; and

f) the product is installed in accordance with the agreed requirements.

6.1.2.3 Activities and tasks

The supplier shall implement the following activities in accordance with applicable organizational policies and procedures with respect to the Supply Process.

6.1.2.3.1 Opportunity identification. This activity consists of the following task:

6.1.2.3.1.1 The supplier should determine the existence and identity of an acquirer who has, or who represents an organization or organizations having, a need for a product or service.

NOTE For a product or service developed for consumers, an agent, e.g., a marketing function within the supplier organization, may represent the acquirer.

6.1.2.3.2 Supplier tendering. This activity consists of the following tasks:

6.1.2.3.2.1 The supplier should conduct a review of requirements in the request for proposal taking into account organizational policies and other regulations.

6.1.2.3.2.2 The supplier should make a decision to bid or accept the contract.

6.1.2.3.2.3 The supplier shall prepare a proposal in response to the request for proposal.

6.1.2.3.3 Contract agreement. This activity consists of the following tasks:

6.1.2.3.3.1 The supplier shall negotiate and enter into a contract with the acquirer to provide the software product or service.

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6.1.2.3.3.2 The supplier may request modification to the contract as part of the change control mechanism.

6.1.2.3.4 Contract execution. This activity consists of the following tasks:

6.1.2.3.4.1 The supplier shall conduct a review of the acquisition requirements to define the framework for managing and assuring the project and for assuring the quality of the deliverable software product or service.

6.1.2.3.4.2 If not stipulated in the contract, the supplier shall define or select a life cycle model appropriate to the scope, magnitude, and complexity of the project. The life cycle model shall be comprised of stages and the purpose and outcomes of each stage. The processes, activities, and tasks of this International Standard shall be selected and mapped onto the life cycle model.

NOTE Ideally, this is performed by using an organizationally-defined life cycle model.

6.1.2.3.4.3 The supplier shall establish requirements for the plans for managing and assuring the project and for assuring the quality of the deliverable software product or service. Requirements for the plans should include resource needs and acquirer involvement.

6.1.2.3.4.4 Once the planning requirements are established, the supplier shall consider the options for developing the software product or providing the software service against an analysis of risks associated with each option. Options include:

a) Develop the software product or provide the software service using internal resources.

b) Develop the software product or provide the software service by subcontracting.

c) Obtain off-the-shelf software products from internal or external sources.

d) A combination of a, b, and c above.

6.1.2.3.4.5 The supplier shall develop and document project management plan(s) based upon the planning requirements and options selected in subclause 6.1.2.3.4.4.

NOTE Items to be considered in the plan include but are not limited to the following:

a) Project organizational structure and authority and responsibility of each organizational unit, including external organizations.

b) Engineering environment (for development, operation, or maintenance, as applicable), including test environment, library, equipment, facilities, standards, procedures, and tools.

c) Work breakdown structure of the life cycle processes and activities, including the software products, software services and non-deliverable items, to be performed together with budgets, staffing, physical resources, software size, and schedules associated with the tasks.

d) Management of the quality characteristics of the software products or services. Separate plans for quality may be developed.

e) Management of the safety, security, and other critical requirements of the software products or services. Separate plans for safety and security may be developed.

f) Subcontractor management, including subcontractor selection and involvement between the subcontractor and the acquirer, if any.

g) Quality assurance (see subclause 7.2.3).

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h) Verification (see subclause 7.2.4) and validation (see subclause 7.2.5), including the approach for interfacing with the verification and validation agent, if specified.

i) Acquirer involvement; that is, by such means as reviews (see subclause 7.2.6), audits (see subclause 7.2.7), informal meetings, reporting, modification and change; implementation, approval, acceptance, and access to facilities.

j) User involvement; by such means as requirements setting exercises, prototype demonstrations and evaluations.

k) Risk management; that is, management of the areas of the project that involve potential technical, cost, or schedule risks.

l) Security policy; that is, the rules for need-to-know and access-to-information at each project organization level.

m) Approval required by such means as regulations, required certifications, proprietary, usage, ownership, warranty and licensing rights.

n) Means for scheduling, tracking, and reporting.

o) Training of personnel (see subclause 6.2.4).

6.1.2.3.4.6 The supplier shall implement and execute the project management plan(s) developed under subclause 6.1.2.3.4.5.

6.1.2.3.4.7 The supplier shall:

a) Develop the software product in accordance with the Technical Processes (subclause 6.4).

b) Operate the software product in accordance with the Software Operation Process (subclause 6.4.9).

c) Maintain the software product in accordance with the Software Maintenance Process (subclause 6.4.10).

6.1.2.3.4.8 The supplier shall monitor and control the progress and the quality of the software products or services of the project throughout the contracted life cycle. This shall be an ongoing, iterative task, which shall provide for:

a) Monitoring progress of technical performance, costs, and schedules and reporting of project status.

b) Problem identification, recording, analysis, and resolution.

6.1.2.3.4.9 The supplier shall manage and control the subcontractors in accordance with the Acquisition Process (subclause 6.1.1). The supplier shall pass down all contractual requirements necessary to ensure that the software product or service delivered to the acquirer is developed or performed in accordance with the prime-contract requirements.

6.1.2.3.4.10 The supplier shall interface with the independent verification, validation, or test agent as specified in the contract and project plans.

6.1.2.3.4.11 The supplier shall interface with other parties as specified in the contract and project plans.

6.1.2.3.4.12 The supplier should coordinate contract review activities, interfaces, and communication with the acquirer's organization.

6.1.2.3.4.13 The supplier shall conduct or support the informal meetings, acceptance review, acceptance testing, joint reviews, and audits with the acquirer as specified in the contract and project plans. The joint reviews shall be conducted in accordance with subclause 7.2.6, audits in accordance with subclause 7.2.7.

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6.1.2.3.4.14 The supplier should perform verification and validation in accordance with subclauses 7.2.4 and 7.2.5 respectively to demonstrate that the software products or services and processes fully satisfy their respective requirements.

6.1.2.3.4.15 The supplier shall make available to the acquirer the reports of evaluation, reviews, audits, testing, and problem resolutions as specified in the contract.

6.1.2.3.4.16 The supplier shall provide the acquirer access to the supplier's and subcontractors' facilities for review of software products or services as specified in the contract and project plans.

6.1.2.3.4.17 The supplier shall perform quality assurance activities in accordance with subclause 7.2.3.

6.1.2.3.5 Product/service delivery and support. This activity consists of the following tasks:

6.1.2.3.5.1 The supplier shall deliver the software product or service as specified in the contract.

NOTE When required by the agreement, the supplier should install the product in accordance with established requirements.

6.1.2.3.5.2 The supplier shall provide assistance to the acquirer in support of the delivered software product or service as specified in the contract.

6.1.2.3.6 Closure. This activity consists of the following tasks:

6.1.2.3.6.1 The supplier shall accept and acknowledge payment or other agreed consideration.

6.1.2.3.6.2 The supplier shall transfer the responsibility for the product or service to the acquirer, or other party, as directed by the agreement.

NOTE The agreement should address terms and authorization for initiating closure of the project.

6.2 Organizational Project-Enabling Processes

6.2.1 Life Cycle Model Management Process

6.2.1.1 Purpose

The purpose of the Life Cycle Model Management Process is to define, maintain, and assure availability of policies, life cycle processes, life cycle models, and procedures for use by the organization with respect to the scope of this International Standard.

This process provides life cycle policies, processes, and procedures that are consistent with the organization's objectives, that are defined, adapted, improved and maintained to support individual project needs within the context of the organization, and that are capable of being applied using effective, proven methods and tools.

6.2.1.2 Outcomes

As a result of the successful implementation of the Life Cycle Model Management Process:

a) policies and procedures for the management and deployment of life cycle models and processes are provided;

b) responsibility, accountability and authority for life cycle management are defined;

c) life cycle processes, models and procedures for use by the organization are defined, maintained and improved; and

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d) prioritized process improvements are implemented.

6.2.1.3 Activities and tasks

The organization shall implement the following activities in accordance with applicable organization policies and procedures with respect to the Life Cycle Model Management Process.

6.2.1.3.1 Process establishment. This activity consists of the following task:

6.2.1.3.1.1 The organization shall establish a suite of organizational processes for all software life cycle processes and life cycle models as they apply to its business activities. The processes and their application to specific cases shall be documented in the organization's publications. As appropriate, a process control mechanism should be established to develop, monitor, control, and improve the process(es).

NOTE Establishing the process control mechanism includes the definition of responsibility, accountability and authority for life cycle management.

6.2.1.3.2 Process assessment. This activity consists of the following tasks:

6.2.1.3.2.1 The organization should develop, document and apply a process assessment procedure. Assessment records should be produced and maintained.

6.2.1.3.2.2 The organization shall plan and carry out reviews of the processes at appropriate intervals to ensure their continuing suitability and effectiveness in the light of assessment results.

6.2.1.3.3 Process improvement. This activity consists of the following tasks:

6.2.1.3.3.1 The organization shall effect such improvements to its processes as it determines to be necessary as a result of process assessment and review. Process documentation should be updated to reflect improvement in the organizational processes.

6.2.1.3.3.2 Historical, technical, and evaluation data should be collected and analyzed to gain an understanding of the strengths and weaknesses of the employed processes. These analyses should be used as feedback to improve these processes, to recommend changes in the direction of the projects (or subsequent projects), and to determine technology advancement needs.

6.2.1.3.3.3 Quality cost data should be collected, maintained, and used to improve the organization's processes as a management activity. These data shall serve the purpose of establishing the cost of both the prevention and resolution of problems and non-conformity in software products and services.

6.2.2 Infrastructure Management Process

6.2.2.1 Purpose

The purpose of the Infrastructure Management Process is to provide the enabling infrastructure and services to projects to support organization and project objectives throughout the life cycle.

This process defines, provides and maintains the facilities, tools, and communications and information technology assets needed for the organization’s business with respect to the scope of this International Standard.

6.2.2.2 Outcomes

As a result of the successful implementation of the Infrastructure Management Process:

a) the requirements for infrastructure to support processes are defined;

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b) the infrastructure elements are identified and specified;

c) infrastructure elements are acquired;

d) the infrastructure elements are implemented; and

e) a stable and reliable infrastructure is maintained and improved.

NOTE The infrastructure elements may include hardware, software, methods, tools, techniques, standards, and facilities for development, operation, or maintenance.

6.2.2.3 Activities and tasks

The organization shall implement the following activities in accordance with applicable organization policies and procedures with respect to the Infrastructure Management Process.

6.2.2.3.1 Process implementation. This activity consists of the following tasks:

6.2.2.3.1.1 The infrastructure should be defined and documented to meet the requirements of the process employing this process, considering the applicable procedures, standards, tools, and techniques.

6.2.2.3.1.2 The establishment of the infrastructure should be planned and documented.

6.2.2.3.2 Establishment of the infrastructure. This activity consists of the following tasks:

6.2.2.3.2.1 The configuration of the infrastructure should be planned and documented. Functionality, performance, safety, security, availability, space requirements, equipment, costs, and time constraints should be considered.

6.2.2.3.2.2 The infrastructure shall be installed in time for execution of the relevant process.

6.2.2.3.3 Maintenance of the infrastructure. This activity consists of the following task:

6.2.2.3.3.1 The infrastructure shall be maintained, monitored, and modified as necessary to ensure that it continues to satisfy the requirements of the process employing this process. As part of maintaining the infrastructure, the extent to which the infrastructure is under configuration management shall be defined.

6.2.3 Project Portfolio Management Process

6.2.3.1 Purpose

The purpose of the Project Portfolio Management Process is to initiate and sustain necessary, sufficient and suitable projects in order to meet the strategic objectives of the organization.

This process commits the investment of adequate organization funding and resources, and sanctions the authorities needed to establish selected projects. It performs continued qualification of projects to confirm they justify, or can be redirected to justify, continued investment.

6.2.3.2 Outcomes

As a result of the successful implementation of the Project Portfolio Management Process:

a) business venture opportunities, investments or necessities are qualified, prioritized and selected;

b) resources and budgets for each project are identified and allocated;

c) project management accountability and authorities are defined;

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d) projects meeting agreement and stakeholder requirements are sustained; and

e) projects not meeting agreement or stakeholder requirements are redirected or terminated.

6.2.3.3 Activities and tasks

The organization shall implement the following activities and tasks in accordance with applicable organization policies and procedures with respect to the Project Portfolio Management Process.

6.2.3.3.1 Project initiation. This activity consists of the following tasks:

6.2.3.3.1.1 The organization shall identify, prioritize, select and establish new business opportunities, ventures or undertakings in a manner that is consistent with the business strategy and action plans of the organization.

NOTE Prioritize the projects to be started and establish thresholds to determine which projects will be executed.

6.2.3.3.1.2 The organization shall define accountabilities and authorities for each project.

6.2.3.3.1.3 The organization shall identify the expected outcomes of the projects.

6.2.3.3.1.4 The organization shall allocate resources for the achievement of project objectives.

6.2.3.3.1.5 The organization shall identify any multi-project interfaces that must be managed or supported by the project.

NOTE This includes the use of enabling systems used by more than one project and the use of common system elements by more than one project.

6.2.3.3.1.6 The organization shall specify the project reporting requirements and review milestones that will govern the execution of the project.

6.2.3.3.1.7 The organization shall authorize the project to commence execution of approved project plans, including the technical plans.

6.2.3.3.2 Portfolio evaluation. This activity consists of the following tasks:

6.2.3.3.2.1 The organization shall evaluate ongoing projects to confirm that:

a) Projects are making progress towards achieving established goals.

b) Projects are complying with project directives.

c) Projects are being conducted according to system life cycle plans and procedures.

d) Projects remain viable, as indicated by, for example, continuing need for the service, practicable product implementation, acceptable investment benefits.

6.2.3.3.2.2 The organization shall act to continue or redirect projects that are satisfactorily progressing or can be expected to progress satisfactorily by appropriate redirection

6.2.3.3.3 Project closure. This activity consists of the following tasks:

6.2.3.3.3.1 The organization shall act to cancel or suspend projects whose disadvantages or risks to the organization outweigh the benefits of continued investments, where agreements permit this.

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6.2.3.3.3.2 After completion of the agreement for products and services, the organization shall act to close the project per organizational policies and procedures and the agreement.

NOTE 1 The organization ensures that project closure accounts for documentation retention by the organization after the project is closed.

NOTE 2 After closure of the project, the organization may authorize release of the project from the project portfolio.

6.2.4 Human Resource Management Process

6.2.4.1 Purpose

The purpose of the Human Resource Management Process is to provide the organization with necessary human resources and to maintain their competencies, consistent with business needs.

The process assures the providing of a supply of skilled and experienced personnel qualified to perform life cycle processes to achieve organization, project and customer objectives.

6.2.4.2 Outcomes

As a result of the successful implementation of the Human Resource Management Process:

a) skills required by projects are identified;

b) necessary human resources are provided to projects;

c) skills of personnel are developed, maintained or enhanced;

d) conflicts in multi-project resource demands are resolved; and

e) individual knowledge, information and skills are collected, shared, reused and improved throughout the organization.

6.2.4.3 Activities and tasks

The organization shall implement the following activities in accordance with applicable organization policies and procedures with respect to the Human Resource Management Process:

6.2.4.3.1 Skill identification. This activity consists of the following tasks:

6.2.4.3.1.1 A review of the organization and project requirements shall be conducted to establish and make timely provision for acquiring or developing the resources and skills required by the management and technical staff. These needs may be met through training, recruitment or other staff development mechanisms.

6.2.4.3.1.2 The types and levels of training and knowledge needed to satisfy organization and project requirements shall be determined.

6.2.4.3.2 Skill development. This activity consists of the following tasks:

6.2.4.3.2.1 A training plan, addressing implementation schedules, resource requirements, and training needs, should be developed and documented.

6.2.4.3.2.2 Training manuals, including presentation materials used in providing training should be developed or acquired.

6.2.4.3.2.3 The training plan shall be implemented to provide training to personnel. Training records should be maintained.

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6.2.4.3.3 Skill acquisition and provision. This activity consists of the following tasks:

6.2.4.3.3.1 Establish a systematic program for recruitment of staff qualified to meet the needs of the organization and projects. Provide opportunities for the career development of existing staff.

6.2.4.3.3.2 Define objective criteria that can be used to evaluate staff performance.

6.2.4.3.3.3 Evaluate the performance of the staff in respect of their contributions to the goals of the organization or project.

6.2.4.3.3.4 Ensure that feedback is provided to the staff on the results of any evaluations performed.

6.2.4.3.3.5 Maintain adequate records of staff performance including information on skills, training completed, and performance evaluations.

6.2.4.3.3.6 Define the organization's and project's need for project teams. Define team structure and operating rules.

NOTE Conflicts in multi-project resource demands should be resolved.

6.2.4.3.3.7 Empower teams to perform their role by ensuring the teams have:

a) An understanding of their role on the project.

b) A shared vision or sense of common interests on the success of the project.

c) Appropriate mechanisms or facilities for communication and interactions among teams.

d) Support from appropriate management to accomplish project requirements.

6.2.4.3.3.8 It should be ensured that the right mix and categories of appropriately trained personnel are available for the planned activities and tasks in a timely manner.

6.2.4.3.4 Knowledge management. This activity consists of the following tasks:

6.2.4.3.4.1 The organization shall plan the requirements for managing the organization's knowledge assets. The planning shall include the definition of the infrastructure and training to support the contributors and the users of the organization's knowledge assets, the classification schema for the assets and the asset criteria.

6.2.4.3.4.2 The organization shall establish a network of experts within the organization. The network shall contain the identification of the organization's experts, a list of their area of expertise and the identification of available information within a classification schema, e.g., knowledge area. The organization shall ensure that the network is maintained current.

6.2.4.3.4.3 The organization shall establish a mechanism to support the exchange of information between the experts and the flow of expert information to the organization's projects. The mechanism shall support the organization's access, storage and retrieval requirements.

6.2.4.3.4.4 The organization shall perform configuration management of assets in accordance with the Configuration Management Process specified in subclause 6.4.2.

6.2.4.3.4.5 The organizations shall capture and maintain information for access by the organization per the plan.

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6.2.5 Quality Management Process

6.2.5.1 Purpose

The purpose of the Quality Management Process is to assure that products, services and implementations of life cycle processes meet organizational quality objectives and achieve customer satisfaction.

6.2.5.2 Outcomes

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

a) organization quality management policies and procedures are defined;

b) organization quality objectives are defined;

c) accountability and authority for quality management are defined;

d) the status of customer satisfaction is monitored; and

e) appropriate action is taken when quality objectives are not achieved.

6.2.5.3 Activities and tasks

The organization shall implement the following activities and tasks in accordance with applicable organization policies and procedures with respect to the Quality Management Process.

6.2.5.3.1 Quality management. This activity consists of the following tasks:

6.2.5.3.1.1 The organization shall establish quality management policies, standards and procedures.

NOTE 1 A process model for quality management system can be found in ISO 9001:2000. For organizations wishing to move beyond ISO 9001:2000, in pursuit of continual improvement of performance, guidance is provided in ISO 9004:2000.

NOTE 2 Guidance for application of ISO 9001:2000 to software can be found in ISO/IEC 90003:2004.

6.2.5.3.1.2 The organization shall establish organization quality management goals and objectives based on business strategy for customer satisfaction.

6.2.5.3.1.3 The organization shall define responsibilities and authority for implementation of quality management.

6.2.5.3.1.4 The organization shall assess customer satisfaction and report.

NOTE The implementation of this International Standard provides the organization with an approach to achieving customer satisfaction.

6.2.5.3.1.5 The organization shall conduct periodic reviews of project quality plans.

NOTE Assure that quality objectives based on the stakeholder requirements are established for each project.

6.2.5.3.1.6 The organization shall monitor the status of quality improvements on products and services.

6.2.5.3.2 Quality management corrective action. This activity consists of the following tasks:

6.2.5.3.2.1 The organization shall take corrective actions when quality management goals are not achieved.

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6.2.5.3.2.2 The organization shall implement corrective actions and communicate results through the organization.

6.3 Project Processes

6.3.1 Project Planning Process

6.3.1.1 Purpose

The purpose of the Project Planning Process is to produce and communicate effective and workable project plans.

This process determines the scope of the project management and technical activities, identifies process outputs, project tasks and deliverables, establishes schedules for project task conduct, including achievement criteria, and required resources to accomplish project tasks.

6.3.1.2 Outcomes

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

a) the scope of the work for the project is defined;

b) the feasibility of achieving the goals of the project with available resources and constraints are evaluated;

c) the tasks and resources necessary to complete the work are sized and estimated;

d) interfaces between elements in the project, and with other project and organizational units, are identified;

e) plans for the execution of the project are developed; and

f) plans for the execution of the project are activated.

6.3.1.3 Activities and tasks

The manager shall implement the following activities in accordance with applicable organization policies and procedures with respect to the Project Planning Process:

6.3.1.3.1 Project initiation. This activity consists of the following tasks:

6.3.1.3.1.1 The manager shall establish the requirements of the project to be undertaken.

NOTE Establishing the requirements includes identifying the project's objectives, motivations and boundaries.

6.3.1.3.1.2 Once the project requirements are established, the manager shall establish the feasibility of the project by checking that the resources (personnel, materials, technology, and environment) required to execute and manage the project are available, adequate, and appropriate and that the timescales to completion are achievable.

6.3.1.3.1.3 As necessary, and by agreement of all parties concerned, the requirements of the project may be modified at this point to achieve the completion criteria.

6.3.1.3.2 Project planning. This activity consists of the following tasks:

6.3.1.3.2.1 The manager shall prepare the plans for execution of the project. The plans associated with the execution of the project shall contain descriptions of the associated activities and tasks and identification of the software products that will be provided. These plans shall include, but are not limited to, the following:

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a) Schedules for the timely completion of tasks.

b) Estimation of effort.

c) Adequate resources needed to execute the tasks.

d) Allocation of tasks.

e) Assignment of responsibilities.

f) Quantification of risks associated with the tasks or the process itself.

g) Quality assurance measures to be employed throughout the project.

h) Costs associated with the process execution.

i) Provision of environment and infrastructure.

j) Definition and maintenance of a life cycle model that is comprised of stages using the defined life cycle models for projects of the organization.

NOTE Organizational models for project use would be provided through the Life Cycle Model Management Process.

6.3.1.3.3 Project activation. This activity consists of the following tasks:

6.3.1.3.3.1 The manager shall obtain authorization for the project.

6.3.1.3.3.2 The manager shall submit requests for necessary resources to perform the project.

6.3.1.3.3.3 The manager shall initiate the implementation of the project plan/s to satisfy the objectives and criteria set, exercising control over the project

6.3.2 Project Assessment and Control Process

6.3.2.1 Purpose

The purpose of the Project Assessment and Control Process is to determine the status of the project and ensure that the project performs according to plans and schedules, and within projected budgets, and that it satisfies technical objectives.

This process includes redirecting the project activities, as appropriate, to correct identified deviations and variations from other project management or technical processes. Redirection may include replanning as appropriate.

6.3.2.2 Outcomes

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

a) progress of the project is monitored and reported;

b) interfaces between elements in the project, and with other project and organizational units, are monitored;

c) actions to correct deviations from the plan and to prevent recurrence of problems identified in the project are taken when project targets are not achieved; and

d) project objectives are achieved and recorded.

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6.3.2.3 Activities and tasks

The manager shall implement the following activities in accordance with applicable organization policies and procedures with respect to the Project Assessment and Control Process:

6.3.2.3.1 Project monitoring. This activity consists of the following task:

6.3.2.3.1.1 The manager shall monitor the overall execution of the project, providing both internal reporting of the project progress and external reporting to the acquirer as defined in the contract.

NOTE The manager ensures that internal project element interfaces, as well as interfaces with other relevant projects and organizational units, are monitored during this activity.

6.3.2.3.2 Project control. This activity consists of the following tasks:

6.3.2.3.2.1 The manager shall investigate, analyze, and resolve the problems discovered during the execution of the project. The resolution of problems may result in changes to plans. It is the manager's responsibility to ensure the impact of any changes is determined, controlled, and monitored. Problems and their resolution shall be documented.

6.3.2.3.2.2 The manager shall report, at agreed points, the progress of the project, declaring adherence to the plans and resolving instances of the lack of progress. These include internal and external reporting as required by the organizational procedures and the contract.

6.3.2.3.3 Project assessment. This activity consists of the following tasks:

6.3.2.3.3.1 The manager shall ensure that the software products and plans are evaluated for satisfaction of requirements.

6.3.2.3.3.2 The manager shall assess the evaluation results of the software products, activities, and tasks completed during the execution of the project for achievement of the objectives and completion of the plans.

NOTE The manager uses assessment results to take steps to prevent future recurrence of problems identified on the project.

6.3.2.3.4 Project closure. This activity consists of the following tasks:

6.3.2.3.4.1 When all software products, activities, and tasks are completed, the manager shall determine whether the project is complete, taking into account the criteria as specified in the contract or as part of organization's procedure.

6.3.2.3.4.2 These results and records shall be archived in a suitable environment as specified in the contract.

6.3.3 Decision Management Process

6.3.3.1 Purpose

The purpose of the Decision Management Process is to select the most beneficial course of project action where alternatives exist.

This process responds to a request for a decision encountered during the system life cycle, whatever its nature or source, in order to reach specified, desirable or optimized outcomes. Alternative actions are analyzed and a course of action selected and directed. Decisions and their rationale are recorded to support future decision-making.

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6.3.3.2 Outcomes

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

a) a decision-making strategy is defined;

b) alternative courses of action are defined;

c) a preferred course of action is selected; and

d) the resolution, decision rationale and assumptions are captured and reported.

6.3.3.3 Activities and tasks

The project shall implement the following activities and tasks in accordance with applicable organization policies and procedures with respect to the Decision Management Process.

6.3.3.3.1 Decision planning. This activity consists of the following tasks:

6.3.3.3.1.1 The project shall define a decision-making strategy.

NOTE This includes identifying decision categories and a prioritization scheme, and identifying responsible parties. The decision makers are identified and given the responsibility and authority to make decisions. Decisions may arise as a result of an effectiveness assessment, a technical trade-off, a problem needing to be solved, action needed as a response to risk exceeding the acceptable threshold, a new opportunity or approval for project progression to the next life cycle stage. A decision-making strategy includes the identification and allocation of responsibility for, and authority to make, decisions.

6.3.3.3.1.2 The project shall involve relevant parties in the decision-making in order to draw on experience and knowledge.

6.3.3.3.1.3 The project shall identify the circumstances and need for a decision.

NOTE Record, categorize and promptly and objectively report problems or opportunities and the alternative courses of action that will resolve their outcome.

6.3.3.3.2 Decision analysis. This activity consists of the following tasks:

6.3.3.3.2.1 The project shall select and declare the decision-making strategy for each decision situation. The project shall identify desired outcomes and measurable success criteria.

6.3.3.3.2.2 The project shall evaluate the balance of consequences of alternative actions, using the defined decision-making strategy, to arrive at an optimization of, or an improvement in, an identified decision situation.

6.3.3.3.3 Decision tracking. This activity consists of the following tasks:

6.3.3.3.3.1 The project shall record, track, evaluate and report decision outcomes to confirm that problems have been effectively resolved, adverse trends have been reversed and advantage has been taken of opportunities.

6.3.3.3.3.2 The project shall maintain records of problems and opportunities and their disposition, as stipulated in agreements or organizational procedures and in a manner that permits auditing and learning from experience.

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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 continuously.

The Risk Management Process is a continuous process for systematically addressing risk throughout the life cycle of a system or software product or service. It can be applied to risks related to the acquisition, development, maintenance or operation of a system.

6.3.4.2 Outcomes

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

a) the scope of risk management to be performed is determined;

b) appropriate risk management strategies are defined and implemented;

c) risks are identified as they develop and during the conduct of the project;

d) risks are analyzed, and the priority in which to apply resources to treatment of these risks is determined;

e) risk measures are defined, applied, and assessed to determine changes in the status of risk and the progress of the treatment activities; and

f) appropriate treatment is taken to correct or avoid the impact of risk based on its priority, probability, and consequence or other defined risk threshold.

6.3.4.3 Activities and tasks

The project shall implement the following activities and tasks in accordance with applicable organization policies and procedures with respect to the Risk Management Process.

NOTE ISO/IEC 16085, *Risk Management Process*, provides a more detailed set of activities and tasks that are aligned with the activities and tasks shown below.

6.3.4.3.1 Risk management planning. This activity consists of the following tasks:

6.3.4.3.1.1 Risk management policies describing the guidelines under which risk management is to be performed shall be defined.

6.3.4.3.1.2 A description of the Risk Management Process to be implemented shall be documented.

6.3.4.3.1.3 The parties responsible for performing risk management and their roles and responsibilities shall be identified.

6.3.4.3.1.4 The responsible parties shall be provided with adequate resources to perform the Risk Management Process.

6.3.4.3.1.5 A description of the process for evaluating and improving the Risk Management Process shall be provided.

NOTE This includes the capture of lessons learned.

6.3.4.3.2 Risk profile management. This activity consists of the following tasks:

6.3.4.3.2.1 The context of the Risk Management Process shall be defined and documented.

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NOTE This includes a description of stakeholders' perspectives, risk categories, and a description (perhaps by reference) of the technical and managerial objectives, assumptions and constraints.

6.3.4.3.2.2 Risk thresholds, defining the conditions under which a level of risk may be accepted, shall be documented.

6.3.4.3.2.3 A risk profile shall be established and maintained.

NOTE The risk profile records: the risk management context; a record of each risk's state including its probability, consequences, and risk thresholds; the priority of each risk based on risk criteria supplied by the stakeholders; and the risk action requests along with the status of their treatment. The risk profile is updated when there are changes in an individual risk's state. The priority in the risk profile is used to determine the application of resources for treatment.

6.3.4.3.2.4 The relevant risk profile shall be communicated periodically to stakeholders based upon their needs.

6.3.4.3.3 Risk analysis. This activity consists of the following tasks:

6.3.4.3.3.1 Risks shall be identified in the categories described in the risk management context.

6.3.4.3.3.2 The probability of occurrence and consequences of each risk identified shall be estimated.

6.3.4.3.3.3 Each risk shall be evaluated against its risk thresholds.

6.3.4.3.3.4 For each risk that is above its risk threshold, recommended treatment strategies shall be defined and documented. Measures indicating the effectiveness of the treatment alternatives shall also be defined and documented.

NOTE Risk treatment strategies include, but are not limited to, eliminating the risk, reducing its probability of occurrence or severity of consequence, or accepting the risk.

6.3.4.3.4 Risk treatment. This activity consists of the following tasks:

6.3.4.3.4.1 Stakeholders shall be provided recommended alternatives for risk treatment in risk action requests.

6.3.4.3.4.2 If the stakeholders determine that actions should be taken to make a risk acceptable, then a risk treatment alternative shall be implemented.

6.3.4.3.4.3 If the stakeholders accept a risk that exceeds its threshold, it shall be considered a high priority and monitored continuously to determine if any future risk treatment actions are necessary.

6.3.4.3.4.4 Once a risk treatment is selected, it shall receive the same management actions as problems do, in accordance with the assessment and control activities in subclause 6.3.2 of this standard or ISO/IEC 15288:2008.

6.3.4.3.5 Risk monitoring. This activity consists of the following tasks:

6.3.4.3.5.1 All risks and the risk management context shall be continuously monitored for changes. Risks whose states have changed shall undergo risk evaluation.

6.3.4.3.5.2 Measures shall be implemented and monitored to evaluate the effectiveness of risk treatments.

6.3.4.3.5.3 The project shall continuously monitor for new risks and sources throughout its life cycle.

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6.3.4.3.6 Risk management process evaluation. This activity consists of the following tasks:

6.3.4.3.6.1 Information shall be collected throughout the project's life cycle for purposes of improving the Risk Management Process and generating lessons learned.

NOTE The risk information includes the risks identified, their sources, their causes, their treatment, and the success of the treatments selected

6.3.4.3.6.2 The Risk Management Process shall be periodically reviewed for its effectiveness and efficiency.

6.3.4.3.6.3 Information on the risks identified, their treatment, and the success of the treatments shall be reviewed periodically for purposes of identifying systemic project and organizational risks.

6.3.5 Configuration Management Process

6.3.5.1 Purpose

The purpose of the Configuration Management Process is to establish and maintain the integrity of all identified outputs of a project or process and make them available to concerned parties.

6.3.5.2 Outcomes

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

a) a configuration management strategy is defined;

b) items requiring configuration management are defined;

c) configuration baselines are established;

d) changes to items under configuration management are controlled;

e) the configuration of released items is controlled; and

f) the status of items under configuration management is made available throughout the life cycle.

NOTE The Software Configuration Management Process is a specialization of the Configuration Management Process and is included in the Software Support Process Group.

6.3.5.3 Activities and tasks

The project shall implement the following activities and tasks in accordance with applicable organization policies and procedures with respect to the Configuration Management Process.

6.3.5.3.1 Configuration management planning. This activity consists of the following tasks:

6.3.5.3.1.1 The project shall define a configuration management strategy.

NOTE This includes defining authorities for the deposition of, access to, release of and control of changes to configuration items; defining the locations and conditions of storage, their environment and, in the case of information, storage media, in accordance with designated levels of integrity, security and safety; defining the criteria or events for commencing configuration control and maintaining baselines of evolving configurations and defining the audit strategy and the responsibilities for ensuring continuous integrity and security of the configuration definition information. The configuration management activities should be compatible with the guidance provided in ISO 10007.

6.3.5.3.1.2 The project shall identify items that are subject to configuration control.

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NOTE Items are distinguished by unique, durable identifiers or markings, where appropriate. The identifiers are in accordance with relevant standards and product sector conventions, such that the items under configuration control are unambiguously traceable to their specifications or equivalent, documented descriptions.

6.3.5.3.2 Configuration management execution. This activity consists of the following tasks:

6.3.5.3.2.1 The project shall maintain information on configurations with an appropriate level of integrity and security.

NOTE This includes taking into account the nature of the items under configuration control. Configuration descriptions conform, where possible, to product or technology standards. Ensure that configuration information permits forward and backward traceability to other baselined configuration states. Consolidate the evolving configuration states of configuration items to form documented baselines at designated times or under defined circumstances. Record the rationale for the baseline and associated authorizations in configuration baseline data. Maintain configuration records through the system life cycle and archive them according to agreements, relevant legislation or best industry practice.

6.3.5.3.2.2 The project shall ensure that changes to configuration baselines are properly identified, recorded, evaluated, approved, incorporated and verified.

NOTE Consolidate the evolving configuration states of configuration items to form documented baselines at designated times or under defined circumstances. Record the steps of configuration, the rationale for the baseline and associated authorizations in configuration baseline data. Maintain configuration records through the system life cycle and archive them according to agreements, relevant legislation or best industry practice. Manage the recording, retrieval and consolidation of the current configuration status and the status of all preceding configurations to confirm information correctness, timeliness, integrity and security. Perform audits to verify conformance of a baseline to drawings, interface control documents and other agreement requirements.

6.3.6 Information Management Process

6.3.6.1 Purpose

The purpose of the Information Management Process is to provide relevant, timely, complete, valid and, if required, confidential information to designated parties during and, as appropriate, after the system life cycle.

This process generates, collects, transforms, retains, retrieves, disseminates and disposes of information. It manages designated information, including technical, project, organizational, agreement and user information.

6.3.6.2 Outcomes

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

a) information to be managed is identified;

b) the forms of the information representations are defined;

c) information is transformed and disposed of as required;

d) the status of information is recorded;

e) information is current, complete and valid; and

f) information is made available to designated parties.

NOTE The Software Documentation Management Process is a specialization of the Information Management Process and is included in the Software Support Process Group.

6.3.6.3 Activities and tasks

The project shall implement the following activities and tasks in accordance with applicable organization policies and procedures with respect to the Information Management Process.

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NOTE ISO/IEC 15289 summarizes requirements for information items (documentation) and provides guidance on their development.

6.3.6.3.1 Information management planning. This activity consists of the following tasks:

6.3.6.3.1.1 The project shall define the items of information that will be managed during the system life cycle and, according to organizational policy or legislation, maintained for a defined period beyond.

6.3.6.3.1.2 The project shall designate authorities and responsibilities regarding the origination, generation, capture, archiving and disposal of items of information.

6.3.6.3.1.3 The project shall define the rights, obligations and commitments regarding the retention of, transmission of and access to information items.

NOTE Due regard is paid to information and data legislation, security and privacy, e.g., ownership, agreement restrictions, rights of access, intellectual property and patents. Where restrictions or constraints apply, information is identified accordingly. Staff having knowledge of such items of information are informed of their obligations and responsibilities.

6.3.6.3.1.4 The project shall define the content, semantics, formats and medium for the representation, retention, transmission and retrieval of information.

NOTE The information may originate and may terminate in any form (e.g., verbal, textual, graphical, numerical) and may be stored, processed, replicated and transmitted using any medium (e.g., electronic, printed, magnetic, optical). Pay due regard to organization constraints, e.g., infrastructure, inter-organizational communications, distributed project working. Relevant information storage, transformation, transmission and presentation standards and conventions are used according to policy, agreements and legislation constraints.

6.3.6.3.1.5 The project shall define information maintenance actions.

NOTE This includes status reviews of stored information for integrity, validity and availability and any needs for replication or transformation to an alternative medium. Consider the need to either retain infrastructure as technology changes so that archived media can be read or the need to re-record archived media using new technology.

6.3.6.3.2 Information management execution. This activity consists of the following tasks:

6.3.6.3.2.1 The project shall obtain the identified items of information.

NOTE This may include generating the information or collecting it from appropriate sources.

6.3.6.3.2.2 The project shall maintain information items and their storage records according to integrity, security and privacy requirements.

NOTE Record the status of information items, e.g., version description, record of distribution, security classification. Information should be legible and stored and retained in such a way that it is readily retrievable in facilities that provide a suitable environment, and that prevent damage, deterioration and loss.

6.3.6.3.2.3 The project shall retrieve and distribute information to designated parties as required by agreed schedules or defined circumstances.

NOTE Information is provided to designated parties in an appropriate form.

6.3.6.3.2.4 The project shall provide official documentation as required.

NOTE Examples of official documentation are certification, accreditation, pilot license and assessment ratings.

6.3.6.3.2.5 The project shall archive designated information, in accordance with the audit, knowledge retention and project closure purposes.

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NOTE Select the media, location and protection of the information in accordance with the specified storage and retrieval periods, and with organization policy, agreements and legislation. Ensure arrangements are in place to retain necessary documentation after project closure.

6.3.6.3.2.6 The project shall dispose of unwanted, invalid or unverifiable information according to organization policy, and security and privacy requirements.

6.3.7 Measurement Process

6.3.7.1 Purpose

The purpose of the Measurement Process is to collect, analyze, and report data relating to the products developed and processes implemented within the organizational unit, to support effective management of the processes, and to objectively demonstrate the quality of the products.

6.3.7.2 Outcomes

As a result of successful implementation of the Measurement Process:

a) the information needs of technical and management processes are identified;

b) an appropriate set of measures, driven by the information needs are identified and/or developed;

c) measurement activities are identified and planned;

d) the required data are collected, stored, analyzed, and the results interpreted;

e) information products are used to support decisions and provide an objective basis for communication;

f) the Measurement Process and measures are evaluated; and

g) improvements are communicated to the Measurement Process owner.

6.3.7.3 Activities and tasks

The project shall implement the following activities and tasks in accordance with applicable organization policies and procedures with respect to the Measurement Process.

NOTE 1 ISO/IEC 15939, *Software Measurement Process*, provides a more detailed set of activities and tasks that are aligned with the activities and tasks shown below.

NOTE 2 Clause 8 of ISO 9001:2000 specifies Quality Management System requirements for measurement and monitoring of processes and products.

6.3.7.3.1 Measurement planning. This activity consists of the following tasks:

6.3.7.3.1.1 The project shall describe the characteristics of the organization that are relevant to measurement.

6.3.7.3.1.2 The project shall identify and prioritize the information needs.

6.3.7.3.1.3 The project shall select and document measures that satisfy the information needs.

6.3.7.3.1.4 The project shall define data collection, analysis, and reporting procedures.

6.3.7.3.1.5 The project shall define criteria for evaluating the information products and the measurement process.

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6.3.7.3.1.6 The project shall review, approve, and provide resources for measurement tasks.

6.3.7.3.1.7 The project shall acquire and deploy supporting technologies.

6.3.7.3.2 Measurement performance. This activity consists of the following tasks:

6.3.7.3.2.1 The project shall integrate procedures for data generation, collection, analysis and reporting into the relevant processes.

6.3.7.3.2.2 The project shall collect, store, and verify data.

6.3.7.3.2.3 The project shall analyze data and develop information products.

6.3.7.3.2.4 The project shall document and communicate results to the measurement users.

6.3.7.3.3 Measurement evaluation. This activity consists of the following tasks:

6.3.7.3.3.1 The project shall evaluate information products and the measurement process.

6.3.7.3.3.2 The project shall identify and communicate potential improvements.

6.4 Technical Processes

6.4.1 Stakeholder Requirements Definition Process

NOTE The Stakeholder Requirements Definition Process in this International Standard is a specialization of the Stakeholder Requirements Definition Process of ISO/IEC 15288. Users may consider claiming conformance to the 15288 process rather than the process in this standard.

6.4.1.1 Purpose

The purpose of the Stakeholder Requirements Definition Process is to define the requirements for a system that can provide the services needed by users and other stakeholders in a defined environment.

It identifies stakeholders, or stakeholder classes, involved with the system throughout its life cycle, and their needs and desires. It analyzes and transforms these into a common set of stakeholder requirements that express the intended interaction the system will have with its operational environment and that are the reference against which each resulting operational service is validated in order to confirm that the system fulfils needs.

6.4.1.2 Outcomes

As a result of successful implementation of the Stakeholder Requirements Definition Process:

a) the required characteristics and context of use of services are specified;

b) the constraints on a system solution are defined;

c) traceability of stakeholder requirements to stakeholders and their needs is achieved;

d) the basis for defining the system requirements is described;

e) the basis for validating the conformance of the services is defined; and

f) a basis for negotiating and agreeing to supply a service or product is provided.

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6.4.1.3 Activities and tasks

The project shall implement the following activities and tasks in accordance with applicable organization policies and procedures with respect to Stakeholder Requirements Definition Process

6.4.1.3.1 Stakeholder identification. This activity consists of the following task:

6.4.1.3.1.1 The project shall identify the individual stakeholders or stakeholder classes who have a legitimate interest in the system throughout its life cycle.

NOTE This includes, but is not limited to, users, operators, supporters, developers, producers, trainers, maintainers, disposers, acquirer and supplier organizations, parties responsible for external interfacing entities, regulatory bodies and members of society. Where direct communication is not practicable, e.g., for consumer products and services, representatives or designated proxy stakeholders are selected.

6.4.1.3.2 Requirements identification. This activity consists of the following tasks:

6.4.1.3.2.1 The project shall elicit stakeholder requirements.

NOTE Stakeholder requirements describe the needs, wants, desires, expectations and perceived constraints of identified stakeholders. They are expressed in terms of a model that may be textual or formal, that concentrates on system purpose and behaviour, and that is described in the context of the operational environment and conditions. A product quality model and quality requirements, such as found in ISO/IEC 9126-1 and ISO/IEC 25030, may be useful for aiding this activity. Stakeholder requirements include the needs and requirements imposed by society, the constraints imposed by an acquiring organization and the capabilities and operational characteristics of users and operator staff. It is useful to cite sources, including solicitation documents or agreements, their justification and rationale, and the assumptions of stakeholders and the value they place on the satisfaction of their requirements. For key stakeholder needs, the measures of effectiveness are defined so that operational performance can be measured and assessed. If significant risks are likely to arise from issues (i.e., needs, wants, constraints, limits, concerns, barriers, factors or considerations) relating to people (users and other stakeholders) and their involvement in or interaction with a system at any time in the life cycle of that system, recommendations for identifying and treating human-system issues can be found in ISO PAS 18152, *A specification for the process assessment of human-system issues.*

6.4.1.3.2.2 The project shall define the constraints on a system solution that are unavoidable consequences of existing agreements, management decisions and technical decisions.

NOTE These may result from 1) instances or areas of stakeholder-defined solution; 2) implementation decisions made at higher levels of system hierarchical structure; 3) required use of defined enabling systems, resources and staff.

6.4.1.3.2.3 The project shall define a representative set of activity sequences to identify all required services that correspond to anticipated operational and support scenarios and environments.

NOTE Scenarios are used to analyze the operation of the system in its intended environment in order and to identify requirements that may not have been formally specified by any of the stakeholders, e.g., legal, regulatory and social obligations. The context of use of the system is identified and analyzed. Include in the context analysis the activities that users perform to achieve system objectives, the relevant characteristics of the end-users of the system (e.g., expected training, degree of fatigue), the physical environment (e.g., available light, temperature) and any equipment to be used (e.g., protective or communication equipment). The social and organizational influences on users that could affect system use or constrain its design are analyzed when applicable.

6.4.1.3.2.4 The project shall identify the interaction between users and the system, taking into the account human capabilities and skills limitations.

NOTE 1 Usability requirements are determined, establishing, as a minimum, the most effective, efficient, and reliable human performance and human-system interaction. Where possible, applicable standards, e.g., ISO 9241, and accepted professional practices are used in order to define:

a) Physical, mental, and learned capabilities;

b) Work place, environment and facilities, including other equipment in the context of use;

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c) Normal, unusual, and emergency conditions;

d) Operator and user recruitment, training and culture.

NOTE 2 If usability is important, usability requirements should be planned, specified, and implemented through the life cycle processes, and the following standards or technical reports may be applicable for obtaining a desired level of usability: ISO 9241-11:1998, ISO 13407:1999, ISO/TR 18529. Annex E contains a process view which is focused on usability.

6.4.1.3.2.5 The project shall specify health, safety, security, environment and other stakeholder requirements and functions that relate to critical qualities and shall address possible adverse effects of use of the system on human health and safety.

NOTE Identify safety risk and, if warranted, specify requirements and functions to provide safety. This includes risks associated with methods of operations and support, health and safety, threats to property and environmental influences. Use applicable standards, e.g., IEC 61508, and accepted professional practices. Identify security risk and, if warranted, specify all applicable areas of system security, including physical, procedural, communications, computers, programs, data and emissions. Identify functions that could impact the security of the system, including access and damage to protected personnel, properties and information, compromise of sensitive information, and denial of approved access to property and information. Specify the required security functions, including mitigation and containment, referencing applicable standards and accepted professional practices where mandatory or relevant.

6.4.1.3.3 Requirements evaluation. This activity consists of the following task:

6.4.1.3.3.1 The project shall analyze the complete set of elicited requirements.

NOTE Analysis includes identifying and prioritizing the conflicting, missing, incomplete, ambiguous, inconsistent, incongruous or unverifiable requirements.

6.4.1.3.4 Requirements agreement. This activity consists of the following tasks:

6.4.1.3.4.1 The project shall resolve requirements problems.

NOTE This includes requirements that cannot be realized or are impractical to achieve.

6.4.1.3.4.2 The project shall feed back the analyzed requirements to applicable stakeholders to ensure that the needs and expectations have been adequately captured and expressed.

NOTE Explain and obtain agreement to the proposals to resolve conflicting, impractical and unrealisable stakeholder requirements.

6.4.1.3.4.3 The project shall establish with stakeholders that their requirements are expressed correctly.

NOTE This includes confirming that stakeholder requirements are comprehensible to originators and that the resolution of conflict in the requirements has not corrupted or compromised stakeholder intentions.

6.4.1.3.5 Requirement recording. This activity consists of the following tasks:

6.4.1.3.5.1 The project shall record the stakeholder requirements in a form suitable for requirements management through the life cycle and beyond.

NOTE These records establish the stakeholder requirements baseline, and retain changes of need and their origin throughout the system life cycle. They are the basis for traceability to the system requirements and form a source of knowledge for requirements for subsequent systems and communications with stakeholders on requirements status.

6.4.1.3.5.2 The project shall maintain stakeholder requirements traceability to the sources of stakeholder need.

NOTE The stakeholder requirements are reviewed at key decision times in the life cycle to ensure that account is taken of any changes of need.

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6.4.2 System Requirements Analysis Process

NOTE The System Requirements Analysis Process in this International Standard is a specialization of the Requirements Analysis Process of ISO/IEC 15288. Users may consider claiming conformance to the 15288 process rather than the process in this standard.

6.4.2.1 Purpose

The purpose of System Requirements Analysis is to transform the defined stakeholder requirements into a set of desired system technical requirements that will guide the design of the system.

6.4.2.2 Outcomes

As a result of successful implementation of System Requirements Analysis:

a) a defined set of system functional and non-functional requirements describing the problem to be solved are established;

b) the appropriate techniques are performed to optimize the preferred project solution;

c) system requirements are analyzed for correctness and testability;

d) the impact of the system requirements on the operating environment are understood;

e) the requirements are prioritized, approved and updated as needed;

f) consistency and traceability are established between the system requirements and the customer's requirements baseline;

g) changes to the baseline are evaluated for cost, schedule and technical impact; and

h) the system requirements are communicated to all affected parties and baselined.

6.4.2.3 Activities and tasks

The project shall implement the following activities and tasks in accordance with applicable organization policies and procedures with respect to the System Requirements Analysis Process.

6.4.2.3.1 Requirements specification. This activity consists of the following tasks:

6.4.2.3.1.1 The specific intended use of the system to be developed shall be analyzed to specify system requirements. The system requirements specification shall describe: functions and capabilities of the system; business, organizational and user requirements; safety, security, human-factors engineering (ergonomics), interface, operations, and maintenance requirements; design constraints and qualification requirements. The system requirements specification shall be documented.

NOTE 1 Appropriate techniques should be performed to optimize the preferred solution.

NOTE 2 The impact of the system requirements on the operating environment should be understood.

NOTE 3 System requirements should be prioritized, approved, baselined and communicated to all affected parties. Updates to the requirements baseline should be evaluated for cost, schedule and technical impact.

6.4.2.3.2 Requirements evaluation. This activity consists of the following tasks:

6.4.2.3.2.1 The system requirements shall be evaluated considering the criteria listed below. The results of evaluations shall be documented.

a) Traceability to acquisition needs;

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b) Consistency with acquisition needs;

c) Testability;

d) Feasibility of system architectural design;

e) Feasibility of operation and maintenance.

NOTE Acquisition needs include the stakeholder requirements baseline.

6.4.3 System Architectural Design Process

NOTE The System Architectural Design Process in this International Standard is a specialization of the Architectural Design Process of ISO/IEC 15288. Users may consider claiming conformance to the 15288 process rather than the process in this standard.

6.4.3.1 Purpose

The purpose of the System Architectural Design Process is to identify which system requirements should be allocated to which elements of the system.

6.4.3.2 Outcomes

As a result of successful implementation of the System Architectural Design Process:

a) a system architecture design is defined that identifies the elements of the system and meets the defined requirements;

b) the system's functional and non-functional requirements are addressed;

c) the requirements are allocated to the elements of the system;

d) internal and external interfaces of each system element are defined;

e) verification between the system requirements and the system architecture is performed;

f) the requirements allocated to the system elements and their interfaces are traceable to the customer's requirements baseline;

g) consistency and traceability between the system requirements and system architecture design is maintained; and

h) the system requirements, the system architecture design, and their relationships are baselined and communicated to all affected parties;

i) human factors and ergonomic knowledge and techniques are incorporated in system design; and

j) human-centred design activities are identified and performed.

6.4.3.3 Activities and tasks

The project shall implement the following activities and tasks in accordance with applicable organization policies and procedures with respect to the System Architectural Design Process.

6.4.3.3.1 Establishing architecture. This activity consists of the following task:

6.4.3.3.1.1 A top-level architecture of the system shall be established. The architecture shall identify items of hardware, software, and manual operations. It shall be ensured that all the system requirements are allocated among the items. Hardware configuration items, software configuration items, and manual

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operations shall be subsequently identified from these items. The system architecture and the system requirements allocated to the items shall be documented.

NOTE 1 Internal and external interfaces of each system element should be defined in the system architecture.

NOTE 2 Human-centred design activities should be identified and performed and human factors and ergonomic knowledge and techniques should be incorporated in system design.

NOTE 3 The system architecture design and the relationship with the system requirements should be baselined and communicated to all affected parties.

6.4.3.3.2 Architectural evaluation. This activity consists of the following task:

6.4.3.3.2.1 The system architecture and the requirements for the items shall be evaluated considering the criteria listed below. The results of the evaluations shall be documented.

a) Traceability to the system requirements.

b) Consistency with the system requirements.

c) Appropriateness of design standards and methods used.

d) Feasibility of the software items fulfilling their allocated requirements.

e) Feasibility of operation and maintenance.

NOTE System architecture traceability to the system requirements should also provide for traceability to the stakeholder requirements baseline.

6.4.4 Implementation Process

6.4.4.1 Purpose

The purpose of the Implementation Process is to realize a specified system element.

NOTE Users of this International Standard have the intention of treating a software product or a software element of a larger system. The Software Implementation Process (subclause 7.1.1) is a conforming instance of the Implementation Process of ISO/IEC 15288, specialized to the particular needs of implementing a software product or service. The Software Implementation Process replaces the Implementation Process in this International Standard.

6.4.5 System Integration Process

NOTE The System Integration Process in this International Standard is a specialization of the Integration Process of ISO/IEC 15288. Users may consider claiming conformance to the 15288 process rather than the process in this standard.

6.4.5.1 Purpose

The purpose of the System Integration Process is to integrate the system elements (including software items, hardware items, manual operations, and other systems, as necessary) to produce a complete system that will satisfy the system design and the customers' expectations expressed in the system requirements.

6.4.5.2 Outcomes

As a result of successful implementation of the System Integration Process:

a) a strategy is developed to integrate the system according to the priorities of the system requirements;

b) criteria are developed to verify compliance with the system requirements allocated to the system elements, including the interfaces between system elements;

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c) the system integration is verified using the defined criteria;

d) a regression strategy is developed and applied for re-testing the system when changes are made;

e) consistency and traceability are established between the system design and the integrated system elements;

f) an integrated system is constructed that demonstrates compliance with the system design; and

g) an integrated system is constructed that demonstrates that a complete set of usable deliverable system elements exists.

6.4.5.3 Activities and tasks

The project shall implement the following activities and tasks in accordance with applicable organization policies and procedures with respect to the System Integration Process.

6.4.5.3.1 Integration. This activity consists of the following task:

6.4.5.3.1.1 The software configuration items shall be integrated, with hardware configuration items, manual operations, and other systems as necessary, into the system. The aggregates shall be tested, as they are developed, against their requirements. The integration and the test results shall be documented.

NOTE 1 The system integration activity should be performed according to a predefined integration strategy that takes into account the priorities of the system requirements.

NOTE 2 The integration strategy should address consistency and traceability between the system design and the integrated system elements.

6.4.5.3.2 Test readiness. This activity consists of the following tasks:

6.4.5.3.2.1 For each qualification requirement of the system, a set of tests, test cases (inputs, outputs, test criteria), and test procedures for conducting System Qualification Testing shall be developed and documented. The developer shall ensure that the integrated system is ready for System Qualification Testing.

NOTE A regression strategy, to be applied for re-testing the system when changes are made, should be developed.

6.4.5.3.2.2 The integrated system shall be evaluated considering the criteria listed below. The results of the evaluations shall be documented.

a) Test coverage of system requirements.

b) Appropriateness of test methods and standards used.

c) Conformance to expected results.

d) Feasibility of system qualification testing.

e) Feasibility of operation and maintenance.

6.4.6 System Qualification Testing Process

NOTE The System Qualification Testing Process in this International Standard contributes to the outcomes of the Verification Process of ISO/IEC 15288. Users may consider claiming conformance to the 15288 process rather than the process in this standard.

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6.4.6.1 Purpose

The purpose of the Systems Qualification Testing Process is to ensure that the implementation of each system requirement is tested for compliance and that the system is ready for delivery.

6.4.6.2 Outcomes

As a result of successful implementation of Systems Qualification Testing Process:

a) criteria for evaluating compliance with system requirements are developed;

b) the integrated system is tested using the defined criteria;

c) test results are recorded; and

d) readiness of the system for delivery is assured.

6.4.6.3 Activities and tasks

The project shall implement the following activities and tasks in accordance with applicable organization policies and procedures with respect to the System Qualification Testing Process.

6.4.6.3.1 Qualification testing. This activity consists of the following tasks:

6.4.6.3.1.1 System qualification testing shall be conducted in accordance with the qualification requirements specified for the system. It shall be ensured that the implementation of each system requirement is tested for compliance and that the system is ready for delivery. The qualification testing results shall be documented.

NOTE Qualification requirements for the system should include criteria for evaluating compliance with system requirements.

6.4.6.3.1.2 The system shall be evaluated considering the criteria listed below. The results of the evaluations shall be documented.

a) Test coverage of system requirements;

b) Conformance to expected results;

c) Feasibility of operation and maintenance.

NOTE Evaluation criteria should address readiness of the system for delivery.

6.4.6.3.1.3 The developer shall support audit(s) in accordance with subclause 7.2.7. The results of the audit(s) shall be documented.

NOTE This subclause is not applicable to those software configuration items for which audits were conducted previously.

6.4.6.3.1.4 Upon successful completion of the audit(s), if conducted, the developer shall update and prepare the deliverable software product for Software Installation and Software Acceptance Support.

NOTE The System Qualification Testing Process may be used in the Software Verification Process (subclause 7.2.4) or the Software Validation Process (subclause 7.2.5).

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6.4.7 Software Installation Process

NOTE The Software Installation Process of this International Standard contributes to the outcomes of the Transition Process of ISO/IEC 15288. Users may consider claiming conformance to the 15288 process rather than the process in this standard.

6.4.7.1 Purpose

The purpose of the Software Installation Process is to install the software product that meets the agreed requirements in the target environment.

6.4.7.2 Outcomes

As a result of successful implementation of the Software Installation Process:

a) a software installation strategy is developed;

b) criteria for software installation are developed that demonstrate compliance with the software installation requirements;

c) the software product is installed in the target environment; and

d) readiness of the software product for use in its intended environment is assured.

6.4.7.3 Activities and tasks

The project shall implement the following activities and tasks in accordance with applicable organization policies and procedures with respect to the Software Installation Process

6.4.7.3.1 Software installation. This activity consists of the following tasks:

6.4.7.3.1.1 The implementer shall develop a plan to install the software product in the target environment as designated in the contract. The resources and information necessary to install the software product shall be determined and be available. As specified in the contract, the implementer shall assist the acquirer with the set-up activities. Where the installed software product is replacing an existing system, the implementer shall support any parallel running activities that are required by contract. The installation plan shall be documented.

NOTE 1 The software installation strategy should be developed in agreement with the customer and the operating organization.

NOTE 2 An important part of developing an installation strategy is to develop a strategy to return to the last working system version. In order to be able to re-install the last working version, a complete backup of the system should be made before starting the installation.

NOTE 3 Based on the installation requirements, the installer should develop criteria for the environment where the software will be installed.

NOTE 4 The installer should specify the requirements for adaptation of the system for its intended environment.

NOTE 5 The installer should adapt the system to meet the requirements for operation.

6.4.7.3.1.2 The developer shall install the software product in accordance with the installation plan. It shall be ensured that the software code and databases initialize, execute, and terminate as specified in the contract. The installation events and results shall be documented.

NOTE The installer should assure that the software product is ready for use in its intended environment.

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6.4.8 Software Acceptance Support Process

NOTE The Software Acceptance Support Process of this standard contributes to the outcomes of the Transition Process of ISO/IEC 15288. The Software Acceptance Support Process of this standard may also contribute to the outcomes of the Validation Process of ISO/IEC 15288. Users may consider claiming conformance to the 15288 process or processes rather than the process in this standard.

6.4.8.1 Purpose

The purpose of the Software Acceptance Support Process is to assist the acquirer to achieve confidence that the product meets requirements.

6.4.8.2 Outcomes

As a result of the successful implementation of the Software Acceptance Support Process:

a) the product is completed and delivered to the acquirer;

b) acquirer acceptance tests and reviews are supported;

c) the product is put into operation in the customers' environment; and

d) problems detected during acceptance are identified and communicated to those responsible for resolution.

NOTE Incremental delivery would be in completed increments.

6.4.8.3 Activities and tasks

The project shall implement the following activities and tasks in accordance with applicable organization policies and procedures with respect to the Software Acceptance Support Process.

6.4.8.3.1 Software acceptance support. This activity consists of the following tasks:

6.4.8.3.1.1 The developer shall support the acquirer's acceptance review and testing of the software product. Acceptance review and testing shall consider the results of the Software Review (subclause 7.2.6), Software Audit (subclause 7.2.7), Software Qualification Testing, and System Qualification Testing (if performed) processes. The results of the acceptance review and testing shall be documented.

NOTE This includes documentation and communication of problems detected during acceptance testing to those responsible for resolution.

6.4.8.3.1.2 The developer shall complete and deliver the software product as specified in the contract.

NOTE The contract may require the developer to put the product into operation in the customer's environment.

6.4.8.3.1.3 The developer shall provide initial and continuing training and support to the acquirer as specified in the contract.

NOTE Initial support includes identifying and communicating problems detected during acceptance to those responsible for resolution.

6.4.9 Software Operation Process

The Software Operation Process in this International Standard is a specialization of the Operation Process of ISO/IEC 15288. Users may consider claiming conformance to the 15288 process rather than the process in this standard.

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6.4.9.1 Purpose

The purpose of the Software Operation Process is to operate the software product in its intended environment and to provide support to the customers of the software product.

6.4.9.2 Outcomes

As a result of the successful implementation of the Software Operation Process:

a) an operation strategy is defined;

b) conditions for correct operation of the software in its intended environment are identified and evaluated;

c) the software is tested and determined to operate in its intended environment;

d) the software is operated in its intended environment; and

e) assistance and consultation is provided to the customers of the software product in accordance with the agreement.

6.4.9.3 Activities and tasks

The project shall implement the following activities and tasks in accordance with applicable organization policies and procedures with respect to the Software Operation Process.

6.4.9.3.1 Preparation for operation. This activity consists of the following tasks:

6.4.9.3.1.1 The operator shall develop a plan and set operational standards for performing the activities and tasks of this process. The plan shall be documented and executed.

6.4.9.3.1.2 The operator shall establish procedures for receiving, recording, resolving, tracking problems, and providing feedback. Whenever problems are encountered, they shall be recorded and entered into the Software Problem Resolution Process (subclause 7.2.8).

6.4.9.3.1.3 The operator shall establish procedures for testing the software product in its operation environment, for entering problem reports and modification requests to the Software Maintenance Process (subclause 6.4.10), and for releasing the software product for operational use.

6.4.9.3.2 Operation activation and check-out. This activity consists of the following tasks:

6.4.9.3.2.1 For each release of the software product, the operator shall perform operational testing, and, on satisfying the specified criteria, release the software product for operational use.

6.4.9.3.2.2 The operator shall ensure that the software code and databases initialize, execute, and terminate as described in the plan.

6.4.9.3.2.3 The operator shall activate the system in its intended operational situation to deliver instances of service or continuous service according to its intended purpose.

NOTE Where agreed, maintain continuous service capacity and quality when the system replaces an existing system that is being retired. During a specified period of changeover or concurrent operation, manage the transfer of services so that continuing conformance to persistent stakeholder needs is achieved.

6.4.9.3.3 Operational use. This activity consists of the following tasks:

6.4.9.3.3.1 The system shall be operated in its intended environment according to the user documentation.

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NOTE 1 Operating in the intended environment includes developing criteria for operational use so that compliance with agreed requirements can be demonstrated, and performing operational testing of each release of the product, assessing satisfaction against specified criteria.

NOTE 2 Risks to product operation are identified and monitored.

NOTE 3 The operator monitors operational service on a regular basis, where appropriate, against defined criteria.

6.4.9.3.4 Customer support. This activity consists of the following tasks:

6.4.9.3.4.1 The operator shall provide assistance and consultation to the users as requested. These requests and subsequent actions shall be recorded and monitored.

NOTE Assistance and consultation includes the providing of training, documentation, and other support services supporting effective use of the product.

6.4.9.3.4.2 The operator shall forward user requests, as necessary, to the Software Maintenance Process (subclause 6.4.10) for resolution. These requests shall be addressed and the actions that are planned and taken shall be reported to the originators of the requests. All resolutions shall be monitored to conclusion.

6.4.9.3.5 Operation problem resolution. This activity consists of the following tasks:

6.4.9.3.5.1 The operator shall forward identified problems to the Software Problem Resolution Process for resolution.

6.4.9.3.5.2 If a reported problem has a temporary work-around before a permanent solution can be released, the originator of the problem report shall be given the option to use it. Permanent corrections, releases that include previously omitted functions or features, and system improvements shall be applied to the operational software product using the Software Maintenance Process (subclause 6.4.10).

6.4.10 Software Maintenance Process

NOTE 1 The Software Maintenance Process in this International Standard is a specialization of the Maintenance Process of ISO/IEC 15288. Users may consider claiming conformance to the 15288 process rather than the process in this standard.

NOTE 2 The Software Maintenance Process of this International Standard is compatible with ISO/IEC 14764:2006.

6.4.10.1 Purpose

The purpose of the Software Maintenance Process is to provide cost-effective support to a delivered software product.

NOTE Pre-delivery Software Maintenance activities include planning for post-delivery operations, supportability, and logistics determination. Post-delivery activities include software modification and operational support, such as training or operating a help desk.

6.4.10.2 Outcomes

As a result of successful implementation of the Software Maintenance Process:

a) a maintenance strategy is developed to manage modification and migration of products according to the release strategy;

b) the impact of changes to the existing system on organization, operations or interfaces are identified;

c) affected system and software documentation is updated as needed;

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d) modified products are developed with associated tests that demonstrate that requirements are not compromised;

e) product upgrades are migrated to the customer's environment; and

f) the system software modification is communicated to all affected parties.

6.4.10.3 Activities and tasks

The maintainer shall implement the following activities in accordance with applicable organization policies and procedures with respect to the Software Maintenance Process.

6.4.10.3.1 Process implementation. This activity consists of the following tasks:

6.4.10.3.1.1 The maintainer shall develop, document, and execute plans and procedures for conducting the activities and tasks of the Software Maintenance Process.

6.4.10.3.1.2 The maintainer shall establish procedures for receiving, recording, and tracking problem reports and modification requests from the users and providing feedback to the users. Whenever problems are encountered, they shall be recorded and entered into the Software Problem Resolution Process (subclause 7.2.8).

6.4.10.3.1.3 The maintainer shall implement (or establish organizational interface with) the Configuration Management Process (subclause 7.2.2) for managing modifications to the existing system.

6.4.10.3.2 Problem and modification analysis. This activity consists of the following tasks:

6.4.10.3.2.1 The maintainer shall analyze the problem report or modification request for its impact on the organization, the existing system, and the interfacing systems for the following:

a) Type; for example, corrective, improvement, preventive, or adaptive to new environment;

b) Scope; for example, size of modification, cost involved, time to modify;

c) Criticality; for example, impact on performance, safety, or security.

6.4.10.3.2.2 The maintainer shall replicate or verify the problem.

6.4.10.3.2.3 Based upon the analysis, the maintainer shall develop options for implementing the modification.

6.4.10.3.2.4 The maintainer shall document the problem/modification request, the analysis results, and implementation options.

6.4.10.3.2.5 The maintainer shall obtain approval for the selected modification option as specified in the contract.

6.4.10.3.3 Modification implementation. This activity consists of the following tasks:

6.4.10.3.3.1 The maintainer shall conduct analysis and determine which documentation, software units, and versions thereof need to be modified. These shall be documented.

6.4.10.3.3.2 The maintainer shall enter the Technical Processes (subclause 6.4) to implement the modifications. The requirements of the Technical Processes shall be supplemented as follows:

a) Test and evaluation criteria for testing and evaluating the modified and the un-modified parts (software units, components, and configuration items) of the system shall be defined and documented.

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b) The complete and correct implementation of the new and modified requirements shall be ensured. It also shall be ensured that the original, unmodified requirements were not affected. The test results shall be documented.

6.4.10.3.4 Maintenance review/acceptance. This activity consists of the following tasks:

6.4.10.3.4.1 The maintainer shall conduct review(s) with the organization authorizing the modification to determine the integrity of the modified system.

6.4.10.3.4.2 The maintainer shall obtain approval for the satisfactory completion of the modification as specified in the contract.

6.4.10.3.5 Migration. This activity consists of the following tasks:

6.4.10.3.5.1 If a system or software product (including data) is migrated from an old to a new operational environment, it shall be ensured that any software product or data produced or modified during migration is in accordance with this International Standard.

6.4.10.3.5.2 A migration plan shall be developed, documented, and executed. The planning activities shall include users. Items included in the plan shall include the following:

a) Requirements analysis and definition of migration.

b) Development of migration tools.

c) Conversion of software product and data.

d) Migration execution.

e) Migration verification.

f) Support for the old environment in the future.

6.4.10.3.5.3 Users shall be given notification of the migration plans and activities. Notifications shall include the following:

a) Statement of why the old environment is no longer to be supported.

b) Description of the new environment with its date of availability.

c) Description of other support options available, if any, once support for the old environment has been removed.

6.4.10.3.5.4 Parallel operations of the old and new environments may be conducted for smooth transition to the new environment. During this period, necessary training shall be provided as specified in the contract.

6.4.10.3.5.5 When the scheduled migration arrives, notification shall be sent to all concerned. Associated old environment documentation, logs, and code should be placed in archives.

6.4.10.3.5.6 A post-operation review shall be performed to assess the impact of changing to the new environment. The results of the review shall be sent to the appropriate authorities for information, guidance, and action.

6.4.10.3.5.7 Data used by or associated with the old environment shall be accessible in accordance with the contract requirements for data protection and audit applicable to the data.

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6.4.11 Software Disposal Process

NOTE The Software Disposal Process in this International Standard is a specialization of the Disposal Process of ISO/IEC 15288. Users may consider claiming conformance to the 15288 process rather than the process in this standard.

6.4.11.1 Purpose

The purpose of the Software Disposal Process is to end the existence of a system's software entity.

This process ends active support by the operation and maintenance organization, or deactivates, disassembles and removes the affected software products, consigning them to a final condition and leaving the environment in an acceptable condition. This process destroys or stores system software elements and related products in a sound manner, in accordance with legislation, agreements, organizational constraints and stakeholder requirements. Where required, it maintains records that may be monitored.

NOTE The objective is to retire a system's existing software products or services while preserving the integrity of organizational operations.

6.4.11.2 Outcomes

As a result of successful implementation of the Software Disposal Process:

a) a software disposal strategy is defined;

b) disposal constraints are provided as inputs to requirements;

c) the system's software elements are destroyed or stored;

d) the environment is left in an agreed-upon state; and

e) records allowing knowledge retention of disposal actions and any analysis of long-term impacts are available.

6.4.11.3 Activities and tasks

The project shall implement the following activities in accordance with applicable organization policies and procedures with respect to the Software Disposal Process.

6.4.11.3.1 Software disposal planning. This activity consists of the following tasks:

6.4.11.3.1.1 A software disposal strategy is defined and documented. A plan to remove active support by the operation and maintenance organizations shall be developed and documented. The planning activities shall include users. The software disposal plan shall address the items listed below:

a) Cessation of full or partial support after a certain period of time.

b) Archiving of the software product and its associated documentation.

c) Responsibility for any future residual support issues.

d) Transition to any new software product, if applicable.

e) Accessibility of archive copies of data.

NOTE 1 This defines schedules, actions and resources that: 1) terminate the delivery of software services; 2) transform the system into, or retain it in, a socially and physically acceptable state, thereby avoiding subsequent adverse effects on stakeholders, society and the environment; 3) take account of the health, safety, security and privacy applicable to disposal actions and to the long-term condition of resulting physical material and information.

NOTE 2 Disposal constraints should be provided as inputs to requirements for the planned disposal activities.

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6.4.11.3.2 Software disposal execution. This activity consists of the following tasks:

6.4.11.3.2.1 The software disposal plan shall be executed.

6.4.11.3.2.2 Users shall be given notification of the plans and activities for the retirement of software products and services. Notifications shall include the following:

a) Description of any replacement or upgrade with its date of availability.

b) Statement of why the software product is no longer to be supported.

c) Description of other support options available, once support has been removed.

6.4.11.3.2.3 Parallel operations of the retiring and any new software product should be conducted for smooth transition to the new system. During this period, user training shall be provided as specified in the contract.

6.4.11.3.2.4 When the scheduled retirement arrives, notification shall be sent to all concerned. All associated development documentation, logs, and code should be placed in archives, when appropriate.

6.4.11.3.2.5 Data used by, or associated with, the retired software product shall be accessible in accordance with the contract requirements for data protection and audit applicable to the data.

7 Software Specific Processes

7.1 Software Implementation Processes

7.1.1 Software Implementation Process

NOTE The Software Implementation Process is a conforming instance of the Implementation Process of ISO/IEC 15288, specialized to the particular needs of implementing a software product or service.

7.1.1.1 Purpose

The purpose of the Software Implementation Process is to produce a specified system element implemented as a software product or service.

This process transforms specified behaviour, interfaces and implementation constraints into actions that create a system element implemented as a software product or service, otherwise known as a "software item." This process results in a software item that satisfies architectural design requirements through verification and stakeholder requirements through validation.

7.1.1.2 Outcomes

As a result of the successful implementation of the Software Implementation Process:

a) an implementation strategy is defined;

b) implementation technology constraints on the design are identified;

c) a software item is realized; and

d) a software item is packaged and stored in accordance with an agreement for its supply.

In addition to its activities, the Software Implementation Process has the following lower-level processes:

— Software Requirements Analysis Process*

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— Software Architectural Design Process*

— Software Detailed Design Process

— Software Construction Process

— Software Integration Process*

— Software Qualification Testing Process*

NOTE Users of ISO/IEC 15288 may decide that the processes marked by an asterisk (*) in the list above are to be provided by recursive application of ISO/IEC 15288 even for software elements of the system.

7.1.1.3 Activities and tasks

The project shall implement the following activities in accordance with applicable organization policies and procedures with respect to the Software Implementation Process.

7.1.1.3.1 Software implementation strategy. This activity consists of the following tasks:

7.1.1.3.1.1 If not stipulated in the contract, the developer shall define or select a life cycle model appropriate to the scope, magnitude, and complexity of the project. The life cycle model shall be comprised of stages and the purpose and outcomes of each stage. The activities and tasks of the Software Implementation Process shall be selected and mapped onto the life cycle model.

NOTE These activities and tasks may overlap or interact and may be performed iteratively or recursively.

NOTE Ideally, this is performed by using an organizationally-defined life cycle model.

7.1.1.3.1.2 The implementer shall:

a) Document the outputs in accordance with the Software Documentation Management Process (subclause 7.2.1).

b) Place the outputs under the Software Configuration Management Process (subclause 7.2.2) and perform change control in accordance with it.

c) Document and resolve problems and non-conformances found in the software products and tasks in accordance with the Software Problem Resolution Process (subclause 7.2.8).

d) Perform supporting processes as specified in the contract.

e) Establish baselines and incorporate configuration items at appropriate times, as determined by the acquirer and the supplier.

7.1.1.3.1.3 The implementer shall select, tailor, and use those standards, methods, tools, and computer programming languages (if not stipulated in the contract) that are documented, appropriate, and established by the organization for performing the activities of the Software Implementation Process and supporting processes.

NOTE Implementation technology constraints on the design should be identified as part of the software implementation strategy.

7.1.1.3.1.4 The implementer shall develop plans for conducting the activities of the Software Implementation process. The plans should include specific standards, methods, tools, actions, and responsibility associated with the development and qualification of all requirements including safety and security. If necessary, separate plans may be developed. These plans shall be documented and executed.

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7.1.1.3.1.5 Non-deliverable items may be employed in the development or maintenance of the software product. However, it shall be ensured that the operation and maintenance of the deliverable software product after its delivery to the acquirer are independent of such items; otherwise, those items should be considered as deliverable.

7.1.2 Software Requirements Analysis Process

NOTE The Software Requirements Analysis Process in this International Standard is a lower-level process of the Software Implementation Process. Users of ISO/IEC 15288 may decide that this process is to be provided by the Requirements Analysis Process of ISO/IEC 15288 in a recursive application of that standard.

7.1.2.1 Purpose

The purpose of Software Requirements Analysis Process is to establish the requirements of the software elements of the system.

7.1.2.2 Outcomes

As a result of successful implementation of the Software Requirements Analysis Process:

a) the requirements allocated to the software elements of the system and their interfaces are defined;

b) software requirements are analyzed for correctness and testability;

c) the impact of software requirements on the operating environment are understood;

d) consistency and traceability are established between the software requirements and system requirements;

e) prioritization for implementing the software requirements is defined;

f) the software requirements are approved and updated as needed;

g) changes to the software requirements are evaluated for cost, schedule and technical impact; and

h) the software requirements are baselined and communicated to all affected parties.

7.1.2.3 Activities and tasks

The project shall implement the following activities and tasks in accordance with applicable organization policies and procedures with respect to the Software Requirements Analysis Process.

7.1.2.3.1 Software requirements analysis. For each software item (or configuration item, if identified) this activity consists of the following tasks:

7.1.2.3.1.1 The implementer shall establish and document software requirements (including the quality characteristics specifications) described below.

a) Functional and capability specifications, including performance, physical characteristics, and environmental conditions under which the software item is to perform.

b) Interfaces external to the software item.

c) Qualification requirements.

d) Safety specifications, including those related to methods of operation and maintenance, environmental influences, and personnel injury.

e) Security specifications, including those related to compromise of sensitive information.

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f) Human-factors engineering (ergonomics) specifications, including those related to manual operations, human-equipment interactions, constraints on personnel, and areas needing concentrated human attention, that are sensitive to human errors and training.

g) Data definition and database requirements.

h) Installation and acceptance requirements of the delivered software product at the operation and maintenance site(s).

i) User documentation requirements.

j) User operation and execution requirements.

k) User maintenance requirements.

NOTE 1 Guidance for specifying quality characteristics may be found in ISO/IEC 9126-1.

NOTE 2 Implementation priority of the software requirements should be determined.

NOTE 3 If usability is an important requirement, recommendations for obtaining a desired level of usability can be found in ISO TR 18529, *Ergonomics—Ergonomics of human-system interaction—Human-centred lifecycle process descriptions*. Annex E contains a process view which is focused on usability.

7.1.2.3.1.2 The implementer shall evaluate the software requirements considering the criteria listed below. The results of the evaluations shall be documented.

a) Traceability to system requirements and system design.

b) External consistency with system requirements.

c) Internal consistency.

d) Testability.

e) Feasibility of software design.

f) Feasibility of operation and maintenance.

7.1.2.3.1.3 The implementer shall conduct review(s) in accordance with subclause 7.2.6.

NOTE Following a successful evaluation and review, the software requirements should be approved, baselined and communicated to all affected parties. Subsequent changes to the software requirements baseline should be evaluated for cost, schedule and technical impact.

7.1.3 Software Architectural Design Process

NOTE The Software Architectural Design Process in this International Standard is a lower-level process of the Software Implementation Process. Users of ISO/IEC 15288 may decide that this process is to be provided by the Architectural Design Process of ISO/IEC 15288 in a recursive application of that standard.

7.1.3.1 Purpose

The purpose of the Software Architectural Design Process is to provide a design for the software that implements and can be verified against the requirements.

7.1.3.2 Outcomes

As a result of successful implementation of the Software Architectural Design Process:

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a) a software architectural design is developed and baselined that describes the software items that will implement the software requirements;

b) internal and external interfaces of each software item are defined; and

c) consistency and traceability are established between software requirements and software design.

7.1.3.3 Activities and tasks

The project shall implement the following activities in accordance with applicable organization policies and procedures with respect to the Software Architectural Design Process.

NOTE This activity is implemented for each software item, consistent with a system architectural design.

7.1.3.3.1 Software architectural design. For each software item (or configuration item, if identified) this activity consists of the following tasks:

7.1.3.3.1.1 The implementer shall transform the requirements for the software item into an architecture that describes its top-level structure and identifies the software components. It shall be ensured that all the requirements for the software item are allocated to its software components and further refined to facilitate detailed design. The architecture of the software item shall be documented.

NOTE The software architectural design also provides a basis for verifying the software items, integration of software items with each other, and integration of software items with the rest of the system items.

7.1.3.3.1.2 The implementer shall develop and document a top-level design for the interfaces external to the software item and between the software components of the software item.

7.1.3.3.1.3 The implementer shall develop and document a top-level design for the database.

7.1.3.3.1.4 The implementer should develop and document preliminary versions of user documentation.

7.1.3.3.1.5 The implementer shall define and document preliminary test requirements and the schedule for Software Integration.

7.1.3.3.1.6 The implementer shall evaluate the architecture of the software item and the interface and database designs considering the criteria listed below. The results of the evaluations shall be documented.

a) Traceability to the requirements of the software item.

b) External consistency with the requirements of the software item.

c) Internal consistency between the software components.

d) Appropriateness of design methods and standards used.

e) Feasibility of detailed design.

f) Feasibility of operation and maintenance.

7.1.3.3.1.7 The implementer shall conduct review(s) in accordance with subclause 7.2.6

7.1.4 Software Detailed Design Process

NOTE The Software Detail Design Process in this International Standard is a lower-level process of the Software Implementation Process.

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7.1.4.1 Purpose

The purpose of the Software Detailed Design Process is to provide a design for the software that implements and can be verified against the requirements and the software architecture and is sufficiently detailed to permit coding and testing.

7.1.4.2 Outcomes

As a result of successful implementation of the Software Detailed Design Process:

a) a detailed design of each software component, describing the software units to be built, is developed;

b) external interfaces of each software unit are defined; and

c) consistency and traceability are established between the detailed design and the requirements and architectural design.

7.1.4.3 Activities and tasks

The project shall implement the following activities in accordance with applicable organization policies and procedures with respect to the Software Detailed Design Process.

7.1.4.3.1 Software detailed design. For each software item (or configuration item, if identified) this activity consists of the following tasks:

7.1.4.3.1.1 The implementer shall develop a detailed design for each software component of the software item. The software components shall be refined into lower levels containing software units that can be coded, compiled, and tested. It shall be ensured that all the software requirements are allocated from the software components to software units. The detailed design shall be documented.

7.1.4.3.1.2 The implementer shall develop and document a detailed design for the interfaces external to the software item, between the software components, and between the software units. The detailed design of the interfaces shall permit coding without the need for further information.

7.1.4.3.1.3 The implementer shall develop and document a detailed design for the database.

7.1.4.3.1.4 The implementer shall update user documentation as necessary.

7.1.4.3.1.5 The implementer shall define and document test requirements and the schedule for testing software units. The test requirements should include stressing the software unit at the limits of its requirements.

7.1.4.3.1.6 The implementer shall update the test requirements and the schedule for Software Integration.

7.1.4.3.1.7 The implementer shall evaluate the software detailed design and test requirements considering the criteria listed below. The results of the evaluations shall be documented.

a) Traceability to the requirements of the software item;

b) External consistency with architectural design;

c) Internal consistency between software components and software units;

d) Appropriateness of design methods and standards used;

e) Feasibility of testing;

f) Feasibility of operation and maintenance.

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7.1.4.3.1.8 The implementer shall conduct review(s) in accordance with subclause 7.2.6.

7.1.5 Software Construction Process

NOTE The Software Construction Process in this International Standard is a lower-level process of the Software Implementation Process.

7.1.5.1 Purpose

The purpose of the Software Construction Process is to produce executable software units that properly reflect the software design.

7.1.5.2 Outcomes

As a result of successful implementation of Software Construction Process:

a) verification criteria are defined for all software units against their requirements;

b) software units defined by the design are produced;

c) consistency and traceability are established between software units and requirements and design; and

d) verification of the software units against the requirements and the design is accomplished.

7.1.5.3 Activities and tasks

The project shall implement the following activities and tasks in accordance with applicable organization policies and procedures with respect to the Software Construction Process.

7.1.5.3.1 Software construction. For each software item (or configuration item, if identified) this activity consists of the following tasks:

7.1.5.3.1.1 The implementer shall develop and document the following:

a) Each software unit and database.

b) Test procedures and data for testing each software unit and database.

7.1.5.3.1.2 The implementer shall test each software unit and database ensuring that it satisfies its requirements. The test results shall be documented.

7.1.5.3.1.3 The implementer shall update the user documentation as necessary.

7.1.5.3.1.4 The implementer shall update the test requirements and the schedule for Software Integration.

7.1.5.3.1.5 The implementer shall evaluate software code and test results considering the criteria listed below. The results of the evaluations shall be documented.

a) Traceability to the requirements and design of the software item.

b) External consistency with the requirements and design of the software item.

c) Internal consistency between unit requirements.

d) Test coverage of units.

e) Appropriateness of coding methods and standards used.

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f) Feasibility of software integration and testing.

g) Feasibility of operation and maintenance.

7.1.6 Software Integration Process

NOTE The Software Integration Process in this International Standard is a lower-level process of the Software Implementation Process. Users of ISO/IEC 15288 may decide that this process is to be provided by the Integration Process of ISO/IEC 15288 in a recursive application of that standard.

7.1.6.1 Purpose

The purpose of the Software Integration Process is to combine the software units and software components, producing integrated software items, consistent with the software design, that demonstrate that the functional and non-functional software requirements are satisfied on an equivalent or complete operational platform.

7.1.6.2 Outcomes

As a result of successful implementation of the Software Integration Process:

a) an integration strategy is developed for software units consistent with the software design and the prioritized software requirements;

b) verification criteria for software items are developed that ensure compliance with the software requirements allocated to the items;

c) software items are verified using the defined criteria;

d) software items defined by the integration strategy are produced;

e) results of integration testing are recorded;

f) consistency and traceability are established between software design and software items; and

g) a regression strategy is developed and applied for re-verifying software items when a change in software units (including associated requirements, design and code) occur.

7.1.6.3 Activities and tasks

The project shall implement the following activities and tasks in accordance with applicable organization policies and procedures with respect to the Software Integration Process.

7.1.6.3.1 Software integration. For each software item (or configuration item, if identified) this activity consists of the following tasks:

7.1.6.3.1.1 The implementer shall develop an integration plan to integrate the software units and software components into the software item. The plan shall include test requirements, procedures, data, responsibilities, and schedule. The plan shall be documented.

7.1.6.3.1.2 The implementer shall integrate the software units and software components and test as the aggregates are developed in accordance with the integration plan. It shall be ensured that each aggregate satisfies the requirements of the software item and that the software item is integrated at the conclusion of the integration activity. The integration and test results shall be documented.

NOTE A regression strategy should be developed to be applied for re-verifying the software items when a change is made to software units (including associated requirements, design and code).

7.1.6.3.1.3 The implementer shall update the user documentation as necessary.

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7.1.6.3.1.4 The implementer shall develop and document for each qualification requirement of the software item a set of tests, test cases (inputs, outputs, test criteria), and test procedures for conducting Software Qualification Testing. The developer shall ensure that the integrated software item is ready for Software Qualification Testing.

7.1.6.3.1.5 The implementer shall evaluate the integration plan, design, code, tests, test results, and user documentation considering the criteria listed below. The results of the evaluations shall be documented.

a) Traceability to the system requirements.

b) External consistency with the system requirements.

c) Internal consistency.

d) Test coverage of the requirements of the software item.

e) Appropriateness of test standards and methods used.

f) Conformance to expected results.

g) Feasibility of software qualification testing.

h) Feasibility of operation and maintenance.

NOTE Evaluation criteria should include consistency and traceability between the software design and the software items.

7.1.6.3.1.6 The implementer shall conduct review(s) in accordance with subclause 7.2.6.

7.1.7 Software Qualification Testing Process

NOTE The Software Qualification Testing Process in this International Standard is a lower-level process of the Software Implementation Process. Users of ISO/IEC 15288 may decide that this process is to be provided by the Verification Process of ISO/IEC 15288 in a recursive application of that standard.

7.1.7.1 Purpose

The purpose of the Software Qualification Testing Process is to confirm that the integrated software product meets its defined requirements.

7.1.7.2 Outcomes

As a result of successful implementation of the Software Qualification Testing Process:

a) criteria for the integrated software is developed that demonstrates compliance with the software requirements;

b) integrated software is verified using the defined criteria;

c) test results are recorded; and

d) a regression strategy is developed and applied for re-testing the integrated software when a change in software items is made.

NOTE A regression strategy should be developed, to be applied for re-testing the integrated software when a change is made to software items.

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7.1.7.3 Activities and tasks

The project shall implement the following activities in accordance with applicable organization policies and procedures with respect to the Software Qualification Testing Process.

7.1.7.3.1 Software qualification testing. For each software item (or configuration item, if identified) this activity consists of the following tasks:

7.1.7.3.1.1 The implementer shall conduct qualification testing in accordance with the qualification requirements for the software item. It shall be ensured that the implementation of each software requirement is tested for compliance. The qualification testing results shall be documented.

7.1.7.3.1.2 The implementer shall update the user documentation as necessary.

7.1.7.3.1.3 The implementer shall evaluate the design, code, tests, test results, and user documentation considering the criteria listed below. The results of the evaluations shall be documented.

a) Test coverage of the requirements of the software item.

b) Conformance to expected results.

c) Feasibility of system integration and testing, if conducted.

d) Feasibility of operation and maintenance.

7.1.7.3.1.4 The implementer shall support audit(s) in accordance with subclause 7.2.7. The results of the audits shall be documented. If both hardware and software are under development or integration, the audits may be postponed until the System Qualification Testing.

7.1.7.3.1.5 Upon successful completion of the audits, if conducted, the implementer shall update and prepare the deliverable software product for System Integration, System Qualification Testing, Software Installation, or Software Acceptance Support as applicable.

NOTE The Software Qualification Testing Process may be used in the Software Verification Process (subclause 7.2.4) or the Software Validation Process (subclause 7.2.5).

7.2 Software Support Processes

NOTE The support processes listed under this subclause are specific to software and are labelled Software Support Processes. Although they play an integral role in assisting the Software Implementation Process, the Software Support Processes may also provide services to other processes, e.g., the Agreement Processes, Systems Qualification Testing, Software Acceptance Support, Software Operation, and the Software Maintenance Process.

7.2.1 Software Documentation Management Process

NOTE The Software Documentation Management Process is a specialization of the Information Management Process from the Project Process Group in this International Standard.

7.2.1.1 Purpose

The purpose of the Software Documentation Management Process is to develop and maintain the recorded software information produced by a process.

NOTE ISO/IEC 15289 provides more detailed content for life cycle process information items (documentation).

7.2.1.2 Outcomes

As a result of successful implementation of the Software Documentation Management Process:

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a) a strategy identifying the documentation to be produced during the life cycle of the software product or service is developed;

b) the standards to be applied for the development of the software documentation are identified;

c) documentation to be produced by the process or project is identified;

d) the content and purpose of all documentation is specified, reviewed and approved;

e) documentation is developed and made available in accordance with identified standards; and

f) documentation is maintained in accordance with defined criteria.

7.2.1.3 Activities and tasks

The project shall implement the following activities in accordance with applicable organization policies and procedures with respect to the Software Documentation Management Process.

7.2.1.3.1 Process implementation. This activity consists of the following task:

7.2.1.3.1.1 A plan, identifying the documents to be produced during the life cycle of the software product shall be developed, documented, and implemented. For identified documentation, the following shall be addressed:

a) Title or name.

b) Purpose and content.

c) Intended audience.

d) Procedures and responsibilities for inputs, development, review, modification, approval, production, storage, distribution, maintenance, and configuration management.

e) Schedule for intermediate and final versions.

7.2.1.3.2 Design and development. This activity consists of the following tasks:

7.2.1.3.2.1 Each identified document shall be designed in accordance with applicable documentation standards for medium, format, content description, page numbering, figure/table placement, proprietary/security marking, packaging, and other presentation items.

NOTE The documentation may originate and may terminate in any form (e.g., verbal, textual, graphical, numerical) and may be stored, processed, replicated and transmitted using any medium (e.g., electronic, printed, magnetic, optical).

7.2.1.3.2.2 The source and appropriateness of input data for the documents shall be confirmed. Automated documentation support tools may be used.

7.2.1.3.2.3 The prepared documents shall be reviewed and edited for format, technical content, and presentation style against their documentation standards. They shall be approved for adequacy by authorized personnel prior to issue.

7.2.1.3.3 Production. This activity consists of the following tasks:

7.2.1.3.3.1 The documents shall be produced and provided in accordance with the plan. Production and distribution of documents may use paper, electronic, or other media. Master materials shall be stored in accordance with requirements for record retention, security, maintenance, and backup.

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7.2.1.3.3.2 Controls shall be established in accordance with the Software Configuration Management Process (subclause 7.2.2).

7.2.1.3.4 Maintenance. This activity consists of the following task:

7.2.1.3.4.1 The tasks of the Software Maintenance Process, that are required when documentation is to be modified, shall be performed (see subclause 6.4.10). For those documents that are under configuration management, modifications shall be managed in accordance with the Software Configuration Management Process (subclause 7.2.2).

7.2.2 Software Configuration Management Process

NOTE The Software Configuration Management Process is a specialization of the Configuration Management Process from the Project Process Group in this International Standard.

7.2.2.1 Purpose

The purpose of the Software Configuration Management Process is to establish and maintain the integrity of the software items of a process or project and make them available to concerned parties.

7.2.2.2 Outcomes

As a result of successful implementation of the Software Configuration Management Process:

a) a software configuration management strategy is developed;

b) items generated by the process or project are identified, defined and baselined;

c) modifications and releases of the items are controlled;

d) modifications and releases are made available to affected parties;

e) the status of the items and modifications are recorded and reported;

f) the completeness and consistency of the items is ensured; and

g) the storage, handling and delivery of the items are controlled.

7.2.2.3 Activities and tasks

The project shall implement the following activities in accordance with applicable organization policies and procedures with respect to the Software Configuration Management Process.

7.2.2.3.1 Process implementation. This activity consists of the following task:

7.2.2.3.1.1 A software configuration management plan shall be developed. The plan shall describe: the configuration management activities; procedures and schedule for performing these activities; the organization(s) responsible for performing these activities; and their relationship with other organizations, such as software development or maintenance. The plan shall be documented and implemented.

NOTE The plan may be a part of the system configuration management plan.

7.2.2.3.2 Configuration identification. This activity consists of the following task:

7.2.2.3.2.1 A scheme shall be established for identification of software items and their versions to be controlled for the project. For each software item and its versions, the following shall be identified: the documentation that establishes the baseline; the version references; and other identification details.

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7.2.2.3.3 Configuration control. This activity consists of the following task:

7.2.2.3.3.1 The following shall be performed: identification and recording of change requests; analysis and evaluation of the changes; approval or disapproval of the request; and implementation, verification, and release of the modified software item. An audit trail shall exist, whereby each modification, the reason for the modification, and authorization of the modification can be traced. Control and audit of all accesses to the controlled software items that handle safety or security critical functions shall be performed.

NOTE The Software Problem Resolution Management Process could provide support for this activity.

7.2.2.3.4 Configuration status accounting. This activity consists of the following task:

7.2.2.3.4.1 Management records and status reports that show the status and history of controlled software items, including baselines shall be prepared. Status reports should include the number of changes for a project, latest software item versions, release identifiers, the number of releases, and comparisons of releases.

7.2.2.3.5 Configuration evaluation. This activity consists of the following task:

7.2.2.3.5.1 The following shall be determined and ensured: the functional completeness of the software items against their requirements and the physical completeness of the software items (whether their design and code reflect an up-to-date technical description).

7.2.2.3.6 Release management and delivery. This activity consists of the following task:

7.2.2.3.6.1 The release and delivery of software products and documentation shall be formally controlled. Master copies of code and documentation shall be maintained for the life of the software product. The code and documentation that contain safety or security critical functions shall be handled, stored, packaged, and delivered in accordance with the policies of the organizations involved.

7.2.3 Software Quality Assurance Process

7.2.3.1 Purpose

The purpose of the Software Quality Assurance Process is to provide assurance that work products and processes comply with predefined provisions and plans.

7.2.3.2 Outcomes

As a result of successful implementation of the Software Quality Assurance Process:

a) a strategy for conducting quality assurance is developed;

b) evidence of software quality assurance is produced and maintained;

c) problems and/or non-conformance with requirements are identified and recorded; and

d) adherence of products, processes and activities to the applicable standards, procedures and requirements are verified.

7.2.3.3 Activities and tasks

The project shall implement the following activities in accordance with applicable organization policies and procedures with respect to the Software Quality Assurance Process.

7.2.3.3.1 Process implementation. This activity consists of the following tasks:

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7.2.3.3.1.1 A quality assurance process suited to the project shall be established. The objectives of the quality assurance process shall be to assure that the software products and the processes employed for providing those software products comply with their established requirements and adhere to their established plans.

7.2.3.3.1.2 The quality assurance process should be coordinated with the related Software Verification (subclause 7.2.4), Software Validation (subclause 7.2.5), Software Review (subclause 7.2.6), and Software Audit (subclause 7.2.7) Processes.

7.2.3.3.1.3 A plan for conducting the quality assurance process activities and tasks shall be developed, documented, implemented, and maintained for the life of the contract. The plan shall include the following:

a) Quality standards, methodologies, procedures, and tools for performing the quality assurance activities (or their references in organization's official documentation).

b) Procedures for contract review and coordination thereof.

c) Procedures for identification, collection, filing, maintenance, and disposition of quality records.

d) Resources, schedule, and responsibilities for conducting the quality assurance activities.

e) Selected activities and tasks from supporting processes, such as Software Verification (subclause 7.2.4), Software Validation (subclause 7.2.5), Software Review (subclause 7.2.6), Software Audit (subclause 7.2.7), and Software Problem Resolution (subclause 7.2.8).

7.2.3.3.1.4 Scheduled and on-going quality assurance activities and tasks shall be executed. When problems or non-conformances with contract requirements are detected, they shall be documented and serve as input to the Problem Resolution Process (subclause 7.2.8). Records of these activities and tasks, their execution, problems, and problem resolutions shall be prepared and maintained.

7.2.3.3.1.5 Records of quality assurance activities and tasks shall be made available to the acquirer as specified in the contract.

7.2.3.3.1.6 It shall be assured that persons responsible for assuring compliance with the contract requirements have the organizational freedom, resources, and authority to permit objective evaluations and to initiate, effect, resolve, and verify problem resolutions.

7.2.3.3.2 Product assurance. This activity consists of the following tasks:

7.2.3.3.2.1 It shall be assured that all the plans required by the contract are documented, comply with the contract, are mutually consistent, and are being executed as required.

7.2.3.3.2.2 It shall be assured that software products and related documentation comply with the contract and adhere to the plans.

7.2.3.3.2.3 In preparation for the delivery of the software products, it shall be assured that they have fully satisfied their contractual requirements and are acceptable to the acquirer.

7.2.3.3.3 Process assurance. This activity consists of the following tasks:

7.2.3.3.3.1 It shall be assured that those software life cycle processes (supply, development, operation, maintenance, and support processes including quality assurance) employed for the project comply with the contract and adhere to the plans.

7.2.3.3.3.2 It shall be assured that the internal software engineering practices, development environment, test environment, and libraries comply with the contract.

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7.2.3.3.3.3 It shall be assured that applicable prime-contract requirements are passed down to the subcontractor, and that the subcontractor's software products satisfy prime-contract requirements.

7.2.3.3.3.4 It shall be assured that the acquirer and other parties are provided the required support and cooperation in accordance with the contract, negotiations, and plans.

7.2.3.3.3.5 It should be assured that software product and process measurements are in accordance with established standards and procedures.

7.2.3.3.3.6 It shall be assured that the staff assigned have the skill and knowledge needed to meet the requirements of the project and receive any necessary training.

7.2.3.3.4 Assurance of quality systems. This activity consists of the following task:

7.2.3.3.4.1 Additional quality management activities may be assured in accordance with the clauses of ISO 9001.

7.2.4 Software Verification Process

7.2.4.1 Purpose

The purpose of the Software Verification Process is to confirm that each software work product and/or service of a process or project properly reflects the specified requirements.

7.2.4.2 Outcomes

As a result of successful implementation of the Software Verification Process:

a) a verification strategy is developed and implemented;

b) criteria for verification of all required software work products is identified;

c) required verification activities are performed;

d) defects are identified and recorded; and

e) results of the verification activities are made available to the customer and other involved parties.

7.2.4.3 Activities and tasks

The project shall implement the following activities and tasks in accordance with applicable organization policies and procedures with respect to the Software Verification Process.

7.2.4.3.1 Process implementation. This activity consists of the following tasks:

7.2.4.3.1.1 A determination shall be made if the project warrants a verification effort and the degree of organizational independence of that effort needed. The project requirements shall be analyzed for criticality. Criticality may be gauged in terms of:

a) The potential of an undetected error in a system or software requirement for causing death or personal injury, mission failure, or financial or catastrophic equipment loss or damage.

b) The maturity of and risks associated with the software technology to be used.

c) Availability of funds and resources.

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7.2.4.3.1.2 If the project warrants a verification effort, a verification process shall be established to verify the software product.

7.2.4.3.1.3 If the project warrants an independent verification effort, a qualified organization responsible for conducting the verification shall be selected. This organization shall be assured of the independence and authority to perform the verification activities.

7.2.4.3.1.4 Based upon the scope, magnitude, complexity, and criticality analysis above, target life cycle activities and software products requiring verification shall be determined. Verification activities and tasks defined in subclause 7.2.4.3.2, including associated methods, techniques, and tools for performing the tasks, shall be selected for the target life cycle activities and software products.

7.2.4.3.1.5 Based upon the verification tasks as determined, a verification plan shall be developed and documented. The plan shall address the life cycle activities and software products subject to verification, the required verification tasks for each life cycle activity and software product, and related resources, responsibilities, and schedule. The plan shall address procedures for forwarding verification reports to the acquirer and other involved organizations.

7.2.4.3.1.6 The verification plan shall be implemented. Problems and non-conformances detected by the verification effort shall be entered into the Software Problem Resolution Process (subclause 7.2.8). All problems and non-conformances shall be resolved. Results of the verification activities shall be made available to the acquirer and other involved organizations.

7.2.4.3.2 Verification. This activity consists of the following tasks:

7.2.4.3.2.1 Requirements verification. The requirements shall be verified considering the criteria listed below:

a) The system requirements are consistent, feasible, and testable.

b) The system requirements have been appropriately allocated to hardware items, software items, and manual operations according to design criteria.

c) The software requirements are consistent, feasible, testable, and accurately reflect system requirements.

d) The software requirements related to safety, security, and criticality are correct as shown by suitably rigorous methods.

7.2.4.3.2.2 Design verification. The design shall be verified considering the criteria listed below:

a) The design is correct and consistent with and traceable to requirements.

b) The design implements proper sequence of events, inputs, outputs, interfaces, logic flow, allocation of timing and sizing budgets, and error definition, isolation, and recovery.

c) Selected design can be derived from requirements.

d) The design implements safety, security, and other critical requirements correctly as shown by suitably rigorous methods.

7.2.4.3.2.3 Code verification. The code shall be verified considering the criteria listed below:

a) The code is traceable to design and requirements, testable, correct, and compliant with requirements and coding standards.

b) The code implements proper event sequence, consistent interfaces, correct data and control flow, completeness, appropriate allocation timing and sizing budgets, and error definition, isolation, and recovery.

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c) Selected code can be derived from design or requirements.

d) The code implements safety, security, and other critical requirements correctly as shown by suitably rigorous methods.

7.2.4.3.2.4 Integration verification. The integration shall be verified considering the criteria listed below:

a) The software components and units of each software item have been completely and correctly integrated into the software item.

b) The hardware items, software items, and manual operations of the system have been completely and correctly integrated into the system.

c) The integration tasks have been performed in accordance with an integration plan.

7.2.4.3.2.5 Documentation verification. The documentation shall be verified considering the criteria listed below:

a) The documentation is adequate, complete, and consistent.

b) Documentation preparation is timely.

c) Configuration management of documents follows specified procedures.

7.2.5 Software Validation Process

7.2.5.1 Purpose

The purpose of the Software Validation Process is to confirm that the requirements for a specific intended use of the software work product are fulfilled.

7.2.5.2 Outcomes

As a result of successful implementation of the Software Validation Process:

a) a validation strategy is developed and implemented;

b) criteria for validation of all required work products are identified;

c) required validation activities are performed;

d) problems are identified and recorded;

e) evidence is provided that the software work products as developed are suitable for their intended use; and

f) results of the validation activities are made available to the customer and other involved parties.

7.2.5.3 Activities and tasks

The project shall implement the following activities and tasks in accordance with applicable organization policies and procedures with respect to the Software Validation Process.

7.2.5.3.1 Process implementation. This activity consists of the following tasks:

7.2.5.3.1.1 A determination shall be made if the project warrants a validation effort and the degree of organizational independence of that effort needed.

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7.2.5.3.1.2 If the project warrants a validation effort, a validation process shall be established to validate the system or software product. Validation tasks defined below, including associated methods, techniques, and tools for performing the tasks, shall be selected.

7.2.5.3.1.3 If the project warrants an independent effort, a qualified organization responsible for conducting the effort shall be selected. The conductor shall be assured of the independence and authority to perform the validation tasks.

7.2.5.3.1.4 A validation plan shall be developed and documented. The plan shall include, but is not limited to, the following:

a) Items subject to validation.

b) Validation tasks to be performed.

c) Resources, responsibilities, and schedule for validation.

d) Procedures for forwarding validation reports to the acquirer and other parties.

7.2.5.3.1.5 The validation plan shall be implemented. Problems and non-conformances detected by the validation effort shall be entered into the Software Problem Resolution Process (subclause 7.2.8). All problems and non-conformances shall be resolved. Results of the validation activities shall be made available to the acquirer and other involved organizations.

7.2.5.3.2 Validation. This activity shall consist of the following tasks:

NOTE Other means besides testing (such as, analysis, modelling, simulation, etc.) may be employed for validation.

7.2.5.3.2.1 Prepare selected test requirements, test cases, and test specifications for analyzing test results.

7.2.5.3.2.2 Ensure that these test requirements, test cases, and test specifications reflect the particular requirements for the specific intended use.

7.2.5.3.2.3 Conduct the tests in subclauses 7.2.5.3.2.1 and 7.2.5.3.2.2, including:

a) Testing with stress, boundary, and singular inputs;

b) Testing the software product for its ability to isolate and minimize the effect of errors; that is, graceful degradation upon failure, request for operator assistance upon stress, boundary, and singular conditions;

c) Testing that representative users can successfully achieve their intended tasks using the software product.

7.2.5.3.2.4 Validate that the software product satisfies its intended use.

7.2.5.3.2.5 Test the software product as appropriate in selected areas of the target environment.

7.2.6 Software Review Process

7.2.6.1 Purpose

The purpose of the Software Review Process is to maintain a common understanding with the stakeholders of the progress against the objectives of the agreement and what should be done to help ensure development of a product that satisfies the stakeholders. Software reviews are at both project management and technical levels and are held throughout the life of the project.

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7.2.6.2 Outcomes

As a result of successful implementation of the Software Review Process:

a) management and technical reviews are held based on the needs of the project;

b) the status and products of an activity of a process are evaluated through review activities;

c) review results are made known to all affected parties;

d) action items resulting from reviews are tracked to closure; and

e) risks and problems are identified and recorded.

7.2.6.3 Activities and tasks

The project shall implement the following activities in accordance with applicable organization policies and procedures with respect to the Software Review Process.

7.2.6.3.1 Process implementation. This activity consists of the following tasks:

7.2.6.3.1.1 Periodic reviews shall be held at predetermined milestones as specified in the project plan(s). Stakeholders should determine the need for any ad hoc reviews in which agreeing parties may participate.

7.2.6.3.1.2 All resources that are required to conduct the reviews shall be provided. These resources include personnel, location, facilities, hardware, software, and tools.

7.2.6.3.1.3 The parties that participate in a review should agree on the following items at each review: meeting agenda, software products (results of an activity) and problems to be reviewed; scope and procedures; and entry and exit criteria for the review.

7.2.6.3.1.4 Problems detected during the reviews shall be recorded and entered into the Software Problem Resolution Process (subclause 7.2.8) as required.

7.2.6.3.1.5 The review results shall be documented and distributed. This communication includes adequacy of review (for example, approval, disapproval, or contingent approval) of the review results.

7.2.6.3.1.6 Participating parties shall agree on the outcome of the review and any action item responsibilities and closure criteria.

7.2.6.3.2 Project Management Reviews. This activity consists of the following task:

7.2.6.3.2.1 Project status shall be evaluated relative to the applicable project plans, schedules, standards, and guidelines. The outcome of the review should be considered by appropriate management and should provide for the following:

a) Making activities progress according to plan, based on an evaluation of the activity or software product status.

b) Maintaining global control of the project through adequate allocation of resources.

c) Changing project direction or determining the need for alternate planning.

d) Evaluating and managing the risk issues that may jeopardize the success of the project.

7.2.6.3.3 Technical Reviews. This activity consists of the following task:

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7.2.6.3.3.1 Technical reviews shall be held to evaluate the software products or services under consideration and provide evidence that:

a) They are complete.

b) They comply with their standards and specifications.

c) Changes to them are properly implemented and affect only those areas identified by the Configuration Management Process (subclause 7.2.2).

d) They are adhering to applicable schedules.

e) They are ready for the next planned activity.

f) The development, operation, or maintenance is being conducted according to the plans, schedules, standards, and guidelines of the project.

7.2.7 Software Audit Process

7.2.7.1 Purpose

The purpose of the Software Audit Process is to independently determine compliance of selected products and processes with the requirements, plans and agreement, as appropriate.

7.2.7.2 Outcomes

As a result of successful implementation of the Software Audit Process:

a) an audit strategy is developed and implemented;

b) compliance of selected software work products and/or services or processes with requirements, plans and agreement is determined according to the audit strategy;

c) audits are conducted by an appropriate independent party; and

d) problems detected during an audit are identified and communicated to those responsible for corrective action, and resolution.

7.2.7.3 Activities and tasks

The project shall implement the following activities in accordance with applicable organization policies and procedures with respect to the Software Audit Process.

7.2.7.3.1 Process implementation. This activity consists of the following tasks:

7.2.7.3.1.1 Audits shall be held at predetermined milestones as specified in the project plan(s).

7.2.7.3.1.2 Auditing personnel shall not have any direct responsibility for the software products and activities they audit.

7.2.7.3.1.3 All resources required to conduct the audits shall be agreed by the parties. These resources include support personnel, location, facilities, hardware, software, and tools.

7.2.7.3.1.4 The parties should agree on the following items at each audit: agenda; software products (and results of an activity) to be reviewed; audit scope and procedures; and entry and exit criteria for the audit.

7.2.7.3.1.5 Problems detected during the audits shall be recorded and entered into the Software Problem Resolution Process (subclause 7.2.8) as required.

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7.2.7.3.1.6 After completing an audit, the audit results shall be documented and provided to the audited party. The audited party shall acknowledge to the auditing party any problems found in the audit and related problem resolutions planned.

7.2.7.3.1.7 The parties shall agree on the outcome of the audit and any action item responsibilities and closure criteria.

7.2.7.3.2 Software audit. This activity consists of the following task:

7.2.7.3.2.1 Software audits shall be conducted to ensure that:

a) As coded, software products (such as a software item) reflect the design documentation.

b) The acceptance review and testing requirements prescribed by the documentation are adequate for the acceptance of the software products.

c) Test data comply with the specification.

d) Software products were successfully tested and meet their specifications.

e) Test reports are correct and discrepancies between actual and expected results have been resolved.

f) User documentation complies with standards as specified.

g) Activities have been conducted according to applicable requirements, plans, and contract.

h) The costs and schedules adhere to the established plans.

7.2.8 Software Problem Resolution Process

7.2.8.1 Purpose

The purpose of the Software Problem Resolution Process is to ensure that all discovered problems are identified, analyzed, managed and controlled to resolution.

7.2.8.2 Outcomes

As a result of successful implementation of the Software Problem Resolution Process:

a) a problem management strategy is developed;

b) problems are recorded, identified and classified;

c) problems are analyzed and assessed to identify acceptable solution(s);

d) problem resolution is implemented;

e) problems are tracked to closure; and

f) the status of all problems reported is known.

NOTE The Software Problem Resolution Process could be used or easily adapted to manage, track and control software change requests.

7.2.8.3 Activities and tasks

The project shall implement the following activities in accordance with applicable organization policies and procedures with respect to the Software Problem Resolution Process.

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7.2.8.3.1 Process implementation. This activity consists of the following task:

7.2.8.3.1.1 A problem resolution process shall be established for handling all problems (including non-conformances) detected in the software products and activities. The process shall comply with the following requirements:

a) The process shall be closed-loop, ensuring that: all detected problems are promptly reported and entered into the Problem Resolution Process; action is initiated on them; relevant parties are advised of the existence of the problem as appropriate; causes are identified, analyzed, and, where possible, eliminated; resolution and disposition are achieved; status is tracked and reported; and records of the problems are maintained as stipulated in the contract.

b) The process should contain a scheme for categorizing and prioritizing the problems. Each problem should be classified by the category and priority to facilitate trend analysis and problem resolution.

c) Analysis shall be performed to detect trends in the problems reported.

d) Problem resolutions and dispositions shall be evaluated: to evaluate that problems have been resolved, adverse trends have been reversed, and changes have been correctly implemented in the appropriate software products and activities; and to determine whether additional problems have been introduced.

7.2.8.3.2 Problem resolution. This activity consists of the following task:

7.2.8.3.2.1 When problems (including non-conformances) have been detected in a software product or an activity, a problem report shall be prepared to describe each problem detected. The problem report shall be used as part of the closed-loop process described above: from detection of the problem, through investigation, analysis and resolution of the problem and its cause, and onto trend detection across problems.

7.3 Software Reuse Processes

NOTE Users of this International Standards who desire to adopt organizational software reuse practices may wish to supplement the provisions of this International Standards with those of IEEE Std 1517™-1999, IEEE Standard for Information Technology—Software Life Cycle Processes—Reuse Processes.

7.3.1 Domain Engineering Process

7.3.1.1 Purpose

The purpose of the Domain Engineering Process is to develop and maintain domain models, domain architectures and assets for the domain.

7.3.1.2 Outcomes

As a result of successful implementation of the Domain Engineering Process:

a) the representation forms for the domain models and the domain architectures are selected;

b) the boundaries of the domain and its relationships to other domains are established;

c) a domain model that captures the essential common and different features, capabilities, concepts, and functions in the domain are developed;

d) a domain architecture describing the family of systems within the domain, including their commonalities and variabilities, is developed;

e) assets belonging to the domain are specified;

f) assets belonging to the domain are acquired or developed and maintained throughout their life cycles; and

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g) the domain models and architectures are maintained throughout their life cycles.

NOTE 1 Domain engineering is a reuse-based approach to defining the scope (i.e., domain definition), specifying the structure (i.e., domain architecture), and building the assets (e.g., requirements, designs, software code, documentation) for a class of systems, subsystems, or applications.

NOTE 2 The Domain Engineering Process may overlap with development and maintenance processes that use assets produced by the Domain Engineering Process.

7.3.1.3 Activities and tasks

The project shall implement the following activities and tasks in accordance with applicable organization policies and procedures with respect to the Domain Engineering Process.

NOTE IEEE Std 1517™, IEEE Standard for Information Technology—Software Life Cycle Processes—Reuse Processes, provides a more detailed set of activities and tasks that are aligned with the activities and tasks shown below.

7.3.1.3.1 Process implementation. This activity consists of the following tasks:

7.3.1.3.1.1 The domain engineer shall create and execute a domain engineering plan.

7.3.1.3.1.2 The domain engineer shall select the form(s) of representation to be used for domain architectures and models.

7.3.1.3.1.3 The domain engineer shall establish procedures for receiving, resolving, and providing feedback to the asset manager whenever problems or change requests occur for assets developed by the domain engineer.

7.3.1.3.2 Domain analysis. This activity consists of the following tasks:

7.3.1.3.2.1 The domain engineer shall define the boundaries of the domain and the relationships between this domain and other domains.

7.3.1.3.2.2 The domain engineer shall identify the current and anticipated needs of stakeholders of software products within this domain.

7.3.1.3.2.3 The domain engineer shall build the domain models using the representation forms selected in the Process Implementation Activity for this process.

7.3.1.3.2.4 The domain engineer shall construct a vocabulary that provides the terminology to describe the important domain concepts and the relationships among similar or common assets of the domain.

7.3.1.3.2.5 The domain engineer shall classify and document the domain models.

7.3.1.3.2.6 The domain engineer shall evaluate the domain models and domain vocabulary in accordance with the provisions of the modelling technique selected and in accordance with the organization's asset acceptance and certification procedures.

7.3.1.3.2.7 The domain engineer shall conduct domain analysis review(s). Software developers, asset managers, domain experts, and users shall be included in the reviews.

7.3.1.3.2.8 The domain engineer shall submit domain models to the asset manager.

7.3.1.3.3 Domain design. This activity consists of the following tasks:

7.3.1.3.3.1 The domain engineer shall create and document the domain architecture, consistent with the domain model and following the organization's standards.

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7.3.1.3.3.2 The domain architecture shall be evaluated in accordance with the provisions of the architecture design technique selected and the organization's asset acceptance and certification procedures.

7.3.1.3.3.3 For each entity selected to be designed for reuse, the domain engineer shall develop and document an asset specification.

7.3.1.3.3.4 For each asset specified, the specification shall be evaluated in accordance with the organization's asset acceptance and certification procedures.

7.3.1.3.3.5 The domain engineer shall conduct domain design review(s). Software developers, domain experts, and asset managers shall be included in the reviews.

7.3.1.3.3.6 The domain engineer shall submit the domain architecture to the asset manager.

7.3.1.3.4 Asset provision. For each asset developed or acquired, this activity consists of the following tasks:

7.3.1.3.4.1 The domain engineer shall obtain the asset by acquisition or by development.

7.3.1.3.4.2 The domain engineer shall document and classify the asset.

7.3.1.3.4.3 The domain engineer shall evaluate the asset in accordance with the organization's asset acceptance and certification procedures.

7.3.1.3.4.4 The domain engineer shall conduct asset review(s). Software developers and asset managers shall be included in the reviews.

7.3.1.3.4.5 The domain engineer shall submit the asset to the asset manager.

7.3.1.3.5 Asset maintenance. The following reuse-related task is added to this Software Maintenance Process when it is applied to maintain an asset.

7.3.1.3.5.1 When analyzing requests for asset modification and choosing implementation options, the domain engineer shall consider:

a) Conformance with the domain models and the domain architecture;

b) Impact on the systems and software products that use the asset;

c) Impact on future users of the asset;

d) Impact on the reusability of the asset.

7.3.2 Reuse Asset Management Process

7.3.2.1 Purpose

The purpose of the Reuse Asset Management Process is to manage the life of reusable assets from conception to retirement.

7.3.2.2 Outcomes

As a result of successful implementation of the Reuse Asset Management Process:

a) an asset management strategy is documented;

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b) an asset classification scheme is established;

c) criteria for asset acceptance, certification and retirement are defined;

d) an asset storage and retrieval mechanism is operated;

e) the use of assets is recorded;

f) changes to the assets are controlled, and

g) users of assets are notified of problems detected, modifications made, new versions created and deletion of assets from the storage and retrieval mechanism.

7.3.2.3 Activities and tasks

The project shall implement the following activities in accordance with applicable organization policies and procedures with respect to the Reuse Asset Management Process.

7.3.2.3.1 Process implementation. This activity consists of the following tasks:

7.3.2.3.1.1 The asset manager shall create an asset management plan to define the resources and procedures for managing assets.

7.3.2.3.1.2 The asset manager shall execute the plan.

7.3.2.3.1.3 The asset management plan shall be reviewed in accordance with the Software Review Process. Domain engineers and reuse program administrators shall be included in the review.

7.3.2.3.2 Asset storage and retrieval definition. This activity consists of the following tasks:

7.3.2.3.2.1 The asset manager shall implement and maintain an asset storage and retrieval mechanism.

7.3.2.3.2.2 The asset manager should develop, document, and maintain a classification scheme to be used in classifying the assets.

7.3.2.3.2.3 The asset manager shall conduct review(s) of the asset storage and retrieval mechanism in accordance with the Software Review Process. Reuse program administrators and domain engineers shall be included in the review(s).

7.3.2.3.3 Asset management and control. For each asset, this activity consists of the following tasks:

7.3.2.3.3.1 For each asset submitted to the asset manager, the asset shall be evaluated based on the asset acceptance and certification criteria.

7.3.2.3.3.2 For each asset accepted, it shall be made available for reuse through the asset storage and retrieval mechanism.

7.3.2.3.3.3 The asset shall be classified in accordance with the reuse classification scheme, if any exists.

7.3.2.3.3.4 The asset manager shall perform configuration management for the asset using the Software Configuration Management Process.

7.3.2.3.3.5 The asset manager shall keep track of each reuse of the asset and report to the domain engineer information about actual reuses of the asset.

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7.3.2.3.3.6 The asset manager shall forward asset modification requests and problem reports received from asset reusers to the domain engineer for review and correction/modification plans and actions.

7.3.2.3.3.7 The asset manager shall monitor and record these asset requests/reports and the subsequent actions taken.

7.3.2.3.3.8 The asset manager shall notify all asset reusers, and the domain engineer, of the problems detected in the asset, modifications made to the asset, new versions of the asset, and deletion of the asset from the asset storage and retrieval mechanism.

7.3.2.3.3.9 The asset manager shall retire assets from the asset storage and retrieval mechanism according to the asset retirement procedures and criteria.

7.3.3 Reuse Program Management Process

7.3.3.1 Purpose

The purpose of the Reuse Program Management Process is to plan, establish, manage, control, and monitor an organization's reuse program and to systematically exploit reuse opportunities.

7.3.3.2 Outcomes

As a result of successful implementation of Reuse Program Management Process:

a) the organization's reuse strategy, including its purpose, scope, goals and objectives, is defined;

b) the domains for potential reuse opportunities are identified;

c) the organization's systematic reuse capability is assessed;

d) the reuse potential of each domain is assessed;

e) reuse proposals are evaluated to ensure the reuse product is suitable for the proposed application;

f) the reuse strategy is implemented in the organization;

g) feedback, communication, and notification mechanisms that operate between affected parties are established; and

h) the reuse program is monitored and evaluated.

NOTE The affected parties may include reuse program administrators, asset managers, domain engineers, developers, operators, and maintainers.

7.3.3.3 Activities and tasks

The project shall implement the following activities in accordance with applicable organization policies and procedures with respect to the Reuse Asset Management Process.

7.3.3.3.1 Initiation. This activity consists of the following tasks:

7.3.3.3.1.1 The reuse program for an organization shall be initiated by establishing the organization's reuse strategy that includes its reuse goals, purposes, objectives, and scope.

7.3.3.3.1.2 A reuse sponsor should be named.

7.3.3.3.1.3 Reuse program participants shall be identified and their roles shall be assigned.

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7.3.3.3.1.4 A reuse steering function shall be established to assume the authority and responsibility for the organization's reuse program.

7.3.3.3.1.5 A reuse program support function shall be established.

7.3.3.3.2 Domain identification. This activity consists of the following tasks:

7.3.3.3.2.1 The reuse program administrator, aided by the appropriate manager, domain engineers, users, and software developers, shall identify and document the domains in which to investigate reuse opportunities or in which the organization intends to practice reuse.

7.3.3.3.2.2 The reuse program administrator, aided by the appropriate managers, domain engineers, users, and software developers, shall evaluate the domains to assure that they accurately reflect the organization's reuse strategy.

7.3.3.3.2.3 The reuse program administrator shall conduct reviews in accordance with the Software Review Process. Software developers, domain engineers, and users shall be included in the reviews.

7.3.3.3.2.4 As more information about the organization's domains and plans for future software products becomes available or when the domains are analyzed, the domains may be refined and rescoped by the reuse program administrator.

7.3.3.3.3 Reuse assessment. This activity consists of the following tasks:

7.3.3.3.3.1 The reuse program administrator shall assess the organization's systematic reuse capability.

7.3.3.3.3.2 The reuse program administrator shall assess each domain being considered for reuse to determine the potential for reuse success in the domain.

7.3.3.3.3.3 The reuse program administrator shall make recommendations for refining the organization's reuse strategy and reuse program implementation plan based on the results of the reuse assessments.

7.3.3.3.3.4 The reuse program administrator, in conjunction with the appropriate acquirers, suppliers, developers, operators, maintainers, asset managers, and domain engineers, shall incrementally improve the skills, technology, reuse processes, organizational structure, and metrics that together comprise the reuse infrastructure.

7.3.3.3.4 Planning. This activity consists of the following tasks:

7.3.3.3.4.1 A reuse program implementation plan shall be created, documented, and maintained to define the resources and procedures for implementing a reuse program.

7.3.3.3.4.2 The plan shall be reviewed and evaluated for completeness, feasibility of implementation, and ability to realize the organization's reuse strategy. Those evaluating the plan should include members of the reuse steering function.

7.3.3.3.4.3 Approval and support for the reuse program implementation plan shall be obtained from the reuse steering function, and the appropriate managers.

7.3.3.3.4.4 The reuse program administrator shall conduct review(s) in accordance with the Software Review Process. Members of the reuse steering function and the appropriate managers shall be included in the reviews.

7.3.3.3.5 Execution and Control. This activity consists of the following tasks:

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7.3.3.3.5.1 Activities in the reuse program implementation plan shall be executed in accordance with the plan.

7.3.3.3.5.2 The reuse program administrator shall monitor the progress of the reuse program against the organization's reuse strategy, and make any necessary adjustments to the plan to realize the strategy.

7.3.3.3.5.3 Problems and non-conformances that occur during the execution of the reuse program implementation plan shall be recorded and resolved.

7.3.3.3.5.4 The reuse program administrator shall periodically reaffirm management sponsorship, support, and commitment to the reuse program.

7.3.3.3.6 Review and evaluation. This activity consists of the following tasks:

7.3.3.3.6.1 The reuse program administrator shall periodically assess the reuse program for achievement of the organization's reuse strategy, and the continued suitability and effectiveness of the reuse program.

7.3.3.3.6.2 The reuse program administrator shall provide assessment results and lessons learned to the reuse steering function, and to the appropriate managers.

7.3.3.3.6.3 The reuse program administrator shall recommend and make changes to the reuse program, expand the reuse program, and improve the reuse program in accordance.

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Annex A
(normative)
Tailoring Process

A.1 Introduction

This Annex provides requirements for the tailoring of this International Standard.

NOTE Tailoring is not a requirement for conformance to the standard. In fact, tailoring is not permitted if a claim of "full conformance" is to be made. If a claim of "tailored conformance" is made then tailoring is to be performed as required by this process.

A.2 Tailoring Process

A.2.1 Purpose of the Tailoring Process

The purpose of the Tailoring Process is to adapt the processes of this International Standard to satisfy particular circumstances or factors that:

a) Surround an organization that is employing this International Standard in an agreement.

b) Influence a project that is required to meet an agreement in which this International Standard is referenced.

c) Reflect the needs of an organization in order to supply products or services.

A.2.2 Tailoring Process outcomes

As a result of the successful implementation of the Tailoring Process:

a) Modified life cycle processes are defined to achieve the purposes and outcomes of a life cycle model.

A.2.3 Tailoring Process activities

If this International Standard is tailored, then the organization or project shall implement the following tasks in accordance with applicable policies and procedures with respect to the Tailoring Process, as required.

A.2.3.1 Identify and document the circumstances that influence tailoring. These influences include, but are not limited to:

a) Stability of, and variety in, operational environments.

b) Risks, commercial or performance, to the concern of interested parties.

c) Novelty, size and complexity.

d) Starting date and duration of utilization.

e) Integrity issues such as safety, security, privacy, usability, availability.

f) Emerging technology opportunities.

g) Profile of budget and organizational resources available.

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h) Availability of the services of enabling systems.

i) Roles and responsibilities in the overall life cycle of the system.

j) The need to conform to other standards.

A.2.3.2 In the case of properties critical to the system, take due account of the life cycle structures recommended or mandated by standards relevant to the dimension of the criticality.

A.2.3.3 Obtain input from all parties affected by the tailoring decisions. This includes, but may not be limited to:

a) The system stakeholders.

b) The interested parties to an agreement made by the organization.

c) The contributing organizational functions.

A.2.3.4 Make tailoring decisions in accordance with the Decision Management Process to achieve the purposes and outcomes of the selected life cycle model.

NOTE 1 Organizations establish standard life cycle models as a part of the Life Cycle Model Management Process. It may be appropriate for an organization to tailor processes of this International Standard in order to achieve the purposes and outcomes of the stages of a life cycle model to be established.

NOTE 2 Projects select an organizationally-established life cycle model for the project as a part of the Project Planning Process. It may be appropriate to tailor organizationally-adopted processes to achieve the purposes and outcomes of the stages of the selected life cycle model.

NOTE 3 In cases where projects are directly applying this International Standard, it may be appropriate to tailor processes of this International Standard in order to achieve the purposes and outcomes of the stages of a suitable life cycle model.

A.2.3.5 Select the life cycle processes that require tailoring and delete selected outcomes, activities, or tasks.

NOTE 1 Irrespective of tailoring, organizations and projects are always permitted to implement processes that achieve additional outcomes or implement additional activities and tasks beyond those required for conformance to this standard.

NOTE 2 An organization or project may encounter a situation where there is the desire to modify a provision of this International Standard. Modification should be avoided because it may have unanticipated consequences on other processes, outcomes, activities or tasks. If necessary, modification is performed by deleting the provision (making the appropriate claim of tailored conformance) and, with careful consideration of consequences, implementing a process that achieves additional outcomes or performs additional activities and tasks beyond those of the tailored standard.

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Annex B
(normative)
Process Reference Model (PRM) for Assessment Purposes

B.1 Introduction

It is understood that some users of this International Standard may desire to assess the implemented processes in accordance with ISO/IEC 15504-2, *Information Technology — Process assessment — Part 2: Performing an assessment*. This Annex provides a Process Reference Model suitable for use in conjunction with that standard.

The source for the processes in this model is the processes in the body of this International Standard. In each case, the name, statement of purpose, and statement of outcomes for each process in the body of this standard have been referenced for use in this annex. In some cases, the processes in the body of the standard have a scope that is considered too large to be effectively assessed. Therefore, in those cases, lower-level processes have been added in this annex for the purpose of assessment. Each of these additional lower-level processes reflects an elaboration of one of the activities of the associated process in the body of the standard.

B.2 Conformance with ISO/IEC 15504-2

B.2.1 General

The Process Reference Model included in this annex is suitable for use in process assessment performed in accordance with ISO/IEC 15504-2, Information Technology — Process Assessment — Part 2: Performing an assessment.

ISO/IEC 15504-2 subclause 6.2 places requirements on Process Reference Models suitable for assessment by that standard. The following sections quote the requirements for Process Reference Models and describe how these are met by this International Standard. In each of the following clauses the *italicized* text quotes the requirement from the text of ISO/IEC 15504-2 and the upright text describes the manner in which the requirement is satisfied in this International Standard.

B.2.2 Requirements for Process Reference Models

A Process Reference Model shall contain:

a) *A declaration of the domain of the Process Reference Model.* This is provided in Clause 1.

b) *A description, meeting the requirements of subclause 6.2.4 of this International Standard, of the processes within the scope of the Process Reference Model.* This is provided in Annex B.3.

c) *A description of the relationship between the Process Reference Model and its intended context of use.* This is provided by Clause 5.

d) *A description of the relationship between the processes defined within the Process Reference Model.* This is provided in Annex B.3 in the description of each process. For example, some process descriptions in this annex include the statement that the process is a lower-level process and that the process replaces a specific activity in the higher level process.

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The Process Reference Model shall document the community of interest of the model and the actions taken to achieve consensus within that community of interest:

a) *The relevant community of interest shall be characterized or specified.* The relevant community of interest is the users of ISO/IEC 15288 and ISO/IEC 12207.

b) *The extent of achievement of consensus shall be documented.* Both ISO/IEC 15288 and ISO/IEC 12207 are International Standards satisfying the consensus requirements of ISO/IEC JTC1.

c) *If no actions are taken to achieve consensus, a statement to this effect shall be documented.* (Not applicable.)

The processes defined within a Process Reference Model shall have unique process descriptions and identification. The process descriptions are unique. The identification is provided by unique names and by the clause numbering of this annex.

B.2.3 Process descriptions

The fundamental elements of a Process Reference Model are the descriptions of the processes within the scope of the model. The process descriptions in the Process Reference Model incorporate a statement of the purpose of the process which describes at a high level the overall objectives of performing the process, together with the set of outcomes which demonstrate successful achievement of the process purpose. These process descriptions shall meet the following requirements:

a) *a process shall be described in terms of its purpose and outcomes*;

b) *in any process description the set of process outcomes shall be necessary and sufficient to achieve the purpose of the process*;

c) *process descriptions shall be such that no aspects of the Measurement Framework as described in Clause 5 of [ISO/IEC 15504-2] beyond level 1 are contained or implied*.

An outcome statement describes one of the following:

— *Production of an artefact;*

— *A significant change of state;*

— *Meeting of specified constraints, e.g., requirements, goals, etc.*

These requirements are met by the process descriptions in this Annex. Some outcomes might be interpreted as contributing to levels of capability above level 1. However, a conforming implementation of the relevant processes does not require achievement of these higher levels of capability.

B.2.4 Common process attributes for capability determination

The attributes in 5.1.9 of this International Standard characterize the specificity of each process. When an implemented process conforms to these attributes, the process' specifically defined purpose and outcomes are achieved through the implementation of its defined activities.

In addition to these basic attributes, processes may be characterized by other attributes common to all processes. These common attributes contribute to the achievement of higher level of process capabilities as defined in ISO/IEC 15504-2. There are 6 levels of process capability in the measurement framework of ISO/IEC 15504-2 as described in the following table:

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Table B.1 — Six Levels of Process Capability

Capability Level	Process Capability
0	Incomplete Process
1	Performed Process
2	Managed Process
3	Established Process
4	Predictable Process
5	Optimizing Process

The achievement of higher level attributes and capabilities is enabled by the interaction of the process with support and organizational processes such as Documentation, Configuration Management, Quality Assurance, etc.

ISO/IEC 15504-2 identifies the following common process attributes (PA) affiliated with the achievement of higher levels pf process capability:

- **performance management** (PA 2.1) – it determines the extent to which the performance of the process is managed. The achievement of this attributes involves the planning, monitoring and adjusting the process performance.

- **work product management** (PA 2.2) – it determines the extent to which the work products produced by the process are appropriately managed. The achievement of this attribute ensures that work products are appropriately established, controlled and maintained.

- **process definition** (PA 3.1) – it determines the extent to which the process is established as a standard process within the organization. The achievement of this attribute involves the definition of the process in terms of required competencies and roles for performing a process, required infrastructure and work environment, methods for monitoring its effectiveness and suitability and tailoring guidelines.

- **process deployment** (PA 3.2) – it determines the extent to which the process is effectively deployed as a tailored instance of the standard process. The achievement of this attribute is reflected in the fidelity to the standard process, the effective deployment of resources to the implementation of the process, and the collection and analysis of data for understanding and refining the behaviour of the process.

- **process measurement** (PA 4.1) – it determines the extent to which process measurements are used to ensure that performance of the process supports the achievement of defined business goals. The achievement of this attribute is concerned with the existence of an effective system for the collection of measures relevant to the performance of the process and the quality of the work products. The measures are applied to determine the extent of achievement of the organization's business goals.

- **process control** (PA 4.2) – it determines the extent to which process is quantitatively managed to produce a process that is stable, capable, and predictable within defined limits. The achievement of this attribute implies the application of analysis and control techniques to ensure that the process performs within defined limits and that corrective action are taken to address deviations.

- **process innovation** (PA 5.1) – it determines the extent to which changes to the process are identified from analysis of variation in performance, and from investigations of innovative approaches to process definition and implementation. The achievement of this attribute is concerned with the existence of a proactive focus on continuous improvement in the fulfilment of both current and projected business goals.

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- **process optimization** (PA 5.2) – it determines the extent to which changes to the definition, management and performance of the process result in effective impact that achieves the relevant process improvement objectives. The achievement of this attribute is concerned with an orderly and proactive approach to identifying and introducing appropriate changes to the process minimizing undesired disruption, evaluating the effectiveness of changes and making adjustments as necessary.

B.3 Process Reference Model

The Process Reference Model is composed of the statement of purpose and outcomes of each of the processes included in Clause 6 and Clause 7 of this International Standard. These are listed in Table B.2.

Table B.2 — ISO/IEC 12207:2008 Processes

ISO/IEC 12207 Clause Number	ISO/IEC 12207:2008 Process Name
6	***System Life Cycle Processes***
6.1	***Agreement Processes***
6.1.1	***Acquisition Process***
6.1.2	***Supply Process***
6.2	***Organizational Project-Enabling Processes***
6.2.1	***Life Cycle Model Management Process***
6.2.2	***Infrastructure Management Process***
6.2.3	***Project Portfolio Management Process***
6.2.4	***Human Resource Management Process***
6.2.5	***Quality Management Process***
6.3	***Project Processes***
6.3.1	***Project Planning Process***
6.3.2	***Project Assessment and Control Process***
6.3.3	***Decision Management Process***
6.3.4	***Risk Management Process***
6.3.5	***Configuration Management Process***
6.3.6	***Information Management Process***
6.3.7	***Measurement Process***
6.4	***Technical Processes***
6.4.1	***Stakeholder Requirements Definition Process***
6.4.2	***System Requirements Analysis***
6.4.3	***System Architectural Design***
6.4.4	***Implementation Process***
6.4.5	***System Integration Process***
6.4.6	***System Qualification Testing Process***
6.4.7	***Software Installation***
6.4.8	***Software Acceptance Support***
6.4.9	***Software Operation Process***
6.4.10	***Software Maintenance Process***
6.4.11	***Software Disposal Process***
7	***Software Life Cycle Processes***
7.1	***Software Implementation Processes***
7.1.1	***Software Implementation Process***
7.1.2	***Software Requirements Analysis Process***
7.1.3	***Software Architectural Design Process***
7.1.4	***Software Detailed Design Process***
7.1.5	***Software Construction Process***
7.1.6	***Software Integration Process***

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ISO/IEC 12207 Clause Number	ISO/IEC 12207:2008 Process Name
7.1.7	*Software Qualification Testing Process*
7.2	*Software Support Processes*
7.2.1	*Software Documentation Management Process*
7.2.2	*Software Configuration Management Process*
7.2.3	*Software Quality Assurance Process*
7.2.4	*Software Verification Process*
7.2.5	*Software Validation Process*
7.2.6	*Software Review Process*
7.2.7	*Software Audit Process*
7.2.8	*Software Problem Resolution Process*
7.3	*Software Reuse Processes*
7.3.1	*Domain Engineering Process*
7.3.2	*Reuse Asset Management Process*
7.3.3	*Reuse Program Management Process*

Some activities of the processes in Clauses 6 and 7 are replaced with corresponding lower-level processes. The descriptions of these lower-level processes are shown below.

B.3.1 Acquisition Process Lower-Level Processes

B.3.1.1 Acquisition Preparation Process

This process is a lower-level process of the Acquisition Process. It replaces the Acquisition Preparation activity (6.1.1.3.1).

B.3.1.1.1 Purpose

The purpose of the Acquisition Preparation Process is to establish the needs and goals of the acquisition and to communicate these with the potential suppliers.

B.3.1.1.2 Outcomes

As a result of successful implementation of the Acquisition Preparation Process:

a) the concept or the need for the acquisition, development, or enhancement is established;

b) stakeholder requirements are defined;

c) an acquisition strategy is developed; and

d) supplier selection criteria are defined.

B.3.1.2 Supplier Selection Process

This process is a lower level-process of the Acquisition Process. It replaces the Supplier Selection activity (6.1.1.3.3).

B.3.1.2.1 Purpose

The purpose of the Supplier Selection Process is to choose the organization that is to be responsible for the delivery of the requirements of the project.

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B.3.1.2.2 Outcomes

As a result of successful implementation of the Supplier Selection Process:

a) the supplier selection criteria are established and used to evaluate potential suppliers;

b) the supplier is selected based upon the evaluation of the supplier's proposals, process capabilities, and other factors; and

c) an agreement is established and negotiated between the acquirer and the supplier.

B.3.1.3 Agreement Monitoring Process

This process is a lower level-process of the Acquisition Process. It replaces the Agreement Monitoring activity (6.1.1.3.5).

B.3.1.3.1 Purpose

The purpose of the Agreement Monitoring Process is to track and assess performance of the supplier against agreed requirements.

B.3.1.3.2 Outcomes

As a result of successful implementation of the Agreement Monitoring Process:

a) joint activities between the acquirer and the supplier are performed as needed;

b) information on technical progress is exchanged regularly with the supplier;

c) performance of the supplier is monitored against the agreed requirements; and

d) agreement changes, if needed, are negotiated between the acquirer and the supplier and documented in the agreement.

B.3.1.4 Acquirer Acceptance Process

This process is a lower-level process of the Acquisition Process. It replaces the Acquirer Acceptance activity (6.1.1.3.6).

B.3.1.4.1 Purpose

The purpose of the Acquirer Acceptance Process is to approve the supplier's deliverable when all acceptance criteria are satisfied.

B.3.1.4.2 Outcomes

As a result of successful implementation of the Acquirer Acceptance Process:

a) the delivered software product and/or service are evaluated with regard to the agreement;

b) the acquirer's acceptance is based on the agreed acceptance criteria; and

c) the software product and/or service is accepted by the acquirer.

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B.3.2 Supply Process Lower-Level Processes

B.3.2.1 Supplier Tendering Process

This process is a lower level-process of the Supply Process. It replaces the Supplier Tendering activity (6.1.2.3.2).

B.3.2.1.1 Purpose

The purpose of the Supplier Tendering Process is to establish an interface to respond to acquirer inquiries and requests for proposal, prepare and submit proposals.

B.3.2.1.2 Outcomes

As a result of successful implementation of the Supplier Tendering Process:

a) a communication interface is established and maintained in order to respond to acquirer inquiries and requests for proposal;

b) requests for proposal are evaluated according to defined criteria to determine whether or not to submit a proposal;

c) the need to undertake preliminary surveys or feasibility studies is determined;

d) suitable resources are identified to perform the proposed work; and

e) a supplier proposal is prepared and submitted in response to the acquirer request.

B.3.2.2 Contract Agreement Process

This process is a lower level-process of the Supply Process. It replaces the Contract Agreement activity (6.1.2.3.4).

B.3.2.2.1 Purpose

The purpose of Contract Agreement Process is to negotiate and approve a contract/agreement that clearly and unambiguously specifies the expectations, responsibilities, work products/deliverables and liabilities of both the supplier and the acquirer.

B.3.2.2.2 Outcomes

As a result of successful implementation of the Contract Agreement Process:

a) a contract/agreement is negotiated, reviewed, approved and awarded to the supplier(s);

b) mechanisms for monitoring the capability and performance of the supplier(s) and for mitigation of identified risks are reviewed and considered for inclusion in the contract conditions;

c) proposers/tenderers are notified of the result of proposal/tender selection; and

d) formal confirmation of agreement is obtained.

NOTE The Contract Agreement Process is used to obtain formal confirmation of assignments that were offered during the Supplier Tendering Process.

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B.3.2.3 Product/Service Delivery and Support Process

This process is a lower-level process of the Supply Process. It replaces the Product/Service Delivery and Support activity (6.1.2.3.6).

B.3.2.3.1 Purpose

The purpose of the Product/Service Delivery and Support Process is to provide the specified product or service to the acquirer with support appropriate to achieve confidence that the requirements have been met.

B.3.2.3.2 Outcomes

As a result of the successful implementation of the Product/Service Delivery and Support Process:

a) the contents of the product release are determined;

b) the release is assembled from configured items;

c) the release documentation is defined and produced;

d) the release delivery mechanism and media are determined;

e) release approval is effected against defined criteria;

f) the product release is made available to the acquirer;

g) confirmation of release is obtained;

h) the product is completed and delivered to the acquirer;

i) acquirer acceptance tests and reviews are supported;

j) the product is put into operation in the customers' environment; and

k) problems detected during acceptance are identified and communicated to those responsible for resolution.

NOTE Incremental delivery would be in completed increments.

B.3.3 Life Cycle Model Management Process Lower-Level Processes

B.3.3.1 Process Establishment Process

This process is a lower-level process of the Life Cycle Model Management Process. It replaces the Process Establishment activity (6.2.1.3.1).

B.3.3.1.1 Purpose

The purpose of the Process Establishment Process is to establish a suite of organizational processes for all life cycle processes as they apply to its business activities.

B.3.3.1.2 Outcomes

As a result of successful implementation of the Process Establishment Process:

a) a defined and maintained standard set of processes are established, along with an indication of each process's applicability;

b) the detailed tasks, activities and associated work products of the standard process are identified, together with expected performance characteristics;

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c) a strategy for tailoring the standard process for the product or service is developed in accordance with the needs of the project; and

d) information and data related to the use of the standard process for specific projects exist and are maintained.

B.3.3.2 Process Assessment Process

This process is a lower-level process of the Life Cycle Model Management Process. It replaces the Process Assessment activity (6.2.1.3.2).

B.3.3.2.1 Purpose

The purpose of the Process Assessment Process is to determine the extent to which the organization's standard processes contribute to the achievement of its business goals and to help the organization focus on the need for continuous process improvement.

B.3.3.2.2 Outcomes

As a result of successful implementation of the Process Assessment Process:

a) information and data related to the use of the standard process for specific projects exists and is maintained;

b) the relative strengths and weaknesses of the organization's standard processes are understood; and

c) accurate and accessible assessment records are kept and maintained.

B.3.3.3 Process Improvement Process

This process is a lower-level process of the Life Cycle Model Management Process. It replaces the Process Improvement activity (6.2.1.3.2).

B.3.3.3.1 Purpose

The purpose of the Process Improvement Process is to continually improve the organization’s effectiveness and efficiency through the processes used and maintained and aligned with the business need.

B.3.3.3.2 Outcomes

As a result of successful implementation of the Process Improvement Process

a) commitment is established to provide resources to sustain improvement actions;

b) issues arising from the organization's internal/external environment are identified as improvement opportunities and justified as reasons for change;

c) analysis of the current status of the existing process is performed, focusing on those processes from which improvement stimuli arise;

d) improvement goals are identified and prioritized, and consequent changes to the process are defined and implemented;

e) the effects of process implementation are monitored and confirmed against the defined improvement goals;

f) knowledge gained from the improvements is communicated within the organization; and

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g) the improvements made are evaluated and consideration given for using solutions elsewhere within the organization.

NOTE 1 Information sources providing input for change may include: process assessment results, audits, customer's satisfaction reports, organizational effectiveness/efficiency, cost of quality.

NOTE 2 The current status of processes may be determined by process assessment.

B.3.4 Human Resource Management Process Lower-Level Processes

B.3.4.1 Skill Development Process

This process is a lower-level process of the Human Resource Management Process. It replaces the Skill Development activity (6.2.4.3.2).

B.3.4.1.1 Purpose

The purpose of the Skill Development Process is to provide the organization and project with individuals who possess the needed skills and knowledge to perform their roles effectively.

B.3.4.1.2 Outcomes

As a result of successful implementation of the Skill Development Process:

a) training is developed or acquired to address the organization and project training needs; and

b) training is conducted to ensure that all individuals have the skills required to perform their assignments, using mechanisms such as training strategies and materials.

B.3.4.2 Skill Acquisition and Provision Process

This process is a lower-level process of the Human Resource Management Process. It replaces the Skill Acquisition and Provision activity (6.2.4.3.3).

B.3.4.2.1 Purpose

The purpose of the Skill Acquisition and Provision Process is to provide the organization and projects with individuals who possess skills and knowledge to perform their roles effectively and to work together as a cohesive group.

B.3.4.2.2 Outcomes

As a result of successful implementation of the Skill Acquisition and Provision Process:

a) individuals with the required skills and competencies are identified and recruited;

b) effective interaction between individuals and groups are supported;

c) the work force have the skills to share information and co-ordinate their activities efficiently; and

d) objective criteria are defined against which group and individual performance is monitored to provide performance feedback and to enhance performance.

B.3.4.3 Knowledge Management Process

This process is a lower-level process of the Human Resource Management Process. It replaces the Knowledge Management activity (6.2.4.3.4).

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B.3.4.3.1 Purpose

The purpose of the Knowledge Management Process is to ensure that individual knowledge, information and skills are collected, shared, reused and improved throughout the organization.

B.3.4.3.2 Outcomes

As a result of successful implementation of the Knowledge Management Process:

a) infrastructure is established and maintained for sharing common and domain information across the organization;

b) knowledge is readily available and shared throughout the organization; and

c) the organization selects an appropriate knowledge management strategy.

B.3.5 Software Operation Process Lower-Level Processes

B.3.5.1 Operational Use Process

This process is a lower-level process of the Software Operation Process. It replaces the Operational Use activity (6.4.9.3.3).

B.3.5.1.1 Purpose

The purpose of the Operational Use Process is to ensure the correct and efficient operation of the product for the duration of its intended usage and in its installed environment.

B.3.5.1.2 Outcomes

As a result of successful implementation of the Operational Use Process:

a) operational risks for the product introduction and operation are identified and monitored;

b) the product is operated in its intended environment according to requirements; and

c) criteria for the operational use are developed that demonstrates compliance with the agreed requirements.

B.3.5.2 Customer Support Process

This process is a lower-level process of the Software Operation Process. It replaces the Customer Support activity (6.4.9.3.4).

B.3.5.2.1 Purpose

The purpose of the Customer Support Process is to establish and maintain an acceptable level of service through assistance and consultation to the customer to support effective use of the product.

B.3.5.2.2 Outcomes

As a result of successful implementation of the Customer Support Process:

a) service needs for customer support are identified and monitored on an ongoing basis;

b) customer satisfaction with both the support services being provided and the product itself is evaluated on an ongoing basis;

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c) operational support is provided by handling customer inquiries and requests and resolving operational problems; and

d) customer support needs are met through delivery of appropriate services.

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Annex C
(informative)
History and rationale

C.1 Introduction

This Annex C provides a history and the rationale for this International Standard and provides and informative description of the structure of the document.

C.2 History

The first version of ISO/IEC 12207 was published in 1995. The developers of that standard saw a need to describe processes and the activities and tasks of those processes in order to facilitate software development in two-party situations. Although ISO/IEC 12207:1995 is oriented towards "what" needs to be done, it describes the processes in terms of activities and tasks.

In the same timeframe, the software industry realized that of equal importance was the need to evaluate process capability on a continuous scale in a comparable and repeatable way to support process improvement and risk reduction during supplier selection. Concepts of continuous process improvement, organizational maturity and capability assessment are now well established and recognized, and are being standardized in the ISO/IEC 15504 series of standards.

Capability determination of processes requires that their descriptions include a clear statement of the purpose of the process and a description of the expected outcomes. Those statements of purpose and outcomes were missing in ISO/IEC 12207:1995 and were supplied by the amendments to ISO/IEC 12207 published in 2002 and 2004. Those amendments also added a number of detail-level processes to facilitate the proper assessment of the complete software life cycle processes.

Although ISO/IEC 12207 addressed software life cycle processes within a systems context, it was evident that a similar standard was needed in the systems domain. ISO/IEC 15288, published in November 2002, filled that need. The developers of this standard benefited from the experience gained in the development of the amended ISO/IEC 12207 and understood the needs as expressed in ISO/IEC 15504; and therefore processes in the ISO/IEC 15288 standard are expressed in terms of purposes and outcomes with description of activities required to achieve those outcomes.

Staggered development of the amendments to ISO/IEC 12207 with ISO/IEC 15288 and a different, initial focus of ISO/IEC 12207, led to some difficulties in applying the amended ISO/IEC 12207, as well as applying the software and system life cycle standards together. A harmonization project within ISO/IEC JTC 1/SC 7—a parallel, carefully controlled revision of ISO IEC 12207 and ISO/IEC 15288, and development of the Technical Report ISO/IEC 24748, which provides guidelines to both of these International Standards—is the first, large step towards an integrated set of standards describing system and software life cycles.

C.3 Goals

This International Standard is a step towards full harmonization of the software and system life cycle processes while supporting the requirements of the assessment community. This standard was developed with the following goals:

— Incorporate and rationalize both amendments;

— Provide a common terminology between the revision of the ISO/IEC 15288 and this International Standard;

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— Where applicable, provide common process names between the revision of the ISO/IEC 15288 and this International Standard;

— Enable user community to evolve towards fully harmonized standards and to provide a stable standard; and

— Leverage ten years of experience with the development and use of ISO/IEC 12207 and ISO/IEC 15288.

C.4 Process constructs and their usage

The process descriptions in this International Standard follow clearly defined rules. Firstly, they were grouped in a logical fashion. Those groupings are dictated by:

— Logical relations among the processes

— Responsibility for execution of the processes

This International Standard groups the activities that may be performed during the life cycle of software systems into seven Process Groups. The top level description of these groups can be found in subclause 5.2.2. Each of the life cycle process within those groups is described in terms of its purpose and desired outcomes and list activities and tasks which need to be performed to achieve those outcomes.

a) Agreement Processes – two processes (subclauses 5.2.2.1.1 and 6.1)

b) Organizational Project-Enabling Processes – five processes (subclauses 5.2.2.1.2 and 6.2)

c) Project Processes – seven processes (subclauses 5.2.2.1.3 and 6.3)

d) Technical Processes – eleven processes (subclauses 5.2.2.1.4 and 6.4)

e) Software Implementation Processes – seven processes (subclauses 5.2.2.2.1and 7.1)

f) Software Support Processes – eight processes (subclauses 5.2.2.2.2 and 7.2)

g) Software Reuse Processes – three processes (subclauses 5.2.2.2.3 and 7.3)

Consistent application of process description rules allows for the normalized clause numbering. Within this International Standard clauses' numbering:

— 6.a and 7.a denote a Process Group

— 6.a.b and 7.a.b denote a process (or lower-level process) within that group

— 6.a.b.1 and 7.a.b.1 describe the purpose of the process

— 6.a.b.2 and 7.a.b.2 describe the outcome of the process

— 6.a.b.3.c and 7.a.b.3.c list activities of the process and clauses

— 6.a.b.3.c.d and 7.a.b.3.c.d list tasks of the activity 'c'

Figure C.1 is a UML representation of process constructs used in this International Standard and in ISO/IEC 15288:2008.

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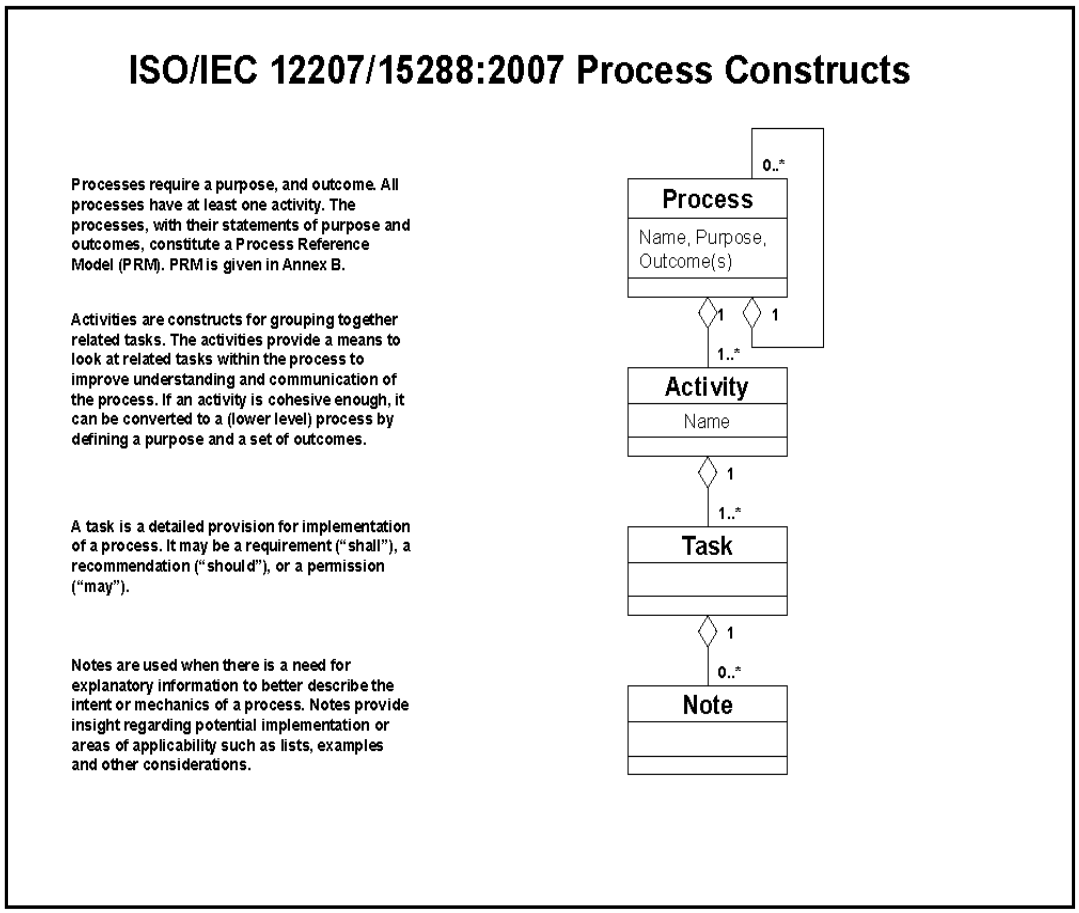

Figure C.1 — ISO/IEC 12207/15288 Process Constructs

C.5 Relations among version of standards

As described above this International Standard is a result of harmonization among four source documents. Figure C.2 depicts the relations among the constructs of the input documents.

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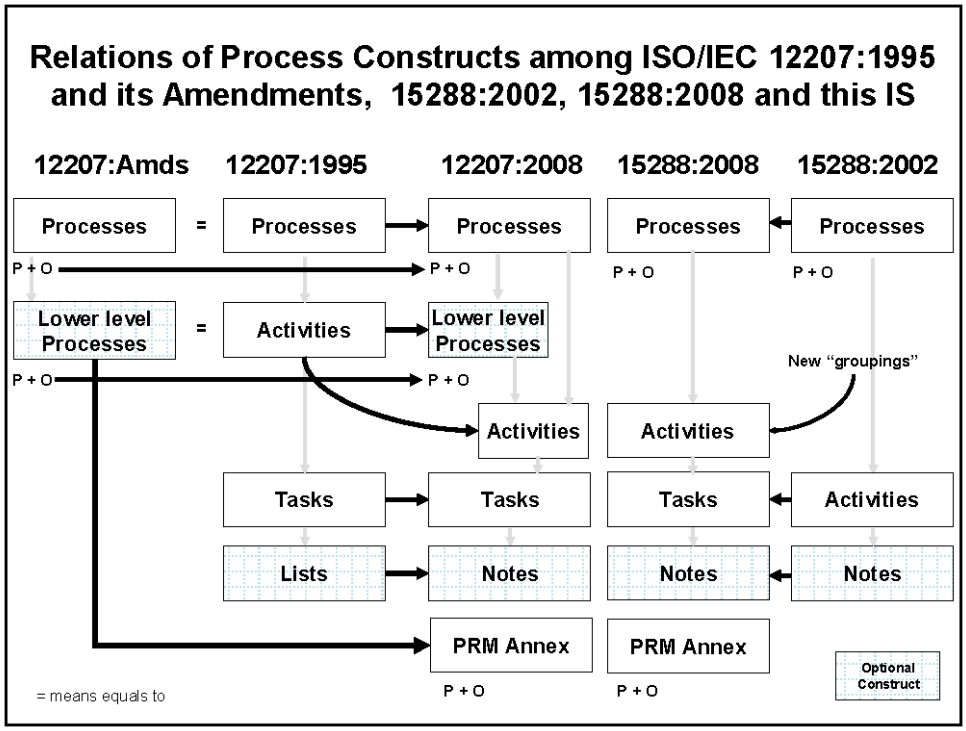

Figure C. 2 — Relationships among Process Constructs

For the benefit of the users of the previous edition of ISO/IEC 12207 and its amendments and the previous edition of ISO/IEC 15288, Table C.1 provides information regarding the source of the provisions in the aligned processes of ISO/IEC 12207:2008. The information in this table should be used with caution because:

— The entries in the table are approximate rather than precise, reflecting the intent of the new work item proposal.

— Provisions were sometimes adapted, occasionally extensively, for better fit into their new context.

— The text of the provisions may have changed during the process of reaching consensus.

The sources cited in the table are the following:

— "12207:1995" refers to ISO/IEC 12207:1995.

— "Amd 1" refers to the annexes added by ISO/IEC 12207:1995/AMD.1:2002.

— "Amd 2" refers to the annexes added by ISO/IEC 12207:1995/AMD.2:2004.

— "Amd 1/Amd 2" refers to the annexes added by AMD.1 as amended by AMD.2.

— "Amended 12207" refers to the main body text of ISO/IEC 12207:1995 as amended by AMD.1 and AMD.2.

— "15288" refers to ISO/IEC 15288:2002.

— "15939" refers to ISO/IEC 15939:2002.

— "16085" refers to ISO/IEC 16085:2004.

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Table C.1 — ISO/IEC 12207:2008 Process Definition Sources

Clause	Process	Source of Purpose and Outcomes	Source of Activities and Tasks
6.1	**Agreement Processes**		
6.1.1	Acquisition	Amd 1, F.1.1	12207:1995, 5.1; 15288, 5.2.2.3
6.1.2	Supply	Amd 1/Amd 2, F.1.2	15288 5.2.3.3 (a, h, i) and 12207:1995, 5.2
6.2	**Organizational Project-Enabling Processes**		
6.2.1	Life Cycle Model Management	15288, 5.3; Amd 1, F.3.3	12207:1995, 7.3
6.2.2	Infrastructure Management	15288, 5.3; Amd 1, F.3.2	12207:1995, 7.2
6.2.3	Project Portfolio Management	15288, 5.3; Amd 1, F.3.1.1	15288, 5.3.3
6.2.4	Human Resource Management	15288, 5.3.5; Amd 1, F.3.4	Amended 12207, 7.4
6.2.5	Quality Management	15288, 5.3.6; Amd 1, F.3.1.4	15288, 5.3.6
6.3	**Project Processes**		
6.3.1	Project Planning	15288, 5.4.2; Amd 1, F.3.1.3	12207:1995, 7.1.1, 7.1.2 and 7.1.3.1
6.3.2	Project Assessment and Control	15288, 5.4.3 and 5.4.4; Amd 1, F.3.1.3 (4), (6), (7)	12207:1995, 7.1.3.2 through 7.1.3.4; 7.1.4; 7.1.5
6.3.3	Decision Management	15288, 5.4.5	15288, 5.4.5
6.3.4	Risk Management	16085, 5; Amd 1, F.1.3.5	16085, 5
6.3.5	Configuration Management	15288, 5.4.7	15288, 5.4.7
6.3.6	Information Management	15288, 5.4.8	15288, 5.4.8
6.3.7	Measurement	15939, 4.1; Amd 1, F.1.3.6	15939, 4 and 5
6.4	**Technical Processes**		
6.4.1	Stakeholder Requirements Definition	Amd 1, F.1.3.1	15288, 5.5.2
6.4.2	System Requirements Analysis	Amd 1, F.1.3.2	12207:1995, 5.3.2
6.4.3	System Architectural Design	Amd 1, F.1.3.3	12207:1995, 5.3.3
6.4.4	Implementation	Not applicable	Not applicable
6.4.5	System Integration	Amd 1, F.1.3.9	12207:1995, 5.3.10
6.4.6	System Qualification Testing	Amd 1, F.1.3.10	Amended 12207, 5.3.11
6.4.7	Software Installation	Amd 1, F.1.3.11	12207:1995, 5.3.12
6.4.8	Software Acceptance Support	Amd 2, F.1.2.4	12207:1995, 5.3.13
6.4.9	Software Operation	15288, 5.5.10; Amd 1/Amd 2, F.1.4	12207:1995, 5.4
6.4.10	Software Maintenance	Amd 1, F.1.5	12207:1995, 5.5.1 through 5.5.5
6.4.11	Software Disposal	15288 5.5.12; Amd 1, F.1.5 (6)	12207:1995, 5.5.6
7.1	**Software Implementation Processes**		
7.1.1	Software Implementation	15288, 5.5.5.1	Amended 12207, 5.3.1
7.1.2	Software Requirements Analysis	Amd 1, F.1.3.4	Amended 12207, 5.3.4
7.1.3	Software Architectural Design	Amd 1, F.1.3.5	12207:1995, 5.3.5
7.1.4	Software Detailed Design	Amd 1, F.1.3.5	
7.1.5	Software Construction	Amd 1, F. 1.3.6	12207:1995, 5.3.7
7.1.6	Software Integration	Amd 1, F.1.3.7	12207:1995, 5.3.8
7.1.7	Software Qualification Testing	Amd 1, F.1.3.8	12207:1995, 5.3.9

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7.2	**Software Support Processes**		
7.2.1	Software Documentation Management	Amd 1, F.2.1	12207:1995, 6.1
7.2.2	Software Configuration Management	Amd 1, F.2.2	12207:1995, 6.2
7.2.3	Software Quality Assurance	Amd 1, F.2.3	Amended 12207, 6.3
7.2.4	Software Verification	Amd 1, F.2.4	12207:1995, 6.4.
7.2.5	Software Validation	Amd 1, F.2.5	12207:1995, 6.5
7.2.6	Software Review	Amd 1, F.2.6	12207:1995, 6.6
7.2.7	Software Audit	Amd 1, F.2.7	12207:1995, 6.7
7.2.8	Software Problem Resolution	Amd 2, F.2.8	12207:1995, 6.8
7.3	**Software Reuse Processes**		
7.3.1	Domain Engineering	Amd 1, F.3.7	Amd 1, G.6
7.3.2	Reuse Asset Management	Amd 1, F.3.5	Amd 1, G.4
7.3.3	Reuse Program Management	Amd 1, F.3.6	Amd 1, G.5

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Annex D
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ISO/IEC 12207 and ISO/IEC 15288 process alignment

This Annex describes the alignment of the processes of ISO/IEC 15288 and ISO/IEC 12207.

The alignment of the processes of the following subclauses is straightforward and obvious. ISO/IEC 12207 and ISO/IEC 15288 use the same process names and the same clause numbers for the individual processes:

— 6.1 Agreement processes

— 6.2 Organizational Project-Enabling processes

— 6.3 Project processes

In each case, the process in ISO/IEC 12207 is intended to be a software specialization of a more general process in ISO/IEC 15288.

Subclause 6.4 of each standard contains "Technical Processes". The two standards use slightly different names for these processes. In some cases, the process in ISO/IEC 12207 is a software specialization of the process in ISO/IEC 15288. In other cases, the process in ISO/IEC 12207 merely contributes to the achievement of one or more outcomes of the corresponding process in ISO/IEC 15288. The table below lists the processes and notes the nature of their relationship.

Table D.1 — Relationship of ISO/IEC 12207 to ISO/IEC 15288 Technical Processes

Clause	Process Name in ISO/IEC 15288	Process Name in ISO/IEC 12207	Relationship
6.4	Technical Processes	Technical Processes	
6.4.1	Stakeholder Requirements Definition	Stakeholder Requirements Definition	Specialization
6.4.2	Requirements Analysis	System Requirements Analysis	Specialization
6.4.3	Architectural Design	System Architectural Design	Specialization
6.4.4	Implementation	Implementation	Specialization
6.4.5	Integration	System Integration	Specialization
6.4.6	Verification	System Qualification Testing Note 1	Contributes to outcomes
6.4.7	Transition	Software Installation Software Acceptance Support	Contributes to outcomes Contributes to outcomes
6.4.8	Validation	Software Acceptance Support Note 2	May contribute to outcomes
6.4.9	Operation	Software Operation	Specialization
6.4.10	Maintenance	Software Maintenance	Specialization
6.4.11	Disposal	Software Disposal	Specialization

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Finally, Clause 7 of ISO/IEC 12207 contains only processes that are specific to software.

NOTE 1 Although in this International Standard the Software Verification Process remains allocated as a supporting process and placed in the Software Support Process Group of Clause 7, if the process is implemented for a system element of software (a software item), the process may contribute to one or more outcomes of the Verification Process of ISO/IEC 15288.

NOTE 2 Although in this International Standard the Software Validation Process remains allocated as a supporting process and placed in the Software Support Process Group of Clause 7, if the process is implemented for a system element of software (a software item), the process may contribute to one or more outcomes of the Validation Process of ISO/IEC 15288.

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Annex E
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Process views

E.1 Introduction

There are instances where those representing a particular engineering interest would like to see gathered in a single place the set of process activities that directly and succinctly address their concern. For such interests, a ***process view*** can be developed to organize processes, activities, and tasks selected from ISO/IEC 12207 or ISO/IEC 15288 to provide a focus to their particular concern in a manner that cuts across all or parts of the life cycle. This Annex provides a process viewpoint that may be used to define process views in these instances.

E.2 Definition

View: a representation of a whole system from the perspective of a related set of concerns.

[ISO/IEC 42010:2007]

Viewpoint: a specification of the conventions for constructing and using a view. A pattern or template from which to develop individual views by establishing the purposes and audiences for a view and the techniques for its creation and analysis.

[ISO/IEC 42010:2007]

NOTE In this definition but not in the rest of the annex, the "system" referenced is the collection of life cycle processes provided by ISO/IEC 15288 and ISO/IEC 12207.

E.3 The process view concept

There may be cases where a unified focus is needed for activities and tasks that are selected from disparate processes to provide visibility to a significant concept or thread that cuts across the processes employed across the life cycle. It is useful to advise users of the standards how to identify and define these activities for their use, even though they cannot locate a single process that addresses their specific concern.

For this purpose, the concept of a ***process view*** has been formulated. Like a process, the description of a process view includes a statement of purpose and outcomes. Unlike a process, the description of a process view does not include activities and tasks. Instead, the description includes guidance explaining how the outcomes can be achieved by employing the activities and tasks of the various processes in ISO/IEC 12207 and ISO/IEC 15288. Process views can be constructed using the process viewpoint template found in E.3.1.

E.3.1 Process viewpoint

A process view conforms to a process viewpoint. The process viewpoint provided here can be used to create process views. E.4 contains an example of applying this viewpoint.

The Process Viewpoint is defined by:

— its stakeholders: users of the standard;

— the concerns it frames: the processes needed to reflect a particular engineering interest;

— the contents of resulting process views should include:

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— process view name;

— process view purpose;

— process view outcomes; and

— identification and description of the processes, activities and tasks which implement the process view, and references to the sources for these processes, activities and tasks in other standards.

NOTE The requirements for documenting viewpoints are found in ISO/IEC 42010:2007 “Systems and software engineering — Recommended practice for architectural description of software-intensive systems”, subclause 5.3. This description is consistent with those requirements.

E.4 Process view for usability

This section provides an example of applying the process viewpoint to yield a process view for Usability, intended to illustrate how a project might assemble processes, activities and tasks of ISO/IEC 12207 to provide focused attention to the achievement of a usable product.

This example treats the cluster of interests, generally called Usability, User centred design or Human-centred design (as described in ISO 13407) that enables optimizing support and training, increased productivity and quality of work, improved human working conditions and reducing the chance of user rejection of the system.

Name: Usability Process View

Purpose: The purpose of the *Usability Process View* is to ensure the consideration of the interests and needs of the stakeholders in order to enable optimizing support and training, increased productivity and quality of work, improved human working conditions and reducing the chance of user rejection of the system.

As a result of successful implementation of the *Usability Process View*:

a) the system meets the needs of users and takes account of their human capabilities and skill limitations;

b) human factors and ergonomics knowledge and techniques are incorporated in systems design;

c) human-centred design activities are identified and performed;

d) system design will address possible adverse effects of use on human health, safety and performance; and

e) systems will have enhanced user effectiveness, efficiency and satisfaction.

NOTE Although involvement of users is a principle of human centred design, the outcomes permit the possibility that the desired characteristics cannot be directly measured but instead might be argued and inferred based on other product or process characteristics that can be measured.

Processes, Activities and Tasks:

This process view can be implemented using the following processes, activities, and tasks from ISO/IEC 12207.

a) The Project Portfolio Management process (6.2.3), in particular the Process Initiation process (6.2.3.3.1), provides for the establishment and maintenance of a focus on user issues in the parts of the organization that deal with markets, concept, development and support; championing of a human-centred approach .

b) The Infrastructure Management Process (6.2.2) provides a specification of how human-centred design activities fit into the whole systems lifecycle process and the organization.

c) The Project Planning Process (6.3.1) provides for: selection of human centred methods and techniques, planning the involvement of users and other stakeholders, planning of human-centred design activities.

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d) The Project Assessment and Control Process (6.3.2) provides for monitoring the extent of achievement of the requirements and communicating the results to stakeholders and managers, ensuring a human centred approach in the design team. Relevant tasks include 6.3.2.3.3.1 and 6.3.2.3.3.2.

e) The Stakeholder Requirements Definition process (6.4.1) provides for the identification and documentation of the context of use and the interaction between users and the system, taking into account human capabilities and skills limitations and the specification of health, safety, security, environment, training, support and other stakeholder requirements and functions that address possible adverse effects of use of the system on human health and safety.

Note: Where possible, applicable standards, e.g. ISO 13407 *Human-centred design process for interactive systems,* ISO, ISO 9241-11 *Guidance on usability* (describes context of use), and 9241 *Ergonomics of human-system interaction* (multi-part standard of requirements and recommendations), and accepted professional practices are used.

f) The System Requirements Analysis Process (6.4.2) provides for the specification and evaluation of the context of use and the usability and human centred design requirements.

g) The System Architectural Design process (6.4.3) provides for the incorporation of design criteria to address the targets for usability and the ergonomic requirements.

h) The System Integration process (6.4.5) provides for planning the integration, including the considerations for user training and the assurance that the achievement of targets for usability and accordance with ergonomic requirements are verified and recorded.

i) The Information Management Process (6.3.6), in its entirety, provides for the specification, development and maintenance of artefacts for documenting and communicating the extent of achievement. For usability this is detailed by ISO/IEC 25062 *Common Industry Format for usability test reports* and related future standards in the same series.

j) The Measurement Process (6.3.7), in its entirety, provides for defining an approach that relates measures to desired characteristics. For software, these are detailed in ISO/IEC 25020: Software engineering – Software product Quality Requirements and Evaluation (SQuaRE) – Measurement reference model and guide.

k) Software Requirements Analysis Process (7.1.2) provides for the specification of the usability and software ergonomics requirements. Relevant task is 7.1.2.3.1.1. (f) and Note 3.

l) The Software Operation Process (6.4.9) provides for use of the system. Assuring that the usability requirements are appropriately achieved involves monitoring the operation of the system. Relevant tasks include 6.4.9.3.3.1 Note 2, 6.4.9.3.4.1 and 6.4.9.3.5.1.

m) The Software Maintenance process (6.4.10) sustains the capabilities of the system, including its usability properties and can be used in its entirety.

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Annex F
(informative)
Some example process descriptions

Since the following process examples are considered highly useful to some readers of this standard, they have been included in this Annex. These could be incorporated into such a user's organizational process documentation.

F.1 Organizational Alignment Process

F.1.1 Purpose

The purpose of Organizational Alignment is to enable the software processes needed by the organization to provided software products and services, to be consistent with its business goals.

F.1.2 Outcomes

As a result of the successful implementation of Organizational Alignment:

a) the organization's business goals are identified;

b) the process framework is identified and defined that includes a set of software processes needed to achieve the business goals of the organization;

c) a strategy is defined for process definition, implementation and improvement;

d) support is provided to enable this strategy;

e) the organization's mission, core values, vision, goals and objectives is made known to all employees;

f) individuals in the organization share a common vision, culture, and understanding of the business goals to empower them to function effectively; and

g) everyone in the organization understands their role in achieving the goals of the business and is able to perform that role

F.2 Organization Management Process

F.2.1 Purpose

The purpose of Organization Management is to establish and perform software management practices, during the performance of the processes needed for providing software products and services, that are consistent with the business goals of the organization.

NOTE Although organizational operations in general have a much broader scope than that of software process, software processes are implemented in a business context and to be effective, require an appropriate organizational environment.

F.2.2 Outcomes

As a result of the successful implementation of Organization Management:

a) the organization will invest in the appropriate management infrastructure;

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b) the best practices are identified to support the implementation of effective organization and project management; and

c) a basis for evaluating the achievement of organization business goals based on these management practices is provided.

F.3 Contract Change Management Process

F.3.1 Purpose

The purpose of the Contract Change Management Process is to develop the new contract contents as agreed by both the acquirer and the supplier when a change request affecting the agreed contract contents is proposed. This process begins with a proposal of the change request by either the acquirer or the supplier and ends with the conclusion acceptable for both parties: withdrawal or overall/partial approval of the change request.

F.3.2 Outcomes

As a result of successful implementation of the Contract Change Management Process:

a) the change request to the contract is proposed explicitly and formally;

b) the roles and responsibilities of both the acquirer and the supplier for the contract change management are established;

c) the impact of the change request to the contract on the project plans, costs, benefits, quality and schedule is evaluated;

d) the actions against the change request are taken to get agreement and satisfaction of both the acquirer and the supplier; and

e) the result of each change request is made known to all affected parties.

F.3.3 Activities and tasks

The acquirer and the supplier shall implement the following activities in accordance with applicable organizational policies and procedures with respect to the Contract Change Management Process.

F.3.3.1 Process preparation. This activity consists of the following tasks:

F.3.3.1.1 The acquirer and the supplier shall agree to negotiate any change to the contract in consultative body and specify this in the contract. They shall establish the consultative body before starting development work.

F.3.3.1.2 The acquirer and the supplier shall define and document a procedure for managing change to the contract.

F.3.3.2 Change request to the contract. This activity consists of the following task:

F.3.3.2.1 In requesting change to the baselined items in the contract, the acquirer or the supplier shall document its specifications, reasons and backgrounds, and explain it to the other. In modifying the contract, the supplier shall document and explain it to the acquirer for impact on project plans, costs, benefits, quality, and schedule.

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F.3.3.3 Investigating and analyzing change impact. This activity consists of the following task:

F.3.3.3.1 For change request to the contract from the acquirer, the supplier shall investigate its impact on project plans, costs, benefits, quality, and schedule, and then document and explain it to the acquirer. In explanation, the supplier should make the basis clear.

F.3.3.4 Negotiation and agreement. This activity consists of the following tasks:

F.3.3.4.1 In negotiation, the acquirer and the supplier shall come to the most appropriate conclusion through considering the change contents, reasons and backgrounds as well as its impact on project plans, costs, benefits, quality, and schedule.

F.3.3.4.2 The acquirer and the supplier, especially in negotiating the costs, shall raise the problem to the upper-level management for its appropriate agreement or solution, as needed.

F.3.3.5 Contract modification. This activity consists of the following tasks:

F.3.3.5.1 The acquirer and the supplier shall document their agreement and confirm it. The acquirer and the supplier shall modify the original contract immediately and conclude the revised contract whenever the modification is necessary. After that, the acquirer and the supplier shall manage the contract contents as part of change control.

F.3.3.5.2 For any contract modification, the affected configuration items shall be baselined. This procedure shall be performed using the Configuration Management Process.

F.3.3.5.3 The result of the contract modification shall be incorporated to the project plans and made known to all affected parties.

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Annex G
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Relationship to other IEEE standards

Relationships to other ISO/IEC standards are described in the body of this International Standard. The purpose of this informative annex is to describe relationships to other IEEE standards. The table below lists the processes of this International Standard. For many of those processes, the table suggests IEEE standards that may be helpful in implementing or executing the process. In each case, a note describes the nature of the relationship. The binning of the standards against particular processes is only approximate. Many of the IEEE standards have a scope larger than a single process.

Table G.1 — Relationship of IEEE Std 12207 to other IEEE standards

Category	Clause	Process	Relevant IEEE Std	Notes
System Agreement Processes	6.1.1	Acquisition Process	1062	This document recommends a set of useful practices that can be selected and applied during software acquisition.
	6.1.2	Supply Process		

Category	Clause	Process	Relevant IEEE Std	Notes
6.2 System Process-Enabling Processes	6.2.1	Life Cycle Model Management Process	1074	This standard describes an approach for the definition of software life cycle processes.
	6.2.2	Infrastructure Management Process	1175 1462	The current and planned parts of IEEE Std 1175 describe the integration of CASE tools into a productive software engineering environment. IEEE Std 1462 provides guidelines for the evaluation and selection of CASE tools. It is very similar to ISO/IEC 14102.
	6.2.3	Project Portfolio Management Process		
	6.2.4	Human Resource Management Process		
	6.2.5	Quality Management Process	90003	This standard provides guidance for organizations in the application of ISO 9001:2000 to software. It is an adoption of ISO/IEC 90003.

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Category	Clause	Process	Relevant IEEE Std	Notes
6.3 System Project Processes	6.3 and its sub-clauses		1490	This document is the IEEE adoption of the circa 2000 edition of the Project Management Body of Knowledge.
	6.3.1	Project Planning Process	1058 (16326) 1228	IEEE Std 1058 describes the format and content of a software project management plan. It is expected to be replaced by ISO/IEC and IEEE Std 16326. IEEE Std 1228 describes the content of a plan for the software aspects of development, procurement, maintenance, and retirement of a safety-critical system.
	6.3.2	Project Assessment and Control Process		
	6.3.3	Decision Management Process		
	6.3.4	Risk Management Process	1540 (16085)	IEEE Std 1540 provides a process for the management of software risk. It is expected to be replaced by ISO/IEC and IEEE Std 16085, which deal with risk at the system and the software level.
	6.3.5	Configuration Management Process		
	6.3.6	Information Management Process		
	6.3.7	Measurement Process	982.1 1045 1061 14143.1	IEEE Std 982.1 provides a set of measures for forecasting and evaluating the reliability of a software product. IEEE Std 1045 provides a consistent terminology for software productivity measures. IEEE Std 1061 describes a methodology—spanning the life cycle—for establishing quality requirements and for identifying, implementing, and validating the corresponding measures. IEEE Std 14143.1 describes the fundamental concepts of a class of measures collectively known as functional size.

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Category	Clause	Process	Relevant IEEE Std	Notes
6.4 System Technical Processes	6.4.1	Stakeholder Requirements Definition Process	1362	This document provides guidance on the format and content of a Concept of Operations document, describing characteristics of a proposed system from the user's viewpoint.
	6.4.2	System Requirements Analysis	1233 1320.1 1320.2	IEEE Std 1233 provides guidance on the development of a system requirements specification and the characteristics and qualities of requirements. IEEE Std 1320.1 and 1320.2 define two languages, IDEF0 and IDEF1X97, that can be used for conceptual modelling, including the representation of requirements.
	6.4.3	System Architectural Design	1471 (42010)	IEEE Std 1471 recommends a conceptual framework and content for the architectural description of software-intensive systems. It is expected to be replaced by a revision, ISO/IEC and IEEE Std 42010.
	6.4.4	Implementation Process		
	6.4.5	System Integration Process		
	6.4.6	System Qualification Testing Process		
	6.4.7	Software Installation		
	6.4.8	Software Acceptance Support		
	6.4.9	Software Operation Process		
	6.4.10	Software Maintenance Process	14764	This standard, identical with ISO/IEC 14764, provides guidance on implementing the software maintenance process of ISO/IEC 12207.
	6.4.11	Software Disposal Process		

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Category	Clause	Process	Relevant IEEE Std	Notes
7.1 Software Implementation Processes	7.1.1	Software Implementation Process		
	7.1.2	Software Requirements Analysis Process	830	This document recommends the content and characteristics of a software requirements specification.
	7.1.3	Software Architectural Design Process	1471 (42010)	IEEE Std 1471 recommends a conceptual framework and content for the architectural description of software-intensive systems. It is expected to be replaced by a revision, ISO/IEC and IEEE Std 42010.
	7.1.4	Software Detailed Design Process	1016	This document recommends content and organization of a software design description.
	7.1.5	Software Construction Process	1008	This document describes an approach to software unit testing.
	7.1.6	Software Integration Process	829	This standard describes the form and content of a basic set of documentation for planning, executing, and reporting software testing.
	7.1.7	Software Qualification Testing Process	829	This standard describes the form and content of a basic set of documentation for planning, executing, and reporting software testing.

Category	Clause	Process	Relevant IEEE Std	Notes
7.2 Software Support Processes	7.2.1	Software Documentation Management Process	1063 12207.1 (15289)	IEEE Std 1063 provides requirements for the structure, content and format of user documentation. IEEE Std 12207.1 provides guidance on recording data resulting from executing the life cycle processes of ISO/IEC 12207. It is expected to be replaced by an IEEE adoption of ISO/IEC 15289.
	7.2.2	Software Configuration Management Process	828	This standard specifies the content of a software configuration management plan along with requirements for specific planning activities.
	7.2.3	Software Quality Assurance Process	730 1061 1465 (25051)	IEEE Std 730 specifies the format and content of a software quality assurance plan. IEEE Std 1061 describes a methodology—spanning the life cycle—for establishing quality requirements and for identifying, implementing, and validating the corresponding measures. IEEE Std 1465 describes quality requirements specifically suitable for software "packages". It is expected to be replaced by an IEEE adoption of ISO/IEC 25051.
	7.2.4	Software Verification Process	1012	This standard describes software verification and validation activities.

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Category	Clause	Process	Relevant IEEE Std	Notes
	7.2.5	Software Validation Process	1012	This standard describes software verification and validation activities.
	7.2.6	Software Review Process	1028	This standard describes five types of software reviews, and procedures for their execution.
	7.2.7	Software Audit Process	1028	This standard describes five types of software reviews, and procedures for their execution.
	7.2.8	Software Problem Resolution Process	1044	This standard provides a uniform approach to the classification of anomalies found in software and its documentation.

Category	Clause	Process	Relevant IEEE Std	Notes
7.3 Software Reuse Processes	7.3 and its sub-clauses		1420.1 1517	IEEE Std 1420.1 and its supplements describe information that software reuse libraries should be able to exchange in order to interchange assets. IEEE Std 1517 provides life cycle processes for systematic software reuse.
	7.3.1	Domain Engineering Process		
	7.3.2	Reuse Asset Management Process		
	7.3.3	Reuse Program Management Process		

The full titles of the IEEE standards are listed below:

IEEE Std 730™-2002
IEEE Standard for Software Quality Assurance Plans

IEEE Std 828™-2005
IEEE Standard for Software Configuration Management Plans

IEEE Std 829™-1998
IEEE Standard for Software Test Documentation

IEEE Std 830™-1998
IEEE Recommended Practice for Software Requirements Specifications

IEEE Std 982.1™-1988
IEEE Standard Dictionary of Measures to Produce Reliable Software

IEEE Std 1008™-1987 (R2003)
IEEE Standard for Software Unit Testing

IEEE Std 1012™-2004
IEEE Standard for Software Verification and Validation

IEEE Std 1016™-1998
IEEE Recommended Practice for Software Design Descriptions.

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IEEE Std 1028™-1997 (R2002)
IEEE Standard for Software Reviews

IEEE Std 1044™-1993 (R2002)
IEEE Standard Classification for Software Anomalies

IEEE Std 1045™-1992 (R2002)
IEEE Standard for Software Productivity Metrics

IEEE Std 1058™-1998
IEEE Standard for Software Project Management Plans

IEEE Std 1061™-1998 (R2004)
IEEE Standard for a Software Quality Metrics Methodology

IEEE Std 1062™-1998 (R2002)
IEEE Recommended Practice for Software Acquisition

IEEE Std 1063™-2001
IEEE Standard for Software User Documentation

IEEE Std 1074™-1997
IEEE Standard for Developing Software Life Cycle Processes

IEEE Std 1175.1™-2002
IEEE Guide for CASE Tool Interconnections—Classification and Description.

IEEE Std 1228™-1994 (R2002)
IEEE Standard for Software Safety Plans

IEEE Std 1233™, 1998 Edition (R2002)
IEEE Guide for Developing System Requirements Specifications.

IEEE Std 1320.1™-1998 (R2004)
IEEE Standard for Functional Modeling Language—Syntax and Semantics for IDEF0

IEEE Std 1320.2™-1998 (R2004)
IEEE Standard for Conceptual Modeling Language—Syntax and Semantics for IDEF1X 97 (IDEF object)

IEEE Std 1362™-1998
IEEE Guide for Information Technology—System Definition—Concept of Operations (ConOps) Document

IEEE Std 1420.1™-1995 (R2002)
IEEE Standard for Information Technology—Software Reuse—Data Model for Reuse Library Interoperability: Basic Interoperability Data Model (BIDM)

IEEE Std 1420.1a™-1996 (R2002)
Supplement to IEEE Standard for Information Technology—Software Reuse—Data Model for Reuse Library Interoperability: Asset Certification Framework

IEEE Std 1420.1b™-1999 (R2002)
IEEE Trial-Use Supplement to IEEE Standard for Information Technology—Software Reuse—Data Model for Reuse Library Interoperability: Intellectual property Rights Framework

IEEE Std 1462™-1998 (R2004)
IEEE Standard: Adoption of International Standard ISO/IEC 14102: 1995, Information Technology—Guideline for the Evaluation and Selection of CASE tools

IEEE Std 1465™-1998 (R2004)
IEEE Standard: Adoption of International Standard ISO/IEC 12119:1994(E), Information Technology—Software Packages—Quality Requirements and Testing

IEEE Std 1471™-2000
IEEE Recommended Practice for Architectural Description of Software Intensive Systems

IEEE Std 1490™-2003
IEEE Guide: Adoption of PMI Standard, A Guide to the Project Management Body of Knowledge (PMBOK® Guide)

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IEEE Std 1517™-1999 (R2004)
IEEE Standard for Information Technology—Software Life Cycle Processes—Reuse Processes

IEEE Std 1540™-2001
IEEE Standard for Software Life Cycle Processes—Risk Management

IEEE/EIA 12207.1™-1996
Industry Implementation of International Standard ISO/IEC 12207:1995, Standard for Information Technology—Software Life Cycle Processes—Life Cycle Data

IEEE Std 14143.1™-2000
IEEE Adoption of ISO/IEC 14143-1:1998, Information Technology—Software Measurement—Functional Size Measurement—Part 1: Definition of Concepts

IEEE Std 14764™-2006
Software Engineering—Software Life Cycle Processes—Software Maintenance

IEEE P90003[1]
Software Engineering—Guidelines for the Application of ISO 9001:2000 Computer Software

[1] Numbers preceded by P are IEEE authorized standards projects that were not approved by the IEEE-SA Standards Board at the time this publication went to press. For information about obtaining drafts, contact the IEEE.

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Annex H
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[15] ISO/IEC 14764:2006, Software Engineering — Software life cycle processes — Maintenance.

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NOTE The ISO/IEC 25000 family of documents is replacing the ISO/IEC 9126 multi-part series. Selections from both sets appear in this International Standard.

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Annex I
(informative)
List of participants

IEEE Participants

At the time this standard was submitted to the IEEE-SA Standards Board for approval, the Working Group for Life Cycle Processes had the following membership:

James W. Moore, *IEEE Liaison to ISO/IEC JTC 1/SC 7*
Teresa Doran, *Editor*
Anatol W. Kark, *Co-editor*

The following members of the individual balloting committee voted on this standard. Balloters may have voted for approval, disapproval, or abstention.

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