
**Software engineering — Product
evaluation —**

**Part 3:
Process for developers**

*Ingénierie du logiciel — Évaluation du produit —
Partie 3: Procédés pour développeurs*
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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 734 10 79
E-mail copyright@iso.ch
Web www.iso.ch

Printed in Switzerland

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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. 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.

International Standard ISO/IEC 14598-3 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 7, *Software engineering*.

ISO/IEC 14598 consists of the following parts, under the general title *Software engineering — Product evaluation*:

- *Part 1: General overview*
- *Part 2: Planning and management*
- *Part 3: Process for developers*
- *Part 4: Process for acquirers*
- *Part 5: Process for evaluators*
- *Part 6: Documentation of evaluation modules*

Annex A of this part of ISO/IEC 14598 is for information only.

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Introduction

This part of ISO/IEC 14598 is intended for use during software development. It is applicable to all software development activities requiring a disciplined process. This part of ISO/IEC 14598 is particularly aimed at those measuring and evaluating the quality of software.

This part of ISO/IEC 14598 provides guidelines for clarifying quality requirements and for implementing and analysing software quality measures. This part of ISO/IEC 14598 applies to all software at all phases of the development life cycle. It focuses on the selection and reporting of those indicators that are useful to predict end product quality by measuring the quality of intermediate products. It also focuses on measuring end product quality.

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Software engineering - Product evaluation - Part 3: Process for developers

1 Scope

This part of ISO/IEC 14598 provides requirements and recommendations for the practical implementation of software product evaluation when the evaluation is conducted in parallel with the development and carried out by the developer. In particular, it may be used to apply the concepts described in ISO/IEC 9126-1, 2, 3 and ISO/IEC 14598-1, 2, 6.

The process described in this part of ISO/IEC 14598 defines the activities needed to analyse evaluation requirements, to specify, design, and perform evaluation actions and to conclude the evaluation of any kind of software product.

The evaluation process is designed to be used concurrently with the development. The evaluation process needs to be synchronised with the software development process and the entities be evaluated as they are delivered.

This part of ISO/IEC 14598 may be used by

- a project manager to clarify quality requirements, to monitor and control the quality of the software during development and to make decisions to assure that the required quality is built in,
- a software designer to identify specific features that should be built into the software or changed in order to meet the quality requirements,
- a quality assurance / control / audit responsible to evaluate whether the quality requirements are met,
- a maintainer to make decisions for the implementation of changes and redesign/reengineering,
- a software acquirer as part of an agreement with a developer when acquiring software (e.g. in the case of outsourcing software development) when an independent evaluation is not required. Acquirers may be personnel in a purchasing role, developers outsourcing a part of the software product, or end-users. The role of the acquirer depends on the agreement between the acquirer and the developer. ISO/IEC 14598-4 describes evaluation from the acquirers point of view.

This part of ISO/IEC 14598 is intended for application at the project level. In order to obtain full benefit from this standard the organization should be involved. This aspect is covered in ISO/IEC 14598-2.

This part of ISO/IEC 14598 does not prescribe specific indicators or metrics nor does it prescribe any particular development method.

2 Conformance

In order to conform to this part of ISO/IEC 14598, an organization shall review all requirements and recommendations in clause 6, to identify which are applicable, and state which requirements have not been implemented.

3 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO/IEC 14598. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO/IEC 14598 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO/IEC 9126-1, *Information technology - Software product quality - Part 1: Quality model*.

ISO/IEC 12207, *Information technology - Software life cycle processes*.

ISO/IEC 14598-1:1999, *Information technology - Software product evaluation - Part 1: General overview*.

ISO/IEC 14598-2:2000, *Information technology - Software product evaluation - Part 2: Planning and management*.

ISO/IEC 14598-6, *Software engineering - Product evaluation - Part 6: Documentation of evaluation modules*.

4 Terms and definitions

For the purposes of this part of ISO/IEC 14598, the definitions given in ISO/IEC 14598-1 and the following definitions apply.

4.1 counting rule

conditions and procedures under which the measurement value is obtained

4.2 external attribute

a measurable property of an entity which can only be derived with respect to how it relates to its environment

Note: External attributes are those that relate to requirements (external properties of the software). External attributes can only be derived from the operational behaviour of the system of which it is a part.

4.3 internal attribute

a measurable property of an entity which can be derived purely in terms of the entity itself

Note: Internal attributes are those that relate to the internal organization of the software and its development.

4.4 unit

a quantity adopted as a standard of measurement

Note: Each unit has an associated scale.

5 Evaluation concepts

5.1 General aspects

The quality of software products can be described in terms of quality characteristics.

Note: A set of quality characteristics is defined in ISO/IEC 9126-1.

However, in general it is not practical to assign measurement values directly to these characteristics. Instead, a set of software quality attributes of the software product is selected that represents the main aspects of the characteristics. Measurement values of these attributes give a quantitative representation of the quality of the software product.

The emphasis of this part of ISO/IEC 14598 is to support the developer when applying software measurement and evaluation during the development life cycle. This is done by identifying attributes of the intermediate products and development activities and by measuring these attributes. This provides a means for quantitatively monitor and control the quality of the software product under development during the development process. The goal is to identify problems in achieving the desired quality as early as possible in the development process.

Today's knowledge of software measurement and evaluation does not justify the recommendation of a single set of attributes that apply to every software product and every software developing organization. Therefore, the selection of attributes of the software product, the intermediate products and development activities is based on the experience of the organization developing the software.

5.2 User needs

Identification of the user needs is an important aspect of establishing general quality requirements. This is done by identifying the user needs for quality in use in particular contexts of use. These general requirements are informal by nature and needs to be formalised. They can be quantified and evaluated using quality in use metrics.

Note : A set of quality in use metrics is described in ISO/IEC 9126-4.

The approach taken in this part of ISO/IEC 14598 is to formulate the general requirements in terms of external attributes.

5.3 External attributes

External quality attributes represent the quality characteristics of the software product. They are used to express external quality requirements quantitatively. This is done by assigning a target measurement value to each attribute.

When the software product is developed actual measurement values of the attributes are collected, hereby providing a quantitative expression of the quality characteristics of the software. Quality evaluation is done by comparing the actual measured values with the target values of all attributes.

Note: A set of external software quality metrics is provided in ISO/IEC 9126-2.

5.4 Internal attributes

In order to monitor and control the software quality during development the external quality requirements are translated into requirements of intermediate products and development activities. This is done by translating the target measurement values of the external attributes of the software product into target measurement values of internal attributes of intermediate products and development activities.

The selection of internal attributes and translation of external target values into internal target values is a non-trivial activity. It depends primarily on personal experience unless the developer provides an infrastructure for collecting and analysing experience from previously completed projects. In that case, the experience of the developer can support the activity.

Note 1: The organizational aspect is described in ISO/IEC 14598-2.

During development actual values of internal attributes are measured. The values are compared to the target values. This provides a control of the software quality during development.

Internal attributes can be used to identify anomalies or outliers (i.e. attribute values that deviate from what would normally be expected). General experience tells that such entities are worth examining more closely.

Some internal attributes can be used to monitor trends in the development when they are measured periodically (e.g. every week). Trends measures are used for identifying problems early, both related to the product and to the development process.

Note 2: A set of internal metrics is provided in ISO/IEC 9126-3.

5.5 Quality indicators

Internal quality attributes can be used as quality indicators. In particular, internal attributes are often used as indicators of external attributes; but no general, direct relationship between quality indicators and external quality attributes has been validated yet. However, it is commonly accepted that quality indicators provide useful guidance when used with care.

Use of quality indicators allows the software developer to identify possible quality problems early in the development and to take corrective actions immediately.

There is no known universal set of quality indicators that is suitable for every software development effort. There are differences in applications, development methods and tools, project organizations and cultural differences to mention some examples. Therefore, some indicators may be useful in one organization, but not work in another organization.

5.6 Evaluation process

The evaluation process described in this part of 14598 consists of a set of activities which are conducted by the developer. These activities are performed on the basis of measurement values obtained during the development process.

Note 1: The generic evaluation process is described in ISO/IEC 14598-1.

Note 2: The organizational aspects of the evaluation is described in ISO/IEC 14598-2.

The evaluation process comprises the five activities listed below:

- Establishment of evaluation requirements which consists of identifying the general quality requirements according to an agreed quality model. This activity is described in 6.2.
- Specification of the evaluation which consists of determining the external metrics and target measurement values (criteria for evaluation). This activity is described in 6.3.1. Specification also consists of determining the internal metrics and target measurement values (criteria for evaluation). This activity is described in 6.3.2.
- Design of the evaluation which consists of planning data collection actions. This activity is described in 6.4.1 and 6.4.2.
- Execution of the evaluation which consists of collecting internal measurement values during development and comparing them with target values (evaluation during development). Internal attribute values (quality indicators) are used to estimate end product quality. This is described in 6.5.1. It also consists of collecting external measurement values when they become available and comparing with target values (evaluation of product quality). This activity is described in 6.5.2.
- Feedback to the organization which is based on a of review of evaluation results. This activity is described in 6.6.

5.7 Relation between evaluation and life cycle processes

Evaluation of a software product can be performed within the context of any life cycle process.

Note 1: Software life cycle processes are defined in ISO/IEC 12207: 1995.

This part of ISO/IEC 14598 relates primarily to the development processes.

Note 2 : Development processes are described in ISO/IEC 12207 subclause 5.3. As stated in ISO/IEC 12207, this implies that it may also be necessary to consider the maintenance process (subclause 5.5) and supporting life cycle processes (clause 6) and organizational life cycle processes (clause 7). When this standard is used in the case of outsourcing software development it also relates to the acquisition process and the supply process as described in ISO/IEC 12207 subclause 5.1 and 5.2

6 Evaluation process requirements

6.1 General requirements

This clause relates to the organizational and project-specific requirement.

6.1.1 Organizational requirements

The developer shall build up an infrastructure that allows for data collection and process modifications based on data analysis.

Note : Organizational aspects of evaluation are described in ISO/IEC 14598-2

6.1.2 Project requirements

The developer shall develop the software following a disciplined development process that allows for planning and conducting software measurement and evaluation.

Note 1: Life cycle processes are described in ISO/IEC 12207. Development are described in subclause 5.3.

Note 2: An overview of software product evaluation can be found in ISO/IEC 14598-1.

The developer shall coordinate evaluation activities with supporting processes and activities.

Note 3 : Supporting processes are described in ISO/IEC 12207, including in particular the quality assurance process (subclause 6.3), the verification process (subclause 6.4), the validation process (subclause 6.5) and the audit process (subclause 6.7).

Many data analysis methods require data from previous projects developed under similar conditions and with comparable quality requirements. The developer should, therefore, apply a development model similar to one that has been used in previous projects in the developers organization. Also the same set of attributes should be applied in the projects to allow for data analysis.

6.2 Establish evaluation requirements

This clause relates to the establishment of the general quality requirements and the analysis of their feasibility.

6.2.1 Quality requirements identification

The developer shall ensure that general quality requirements applicable to the software system are identified. User needs, organizational experience, application area experience, software integrity requirements, required standards, regulations, laws etc. should be considered when identifying general requirements.

Note 1: Software integrity levels are described in ISO/IEC 15026.

The developer shall ensure that an agreed quality model is used for structuring the quality requirements.

Note 2 : A quality model is described in ISO/IEC 9126-1.

A list of other system requirements that may affect the feasibility of the quality requirements shall be produced. Acquisition concerns, such as cost and schedule constraints, warranties, and organizational concerns should be considered. Mutually exclusive requirements should be resolved.