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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.

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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]

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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.

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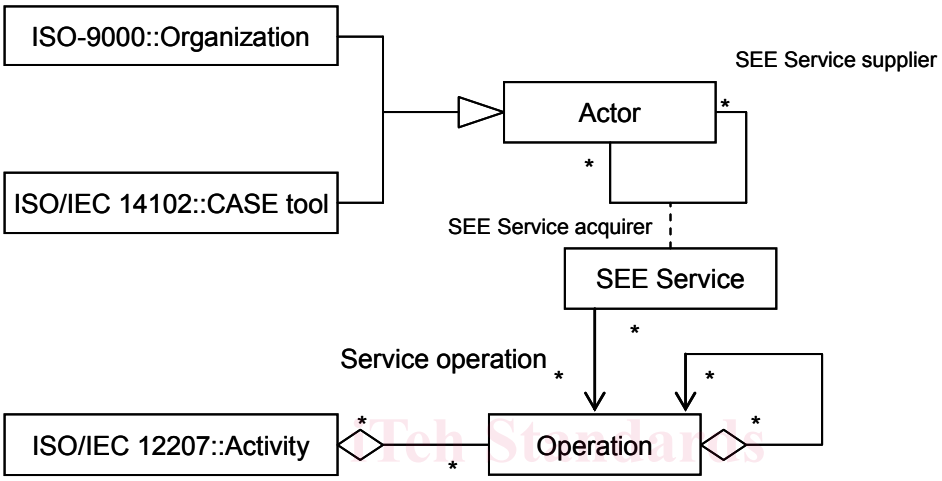
- CASE Tool;
- Actor;
- Activity;
- Organization.

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.



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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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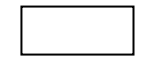
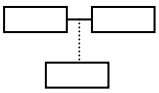
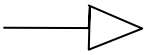
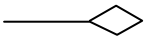
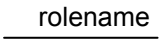
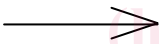
	class: A class is drawn as a solid-outline rectangle with a class name. A class name proceeding package names separated by double colons (::) indicate a class defined in another package
	association class: An association that also has class properties (or a class that has association properties) shown as a class symbol (rectangle) attached by a dashed line to an association path
	association: Binary associations are shown as lines connecting two class symbols
	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
	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
	rolename: A name string near the end of the line indicates the role played by the class attached, if specified
	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)
	* 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

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Figure 1 — SEE Reference Model described in UML

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.

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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.

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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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