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Information technology — Software life cycle processes

AMENDMENT 1

Technologies de l'information — Processus du cycle de vie du logiciel

AMENDEMENT 1

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Foreword

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

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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.

Attention is drawn to the possibility that some of the elements of this Amendment may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

Amendment 1 to International Standard ISO/IEC 12207:1995 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 7, *Software engineering*.

Introduction

ISO/IEC 12207 was published on 1 August 1995 and is 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, stand alone software product, and software services. The standard provides common software process architecture for the acquisition, supply, development, operation and maintenance of software. The standard also provides the necessary supporting processes, activities and tasks, and organizational processes, activities and tasks for managing and improving the processes.

This Amendment provides an interim revision to ISO/IEC 12207 that establishes a co-ordinated set of software process information that can be used for process definition and process assessment and improvement. The Amendment accommodates the requirements of current and developing SC 7 standards and technical reports, notably ISO/IEC 12207 and ISO/IEC/TR 15504, and considers other standards, e.g., ISO/IEC 14598 and ISO/IEC 15939. Experience in using ISO/IEC 12207 as the basis for organizations' software life cycle process and in two-party situations, has resulted in some lessons learned and has provided some valuable inputs to the update process.

During the development of ISO/IEC/TR 15504-2, issues were highlighted in regard to the granularity of the process definition in ISO/IEC 12207, i.e.; it was difficult to derive a process rating component for the purpose of process assessment and improvement. This Amendment resolves this granularity issue and provides process purpose and outcomes to establish a Process Reference Model in accordance with the requirements of ISO/IEC 15504-2. A Process Reference Model provides definitions of processes in a life cycle described in terms of process purpose and outcomes, together with an architecture describing relationships between the processes. A Process Reference Model provides the mechanism whereby externally defined assessment models are related to the assessment framework defined by ISO/IEC 15504.

The current ISO/IEC 12207 process architecture defines the hierarchical relationship among processes, activities and tasks and the invocation rules for the software life cycle processes. Inclusion of a process, an activity, or a task for the Amendment is in accordance and consistent with the existing architecture of ISO/IEC 12207.

Information technology — Software life cycle processes

AMENDMENT 1

Throughout the text:

Change the name of the “Training”process to the “Human Resource”process.

Modify the last sentence of the Foreword to read as follows:

“Annexes A and F form an integral part of this International Standard. Annexes B, C, D, E, G and H are for information only.”

Modify subclause 1.2, paragraph 4, to read as follows:

1.2 Field of Application

This clause does not prevent the use of ISO/IEC 12207 by suppliers or developers of off-the-shelf software.

In subclause 1.4, change “compliance” to read “conformance”.

Add the following text to subclause 1.4:

1.4.1 Conformance to Purposes and Outcomes

Annex F provides an alternative form of conformance useful in situations where implemented processes are intended to achieve the same goals of those described in this standard, but which may not implement the detailed provisions prescribed in the body of this standard. To claim conformance, it shall be demonstrated that, for any process from the set of processes declared by the organization, implementation of the processes results in the realization of the corresponding Purpose and Outcomes provided in Annex F. Any organization shall define the set of processes applicable for it, taking into account the proposed set of processes described in Annex F and its own environmental parameters. Application of the standard allows the creation of additional outcomes.

NOTE In ISO/IEC 12207:1995, the term “compliance”is used in clause 1.4, however, in accordance with ISO/IEC Guide 2, *Standardization and Related Activities — General Vocabulary*, conformance is the appropriate term for this clause. Conformance is the fulfilment by a product, process or service of specified requirements.

Modify subclause 1.5, paragraph 6, to read as follows:

1.5 Limitations

In this International Standard, there are a number of lists for tasks; none of these is presumed to be exhaustive — they are intended as examples unless introduced by a clause containing a “shall”or a “will.”

Add the following reference to clause 2:

ISO/IEC 15504-2, *Software Engineering — Software process assessment — Part 2: Performing an assessment*

Add the following definitions to clause 3:

3.38 Process Purpose: The high level objective of performing the process and the likely outcomes of effective implementation of the process. The implementation of the process should provide tangible benefits to the stakeholders.

3.39 Process Outcome: an 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.

NOTE A list of the principal process outcomes forms part of the description of each process in the reference model.

Add the following subclause to clause 4:

4.2 Relationship of Annex F to the main text of this International Standard

Annex F 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 provided in Annex F 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 F rather than against the detailed provisions in the main text of this International Standard.

NOTES

1) The term “process reference model”is used with the same meaning as the planned revision of ISO/IEC 15504-2.

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

3) The processes described in Annex F contain extensions, elaborations and some new processes where there is no corresponding development of activities and tasks in ISO/IEC 12207:1995. This will be rectified during the full revision of ISO/IEC 12207:1995. In the meantime, new subclauses 6.9, 7.1.6 and 7.4 to 7.7 provide activities and tasks for the “new”processes of Annex F.

Add the following text to subclause 5.1.1.5:

The acquirer may use Requirements Elicitation sub-process described in Annex F to establish the customer requirements.

Modify subclause 5.1.3.5, sentence 2, as follows:

Subclause 5.1.3.5, “Shall” should be changed to “will”

Add the following text to subclause 5.3.1.2, list item e):

e) Establish baselines for each configuration item at appropriate times, as determined by the acquirer and the supplier.

Delete sentence 2 of subclause 5.3.4.3.

Delete subclause 5.3.9.5.b.

Delete subclause 5.3.11.4.b.

Add the following text as a second paragraph to the preamble of subclause 6.1:

Execution of this process by an organization results in the establishment of internal documentation standards (such as standards for program management plan and software design document) in a suitable media. The terms used in this process need to be interpreted accordingly for a given media or domain.

Modify line 2 of the preamble of subclause 6.2 as follows:

"Baseline" should be deleted. The resulting sentence should read as follows:

The Configuration Management Process is a process of applying administrative and technical procedures to support the software life cycle to: identify and define software items in a system; control modifications and releases of the items; record and report the status of the items and modification requests; ensure the completeness, consistency, and correctness of the items, and control storage, handling, and delivery of the items.

Replace subclause 6.3.4.1 with the following:

Additional quality management activities can be assured in accordance with the clauses of ISO 9001.

Add the following note to subclause 6.5.2:

NOTE Other means besides testing (such as, analysis, modelling, simulation, etc.) may be employed for validation.

Replace list item e) in subclause 6.6.3.1 with the following:

e) They are ready for the next planned activity.

Add the following references to annex D:

IEEE Std 1517 — 1999, *IEEE Standard for Information Technology — Software Life Cycle Processes — Reuse Processes*

ISO 9000-3, *Quality management and quality assurance standards -- Part 3: Guidelines for the application of ISO 9001:1994 to the development, supply, installation and maintenance of computer software*

ISO 9000: 2000, *Quality management systems — Concepts and vocabulary*

ISO 9001: 2000, *Quality management systems — Requirements*

ISO 9004: 2000, *Quality management systems — Guidance for performance improvement*

ISO/IEC 9126:1991, *Software Product Evaluation — Quality Characteristics and Guidelines for their Use*

ISO 13407:1999, *Ergonomics — Ergonomics of human-system interaction — Human-centred design process for interactive systems*

ISO/IEC 14598:1998, *Software Engineering — Product Evaluation*

ISO/IEC/TR 15504:(all parts), *Information technology — Software process assessment*

ISO/IEC 15504-1, (to be published) *Software Engineering — Software process assessment — Part 1: Concepts and Vocabulary*

ISO/TR 18529, *Ergonomics — Ergonomics of human-system interaction — Human-centred lifecycle process descriptions*

ISO/IEC 15939 *Software Engineering — Software process measurement*

Add the following annexes E, F, G and H:

Annex E
(informative)

Relationship to ISO 12207:1995

E.1 Relationship of Purpose and Outcomes to ISO/IEC 12207:1995

ISO/IEC 12207:1995 documents the set of software engineering processes that are fundamental to good software engineering and cover best practices. The Processes of the Life Cycle are described in Annex F in terms of the achievement of defined Purposes and Outcomes; these descriptions constitute a reference model, which describes processes that an organization can use to acquire, supply, develop, operate and maintain software. The reference model is also used to provide a common basis for different models and methods for software process assessment, ensuring that the results of the assessments can be reported in a common context. The substantive part of ISO/IEC 12207:1995 sets out the activities and tasks required to implement the high level life cycle processes to achieve desirable capability for acquirers, suppliers, developers, maintainers and operators of systems containing software.

Annex F groups the Purposes and Outcomes into the three life cycle process categories of ISO/IEC 12207:1995, i.e., Organizational, Primary and Supporting. Within each of the process categories are descriptions in terms of a purpose statement, which comprise unique functional objectives when instantiated in a particular environment. The purpose statement includes additional material identifying the outcomes of successful implementation.

Annex F does not define how, or in what order, the elements of the purpose statements are to be achieved. The outcomes will be achieved in an organization through various detailed practices being carried out to produce work products. These performed practices, and the characteristics of the work products produced, are indicators that demonstrate whether the specific purpose is being achieved.

The structure of Annex F and its relationship to the existing International Standard, ISO/IEC 12207:1995, is depicted in Table E-1. For those Purpose and Outcomes that are an "new" to ISO/IEC 12207:1995, descriptions of their activities and/or tasks are provided in new subclauses 6.9, 7.1.6 and 7.4 to 7.7. The activity and task descriptions provided in these new subclauses are in accordance with process structure of ISO/IEC 12207:1995.

E.2 Purpose and Outcomes

The Purpose and Outcomes in Annex F are at the appropriate process, activity or task level to align with the process structure of ISO/IEC 12207. The definition of purpose and outcomes is provided in clause 1.1.2 of this Amendment.

E.3 Process Type

Table E-1 provides a detailed mapping of the content of Annex F to the existing International Standard, ISO/IEC 12207:1995, the source of the information, the structure of the content and the content type. The process structure relationship of Annex F to ISO/IEC 12207 :1995 is defined by process type as follows:

- Basic — These processes and sub-processes are identical to the processes and activities of ISO/IEC 12207:1995.
- New — These processes and sub-processes are an expansion to the process definition of ISO/IEC 12207:1995.
- Extended — These processes and sub-processes are elaborations of the existing processes and activities of ISO/IEC 12207:1995.
- Component — These are groupings of existing activities of ISO/IEC 12207:1995.

Table E.1 — Correlation of ISO/IEC 12207:1995 to Annex F

12207	12207 Processes & activities	Annex F Source	Annex F Process Structure	Process Type
5.	*Primary life cycle processes*			
5.1	Acquisition process	ISO/IEC 12207	Acquisition process	basic
		ISO/IEC/TR 15504-2	Acquisition preparation	component
		ISO/IEC/TR 15504-2	Supplier selection	component
		ISO/IEC/TR 15504-2	Supplier monitoring	component
		ISO/IEC/TR 15504-2	Customer acceptance	component
5.2	Supply process	ISO/IEC 12207	Supply process	basic
5.3	Development process	ISO/IEC 12207	Development process	basic
5.3.1	Process implementation			
		ISO/IEC/TR 15504-2	Requirements elicitation	extended
5.3.2	System requirements analysis	ISO/IEC 12207	System requirements analysis	basic
5.3.3	System architectural design	ISO/IEC 12207	System architectural design	basic
5.3.4	Software requirements analysis	ISO/IEC 12207	Software requirements analysis	basic
5.3.5	Software architectural design	ISO/IEC/TR 15504-2	Software design	component
5.3.6	Software detailed design	ISO/IEC/TR 15504-2	Software design	component
5.3.7	Software coding and testing	ISO/IEC/TR 15504-2	Software construction	component
5.3.8	Software integration	ISO/IEC 12207	Software integration	basic
5.3.9	Software qualification testing	ISO/IEC/TR 15504-2	Software testing	component
5.3.10	System integration	ISO/IEC/TR 15504-2	System integration	component
5.3.11	System qualification testing	ISO/IEC/TR 15504-2	System testing	component
5.3.12	Software installation	ISO/IEC 12207	Software installation	basic
5.3.13	Software acceptance support	ISO/IEC 12207	Supply process	basic
5.4	Operation process	ISO/IEC 12207	Operation process	basic
		ISO/IEC/TR 15504-2	Operational use	extended
		ISO/IEC/TR 15504-2	Customer support	extended
5.5	Maintenance process	ISO/IEC 12207	Maintenance process	basic
6.	*Supporting life cycle processes*			
6.1	Documentation process	ISO/IEC 12207	Documentation process	basic
6.2	Configuration management process	ISO/IEC 12207	Configuration management process	basic
6.3	Quality assurance process	ISO/IEC 12207	Quality assurance process	basic
6.4	Verification process	ISO/IEC 12207	Verification process	basic
6.5	Validation process	ISO/IEC 12207	Validation process	basic
6.6	Joint review process	ISO/IEC 12207	Joint review process	basic
6.7	Audit process	ISO/IEC 12207	Audit process	basic
6.8	Problem resolution process	ISO/IEC12207	Problem resolution process	basic
		ISO 13407	Usability process	new
		ISO/IEC 14598	Product evaluation process	extended

Table E.1 — *(continued)*

12207	12207 Processes & activities	Annex F Source	Annex F Process Structure	Process Type
7.	*Organizational life cycle processes*			
7.1	Management process	ISO/IEC 12207	Management process	basic
		ISO/IEC/TR 15504-2	Organizational alignment	extended
		ISO/IEC 12207	Organizational management	basic
		ISO/IEC/TR 15504-2	Project management	extended
		ISO/IEC/TR 15504-2	Quality Management	extended
		ISO/IEC/TR 15504-2	Risk Management	extended
		ISO/IEC 15939	Measurement	new
7.2	Infrastructure process	ISO/IEC 12207	Infrastructure process	basic
7.3	Improvement process	ISO/IEC 12207	Improvement process	basic
7.3.1	Process establishment	ISO/IEC/TR 15504-2	Process establishment	component
7.3.2	Process assessment	ISO/IEC/TR 15504-2	Process assessment	component
7.3.3	Process improvement	ISO/IEC/TR 15504-2	Process improvement	component
7.4	Training process	ISO/IEC/TR 15504-2	Human Resource process	new
		ISO/IEC/TR 15504-2	Human resource management	new
		ISO/IEC 12207	Training	basic
			Knowledge management	new
7.5		IEEE 1517	Asset management process	new
7.6		IEEE 1517	Reuse program management process	new
7.7		IEEE 1517	Domain engineering process	new

Annex F
(normative)

Purpose and Outcomes

Annex F provides a process reference model that is characterized in terms of process purposes and outcomes, together with an architecture describing the relationships between processes, that describe the expected results from the implementation of this Annex by an organization or a project. The process reference model is applicable to an organization that is assessing processes needed for business success and the subsequent continuous improvement of these processes.

The process 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 tailored 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.

The reference model's purpose and outcomes are indicators that demonstrate whether the organization's processes are being achieved. These indicators are useful to process assessors to determine the capability of the organization's implemented process and to provide source material to plan organizational process improvement. The reference model is strongly aligned with ISO/IEC 12207:1995, provides detailed process expectations and includes additional processes determined as essential to enable a reliable and repeatable assessments of software organizations.

NOTE Copyright release: Users may freely reproduce the detailed descriptions of process purpose and outcomes in this annex as part of any Assessment Model based upon the Process Reference Model, or as part of any demonstration of compatibility with the Process Reference Model, so that it can be used for its intended purpose.

F.1 Primary Life Cycle Processes

F.1.1 Acquisition Process

Purpose:

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

NOTE Annex H provides an extension of the acquisition process that may be used in lieu of the acquisition process provided in Annex F.

Outcomes:

As a result of successful implementation of the *Acquisition Process* :

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

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

3) a product and/or service is acquired that satisfies the customer's stated need;

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

5) supplier deliverables are accepted;

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

NOTE Numbering of outcomes is for identification only and does not imply priority or sequence.

The *Acquisition Process* includes purposes and outcomes for the following sub-processes:

- Acquisition Preparation
- Supplier Selection
- Supplier Monitoring
- Customer Acceptance

F.1.1.1 Acquisition preparation

Purpose:

The purpose of *Acquisition preparation* is to establish the needs and goals of the acquisition and to communicate these with the potential suppliers.

Outcomes:

As a result of successful implementation of *Acquisition preparation*:

1) the concept or the need for the acquisition, development, or enhancement is established;
2) the needed acquisition requirements defining the project needs are defined and validated;
3) the customer's known requirements are defined and validated;
4) an acquisition strategy is developed; and
5) supplier selection criteria are defined.

F.1.1.2 Supplier selection

Purpose:

The purpose of *Supplier selection* is to choose the organization that is to be responsible for the delivery of the requirements of the project.

Outcomes:

As a result of successful implementation of *Supplier selection*:

1) the supplier selection criteria are established and used to evaluate potential suppliers;
2) the supplier is selected based upon the evaluation of the supplier's proposals, process capabilities, and other factors; and
3) an agreement is established and negotiated between the customer and the supplier.

F.1.1.3 Supplier monitoring

Purpose:

The purpose of *Supplier monitoring* is to track and assess performance of the supplier against agreed requirements.

Outcomes:

As a result of successful implementation of *Supplier monitoring*:

1) joint activities between the customer and the supplier are performed as needed;

2) information on technical progress is exchanged regularly with the supplier;

3) performance of the supplier is monitored against the agreed requirements; and

4) agreement changes, if needed, are negotiated between the acquirer and the supplier and documented in the agreement.

F.1.1.4 Customer acceptance

Purpose:

The purpose of *Customer acceptance* is to approve the supplier's deliverable when all acceptance criteria are satisfied.

Outcomes:

As a result of successful implementation of *Customer acceptance*:

1) the delivered software product and/or service are evaluated with regard to the agreement

2) the customer's acceptance is based on the agreed acceptance criteria; and

3) the software product and/or service is accepted by the customer.

F.1.2 Supply Process

Purpose:

The purpose of the *Supply process* is to provide a product or service to the customer that meets the agreed requirements.

Outcomes:

As a result of successful implementation of the *Supply process*:

1) a response to customer's request is produced;

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

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

4) the product and/or service is delivered to the customer in accordance with the agreed requirements.

F.1.3 Development Process

Purpose:

The purpose of the *Development Process* is to transform a set of requirements into a software product or software-based system that meets the customer's stated needs. The activities of the Development Process are composed for Systems Developer role and Software Developer role.

Outcomes:

As a result of the successful implementation of the *Development Process* :

1) requirements for the development of software are gathered and agreed;

2) a software product or software-based system is developed;

3) intermediate work products are developed that demonstrate that the end product is based upon the requirements;

4) consistency is established between the products of the development process;

5) system quality factors are optimized against system requirements, e.g., speed, development cost, usability, etc.;

6) evidence (for example, testing evidence) is provided that demonstrates that the end product meets the requirements; and

7) the end product is installed in accordance with the agreed requirements.

The *Development Process* includes purposes and outcomes for the following sub-processes:

- Requirements Elicitation
- System Requirements Analysis
- System Architecture Design
- Software Requirements Analysis
- Software Design
- Software Construction (Code and Unit Test)
- Software Integration
- Software Testing
- System Integration
- System Testing
- Software Installation

F.1.3.1 Requirements elicitation

Purpose:

The purpose of R*equirements elicitation* is to gather, process, and track evolving customer needs and requirements throughout the life of the product and/or service so as to establish a requirements baseline that serves as the basis for defining the needed work products. *Requirements elicitation* may be performed by the acquirer or the developer of the system.

Outcomes:

As a result of successful implementation of *Requirements elicitation:*

1) continuing communication with the customer is established;

2) agreed customer requirements are defined and baselined;

3) a change mechanism is established to evaluate and incorporate changes to customer requirements into the baselined requirements based on changing customer needs;

4) a mechanism is established for continuous monitoring of customer needs;

5) a mechanism is established for ensuring that customers can easily determine the status and disposition of their requests; and

6) enhancements arising from changing technology and customer needs are identified and there impact managed.

F.1.3.2 System requirements analysis

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.

Outcomes:

As a result of successful implementation of *System requirements analysis*:

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

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

3) system requirements are analyzed for correctness and testability;

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

5) the requirements are priortized, approved and updated as needed;

6) consistency and traceability is established between the system requirements and the customer's requirements baseline;

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

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

F.1.3.3 System architectural design

Purpose:

The purpose of *System architectural design* is to identify which system requirements should be allocated to which elements of the system.

Outcomes:

As a result of successful implementation of *System architectural design*:

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

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

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

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