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Systems and software engineering — Guideline for the evaluation and selection of software engineering tools

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National foreword

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Systems and software engineering — Guideline for the evaluation and selection of software engineering tools

Ingénierie des systèmes et du logiciel — Lignes directrices pour l'évaluation et le choix des outils d'ingénierie logicielle

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

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

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Introduction

Within systems and software engineering, software engineering tools represent a major part of the supporting technologies used to develop and maintain information technology systems. Their selection is carried out with careful consideration of both the technical and management requirements.

The objective of an evaluation process is to provide quantitative and comparable results of all candidate alternatives. The final selection can then be based on these results. To be widely useful and accepted, the software engineering tool evaluation and selection processes are supposed to help both the users and the suppliers of software engineering tools. The more objective, repeatable, and impartial the evaluation and selection processes are, the more widely acceptable they are. The information and guidance outlined in this document are intended to lead to more cost-effective selections of software engineering tools and to a greater uniformity in how software engineering tool functions and features are described.

For evaluating and selecting software engineering tools, a set of processes providing a procedure for evaluation and selection, a list of capabilities providing scope of functional requirements, and a list of characteristics providing scope of non-functional requirements are needed.

Evaluation and selection of software engineering tools is usually performed within a specific, purpose-oriented tool area for practical reasons, to manage the scope of evaluation and selection. Examples of such tool areas are requirements engineering tools and configuration management tools. Lists of capabilities are tool area specific, but the list of characteristics and the set of evaluation and selection processes are more generic for all software engineering tool areas.

This document defines a set of processes and a list of characteristics which can be used by all software engineering tool areas. This document can be used together with any tool area-specific standard which defines list of capabilities for the tool area.

International standards defining lists of capabilities for specific tool areas have been published, such as ISO/IEC 30130 for “software testing tools”, ISO/IEC TR 24766 for “requirements engineering tools”, and ISO/IEC TR 18018 for “configuration management tools”. Lists of capabilities for other tool areas of software engineering can be developed as a series of standards according to their priority.

It is supposed in this document that tool area is decided before starting the evaluation and selection. It is recommended that the decision would be based on ISO/IEC 15940 which defines the software engineering service for each tool area.

This document adopts the general model of software product quality characteristics and sub-characteristics defined in ISO/IEC 25010 and gives additional guidance how to apply the model when the software product is a software engineering tool. The document follows also the software product evaluation model defined in ISO/IEC 25041.

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Systems and software engineering — Guideline for the evaluation and selection of software engineering tools

1 Scope

This document gives guidelines for the evaluation and selection of software engineering tools, covering a partial or full portion of the software engineering life cycle.

It establishes processes and activities to be applied for the evaluation of software engineering tools and selecting the most appropriate software engineering tools from several candidates.

It establishes, for selected processes, the tasks and activities that can be applied for the evaluation of software engineering tools and selecting the most appropriate software engineering tools from several candidates.

It establishes processes that can be applied for the evaluation of software engineering tools and selecting the most appropriate software engineering tools from several candidates.

As these processes are generic, organizations can adapt these generic processes to meet organizational needs. The software engineering tool evaluation and selection processes can be viewed in the larger context of the organization's technology adoption process.

This document provides the following:

a) guidance on identifying organizational requirements for software engineering tools;

b) guidance on mapping those requirements to software engineering tool characteristics to be evaluated;

c) a process for selecting the most appropriate software engineering tool from several tools, based on measurements of the defined characteristics.

NOTE 1 Guidance on mapping those requirements to software engineering tool capabilities to be evaluated is not covered by this document, but is covered by a series of standards for each tool area.

Primary users of this document are organizations that intend to adopt software engineering tools to support their software life cycle processes. Software tool suppliers can also use this document to describe characteristics of their software engineering tools.

This document is not intended to apply to:

a) software engineering frameworks whose purpose is to provide mechanisms for data, control and presentation integration;

b) general purpose tools (e.g. word processors, spreadsheets) which can be used in software engineering activities, nor software engineering tools of very narrow scope or specific purpose (e.g. a compiler);

c) planning for the implementation of software engineering tools within an organization.

NOTE 2 A user of this document can make the best possible selection of a software engineering tool and yet have no guarantee of a successful implementation.

The methods described in this document are useful not only for the selection of software engineering tools, but for any project where COTS/FOSS software can be selected instead of engaging in new software development.

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To follow the guidance provided in this document consists in applying the activities and tasks that are attached to the defined processes to evaluate and select software. Organizations using this document for trade purposes can specify the minimum set of processes and their related activities and tasks, suitable to their given application.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
atomic sub-characteristic
lowest level sub-characteristics

Note 1 to entry: The highest level evaluation categories are called characteristics. Characteristics are usually subdivided into sub-characteristics. At the lowest level, when no further subdivision is appropriate, the sub-characteristics are referred to as atomic sub-characteristics.

3.2
characteristic
aspect of a product by which it can be described and evaluated

Note 1 to entry: A characteristic can be refined into multiple levels of sub-characteristics that bear on its ability to satisfy stated or implied needs.

3.3
measure (noun)
variable to which a value is assigned as the result of measurement

Note 1 to entry: The term “measures” is used to refer collectively to base measures, derived measures, and indicators.

[SOURCE: ISO/IEC 15939:2007, 2.15, modified — The words “plural form” have been changed to “term”.]

3.4
measure (verb)
make a measurement

[SOURCE: ISO/IEC 25040:2011, 4.39]

3.5
measurement
set of operations having the object of determining a value of a measure

Note 1 to entry: Measurement can include assigning a qualitative category such as the language of a source program (ADA, C, COBOL, etc.).

[SOURCE: ISO/IEC 15939:2007, 2.17, modified — Note 1 to entry has been changed.]

3.6
software engineering tool
software product that assists software engineers by providing automated support

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3.7
rating
action of mapping the measured value to the appropriate rating level

Note 1 to entry: Used to determine the rating level associated with the software for a specific quality characteristic.

Note 2 to entry: Rating and rating levels can be applied to characteristics other than quality characteristics.

3.8
rating level
scale point on an ordinal scale which is used to categorize a measurement scale

Note 1 to entry: The rating level enables software to be classified (rated) in accordance with the stated or implied needs (see 8.2).

Note 2 to entry: Appropriate rating levels can be associated with the different views of quality, i.e. "Users", "Managers" or "Developers".

4 Abbreviated terms

BMT benchmark test

COTS commercial off-the-shelf

FOSS free/open-source software

GUI graphical user interface

5 Overview of evaluation and selection of software engineering tools

5.1 Introduction of the evaluation and selection of software engineering tools

This document defines both a set of processes and a structured set of software engineering tool characteristics for use in the technical evaluation and the ultimate selection of a software engineering tool. It follows the software product evaluation model defined in ISO/IEC 25041.

This document adopts the general model of software product quality characteristics and sub-characteristics defined in ISO/IEC 25010 and extends these when the software product is a software engineering tool; it provides product characteristics unique to software engineering tools as described in 10.2 to 10.4. This larger set of characteristics is then organized into three groups; they are characteristics related to software engineering tool usage functionality, general quality and not related to quality.

NOTE The capabilities of software engineering tools are defined in a series of standards for each tool area.

The objective of the technical evaluation process is to provide quantitative results on which the final selection can be based. Measurement assigns numbers (or other ratings) to attributes of entities; a major activity of evaluation is to obtain these measurements for use in selection. The final selection results should aim to achieve objectivity, repeatability and impartiality. These objectives and the confidence in the outcomes depend in part on the resources allocated to the overall evaluation and selection process. The user of this document is asked to deal with these issues at an early stage.

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5.2 Framework of the evaluation and selection of software engineering tools

This subclause illustrates an overview of the evaluation and selection of software engineering tools discussed in this document as shown in Figure 1. Evaluation and selection of software engineering tools includes four major processes:

— preparation process;

— structuring process;

— evaluation process; and

— selection process.

In the process diagrams Figures 1 to 5, round corner rectangle is process/activity, normal rectangle is outcome of the process/activity and dashed rectangle is a plan which is referred by each process without reference. Also, a solid arrow shows data flow and a dashed arrow shows control flow of transition between processes/activities.

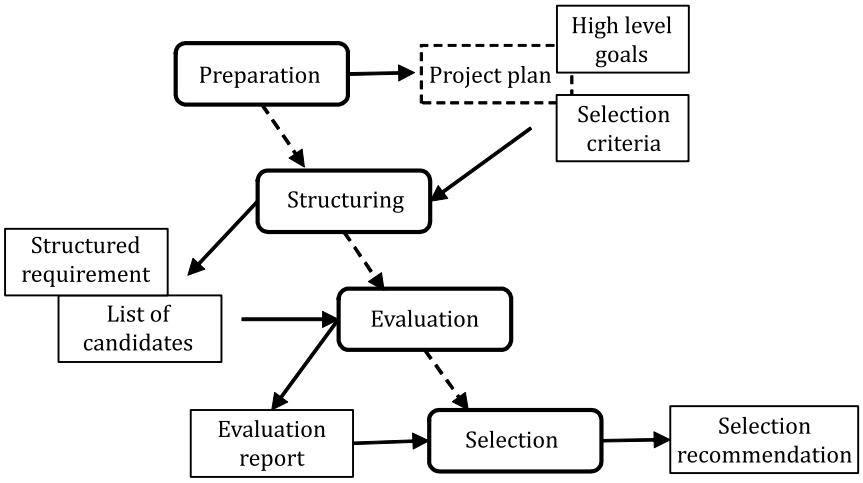

Figure 1 — Framework of evaluation and selection of software engineering tools

A key process is the structuring of a set of requirements against which candidate software engineering tools are to be evaluated and upon which selection decisions are based. The software engineering tool characteristics defined in 10.2 to 10.4 form the basis for requirements structuring and play a central role in the overall process.

5.3 General process considerations

There are several considerations that apply to the processes described in this document on a global basis. The intent is for the user of this document to tailor its application in such a way as to maximize the probability of a successful evaluation and selection process, and minimize its cost and risk.

5.3.1 Sequencing of processes

This document does not impose the sequence of process activities described above and in the following clauses. It is up to the organization to select the relevant processes and activities needed to meet its evaluation and selection goals.

The organization decides which to employ, in what sequence, and with what degree of parallelism. The sequencing of the processes' activities is then documented in an evaluation project plan.

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5.3.2 Reducing cost and risk

In general, organizations which apply this document want to minimize the cost of the entire evaluation and selection process to the extent possible, while maintaining the level of effort necessary to select the most appropriate software engineering tool(s) for their use. These objectives can be addressed by minimizing the number of tools evaluated, minimizing the cost of evaluating specific tools, and ensuring that the formality of the process is appropriate to the organization.

The activities of software engineering tool information gathering and identifying final candidates for selection (see Clause 9) effectively allow the user of this document to screen the available tools against the organization's needs, and eliminate from consideration tools which do not, or are not likely to, substantially address the organization's needs.

The organization can be unable to find any tool which appears likely to sufficiently meet its needs. In such a case, the stated needs themselves should be re-examined, and if they are found to accurately reflect the organization's actual requirements for technology improvement, the overall evaluation and selection process can be abandoned. Similarly, if the final candidate tools appear to be marginal in addressing the organization's needs, the level of detail and formality of the subsequent activities should be made to reflect the risk factor, and the organization should be prepared to not select a tool if the evaluation process so indicates, as the typical cost of bringing a new tool into operational use is substantial.

Evaluations of candidate tools might have already been performed and be available to the organization. Such information can be used to reduce the cost of candidate tool evaluation.

NOTE 1 Previous evaluations which have been performed on a different version of the candidate tool can still yield useful information. Similarly, evaluations which addressed a different set of organizational needs can still provide useful information.

This document calls for the development of several plans and reports, and implicitly, for their review by various personnel within the organization. In addition, activities are required to perform the four processes outlined.

The format and level of detail of the data products are left to the discretion of the organization, as is the level of effort necessary to perform the activities.

NOTE 2 Some organizations can be required to limit the scope, detail and formality of the processes to apply this document within existing resource constraints.

6 Preparation process

6.1 Purpose

In this process, the objective and criteria for tool selection are clarified, and the project plan is defined for tool evaluation and selection.

A set of software engineering tool selection guidelines is identified and a project plan developed. The process is shown in Figure 2.

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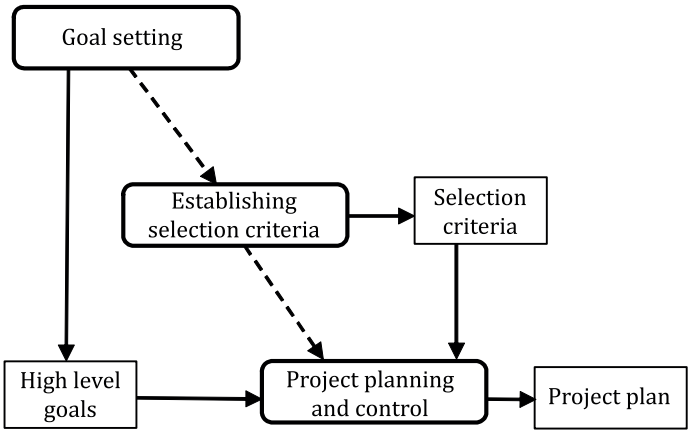

Figure 2 — Overview of preparation process

6.2 Outcomes

Outcomes resulting from the successful implementation of the preparation process:

a) objective for tool selection;

b) list of selection criteria; and

c) project plan for evaluation and selection tools.

6.3 Activities and tasks

6.3.1 Goal setting

The development of a set of realistic goals is a necessary first activity. In developing goals, both a rationale for acquisition (why acquire a software engineering tool) and a general policy for acquisition (what type of tool to acquire and how to do it) should be developed.

NOTE Goal setting activities, including possibly the identification of selection criteria, might have already been performed as a part of other efforts prior to formally entering the preparation process of evaluation and selection of software engineering tools.

The following tasks should be performed:

a) develop rationale for acquisition:

   1) review the organization's current software development process, determining its maturity and areas of concern;

   2) review the current state of software engineering tool technology and observe trends for consideration as future reference technology;

   3) compare the organization's current practices to possible future practices if software engineering tools are adopted and identify areas of potential benefit;

b) define goals and expectations:

   1) set overall goals (e.g. productivity improvement, quality improvement, enhanced process manageability);

   2) define evaluation and selection constraints (e.g. cost, schedule, resources);

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