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# Systems and software engineering — Software Engineering Environment Services

*Ingénierie du logiciel et des systèmes — Services d'environnement en ingénierie du logiciel*

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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 2.

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 document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

ISO/IEC 15940 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 15940:2006), which has been technically revised.

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# Introduction

Software engineering environments, or “SEEs” refer to a collection of services, partially or fully automated by software tools, that are used to support the execution of human activities in systems and software engineering.

These activities are usually carried out within a software or system development/maintenance project, and cover such areas as the specification, development, re-engineering or maintenance of systems.

ISO/IEC 12207 describes in a comprehensive manner all of the processes, activities and tasks performed during the software life cycle.

The term “Software Engineering Environment” may cover several situations; from the mere juxtaposition of a few tools running on the same operating system, to the fully integrated environment, able to handle, monitor, and even control all the data, processes, and activities in the systems and software engineering life cycle. A SEE provides support to human activities through a series of services that describe the capabilities of the environment. The software process supported by a SEE becomes an assisted or automated software process. This International Standard describes SEE services and relates them to ISO/IEC 12207:2008 in a manner applicable to a range of organizations. In defining a life cycle process for an organization, the user needs to find the appropriate level of automation provided by a software engineering environment. This may result in establishing a new SEE or improving an existing one.

Through the automation of activities, either partially or fully, the SEE provides benefits to an organization through reduced cost (higher productivity), improved management and from the higher product quality that can result. For example, the automation of repetitive activities such as the execution of test cases provides not only productivity gains, but can also help to ensure completeness and consistency in the testing activities

This International Standard defines the SEE services conceptually in a reference model that can be adapted to any SEEs to automate one or more software and system engineering activities.

For a user interested in a specific process, this International Standard describes the relationship between given systems and software engineering processes, the software engineering services, and the corresponding exemplary software engineering tools.

The suite of SEE services described supports the process definitions in ISO/IEC 12207. The purpose is to define a set of SEE Services that are compatible with ISO/IEC 12207:2008, and that can be used either as a general reference, or to define an automated software and system process.

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# Systems and software engineering — Software Engineering Environment Services

## 1 Scope

This International Standard provides a description of SEE services that supports all of the software and system life cycle processes defined in ISO/IEC 12207.

The services are intended as a complete set and can be used in any systems and software engineering development or support organization where there is a need to select one or more SEE services. Such an organization may or may not have systems and software projects that use the ISO/IEC 12207 process framework.

A reference model for SEE Services is provided within this International Standard. This reference model has been produced starting from References [8] and [9]. This International Standard was produced using material originally published by the Software engineering Institute (Carnegie Mellon University, USA), NIST and ECMA, which finally resulted in a joint effort from ECMA and NIST indicating a broad consensus at the time of publication. In addition to this background process, structure from ISO/IEC 12207:2008 has been used as a baseline.

SEE Services for System Engineering and Software Reuse have been added to the revision of this International Standard. The list of changes between the previous version (ISO/IEC 15940:2006) and this version is given in Annex F.

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## 2 Terms and definitions

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

**2.1**
**life cycle model**
framework containing the processes, activities and tasks involved in the development operation and maintenance of a software and system product, spanning the life of the system from the definition of its requirements to the termination of its use

[ISO/IEC 12207:2008]

**2.2**
**CASE**
**computer-aided software engineering**
use of computers to aid in the software engineering process

[ISO/IEC/IEEE 24765:2010]

**2.3**
**CASE tool**
software product that can assist software and system engineers by providing automated support for software and system engineering life-cycle activities as defined in ISO/IEC 12207:2008

[ISO/IEC 14102:2008]

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**2.4**
**organization**
group of people and facilities with an arrangement of responsibilities, authorities and relationships

[ISO 9000:2005]

**2.5**
**work product**
any artefact produced by a process

NOTE This may include files, documents, part of the product, services, processes, specifications, and invoices.

[ISO/IEC/IEEE 24765:2010]

**2.6**
**systems engineering**
interdisciplinary approach governing the total technical and managerial effort required to transform a set of customer needs, expectations, and constraints into a solution and to support that solution throughout its life

NOTE This may include the definition of technical performance measures; the integration of engineering specialties toward the establishment of an architecture; and the definition of supporting lifecycle processes that balance cost, performance and schedule objectives

[ISO/IEC/IEEE 24765:2010]

**2.7**
**software engineering environment**
**SEE**
provides automated system context services and software specific services for the engineering of software systems and related domains (e.g., project management, process management, etc.)

NOTE It includes the platform, system software, utilities, and CASE tools installed.

**2.8**
**SEE Service**
consists in one or more service operations to support life cycle activities for the SEE

NOTE A SEE Service supplier provides a SEE Service for a SEE Service acquirer.

**2.9**
**automated or assisted systems or software process**
systems or software process that is performed either fully or partially supported by CASE tools

**2.10**
**actor**
organization or CASE tool that supplies and/or acquires SEE Services

**2.11**
**operation**
action needed to perform an Activity

NOTE One or more operations are necessary to execute an Activity. An operation may consist of other operations.

**2.12**
**SEE Service acquirer**
actor that acquires a SEE Service

**2.13**
**SEE Service supplier**
actor that supplies a SEE Service

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# 3 Abbreviated terms

CASE – Computer Aided Software Engineering

SEE – Software Engineering Environment.

# 4 Reference Model for SEE services

## 4.1 Categories of SEE services

This International Standard provides a reference model for SEE services. As a reference model, this International Standard uses a set of conceptual descriptions to describe each service used in a software engineering environment. The “conceptual description” indicates that the description is from a reference viewpoint, and does not deal with any specific implementation. The description is therefore general and does not assume any specific application domain, life cycle model, or tool in a project. In this way, this International Standard can be applied to any defined organizational environment.

An actual environment is one that is built from a reference model containing conceptual descriptions. Therefore, an actual description of a specific environment would reflect a particular activity with its tools and standards. The services described in this International Standard are grouped into eight categories that reflect broad functional activities within a typical systems and software engineering organization. The eight categories are:

- Software engineering services (e.g., Software Modelling );
- Systems engineering services (e.g., System Modelling);
- Systems engineering techniques services (e.g. Value analysis);
- Technical management services (e.g., Reuse, Configuration management);
- Project management services (e.g., Estimation, Project monitoring);
- Process management services (e.g., Process Monitoring, Process improvement);
- SEE Support services (e.g., Publishing, Policy enforcement);
- SEE infrastructure services (e.g., Repository, Communication, Operating System services).

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## 4.2 Structure of service description

Each service is defined under two headings:

- Service Concept, to provide a description of the service in terms that are not related to a specific implementation;
- Service Operations, to list those operations that may be included in a service. These lists of operational capabilities represent, in most cases, primary services only and are not intended to be complete.

Exemplary automated supports for each SEE Services are listed in Annex A, it includes lists of corresponding service operations to help readers understand SEE.

## 4.3 Reference model

SEE services can be identified within a Reference model. This section presents those concepts that are part of this reference model (see Fig.1 SEE Reference Model described in UML). The reference model is made of the following concepts:

- Software and system engineering Environment (model itself);
- SEE Service;
- SEE Service Operation;

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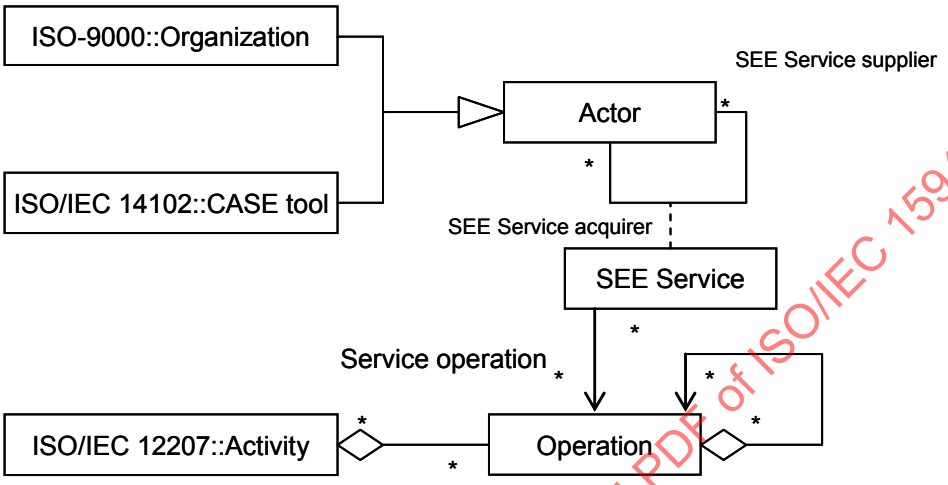
- CASE Tool;
- Actor;
- Activity;
- Organization.

While engineering software and systems and in related domains (e.g. project management), a life cycle Activity is achieved by one or more Operations. SEE Service operations satisfy target life cycle activities. Actor provides and/or consumes SEE Service.




NOTE Actor itself can be acquirer and/or supplier of a SEE service that is provided by an association of Actors. SEE Service can not exist alone without Actor.

NOTE brief usages of UML notation are described here for readers benefit

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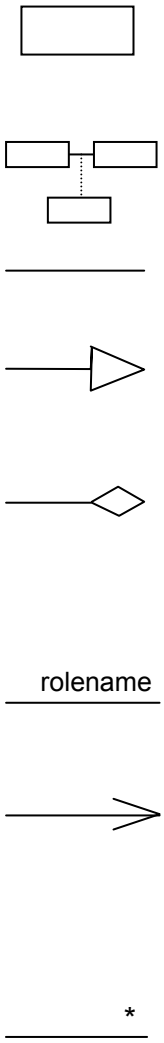
|  | class: A class is drawn as a solid-outline rectangle with a class name. A class name proceeding package names separated by double colons (::) indicate a class defined in another package<br><br>association class: An association that also has class properties (or a class that has association properties) shown as a class symbol (rectangle) attached by a dashed line to an association path<br><br>association: Binary associations are shown as lines connecting two class symbols<br><br>inheritance: A subclass "inherits" from the superclass, ("is a" relationship)It is represented in the image with a line starting at the subclass and ending in a white arrow at the superclass<br><br>aggregation: A superclass instance "uses a" subclass instance (or more than one)It is represented in the images with a line starting at the superclass with a white diamond and ending in the subclass<br><br>rolename: A name string near the end of the line indicates the role played by the class attached, if specified<br><br>navigability: An arrow may be attached to the end of the line to indicate that navigation is supported toward the classifier attached to the arrow. Normally one-way navigability is shown and two-way navigability is suppressed (no-way navigability is rare in practice)<br><br>* multiplicity: specifies the number of target instances that may be associated with a single source instance across the given Association. A single star '*' denotes the unlimited nonnegative integer range multiplicity that means many |

Figure 1 — SEE Reference Model described in UML

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# 5 Software engineering services

## 5.1 Overview

The services in this section support activities related to software life cycle specific services. The following services are defined and grouped in this section:

* Software requirements engineering services;
* Software reverse engineering service;
* Software re-engineering service;
* Software prototyping service;
* Software design service;
* Software modelling service;
* Software simulation service;
* Software component based software generation service;

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* Software source code generation service;
* Software compilation service;
* Software debugging service;
* Software static/dynamic analysis service;
* Software testing services;
* Software verification service;
* Software integration services;
* Software domain engineering service (Software reuse);
* Software reuse asset management service (Software reuse);
* Software reuse program management service (Software reuse).

## 5.2 Software requirements engineering service

### 5.2.1 Service concept

This service provides the ability to capture, represent, analyse, validate, and refine those system requirements that fulfil operational needs and are allocated to software components.

### 5.2.2 Service operations

This service provides the ability to:

- Elicit and capture software and business requirements;
- Structure the software requirements;
- Create, modify, browse, and present software requirements;
- Group and prioritise software requirements;
- Check consistency of software requirements;
- Allocate software requirements for each software component;
- Conduct impact analysis for the addition, subtraction, or modification in a requirement against the project , value, resources, and timeline;
- Validate and baseline the document specs based on stakeholders and developers.

## 5.3 Software reverse engineering service

### 5.3.1 Service concept

This service provides the ability to capture design information from source or object code, and produce structure charts, call graphs, and other design documentation to provide new functionality or support a new environment.

### 5.3.2 Service operations

This service provides the ability to:

- Generate design from source code;
- Generate source program from object code;

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- Generating design metrics (complexity metrics etc) (so that they can be considered for decision for reengineering or rewrite);
- Identifying unused code so that it can be removed if necessary.

## 5.4 Software re-engineering service

### 5.4.1 Service concept

This service provides the ability to take a new or a modified set of software requirements and the existing design as input and produce a new or modified design.

### 5.4.2 Service operations

This service provides the ability to:

- Revise or restructure existing design, components and/or code;
- Perform impact analysis of new design on existing software components;
- Translate from one notation or language into another;
- Check that the new set of requirements is consistent with the existing system;
- Determine the impact of the altered design on the existing set of components;
- Creating reusable modules from existing code;
- Creating wrappers for existing modules.

## 5.5 Software prototyping service

### 5.5.1 Service concept

This service provides the ability to enable the production of a software system that reproduces the user interface and emulates the functionality and behaviour of the final system to be built.

### 5.5.2 Service operations

This service provides the ability to:

- Build a prototype from requirements;
- Develop reusable or throw away prototype;
- Document the findings from prototype;
- Develop sample prototype of reports required;
- Invoke software modelling service if necessary and available;
- Produce a user interface from requirements;
- Execute a prototype : Also include capture user feedback on prototype;
- Conduct simulations if necessary and available.

## 5.6 Software modelling service

### 5.6.1 Service concept

This service provides the ability to model requirements and/or design in order to determine the effectiveness of alternative designs with respect to such attributes as user interface characteristics or execution flow.

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#### 5.6.2 Service operations

This service provides the ability to:

- Build a software model (graphical, logical, mathematical, formal, etc.) from requirements;
- Validate a software model; it can be based on completeness and correctness with respect to the requirements;
- Map and/or transform one software model into another;
- Analyse a software model.

### 5.7 Software simulation service

#### 5.7.1 Service concept

This service provides the ability to validate a software model by simulation in order to determine the effectiveness of alternative designs with respect to such attributes as user interface characteristics or execution flow.

#### 5.7.2 Service operations

This service provides the ability to:

- Build a simulation model by invoking the software modelling service if necessary and available;
- Execute a software model;
- Capture simulation results of software models.

### 5.8 Software design service

#### 5.8.1 Service concept

This service provides the ability to capture, represent, create, analyse, and refine the design attributes of the software components of a system or subsystem. The outcome of the software design service includes the definition of the software components and sub-components.

#### 5.8.2 Service operations

This service provides the ability to:

- Translate requirements into architecture and design elements;
- Create and modify software architecture and design representation;
- Validate architecture and design artefacts to requirements;
- Produce structure charts, graphs, screens or other design information from a design representation;
- Structure design specifications;
- Architecture and design documentation;
- Evaluate architecture and design representations.

### 5.9 Software component based software generation service

#### 5.9.1 Service concept

This service provides the ability to produce automatically and semi-automatically software components using existing components or component templates.

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#### 5.9.2 Service operations

This service provides the ability to:

- Generate a parser from a syntactic language description;
- Generate a script for the composition and interconnection of software components;
- Generate a rule-based system from a set of rules;
- Generate a user interface component for a software system.

### 5.10 Software source code generation service

#### 5.10.1 Service concept

This service provides the ability to generate modules from design specifications.

#### 5.10.2 Service operations

This service provides the ability to:

- Generate modules from design specifications;
- Invoke the software static/dynamic analysis service and work-through source code;
- Provide for traceability to design specifications.

### 5.11 Software compilation service

#### 5.11.1 Service concept

This service provides the ability to support the translation (e.g., build, compile or interpretation) and linking of software components written in various programming languages. The principal outputs from this service are executable programs supporting the implementation of some target system.

#### 5.11.2 Service operations

This service provides the ability to:

- Find code and inheritance dependencies among a set of software components;
- Pre-process source code to produce modified source code;
- Apply macro expansions to source code;
- Translate a source program into some target object code language;
- Produce report on the translation; this may include source listings of various complexity, including cross-reference data, compilation speeds, CPU usage, etc.;
- Link the object code into executable images. When intended for use on a remote target, link code into loadable/bootable images;
- Update the compiled system incrementally to reflect new changes.

### 5.12 Software debugging service

#### 5.12.1 Service concept

This service provides the ability to locate and repair source code errors in individual software components by controlled or monitored execution of the code to track down errors and replace code.

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#### 5.12.2 Service operations

This service provides the ability to:

- Instrument source programs by inserting breakpoints, instruction traps, printing out data values, and modifying source text;
- Execute programs incrementally;
- Monitor and save execution output;
- Log and measure debugging results;
- Analyse properties of programs and their current data values.

### 5.13 Software static/dynamic analysis service

#### 5.13.1 Service concept

This service provides for the static analysis, or source code analysis, of software components in order to determine execution structure within the component and for the dynamic analysis, or code in execution analysis, in order to determine execution behaviour characteristics.

#### 5.13.2 Service operations

This service provides the ability to:

- Collect raw statistics from a software module and/or component;
- Compute complexity measures from a software module and/or component;
- Produce and graphically represent cross reference lists;
- Collect raw statistics from a software module and/or component in execution;
- Produce and graphically represent characteristics of the execution behaviour;
- Produce findings according predefined template or rules.

### 5.14 Software testing service

#### 5.14.1 Service concept

This service provides test software systems at the levels of individual software components (unit testing), on collections of software components (integration testing), and on complete software systems (system testing).

#### 5.14.2 Service operations

This service provides the ability to:

- Develop test strategy : top down or bottom up integration testing, black box and white box testing;
- Estimate the testing required based on various defect models like error injection models etc and accordingly to testing plan;
- Develop test cases from requirements (e.g. from use cases);
- Determine test coverage of the code;
- Develop stubs for unit testing;
- Develop test data using test data generation tools for unit testing, integration testing and regression testing with consideration of boundary values, high volume or representative data;
- Keep track of defects found during the testing; Categorize defects based on priority, severity, module etc. Develop defect statistics reports for project management and status tracking;

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- Generate test cases;
- Analyse source programs and generate reports;
- Enable traceability to requirements;
- Perform appropriate types of testing (e.g., functional, operational, security, performance etc.);
- Perform non-regression testing of required previous test cases on the object under test;
- Simulate the overall working environment and perform system load testing;
- Compare test results with expected results.

## 5.15 Software verification service

### 5.15.1 Service concept

This service provides the ability to confirm by examination and provision of evidence that the specified requirements have been fulfilled.

### 5.15.2 Service operations

This service provides the ability to:

- Analyse specifications for consistency;
- Review and inspect source component (either source programming language or design language);
- Identify errors (between specifications and verified object);
- Produce summary report.

## 5.16 Software integration service

### 5.16.1 Service concept

This service provides the ability to support the integration of software modules and/or components to make up the final integrated software system.

### 5.16.2 Service operations

This service provides the ability to:

- Prepare software modules and/or components to be integrated;
- Manage module and/or component repository and libraries;
- Integrate modules and/or components according to a predefined architecture and model;
- Monitor integration and produce a status report.

## 5.17 Software domain engineering service (Software reuse)

### 5.17.1 Service concept

This service provides the ability to develop and maintain domain models, domain architectures and domain assets.

### 5.17.2 Service operations

This service provides the ability to:

- Create and execute a domain engineering plan;

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- Select the form(s) of representation to be used for domain architecture and model;
- Define the boundaries of the domain and the relationships between domains;
- Identify the needs of stakeholders;
- Construct a vocabulary;
- Classify and document the domain models and architecture;
- Evaluate the domain models, domain vocabulary, and domain architecture;
- Conduct domain analysis and domain asset review;
- Develop and document an domain asset specification;
- Analyse the impact on the changes of domain asset.

## 5.18 Software reuse asset management service (Software reuse)

### 5.18.1 Service concept

This service provides the ability to manage the life of reusable assets from conception to retirement.

### 5.18.2 Service operations

This service provides the ability to:

- Create and review an asset management plan;
- Implement and maintain an asset storage and retrieval mechanism;
- Develop, document, and maintain a classification scheme;
- Conduct review of the asset storage and retrieval mechanism;
- Evaluate the asset based on the asset acceptance criteria;
- Classify asset in accordance with the reuse classification scheme;
- Perform configuration management for the asset;
- Track each reuse of the asset;
- Forward the change, modification, request, and problem reports on asset;
- Monitor and record asset status reports;
- Retire assets from the asset storage.

## 5.19 Software reuse program management service (Software reuse)

### 5.19.1 Service concept

This service provides the ability to plan, establish, manage, control and monitor an organization's reuse program.

### 5.19.2 Service operations

This service provides the ability to:

- Establish organization's reuse strategy including reuse goals, purposes, objectives, and scope;
- Name a reuse sponsor;
- Identify the reuse program participants and assign their roles;
- Identify and document the domains where reuse opportunities arise;

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- Evaluate the domains to be reused;
- Conduct reviews in accordance with the software review process;
- Assess the organization's reuse capabilities;
- Assess each domain to determine the reuse potential;
- Create, document, maintain the reuse program implementation plan;
- Review and evaluate the reuse plan;
- Monitor the status of the reuse progress;
- Record and resolve the problems and non-conformances to the reuse plan;
- Assess reuse program periodically;
- Report the reuse steering function about assessment results and lessons learned.

# 6 Systems engineering services

## 6.1 Overview

The services in this section support activities related to the system life cycle specific services. The following services are defined and grouped in this section:

- System solution orientation service;
- System Operational scenarios service;
- System Requirements engineering service;
- System modelling service;
- System Architectural Design service;
- System Re-engineering service;
- System Simulation service;
- System Integration services;
- System Testing services;
- System Test synthesis & report service;
- System Work product verification service.

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## 6.2 System solution orientation service

### 6.2.1 Service concept

This service provides the ability to identify the orientations is terms of technical solutions, indicating main elements for each technical solution (performance (critical requirements), costs estimation and schedule). Inputs are high-level business or operational concepts identified from operational domain & needs analysis and/or market analysis. Other inputs may come from research results.

### 6.2.2 Service operations

This service provides the ability to:

- Elicit and analyse high level operational environment and needs;
- Analyse technology trends (including standards), their maturity levels (Technology Readiness Levels - TRLs) and potential technology migration stakes and planning;

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- Analyse necessary and possible operational performance (critical requirements);
- Evaluate the requirements whether build versus buy versus harvest options based on evaluation criteria of effort , cost etc.;
- Estimate costs and identify associated key requirements;
- Analyse schedule and main milestones;
- Maintain the related data.

## 6.3 System Operational scenarios service

### 6.3.1 Service concept

This service provides the ability to confirm by generation and usage of operational scenarios that the operational needs have been taken into account for constructing, using, maintaining and disposal of the product/system.

### 6.3.2 Service operations

This service provides the ability to:

- Develop, refine, review, analyse and maintain the operational scenarios (e.g. by involving operational stakeholders);
- Validate the product/system against operational scenarios (e.g. by describing a sequence of events that includes the interaction among its product/components).

## 6.4 System modelling service

### 6.4.1 Service concept

This service provides the ability to model operational needs and system architectures in order to support system analysis, and determine the effectiveness of alternative architectures with respect to constraints.

### 6.4.2 Service operations

This service provides the ability to:

- Structure the system model according to abstraction levels, each one being dedicated to a particular concern (e.g. operational model, system services model, architectural model etc.), or level of detail;
- Produce models, according to the model structure, dedicated to each abstraction level, with model elements dedicated to the considered abstraction level (e.g. graphical, logical, mathematical, formal modelling language elements);
- Maintain consistency with on assistance and early validation (i.e.: modelling assistants, model check);
- Define mapping/refinement between models of different abstraction levels;
- Define links with elements external to the model (e.g. tests descriptions etc.), and associated consistency maintenance;
- Compare alternative architectural solutions;
- Monitor the modelling activity.

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## 6.5 System architectural design service

### 6.5.1 Service concept

This service provides the ability to define the main critical viewpoints, to define the architecture drivers and to find the best architectural compromise to support the analysis of operational needs and architecture models.

### 6.5.2 Service operations

This service provides the ability to:

- Define architectural viewpoints (i.e. efficiency of functions/architectural components allocation, interface complexity, critical functional chains etc.);
- Identify architecture drivers (i.e. flexibility against operational or technical evolutions, cost, legacy reuse, logistics etc.);
- Analyse models according to viewpoints (e.g. based on safety viewpoints);
- Apply architecting rules (e.g. based on rules engine, architectural patterns).

## 6.6 System Requirements engineering service

### 6.6.1 Service concept

This service provides the ability to capture, represent, analyse, validate, and refine those system requirements that fulfil operational needs and allocated to components.

### 6.6.2 Service operations

This service provides the ability to:

- Elicit and capture requirements;
- Check Testability of requirements;
- Structure the requirements;
- Create, modify, browse, and present requirements;
- Group and prioritise requirements;
- Check consistency of requirements with architecture models;
- Allocate requirements for each component;
- Conduct impact analysis for the addition, subtraction, or modification in a requirement against the project ;
- Estimate efforts, resources, and timeline;
- Validate and baseline the document specs based on stakeholders and developers;
- Check the traceability of all requirements.

## 6.7 System Re-engineering service

### 6.7.1 Service concept

This service provides the ability to take a new or a modified set of requirements and the existing architecture and design as input and produce a new or modified architecture/ design/ requirements.

### 6.7.2 Service operations

This service provides the ability to:

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- Revise or restructure existing system/ component;
- Perform impact analysis of new design on existing components;
- Translate from one notation or language into another;
- Check that the new set of requirements is consistent with the existing system;
- Determine the impact of the altered design on the existing set of components.

## 6.8 System Simulation service

### 6.8.1 Service concept

This service provides the ability to validate architectures by models simulation in order to determine the effectiveness of alternative architectures with respect to such attributes as user interface characteristics or execution flow.

### 6.8.2 Service operations

This service provides the ability to:

- Build a simulation model by invoking the modelling service if necessary and available;
- Execute a model;
- Capture simulation results of models.

NOTE It can be qualitative (e.g. Human aspect for security case) and quantitative simulation (e.g. Monte Carlo for quantitative).

## 6.9 System Integration service

### 6.9.1 Service concept

This service provides the ability to support the integration of system elements and/or components to make up the final integrated system

### 6.9.2 Service operations

This service provides the ability to:

- Prepare system elements and/or components to be integrated;
- Manage system elements and/or component;
- Manage external and internal interfaces of the system elements and/or component;
- Integrate system elements and/or components according to a predefined architecture and model;
- Monitor integration and produce a status report.

## 6.10 System testing service

### 6.10.1 Service concept

This service provides test at the system and/or system element level. The service is for the purpose of testing at system level of integrating the various software which have been developed and tested separately.

### 6.10.2 Service operations

This service provides the ability to:

- Plan the system level testing;

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- Enable traceability to requirements at system level and map the system level requirements to different software modules;
- Generate test cases at system level;
- Generate test cases and measurements steps to serve as inputs for value analysis and effectiveness analysis (e.g. cost of operation of the whole system, elapsed time of operation of a business process, resource usage of a business process etc.);
- Perform appropriate types of testing (e.g., functional, operational, security, performance/ load, interfaces etc.);
- Perform regression testing of required previous test cases on the objects under test;
- Simulate the overall working environment;
- Compare test results with expected results;
- Create and maintain defect management reports; identify the source of defects to respective software modules and assign responsibilities to the respective software developers. Retest after the defects are corrected;
- Create and manage test data for system level and interfacing testing;
- Generate test data for high volume and representative data;
- Manage test environment with necessary operating system, databases etc. as per required versions.

## 6.11 System test synthesis & report service

### 6.11.1 Service concept

This service provides the ability to synthesise system test and to report the results.

### 6.11.2 Service operations

This service provides the ability to:

- Plan system tests;
- Consolidate test scenarios to provide a synthesis;
- Analyse and synthesise the system test data;
- Define the expected test results;
- Decide the adequacy of the test results to the purpose of the system test;
- Report the results;
- Create and maintain defect management reports; identify the source of defects to respective software modules and assign responsibilities to the respective software developers. Retest after the defects are corrected;
- Conduct causal analysis of defects and remove root causes;
- Coordinate with product vendors if defects were found in purchased components / products to fix the defects or design work around.

## 6.12 System work product verification service

### 6.12.1 Service concept

This service provides the ability to confirm by examination and provision of evidence that the work product specified requirements have been fulfilled.

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#### 6.12.2 Service operations

This service provides the ability to:

- Plan work product verification;
- Define Work product verification criteria;
- Check work product regarding verification criteria;
- Analyse models and specifications for consistency;
- Review and inspect component;
- Identify errors (between specifications and verified object);
- Produce summary report.

## 7 System engineering techniques services

### 7.1 Overview

The services in this section fall into a category that includes both Engineering and Project Management. These services relate to activities that are often shared by engineers and managers. This section describes the following services:

- Value analysis service;
- Trade-off analysis service;
- Effectiveness analysis service;
- Technology maturity analysis service.

### 7.2 Value analysis service

#### 7.2.1 Service concept

This service provides the ability to challenge the functionality and activities of the system/product against its cost and the customer's satisfaction, by assessing both the competitiveness and the profitability of the system/product.

#### 7.2.2 Service operations

This service provides the ability to estimate the pertinence of the following viewpoints:

- Analyse the functional aspect: formulation in terms of end-aims and not only in terms of solutions, ensuring that development of functionality is consistent with the economic constraints;
- Analyse the economical aspect: systematically refers to costs, both those relating to products within the same family and their functions and those that can be estimated for each new function or solution;
- Analyse key value items and chains all along the life cycle;
- Measure the progress of value achievement all along the life cycle;
- Challenge the multi-disciplinary aspect: team-work, people with different objectives and responsibilities.

### 7.3 Trade-off analysis

#### 7.3.1 Service concept

This service provides the ability to assess competitive designs that permits them to be compared against the technical specifications expressed in the system requirements and the performance, costs, time scales and

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risks expressed in the stakeholders needs. By evaluating the system characteristics achieved using different candidate components in the system architecture, the trade-off decisions lead toward an optimised design..

#### 7.3.2 Service operations

This service provides the ability to:

- Assess problem definition / solution alternative against technical specification;
- Evaluate system characteristics;
- Generate potential trade-off alternatives;
- Justify the choice (e.g. utility measurement);
- Register the trade-off decision criteria and related information.

### 7.4 Effectiveness analysis

#### 7.4.1 Service concept

This service provides the ability to provide an assessment of how well a product associated with an alternative logical, physical, or design solution is expected to perform or operate, given an anticipated usage scenario.

#### 7.4.2 Service operations

This service provides the ability to:

- Assess the product against an usage scenario;
- Monitor the effectiveness;
- Register the usage scenario and the product effectiveness.

### 7.5 Technology maturity analysis

#### 7.5.1 Service concept

This service provides the ability to assess the maturity of technologies and/or equipment for use in the system operational context and to recommend appropriate investment decisions.

A technology is ready when it can consistently provide the intended function and performance, in the environmental conditions appropriate to the intended use, within broadly acceptable mass, volume, power, throughput and cost constraints.

#### 7.5.2 Service operations

This service provides the ability to:

- Assess the maturity against intended function , performance and integration;
- Define the maturity gap;
- Recommend investment decisions;
- Register the assessment.

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# 8 Technical management services

## 8.1 Overview

The services in this section fall into a category that includes both systems and software engineering and Project Management. These services relate to activities that are often shared by engineers and managers. This section describes the following services:

- Configuration management service;
- Change management service;
- SEE Repository management service;
- Reuse management service;
- Measurement and analysis service;
- Quality assurance service;
- Audit service;
- Traceability service;
- Documentation service;
- Review service support.

## 8.2 Configuration management service

### 8.2.1 Service concept

This service provides facilities for the identification, documentation, and control of the functional and physical characteristics of configuration items to ensure traceability, management of interrelationships between system components, and reproducibility of a project's end products

### 8.2.2 Service operations

This service provides the ability to:

- Provide unique identification of each configuration item;
- Enable access control for every element;
- Define configuration items in a system;
- Invoke change management;
- Provide selection support for configuration items of a specified version.

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## 8.3 Change management service

### 8.3.1 Service concept

This service provides facilities for the creation and control of change requests, change orders, and provides an audit trail of changes to product components. It records all decisions, task assignments, product changes, and other activities related to these items

### 8.3.2 Service operations

This service provides the ability to:

- Create a change request in response to a reported error, omission, or required update;
- Support the analysis of the impact of the proposed change;


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- Classify, and retain a historical record of a change request;
- Create, evaluate, and track a change order based on a change request;
- Permit communication channels within the stakeholders.

## 8.4 SEE repository management service

### 8.4.1 Service concept

This service provides the ability to create, access, and modify information objects (i.e. requirements specifications, test cases, simulation cases, diagrams, etc.) in the SEE repository management and recording the relationships between them

### 8.4.2 Service operations

This service provides the ability to:

- Create, access, and modify information objects;
- Create, access, and modify groups of information objects;
- Create, access, and modify relationships among information objects;
- Manage access control;
- Provide multi-user and collaborative working environments.

## 8.5 Reuse management service

### 8.5.1 Service concept

This service provides the facilities for the search, storage, classification, and inspection on the reuse of the assets related to software and system engineering processes

### 8.5.2 Service operations

This service provides the ability to:

- Store, acquire, or submit assets into repository;
- Catalogue, register, and classify the asset;
- Search or browse the asset repository;
- Examine or extract the asset;
- Register the extractor or submitter;
- Report the usage and limitation of an asset.

## 8.6 Measurement and analysis service

### 8.6.1 Service concept

This service provides facilities for the collection and organization of primitive data into meaningful information to the end-users of the SEE

### 8.6.2 Service operations

This service provides the ability to:

- Allow definition of measures and measurement criteria;

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- Allow the definition of artefacts such as patterns and rules to support analysis;
- Check consistency of measurement and analysis model if necessary;
- Insert and delete data from data set;
- Pick appropriate model for given data set;
- Compare data set to the predictive model;
- Compute general statistics on a data set;
- Support different viewpoints for different stakeholders at repository level;
- Capture an appropriate number of characteristics according to non-functional requirements, such as reliability, criticality or dependability for the software product.

## 8.7 Quality assurance service

### 8.7.1 Service concept

This service provides facilities for the definition, tracking, and performance of quality assurance activities and the analysis of their results

### 8.7.2 Service operations

This service provides the ability to:

- Establish and maintain records of Quality Assurance activities;
- Define specific product and/or process items that are subject to Quality Assurance review;
- Analyse Quality Assurance data for compliance with requirements.

## 8.8 Audit service

### 8.8.1 Service concept

This service provides facilities for the planning and performance of audits and the analysis and reporting of their results. The audit may include environment, process, and project

### 8.8.2 Service operations

This service provides the ability to:

- Maintain a set of audit checklists and support user creation and customisation of checklists;
- Support audit preparation and scheduling;
- Provide for retention of audit data;
- Provide for analysis of audit data (e.g., pass/fail, trend analysis).

## 8.9 Traceability service

### 8.9.1 Service concept

This service provides facilities for the ability to record the relationships between items of the component/system lifecycle process. This service is obtained through the repository subschema exploitation

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#### 8.9.2 Service operations

This service provides the ability to:

- Create, update, and destroy relationships between two items;
- Query and report current status of relationships;
- Query relationship history;
- Trace requirements throughout stages of the life cycle process;
- Navigate relationships and items;
- Generate cross references matrix.

### 8.10 Documentation service

#### 8.10.1 Service concept

This service provides facilities for the development, integration, configuration management and traceability analysis of any media documentation (e.g. on-line, paper, and other relevant media of documentation)

#### 8.10.2 Service operations

This service provides the ability to:

- Author documentation;
- Allow linking context sensitive documentation;
- Build online documentation into delivery package;
- Manage and control documentation;
- Produce any relevant media formats;
- Flag dependent documentation items due to changes;
- Enable document version management;
- Review cycle management;
- Enable access control.

### 8.11 Review service support

#### 8.11.1 Service concept

This service provides facilities for various review activities in the software and system development life cycle

#### 8.11.2 Service operations

This service provides the ability to:

- Prepare documents for review;
- Annotate comments, make refer and/or paste link related documents to the review documents;
- Find and/or retrieve keywords from the documents and the SEE repository;
- Report and catalogue review results.

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# 9 Project management services

## 9.1 Overview

The services in this section support the activities related to planning and executing a project. Following project initiation, detailed planning of the project activities will be necessary, together with ongoing monitoring and replanning of the project to ensure its continued progress. This section describes the following services:

- Project Strategy Service;
- Project Planning Service;
- Project Estimation Service;
- Project Risk management Service;
- Project monitoring and scheduling Service;
- Project Evaluation Service;
- Decision Management Service;
- Information Management Service.

## 9.2 Project strategy service

### 9.2.1 Service concept

This service supports operations that permit handling of a set of services according to a set of services constraints according to business objectives.

### 9.2.2 Service operations

This service provides the ability to:

- Translate project objectives into key project services,
- Allow the selection of a set of services (basic and optional);
- Allow add-on of project specific services;
- Allow assignment of dependencies between the services;
- Estimate the services performance criteria;
- Validate the services architecture;
- Register the set of services and related information.

## 9.3 Project planning service

### 9.3.1 Service concept

This service supports operations that permit handling of data according to a set of project objectives relevant to a project's constraints

### 9.3.2 Service operations

This service provides the ability to:

- Translate project objectives into key project events;
- Quantify inputs and outputs for work activities;
- Allow assignment of relationships (dependencies) between activities;

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- Estimate event lead times;
- Calculate start and finish dates;
- Analyse critical paths;
- Generate detailed event schedules;
- Enable resource allocation;
- Register assignment of work responsibilities to individuals or organizations;
- Establish communication channels within the project team including the identification of the communication medium, frequency and content;
- Establish evaluation criteria.

## 9.4 Project estimation service

### 9.4.1 Service concept

This service supports quantification, analysis, and prediction of project costs and resource needs

### 9.4.2 Service operations

This service provides the ability to:

- Create and modify cost, size, time and resource estimates;
- Maintain history of cost, size, time and resource estimates;
- Generate estimates for variable parameters such as workload mixes or for differing design;
- Compare estimates against actual results.

## 9.5 Project risk management service

### 9.5.1 Service concept

This service supports those planning and assessment activities that consider elements related to the success or failure of a project

### 9.5.2 Service operations

This service provides the ability to:

- Perform trade-off analyses based on differing parameters for resource allocation and scheduling data;
- Evaluate risks due to cost, resource, schedule, and failure;
- Estimate cost and probability of failure;
- Manage risk mitigation;
- Generate reports for various allocation strategies.

## 9.6 Project monitoring and scheduling service

### 9.6.1 Service concept

This service supports tracking of project progress including cost, schedule, and user requirements

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#### 9.6.2 Service operations

This service provides the ability to:

- Gather measurement data related to current status of a project and its constituent work activities;
- Compare cost, size, time and resource estimates with actual results;
- Read and display status of all project variables, and produce project data and summary information;
- Track the evolution of user requirements.

### 9.7 Project evaluation service

#### 9.7.1 Service concept

This service supports the analysis, evaluation, and decision making associated with the tracking service, measurement data collection, and user acceptance criteria

#### 9.7.2 Service operations

This service provides the ability to:

- Evaluate actual cost, size, time and resource data against tracking service data and project planning data;
- Create Modify and Store user comments, recommendations, and errors;
- Elicit user acceptance for each requirement against the project product;
- Collect measurement data to support trade-off analysis and impact analysis.

### 9.8 Decision management service

#### 9.8.1 Service concept

This service supports the analysis, selection, and specification of a decision making to desirable or optimized project action.

#### 9.8.2 Service operations

This service provides the ability to:

- Identify decision categories, prioritization scheme, responsible parties;
- Identify the circumstances and need for a decision;
- Allocate responsibility and authority to decisions;
- Select and declare the decision-making strategy;
- Identify desired outcomes and success criteria;
- Evaluate the balance of consequences of alternative decision;
- Record, track, evaluate and report decision outcomes;
- Maintain records of problems and opportunities and their disposition;
- Distribute the information to the relevant stakeholders.

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## 9.9 Information management service

### 9.9.1 Service concept

This service supports the generations, collection, transformation, retrieval, dissemination and disposal of information during or after the system life cycle.

### 9.9.2 Service operations

This service provides the ability to:

- Define items of information that will be managed during the system life cycle;
- Designate authorities and responsibilities regarding the origination, generation, capture, archiving and disposal of items of information;
- Define the rights, obligations, and commitments regarding the retention, transformation, and access to information items;
- Define content, semantics, formats and medium for the representation, retention, transmission and retrieval of information;
- Review stored information for integrity, validity, and availability for replication or transmission to an alternative medium;
- Generate or collect identified items of information;
- Record the status of information items, e.g., version description, record of distribution, security classification;
- Retrieve and distribute information in an appropriate form;
- Provide official documentation, e.g., certification, accreditation, license and assessment ratings;
- Select the media, location and protection of information in accordance with the specified storage and retrieval periods, and with organization policy, agreements and legislation.

# 10 Process management services

## 10.1 Overview

The services in this section support projects in achieving discipline, control, and clear understanding in their life-cycle development processes as understood in ISO/IEC 12207 and individual process steps. This section describes the following services:

- Process definition service;
- Process library service;
- Process initiation service;
- Process usage service;
- Process monitoring service;
- Process improvement support service;
- Process documentation service.

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## 10.2 Process definition service

### 10.2.1 Service concept

This service supports the establishment of the organizational processes covering the software and system engineering life cycle through adaptation and tailoring a set of higher order reference processes. This adaptation includes the specifics of the organization's policies, including its infrastructure technology, methods, and procedures

### 10.2.2 Service operations

This service provides the ability to:

- Analyse process requirements, including domain-specific analysis and application-specific analysis;
- Instantiate, compose, decompose, tailor, and modularise process definitions;
- Simulate, model, and validate process definitions against organization standards, guidelines and policies.

## 10.3 Process library service

### 10.3.1 Service concept

This service supports reuse capabilities for processes, including creation, update, deletion, certification, measurement, and management of process assets (activities, tasks, etc.)Process assets may range from complete life-cycle process definitions to individual process steps. Process assets may also be objects that can be versioned

### 10.3.2 Service operations

This service provides the ability to:

- Create, update, and delete process assets;
- Certify, measure, and administer process assets;
- Provide access control to process assets if necessary.

## 10.4 Process initiation service

### 10.4.1 Service concept

This service supports the assignment of a life cycle model, a set of processes and the SEE to meet the requirements and constraints for a particular project

### 10.4.2 Service operations

This service provides the ability to:

- Review project criteria and constraints and select life cycle model;
- Define relationships and tailor processes and activities;
- Define process roles and responsibilities;
- Provide process training, if necessary.

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## 10.5 Process usage service

### 10.5.1 Service concept

This service supports guidance of users' in the selection and control of process steps, navigational and help facilities and the query of institutionalised processes for information on previous and subsequent actions

### 10.5.2 Service operations

This service provides the ability to:

- Process help and guidance facility for project team members;
- Query and report on process utilisation and status;
- Specify, collect, and report on project process measures;
- Allow interaction between process definition simulations and high-level representations with SEE data management.

## 10.6 Process monitoring service

### 10.6.1 Service concept

This service supports the observation, detection, logging, and tracking of process activities (within projects)

### 10.6.2 Service operations

This service provides the ability to:

- Set up monitoring conditions and criteria;
- Observe the evolving enactment state of processes;
- Detect and log the occurrence of specific process events;
- Report the monitoring results.

## 10.7 Process improvement support service

### 10.7.1 Service concept

This service supports the assessment, measurement and modifications of the organizational and project specific processes, and project life cycles

### 10.7.2 Service operations

This service provides the ability to:

- Define effectiveness goals;
- Identify measurements correlated to the goals;
- Set threshold values for goal attainment;
- Assess process capability;
- Prepare assessment reports that compare the actual data with target or baseline data;
- Provide data to schedule assessments.

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## 10.8 Process documentation service

### 10.8.1 Service concept

This service supports the services related to process documentation

### 10.8.2 Service operations

This service provides the ability to:

- Identify the documentation requirements;
- Design and develop the documents;
- Produce and edit the document;
- Distribute the document;
- Maintain those documents.

# 11 SEE support services

## 11.1 Overview

The services in this section comprise services that the rest of the services will require to become operational.

They generally include those services associated with processing, formatting, and disseminating human-readable information and data. This section describes the following services:

- SEE Common Support Service;
- SEE Publishing Service;
- SEE Cooperative work support service;
- SEE User Communication Support Service;
- SEE Administration Service;
- SEE Policy Enforcement Service;
- SEE Data/Information mining services;
- SEE Data storage services;
- SEE Data/Information exchange service;
- SEE enabling support service.

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## 11.2 SEE common support service

### 11.2.1 Service concept

This service provides the ability to create and manipulate text, graphics and image, audio and video objects information within the SEE

### 11.2.2 Service operations

This service provides the ability to:

- Create, modify, edit and save text, formulas and spread sheets, graphics, images or figures;
- Import or export text, graphics or images in various file formats;
- Format and print text, graphics or images;


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- Create, capture, modify, store, playback and transmit audio & video objects;
- Transform audio and video objects into other formats.

## 11.3 SEE publishing service

### 11.3.1 Service concept

This service provides for creating, modifying, editing, and structuring of the objects that compose documents, for storing, printing, and sharing these documents

### 11.3.2 Service operations

This service provides the ability to:

- Create, modify and save document objects and documents;
- Create tables of contents, indices, bibliographies, and glossaries;
- Format, build, preview, and print documents, create and print templates;
- Create or modify layouts or styles for documents;
- Control document versions.

## 11.4 SEE cooperative work support service

### 11.4.1 Service concept

This service provides the ability to support cooperative work in single and multiple locations

### 11.4.2 Service operations

This service provides the ability to:

- Support the sharing of repositories;
- Support conferencing;
- Support the sharing of project group and/or user scheduling;
- Support concurrent engineering.

## 11.5 SEE user communication support service

### 11.5.1 Service concept

This service provides the ability for communications among customers and supplier teams including mail, bulletin board, conferencing and online messaging on a network.

### 11.5.2 Service operations

This service provides the ability to:

- Receive, archive, compose, send, reply, forward, broadcast, and acknowledge messages;
- Customise the mail's communication capabilities;
- Subscribe and post messages;
- Reply or add information to posted messages;

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- Open and close connections;
- Support local area network, wide area network, public network, Internet connectivity, etc.

## 11.6 SEE administration service

### 11.6.1 Service concept

This service provides the ability to control user access to the SEE, to define users to the system, and to monitor and control SEE operations, in order to adjust the environment to improve its availability and performance. It also provides online information for users in the form of an interactive tutorial and/or invoked as part of “help” facility

### 11.6.2 Service operations

This service provides the ability to:

- Manage user access;
- Display the SEE status by invoking the SEE infrastructure management service;
- Set user privileges and access to resources.

## 11.7 SEE policy enforcement service

### 11.7.1 Service concept

This service provides facilities for enacting policy enforcement on security, access control, integrity of data and objects, secure exchange of data and objects, backup, recovery and audit process.

### 11.7.2 Service operations

This service provides the ability to:

- Support the establishment of security information;
- Identify users and properly associate with access rights;
- Govern access to information contents;
- Protect data and objects from unauthorized or unconstrained modification;
- Export and import data and objects in a secure manner;
- Provide tracking and control information for a security-related audit;
- Backup and recovery.

## 11.8 SEE data/information mining service

### 11.8.1 Service concept

This service provides the ability for data/information mining on a SEE repository to understand software and system development, to support predictions about software and system development, and to plan various aspects of software and system projects.

### 11.8.2 Service operations

This service provides the ability to:

- Recover useful data/information from repositories;
- Integrate mined data/information from repositories;

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- Visualize and present the mined data/information;
- Extract and analyse the changing patterns present in the repositories;
- Support modelling of software characteristics using data/information from repositories;
- Support of reuse.

## 11.9 SEE data retrieve/storage service

### 11.9.1 Service concept

This service provides the ability for handling of data retrieve/storage.

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.

### 11.9.2 Service operations

This service provides the ability to:

- Retrieve the original data;
- Check the data/ information rights;
- Record the status of the data;
- Maintain the data and the storage records according to specified storage and retrieval periods and with organization policy, agreements and legislation.

## 11.10 SEE data/information exchange service

### 11.10.1 Service concept

This service provides the ability for data/information exchange with project environments.

### 11.10.2 Service operations

This service provides the ability to:

- Define/select and integrate the interoperability, legacy and coupling constraints;
- Assess interfacing capability and performance;
- Select the data exchange format;
- Establish and maintain the support for data/information exchange;
- Monitor and control the execution of data/information exchange;
- Report the data exchange status log.

## 11.11 SEE enabling support service

### 11.11.1 Service concept

This service provides the ability to enable SEE project support all along SEE and projects life cycle.

### 11.11.2 Service operations

This service provides the ability to:

- Provide methodological information and useful links;

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- Provide document templates;
- Provide information relating to the user's profile: roles, rights, work sessions, etc.;
- Provide information relating to the projects context and status;
- Import data in a pre-defined and documented format, produced by an older environment (for "iso-services" and "iso-deliverables"), and make them reusable to initialise a project with the current SEE version;
- Retrieve, from SEE repository, data evidence and necessary meta-data (e.g. requirements DB, Models, Source codes repositories, Test script, documentation templates, etc.) used to build deliverables in any older SEE version;
- Make these data usable in either the current version of SEE or any new "iso-services for iso-deliverables" Engineering environment (guarantee of functional interchangeability);
- Identify necessary resources and environment constraints to deliver and maintain SEE projects within Unit;
- Allow to apply the necessary variability and customisation that meet to each SEE project Business constraints;
- Provide a multi-lingual help desk H24, from any worldwide location (English, French, Spanish, German, Dutch, Mandarin, Hindi; etc.);
- Make available to any SEE stakeholder (end user, administrator, trainer, manager, etc.) relevant e-learning providing them progressively efficiency and autonomy in their usage and allowing to assess one's knowledge.

# 12 SEE infrastructure services

## 12.1 Overview

The services in this section comprise the infrastructure of a SEE and will be required to support a SEE actually implemented. This section describes the following services:

- SEE infrastructure management service;
- SEE information sharing service;
- SEE repository service;
- SEE Operating System service.

## 12.2 SEE infrastructure management service

### 12.2.1 Service concept

This service provides the ability to manage SEE infrastructure resources

### 12.2.2 Service operations

This service provides the ability to:

- Add, delete, or amend resources (including tools);
- Query status and provide statistics of a resource;
- Make a resource available to a specific user and/or a category of users defined by a role;
- Send diagnostic messages to the system administrator;
- Transfer data or tool between SEEs;

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- Transfer user and/or a category of users defined by a role between SEEs;
- Transfer task descriptions between SEEs;
- Install or un-install, register or de-register tools and update to a new tool version;
- Monitor and diagnose SEE facilities.

## 12.3 SEE information sharing service

### 12.3.1 Service concept

This service provides facilities for a standard communication mechanism that can be used for communication through the network and information sharing among networks

### 12.3.2 Service operations

This service provides the ability to:

- Support information processing and sharing;
- Provide primitive operating system process communications;
- Support communication among collection of processes between same and/or different machines;
- Allow communication over a distributed collection of services and tools;
- Support the notification of messages based upon certain triggering conditions.

## 12.4 SEE repository service

### 12.4.1 Service concept

This service provides the definition, storage, maintenance, management, and access of information and data object entities and the relationships among them

### 12.4.2 Service operations

This service provides the ability to:

- Allow meta-data to operate according to the structure of the objects;
- Define and initiate a data transaction;
- Support management and access of distributed objects;
- Allow archiving and versioning operations;
- Restore the development environment to a consistent state after any failure;
- Retrieve sets of objects according to defined properties and values;
- Offer two-way translation between data repositories in the same or different environments.

## 12.5 SEE operating system service

### 12.5.1 Service concept

This service provides virtual operating system services to emulate the target operating environments on top of a basic operating system, especially in cross platform developments, or to make common portable operating environments among a variety of operating systems. The set of services includes system process management, file management, resource management, input/output management and other mechanisms of operating systems

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### 12.5.2 Service operations

This service provides the ability to:

- Provide operating system process management;
- Provide operating system synchronization;
- Provide generalized input and output;
- Manage storage;
- Provide asynchronous event/messaging;
- Provide interval timing;
- Provide resource management.

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# Annex A
(informative)

# Exemplary automated support for the SEE services

**Table A.1 - Exemplary automated supports for each SEE services**

| SEE service | Exemplary automated support |
|---|---|
| **5. Software engineering services** | |
| 5.2 Software requirements engineering service | Requirements traceability support;<br>Repository management support;<br>Requirements modification and querying support;<br>Requirements presentation support;<br>Consistency checking support;<br>Impact Analysis support;<br>Requirements validation support. |
| 5.3 Software reverse engineering service | Design documents generation support;<br>Source code generation support;<br>De-compilation support;<br>Code translation support;<br>Automated cross-referencing support |
| 5.4 Software re-engineering service | Software translation support;<br>Design specification generation support;<br>Consistency checking support;<br>Impact analysis support. |
| 5.5 Software prototyping service | Software model visualization support;<br>Software Model construction support;<br>Software model execution support. |
| 5.6 Software modelling service | Software model visualization support;<br>Mathematical and logical model analysis support;<br>Software model validation support. |
| 5.7 Software simulation service | Software model visualization support;<br>Software model simulation support;<br>Simulation results comparison support. |

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| SEE service | Exemplary automated support |
|---|---|
| 5.8 Software design service | Traceability and consistency checking support;<br>Repository design support;<br>Repository data reuse support;<br>Design representation support;<br>Design representation support;<br>Schema generation support. |
| 5.9 Software component based software generation service | CBS (Component based software) service architecture support;<br>CBS construction support;<br>Traceability support;<br>Parser generation support. |
| 5.10 Software source code generation service | Source code to design specifications linking support;<br>Traceability support;<br>Work-through support;. |
| 5.11 Software compilation service | Source code compilation support;<br>Compilation error and source code listing support;<br>Compilation reporting support;<br>Object code optimisation support;<br>Object code linking support. |
| 5.12 Software debugging service | Execution output monitoring and saving support;<br>Source code instrumentation support;<br>Incremental execution support;<br>Error data collection and presentation support;<br>Defect analysis support. |
| 5.13 Software static/dynamic analysis service | Complexity measure computation support;<br>Code characteristics analysis support;<br>Control flow analysis support;<br>Code complexity analysis support;<br>Cross reference list generation support;<br>Data flow analysis support;<br>Findings reporting support;<br>Execution behaviour visualisation support. |
| 5.14 Software testing service | Test data database management support;<br>Test cases archiving support;<br>Test data cases and scenario generation support;<br>Test case execution support;<br>Test result presentation support;<br>Test case/plan generation support;<br>Source programs analysis support;<br>Requirements traceability and cross referencing support;<br>Automatic window operation testing support. |

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| SEE service | Exemplary automated support |
|---|---|
| 5.15 Software verification service | Consistency-checking support;<br>Specifications and object comparisons support;<br>Inconsistency identification and pinpointing support. |
| 5.16 Software integration service | Module/Component interfaces management support;<br>Software module/Component integration support. |
| 5.17 Software domain engineering service (Software reuse) | Consistency-checking support between domain models, domain vocabulary, and domain architecture; |
| 5.18 Software reuse asset management service (Software reuse) | Consistency-checking support for the change, modification, request, and problem reports on asset |
| 5.19 Software reuse program management service (Software reuse) | Reuse progress status support<br>Problems and non-conformances to the reuse plan recording support |
| **6 Systems engineering services** | |
| 6.2 System solution orientation service | Operational concept documents generation support;<br>Solution presentation support;<br>Consistency checking support;<br>Impact Analysis support |
| 6.3 System Operational scenarios service | Operational scenarios documents generation support |
| 6.4 System modelling service | System model visualization support;<br>Logical and physical model analysis support;<br>System model validation support;<br>Alternative architectural solution selection (e.g. based on criteria) |
| 6.5 System architectural design service | Traceability and consistency checking support;<br>Repository architectural design support;<br>Repository architecture drivers support;<br>Architectural design representation support;<br>Schema generation according to viewpoints support. |
| 6.6 System requirements engineering service | Requirements traceability support;<br>Repository management support;<br>Requirements modification and querying support;<br>Requirements presentation support;<br>Consistency checking support;<br>Impact Analysis support<br>Requirements validation support. |
| 6.7 System re-engineering service | System/component structure analysis support;<br>Design specification generation support;<br>Consistency checking support;<br>Impact analysis support. |

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| SEE service | Exemplary automated support |
|---|---|
| 6.8 System simulation service | System model visualization support;<br>System model simulation support;<br>Simulation results comparison support. |
| 6.9 System integration service | System elements /Component interfaces management support;<br>System elements /Component integration support;<br>System integration report support |
| 6.10 System testing service | System testing report<br>Test cases, scenarios and plans generation support<br>Test cases archiving support<br>Traceability from requirements to different software modules support<br>Testing at functional , operational, security , performance / load, interfaces etc. support<br>Regression testing support<br>Overall working environment simulation support<br>Test results generation support<br>Test results comparison support<br>Defect management system support<br>Creation and management of test data support<br>Testing environment support |
| 6.11 System test synthesis & report service | Test scenarios consolidation and synthesis generation support;<br>System test data analysis and synthesis support<br>Expected test results generation support<br>Analysis of adequacy of testing support<br>Test results report generation support<br>Test result analysis support; Defect management system support<br>Defect root causal analysis support |
| 6.12 System work product verification service | Consistency-checking support;<br>Specifications and work product comparisons support;<br>Inconsistency identification and pinpointing support. |
| **7 System engineering techniques services** | |
| 7.2 Value analysis service | Value analysis support;<br>Cross value analysis support; |
| 7.3 Trade-off analysis | Alternatives solution repository support<br>Potential trade-off alternatives generation support; |
| 7.4 Effectiveness analysis | Effectiveness repository support |
| 7.5 Technology maturity analysis | Maturity assessment and decision criteria repository support |

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| SEE service | Exemplary automated support |
|---|---|
| **8. Technical management services** | |
| 8.2 Configuration management service | Configuration items identification support;<br>Configuration item changes traceability support;<br>Configuration items selection support;<br>Access control support. |
| 8.3 Change management service | Historical record archiving support;<br>Change request history retention support;<br>Change order tracking support;<br>Communication support. |
| 8.4 SEE repository management service | Data/information objects management support;<br>SEE repository access control support. |
| 8.5 Reuse management service | Asset registration and cataloguing support;<br>Asset recording support;<br>Repository searching support;<br>Asset browsing within the repository support. |
| 8.6 Measurement and analysis service | Primitive data collection support;<br>Measurement model selections support;<br>New model creation support;<br>Data set import and export support;<br>Various statistical calculations support;<br>Data set visualisation support;<br>Non-regression analysis support. |
| 8.7 Quality assurance service | Impact analysis of quality assurance failure on a specific process assurance item support;<br>Quality assurance data linking with audit checklists support. |
| 8.8 Audit service | Audit checklist linking with requirements support;<br>Schedule of audits linking with key project events support;<br>Audit data creation, storage, and analysis support. |
| 8.9 Traceability service | Traceability analysis support;<br>Traceability analysis reports presentation support;<br>Communication and distribution of analysis results support.;<br>Query and navigation support. |

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| SEE service | Exemplary automated support |
|---|---|
| 8.10 Documentation service | Documentation authoring support;<br>Context sensitive documentation linking support;<br>Online documentation into delivery package construction support;<br>Printing support;<br>Media formats conversion support;<br>Software change dependent documentation items flagging support;<br>Document version management and access control support;<br>Review cycle management support. |
| 8.11 Review service support | Information mining support on SEE repository;<br>Retrieving support for the SEE repository;<br>Cross-referencing support of the documents;<br>Review reports cataloguing support. |
| **9. Project management services** | |
| 9.2 Project strategy service | Key project services identification support;<br>Cross-services usage checking support |
| 9.3 Project planning service | Key project events visualisation support;<br>Resource levelling support;<br>Critical path analysis support;<br>Impact analysis support;<br>Budget calculations and forecasts support. |
| 9.4 Project estimation service | Change impact estimation support;<br>Variable parameter sensitivity analysis support. |
| 9.5 Project risk management service | Cost and schedule measuring support;<br>Trade-off analysis support. |
| 9.6 Project monitoring and scheduling service | Measurement data gathering support;<br>Support of a trend analysis for deviation of costs, size, and resource estimates from the actual amounts;<br>Triggering or alarming support when actual data differ from planned resource usage, or when action items have not been closed after a certain period. |
| 9.7 Project evaluation service | Project/product outcomes evaluation support against user acceptance criteria;<br>Impact analysis support to assist in the determination of a recovery path for minimal impact |
| 9.8 Decision management service | Decision and selection criteria repository support |
| 9.9 Information management service | Safety and security information items rules generation support<br>Assessment of effectiveness of information management support |

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| SEE service | Exemplary automated support |
|---|---|
| **10. Process management services** | |
| 10.2 Process definition service | Analysis support for process requirements, including domain-specific analysis and application-specific analysis;<br>Process definition lifecycle support;<br>Support simulation, modelling, and validation of process definitions. |
| 10.3 Process library service | Process assets storage and versioning support;<br>Access control and status reporting support. |
| 10.4 Process initiation service | Support of relationship definition and tailoring of processes and activities;<br>Process definition support<br>Process training support. |
| 10.5 Process usage service | Process utilisation and status querying and reporting support. |
| 10.6 Process monitoring service | Detection and logging monitoring support;<br>Monitored data visualisation support;<br>Monitored data distribution support. |
| 10.7 Process improvement support service | Measurement data collection support;<br>Process capability assessment support;<br>Assessment reports preparation support<br>Assessment scheduling support. |
| 10.8 Process documentation service | Documentation design, production, and editing support;<br>Documentation distribution and maintenance support. |
| **11. SEE support services** | |
| 11.2 SEE common support service | Supporting create, modify, edit and save various objects;<br>Supporting import or export of various objects in various file formats;<br>Supporting format and print various objects;<br>Supporting create, capture, modify, store, playback and transmit various objects;<br>Supporting transform various objects into other formats. |
| 11.3 SEE publishing service | Document objects and documents lifecycle support;<br>Support of create tables of contents, indices, bibliographies, and glossaries;<br>Support of format, build, preview, and print documents, create and print templates;<br>Support of create or modify layouts or styles for documents;<br>Document version control support. |
| 11.4 SEE cooperative work support service | Shared repositories support;<br>Conferencing support;<br>Schedule sharing support;<br>Concurrent engineering support. |

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| SEE service | Exemplary automated support |
|---|---|
| 11.5 SEE user communication support service | Receive, archive, compose, send, reply, forward, broadcast, and acknowledge messages support;<br>Communication (mail, chat, messaging, etc.) customising support;<br>Message handling and management support;<br>Messaging over network support. |
| 11.6 SEE administration service | Managing user access support;<br>Monitoring the SEE status support;<br>Resource access control support. |
| 11.7 SEE policy enforcement service | Identification and authentication support;<br>Mandatory and discretionary access control support;<br>Integrity protection support;<br>Backup and recovery support;<br>Exportation and importation security support. |
| 11.8 SEE data/information mining service | Useful data/information selection from repository support;<br>Mined data/information integration support;<br>Useful patterns analysis and extraction support;<br>Data/information visualising support;<br>Software characteristic modelling support;<br>Invoking reuse management support. |
| 11.9 SEE data retrieve/storage service | Data characteristics checking support;<br>Data storage periodic assessment support |
| 11.10 SEE data/information exchange service | Data constraints and transformation rules identification support<br>Data exchange means and effectiveness analysis support |
| 11.11 SEE enabling support service | Enabling service identification analysis support<br>Enabling service management support<br>Enabling service Service Level Agreement definition support<br>Enabling service monitoring support |
| **12. SEE infrastructure services** | |
| 12.2 SEE infrastructure management service | SEE infrastructure resource management support;<br>Query and reporting services support of the SEE resources;<br>Self-testing support of SEE facilities;<br>Administration messaging to the system administrator support;<br>Support making sharable data and/or tools, user and/or role, task information among SEEs;<br>Support notification of the SEE environmental changes to all users. |

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| SEE service | Exemplary automated support |
|---|---|
| 12.3 SEE information sharing service | Data sharing support;<br>Inter-process communication support;<br>Message handling support;<br>Event notification support. |
| 12.4 SEE repository service | Meta-data base and object database management support;<br>Object data transaction support;<br>Version and archive control support;<br>Query/retrieving support;<br>Object data interchange support. |
| 12.5 SEE operating system service | Operating system process management support;<br>Operating system synchronization support;<br>Generalized input and output support;<br>File storage management support;<br>Asynchronous event/messaging support;<br>Interval timing triggering support;<br>Resource management support. |

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# Annex B
(informative)

# Services mapped on to ISO/IEC 12207 activities

**Table B.1 – SEE Services mapped on to ISO/IEC-12207:2008**

| SEE Services | ISO/IEC 12207:2008 | | |
|---|---|---|---|
| Project planning service | Agreement | acquisition process | Acquisition preparation. |
| Project estimation service | | | Acquisition preparation. |
| SEE publishing service | | | Acquisition preparation. |
| SEE user communication support service | | | Acquisition advertisement. |
| Project risk management service | | | Supplier selection. |
| Project evaluation service | | | Supplier selection. |
| Project risk management service | | | Contract agreement. |
| Project evaluation service | | | Contract agreement. |
| SEE user communication support service | | | Contract agreement. |
| Project monitoring and scheduling service | | | Agreement monitoring. |
| SEE user communication support service | | | Agreement monitoring. |
| Project evaluation service | | | Acquirer acceptance. |
| Project evaluation service | | | Closure. |
| Project evaluation service | | supply process | Opportunity identification. |
| Project risk management service | | | Supplier tendering. |
| Project evaluation service | | | Supplier tendering. |
| SEE user communication support service | | | Supplier tendering. |
| Project risk management service | | | Contract agreement. |
| Project evaluation service | | | Contract agreement. |
| SEE user communication support service | | | Contract agreement. |
| Project planning service | | | Contract execution. |
| Project estimation service | | | Contract execution. |
| Process initiation service | | | Contract execution. |
| SEE publishing service | | | Contract execution. |
| Process definition service | Org. project enabling | life cycle model management process | Process establishment. |
| Process library service | | | Process establishment. |
| Process improvement support service | | | Process establishment. |
| Process documentation service | | | Process establishment. |
| Project evaluation service | | | Process assessment. |
| Process library service | | | Process assessment. |
| Process monitoring service | | | Process assessment. |
| Measurement and analysis service | | | Process improvement. |
| Process improvement support service | | | Process improvement. |
| Process documentation service | | | Process improvement. |
| Project planning service | | infrastructure management process | Process implementation. |
| SEE policy enforcement service | | | Process implementation. |
| Project planning service | | | Establishment of the infrastructure. |
| SEE policy enforcement service | | | Establishment of the infrastructure. |

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| SEE Services | ISO/IEC 12207:2008 | | |
|---|---|---|---|
| SEE infrastructure management service | Project | | Establishment of the infrastructure. |
| SEE policy enforcement service | | | Maintenance of the infrastructure. |
| SEE infrastructure management service | | | Maintenance of the infrastructure. |
| SEE information sharing service | | | Maintenance of the infrastructure. |
| Project planning service | | project portfolio management process | Project initiation. |
| Project estimation service | | | Project initiation. |
| Project risk management service | | | Project initiation. |
| Project monitoring and scheduling service | | | Project initiation. |
| Project evaluation service | | | Project initiation. |
| SEE user communication support service | | | Project initiation. |
| Project monitoring and scheduling service | | | Portfolio evaluation. |
| Project evaluation service | | | Portfolio evaluation. |
| Project risk management service | | | Project closure. |
| Project evaluation service | | | Project closure. |
| Project planning service | | human resource management process | Skill identification. |
| Project planning service | | | Skill development. |
| Process initiation service | | | Skill development. |
| SEE user communication support service | | | Skill acquisition and provision. |
| SEE cooperative work support service | | | Knowledge management. |
| Quality assurance service | | quality management process | Quality management. |
| Project monitoring and scheduling service | | | Quality management corrective action. |
| Process monitoring service | | | Quality management corrective action. |
| Project strategy service | | project planning process | Project initiation. |
| Project planning service | | | Project planning. |
| Project estimation service | | | Project planning. |
| Project risk management service | | | Project planning. |
| | | | Project activation. |
| Project monitoring and scheduling service | | project assessment and control process | Project monitoring. |
| Measurement and analysis service | | | Project control. |
| Project monitoring and scheduling service | | | Project control. |
| Process monitoring service | | | Project control. |
| Project evaluation service | | | Project assessment. |
| Project evaluation service | | | Project closure. |
| Decision management service | | decision management process | Decision planning. |
| Decision management service | | | Decision analysis. |
| Project risk management service | | risk management process | Risk management planning. |
| Project risk management service | | | Risk profile management. |
| Project risk management service | | | Risk analysis. |
| Project risk management service | | | Risk treatment. |
| Project risk management service | | | Risk monitoring. |
| Project risk management service | | | Risk management process evaluation. |
| Configuration management service | | configuration management process | Configuration management planning. |
| Configuration management service | | | Configuration management execution. |
| Information management service | | information management process | Information management planning. |
| Information management service | | | Information management execution. |
| Measurement and analysis service | | measurement process | Measurement planning. |
| Measurement and analysis service | | | Measurement performance. |
| Measurement and analysis service | | | Measurement evaluation. |

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| SEE Services | ISO/IEC 12207:2008 | | |
|---|---|---|---|
| Project planning service | Technical | stakeholder requirements definition process | Stakeholder identification. |
| Requirements engineering service | | | Requirements identification. |
| Requirements engineering service | | | Requirements evaluation. |
| Requirements engineering service | | | Requirements agreement. |
| Requirements engineering service | | | Requirement recording. |
| Requirements engineering service | | system requirements analysis process | Requirements specification. |
| Documentation service | | | Requirements specification. |
| SEE user communication support service | | | Requirements specification. |
| System architectural design service | | system architectural design process | Establishing architecture. |
| Traceability service | | | Establishing architecture. |
| Project evaluation service | | | Establishing architecture. |
| Traceability service | | | Architectural evaluation. |
| Testing service | | system integration process | Integration. |
| Integration service | | | Integration. |
| Measurement and analysis service | | | Integration. |
| System test synthesis and report service | | | Test readiness. |
| Testing service | | system qualification testing process | Qualification testing. |
| Work product verification service | | | Qualification testing. |
| System test synthesis and report service | | | Qualification testing. |
| Measurement and analysis service | | | Qualification testing. |
| Documentation service | | | Qualification testing. |
| Documentation service | | software installation process | Software installation. |
| Process documentation service | | | Software installation. |
| SEE user communication support service | | | Software installation. |
| Testing service | | software acceptance support process | Software acceptance support. |
| Documentation service | | | Software acceptance support. |
| SEE user communication support service | | | Software acceptance support. |
| Project planning service | Implementation | software operation process | Preparation for operation. |
| SEE policy enforcement service | | | Preparation for operation. |
| Work product verification service | | | Operation activation and check-out. |
| Operational scenario service | | | Operation activation and check-out. |
| Configuration management service | | | Operation activation and check-out. |
| Operational scenario service | | | Operational use. |
| SEE user communication support service | | | Operational use. |
| Change management service | | | Customer support. |
| Measurement and analysis service | | | Customer support. |
| Project monitoring and scheduling service | | | Customer support. |
| SEE user communication support service | | | Customer support. |
| | | | Operation problem resolution. |
| Project planning service | | software maintenance process | Process implementation. |
| SEE policy enforcement service | | | Process implementation. |
| Change management service | | | Problem and modification analysis. |
| Project risk management service | | | Operational use. |
| Project risk management service | | | Problem and modification analysis. |
| Project evaluation service | | | Operational use. |
| Project evaluation service | | | Problem and modification analysis. |

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| SEE Services | ISO/IEC 12207:2008 | | |
|---|---|---|---|
| Re-engineering service | SW implementation | | Modification implementation. |
| Software reverse engineering service | | | Modification implementation. |
| Configuration management service | | | Modification implementation. |
| Documentation service | | | Modification implementation. |
| Work product verification service | | | Maintenance review/acceptance. |
| Project evaluation service | | | Maintenance review/acceptance. |
| Project planning service | | | Migration. |
| Project evaluation service | | | Migration. |
| SEE user communication support service | | | Migration. |
| Project planning service | | software disposal process | Software disposal planning. |
| SEE user communication support service | | | Software disposal planning. |
| SEE user communication support service | | | Software disposal execution. |
| Project strategy service | | software implementation process | Software implementation strategy. |
| Requirements engineering service | | software requirements analysis process | Software requirements analysis. For each software item (or configuration item, if identified) |
| Software prototyping service | | | Software requirements analysis. For each software item (or configuration item, if identified) |
| SEE user communication support service | | | Software requirements analysis. For each software item (or configuration item, if identified) |
| Simulation service | | software architectural design process | Software architectural design. For each software item (or configuration item, if identified) |
| Software modelling service | | | Software architectural design. For each software item (or configuration item, if identified) |
| Software design service | | | Software architectural design. For each software item (or configuration item, if identified) |
| Project evaluation service | | | Software architectural design. For each software item (or configuration item, if identified) |
| Simulation service | | software architectural design process | Software detailed design. For each software item (or configuration item, if identified) |
| Software modelling service | | | Software detailed design. For each software item (or configuration item, if identified) |
| Software design service | | | Software detailed design. For each software item (or configuration item, if identified) |
| Software static/dynamic analysis service | | | Software detailed design. For each software item (or configuration item, if identified) |
| Testing service | | software construction process | Software construction. For each software item (or configuration item, if identified) |
| Source code generation service | | | Software construction. For each software item (or configuration item, if identified) |

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