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Software engineering — Software product Quality Requirements and Evaluation (SQuaRE) — Guide to SQuaRE

Ingénierie du logiciel — Exigences de qualité du produit logiciel et évaluation (SQuaRE) — Guide de SQuaRE

Reference number
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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 25000 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 7, *Software and system engineering*.

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Introduction

Computers are being used in an increasingly wide variety of application areas, and their intended and correct operation is often critical for business success and/or human safety. Developing or selecting high quality software products is therefore of prime importance. Comprehensive specification and evaluation of software product quality is a key factor in ensuring adequate quality. This can be achieved by defining appropriate quality characteristics, while taking account of the intended use of the software product. It is important that every relevant software product quality characteristic is specified and evaluated, whenever possible using validated or widely accepted measures.

As quality characteristics and associated measures can be useful not only for evaluating a software product but also for defining quality requirements, the predecessor of SQuaRE, ISO/IEC 9126:1991 has been replaced by two related multipart International Standards: ISO/IEC 9126 (Software product quality) and ISO/IEC 14598 (Software product evaluation). The following points derived from practical use of both series gave the logical impulse for creating the new SQuaRE series of International Standards:

- Both ISO/IEC 9126 and ISO/IEC 14598 have common normative, referential and functional roots,
- ISO/IEC 9126 and ISO/IEC 14598 form a complementary set of standards,
- The independent life cycles of both series have created inconsistencies between them.

The general goal of creating the SQuaRE set of International Standards is to move to a logically organized, enriched and unified series covering two main processes: software quality requirements specification and software quality evaluation, supported by a software quality measurement process. The purpose of the SQuaRE set of International Standards is to assist those developing and acquiring software products with the specification and evaluation of quality requirements. It establishes criteria for the specification of software product quality requirements, their measurement, and evaluation. It includes a two-part quality model for aligning customer definitions of quality with attributes of the development process. In addition, the series provides recommended measures of software product quality attributes that can be used by developers, acquirers, and evaluators.

It has to be stressed that the SQuaRE series of International Standards is dedicated to software product quality only. SQuaRE ISO/IEC 25000n — Quality Management Division addresses software product quality requirements specification, measurement and evaluation, and is separate and distinct from the "Quality Management" of processes, which is defined in the ISO 9000 family of standards.

The major benefits of the SQuaRE series over its predecessor standards include:

- the coordination of guidance on software product quality measurement and evaluation,
- guidance for the specification of software product quality requirements, and
- harmonization with ISO/IEC 15939 in the form of Software product Quality Measurement Reference Model presented in ISO/IEC 25020 - Software engineering - Software product Quality Requirements and Evaluation (SQuaRE) Measurement reference model and guide.

The major differences between ISO/IEC 9126, ISO/IEC 14598 and SQuaRE series of International Standards are:

- the introduction of the new general reference model,
- the introduction of dedicated, detailed guides for each division,

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- the introduction of Quality Measure elements within Quality Measurement Division,
- the introduction of the Quality Requirements Division,
- incorporation and revision of the evaluation processes,
- the introduction of guidance of practical use in form of examples,
- coordination and harmonization of the content with ISO/IEC 15939.

SQuaRE consists of the following five divisions:

- ISO/IEC 2500n - Quality Management Division,
- ISO/IEC 2501n - Quality Model Division,
- ISO/IEC 2502n - Quality Measurement Division,
- ISO/IEC 2503n - Quality Requirements Division, and
- ISO/IEC 2504n - Quality Evaluation Division,

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SQuaRE provides:

- Terms and definitions,
- Reference models,
- General guide,
- Individual division guides, and
- International Standards for requirements specification, planning and management, measurement and evaluation purposes.

SQuaRE includes International Standards on quality model and measures, as well as on quality requirements and evaluation.

SQuaRE replaces the current ISO/IEC 9126 series and the 14598 series.

This part of SQuaRE series of standards is a new International Standard with the goal of providing a common set of reference models, terminology, definitions and guidance for practical use of the associated standards and technical reports.

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Software engineering — Software product Quality Requirements and Evaluation (SQuaRE) — Guide to SQuaRE

1 Scope

This International Standards provides guidance for the use of the new series of International Standards named Software product Quality Requirements and Evaluation (SQuaRE). The purpose of this Guide is to provide a general overview of SQuaRE contents, common reference models and definitions, as well as the relationship among the documents, allowing users of the Guide a good understanding of those series of standards, according to their purpose of use. This document contains an explanation of the transition process between the old ISO/IEC 9126 and the 14598 series and SQuaRE and also presents information on how to use the ISO/IEC 9126 and 14598 series in their previous form.

SQuaRE series of standards is intended for, but not limited to, developers, acquirers and independent evaluators of software products, particularly those responsible for defining software quality requirements and for software product evaluation. It is recommended that users of the SQuaRE as well as ISO/IEC 14598 and 9126 series of standards also use this International Standard as a guide to execute their tasks.

2 Conformance

There is no particular conformance clause for this document. Users, for their intended use of SQuaRE series of Standards should follow individual conformance clauses stated in each document of the series.

3 Normative references

This International Standard does not require any normative references. All informative references are presented in the Bibliography.

4 Terms and definitions

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

NOTE The definitions are common to all parts of SQuaRE series of standards.

4.1
acquirer
individual or organisation that acquires or procures a system, software product or software service from a supplier

NOTE Based on the definition in ISO/IEC 12207:1995.

4.2
analysis model
algorithm or calculation combining one or more base and/or derived measures with associated decision criteria

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4.3
attribute
inherent property or characteristic of an entity that can be distinguished quantitatively or qualitatively by human or automated means

NOTE 1 Based on ISO/IEC 15939:2002.

NOTE 2 ISO 9000 distinguishes two types of attributes: a permanent characteristic existing inherently in something; and an assigned characteristic of a product, process or system (e.g. the price of a product, the owner of a product). The assigned characteristic is not an inherent quality characteristic of that product, process or system.

4.4
attribute for quality measure
attribute that relates to software product itself, to the use of the software product or to its development process

NOTE Attributes for quality measure are used in order to obtain quality measure elements.

4.5
base measure
measure defined in terms of an attribute and the method for quantifying it

NOTE A base measure is functionally independent of other measures.

[ISO/IEC 15939:2002, based on the definition in International Vocabulary of Basic and General Terms in Metrology, 1993].

4.6
commercial-off-the-shelf software product
software product defined by a market-driven need, commercially available, and whose fitness for use has been demonstrated by a broad spectrum of commercial users

4.7
context of use
users, tasks, equipment (hardware, software and materials), and the physical and social environments in which a product is used

[ISO 9241-11:1998]

4.8
custom software
software product developed for a specific application from a user requirements specification

4.9
data
collection of values assigned to base measures, derived measures and/or indicators

[ISO/IEC 15939:2002]

4.10
decision criteria
thresholds, targets, or patterns used to determine the need for action or further investigation, or to describe the level of confidence in a given result

[ISO/IEC 15939:2002]

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4.11
derived measure
measure that is defined as a function of two or more values of base measures

[ISO/IEC 15939:2002, based on the definition in International Vocabulary of Basic and General Terms in Metrology, 1993].

NOTE A transformation of a base measure using a mathematical function can also be considered as a derived measure.

4.12
developer
individual or organisation that performs development activities (including requirements analysis, design, testing through acceptance) during the software life cycle process

NOTE Based on the definition in ISO/IEC 12207:1995.

4.13
division of standards
division forms a family of standards serving complementary purposes

4.14
end user
individual person who ultimately benefits from the outcomes of the system

NOTE The end user may be a regular operator of the software product or a casual user such as a member of the public.

4.15
entity
object that is to be characterised by measuring its attributes

EXAMPLE An object can be a process, product, project, or resource.

[ISO/IEC 15939:2002]

4.16
evaluation method
procedure describing actions to be performed by the evaluator in order to obtain results for the specified measurement applied to the specified product components or on the product as a whole

4.17
evaluation module
package of evaluation technology for measuring software quality characteristics, subcharacteristics or attributes

NOTE The package includes evaluation methods and techniques, inputs to be evaluated, data to be measured and collected and supporting procedures and tools.

4.18
evaluator
individual or organisation that performs an evaluation

4.19
external software quality
capability of a software product to enable the behaviour of a system to satisfy stated and implied needs when the system is used under specified conditions

NOTE Attributes of the behaviour can be verified and/or validated by executing the software product during testing and operation.

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EXAMPLE The number of failures found during testing is an external software quality measure related to the number of faults present in the program. The two measures are not necessarily identical since testing may not find all faults, and a fault may give rise to apparently different failures in different circumstances.

4.20
failure
termination of the ability of a product to perform a required function or its inability to perform within previously specified limits

NOTE Based on the definition in IEEE 610.12-1990.

4.21
fault
incorrect step, process or data definition in a computer program

[IEEE 610.12-1990]

4.22
functional requirement
requirement that specifies a function that a system or system component must be able to perform

[IEEE 610.12-1990]

NOTE The software quality characteristic “functionality” can be used to specify or evaluate the suitability, accuracy, interoperability, security and compliance of a function (see ISO/IEC 9126-1 [ISO/IEC 25010]).

4.23
implied needs
needs that may not have been stated but are actual needs

NOTE Some implied needs only become evident when the software product is used in particular conditions.

EXAMPLE Implied needs include: needs not stated but implied by other stated needs and needs not stated because they are considered to be evident or obvious.

4.24
indicator
measure that provides an estimate or evaluation of specified attributes derived from a model with respect to defined information needs

[ISO/IEC 15939:2002]

NOTE In ISO/IEC 14598 this definition was: "a measure that can be used to estimate or predict another measure".

4.25
information need
insight necessary to manage objectives, goals, risks, and problems

[ISO/IEC 15939:2002]

4.26
information product
one or more indicators and their associated interpretations that address information need

EXAMPLE A comparison of a measured defect rate to planned defect rate along with an assessment of whether or not the difference indicates a problem.

[ISO/IEC 15939:2002]

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4.27
information system needs
needs that can be specified as quality requirements by external measures and sometimes by internal measures

4.28
intermediate software product
product of the software development process that is used as input to another stage of the software development process

EXAMPLE Intermediate software products can include static and dynamic models, other documents and source code.

4.29
intermediate software product needs
needs that can be specified as quality requirements by internal measures

4.30
internal software quality
capability of a set of static attributes of a software product to satisfy stated and implied needs when the software product is used under specified conditions

NOTE 1 Static attributes include those that relate to the software architecture, structure and its components.

NOTE 2 Static attributes can be verified by review, inspection and/or automated tools.

EXAMPLE The number of lines of code, complexity measures and the number of faults found in a walk through are all internal software quality measures made on the product itself.

4.31
maintainer
individual or organisation that performs maintenance activities

NOTE Based on the definition in ISO/IEC 12207:1995.

4.32
measure (noun)
variable to which a value is assigned as the result of measurement

NOTE The term “measures” is used to refer collectively to base measures, derived measures, and indicators.

[ISO/IEC 15939:2002]

4.33
measure (verb)
make a measurement

[ISO/IEC 14598-1:1999]

4.34
measurement
set of operations having the object of determining a value of a measure

[ISO/IEC 15939:2002, based on the definition in International Vocabulary of Basic and General Terms in Metrology, 1993]

NOTE Measurement can include assigning a qualitative category such as the language of a source program (ADA, C, COBOL, etc.).

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4.35
measurement function
algorithm or calculation performed to combine two or more base measures

[ISO/IEC 15939:2002]

4.36
measurement method
logical sequence of operations, described generically, used in quantifying an attribute with respect to a specified scale

[ISO/IEC 15939:2002, based on the definition in International Vocabulary of Basic and General Terms in Metrology, 1993].

4.37
measurement procedure
set of operations, described specifically, used in the performance of a particular measurement according to a given method

[ISO/IEC 15939:2002, based on the definition in International Vocabulary of Basic and General Terms in Metrology, 1993]

4.38
measurement process
process for establishing, planning, performing and evaluating software measurement within an overall project or organisational measurement structure

[ISO/IEC 15939:2002]

4.39
observation
instance of applying a measurement procedure to produce a value for a base measure

[ISO/IEC 15939:2002]

4.40
operator
individual or organisation that operates the system

NOTE Based on the definition in ISO/IEC 12207:1995.

4.41
process
system of activities, which use resources to transform inputs into outputs

[ISO 9000:2000]

4.42
quality in use (measure)
the extent to which a product used by specific users meets their needs to achieve specific goals with effectiveness, productivity, safety and satisfaction in specific contexts of use

4.43
quality measure elements
measure, which is either a base measure or a derived measure, that is used for constructing software quality measures

NOTE The software quality characteristic or subcharacteristic of the entity is derived afterwards by calculating a software quality measure.

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4.44
quality model
defined set of characteristics, and of relationships between them, which provides a framework for specifying quality requirements and evaluating quality

4.45
rating
action of mapping the measured value to the appropriate rating level. Used to determine the rating level associated with the software product for a specific quality characteristic

4.46
rating level
scale point on an ordinal scale, which is used to categorise a measurement scale

NOTE 1 The rating level enables software product to be classified (rated) in accordance with the stated or implied needs.

NOTE 2 Appropriate rating levels may be associated with the different views of quality i.e. Users', Managers' or Developers'.

4.47
requirements
expression of a perceived need that something be accomplished or realized

NOTE The requirements may be specified as part of a contract, or specified by the development organisation, as when a product is developed for unspecified users, such as consumer software, or the requirements may be more general, as when a user evaluates products for comparison and selection purpose.

4.48
scale
ordered set of values, continuous or discrete, or a set of categories to which the attribute is mapped

[ISO/IEC 15939:2002, based on the definition in International Vocabulary of Basic and General Terms in Metrology, 1993]

EXAMPLE Types of scales are: a nominal scale which corresponds to a set of categories; an ordinal scale which corresponds to an ordered set of scale points; an interval scale which corresponds to an ordered scale with equidistant scale points; and a ratio scale which not only has equidistant scale point but also possesses an absolute zero. Measures using nominal or ordinal scales produce qualitative data, and measures using interval and ratio scales produce quantitative data.

4.49
software product
set of computer programs, procedures, and possibly associated documentation and data

[ISO/IEC 12207:1995]

NOTE 1 Products include intermediate products, and products intended for users such as developers and maintainers.

NOTE 2 In SQuaRE standards software quality has the same meaning as software product quality.

4.50
software product evaluation
technical operation that consists of producing an assessment of one or more characteristics of a software product according to a specified procedure

4.51
software quality
capability of software product to satisfy stated and implied needs when used under specified conditions

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NOTE This definitions differs from the ISO 9000:2000 quality definition mainly because the software quality definition refers to the satisfaction of stated and implied needs, while the ISO 9000 quality definition refers to the satisfaction of requirements.

4.52
software quality characteristic
category of software quality attributes that bears on software quality

NOTE Software quality characteristics may be refined into multiple levels of subcharacteristics and finally into software quality attributes.

4.53
software quality evaluation
systematic examination of the extent to which a software product is capable of satisfying stated and implied needs

4.54
software quality in use
capability of the software product to enable specific users to achieve specific goals with effectiveness, productivity, safety and satisfaction in specific contexts of use

NOTE Before the product is released, quality in use can be specified and measured in a test environment for the intended users, goals and contexts of use. Once in use, it can be measured for actual users, goals and contexts of use. The actual needs of users may not be the same as those anticipated in requirements, so actual quality in use may be different from quality in use measured earlier in a test environment.

4.55
software quality measure
measure of internal software quality, external software quality or software quality in use

NOTE Internal software quality, external software quality and software quality in use are described in the quality model in ISO/IEC 9126-1 [ISO/IEC 25010].

4.56
stakeholder
a party having a right, share or claim in a system or in its possession of characteristics that meet that party's needs and expectations

[ISO/IEC 15288:2002]

NOTE Stakeholders include, but are not limited to, end users, end user organisations, supporters, developers, producers, trainers, maintainers, disposers, acquirers, supplier organisations and regulatory bodies

4.57
supplier
individual or organisation that enters into a contract with the acquirer for the supply of a system, software product or software service under the terms of the contract

[ISO/IEC 12207:1995]

4.58
system
a combination of interacting elements organised to achieve one or more stated purposes

NOTE 1 A system may be considered as a product or as the services it provides.

NOTE 2 In practice, the interpretation of its meaning is frequently clarified by the use of an associative noun, e.g. aircraft system. Alternatively the word system may be substituted simply by a context dependent synonym, e.g. aircraft, though this may then obscure a system principles perspective.

[ISO/IEC 15288:2002]

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4.59
target of process
software product or task executed by software product to which measurement or evaluation process is applied

4.60
unit of measurement
particular quantity defined and adopted by convention, with which other quantities of the same kind are compared in order to express their magnitude relative to that quantity

[ISO/IEC 15939:2002, based on the definition in International Vocabulary of Basic and General Terms in Metrology, 1993]

4.61
user
individual or organisation that uses the system to perform a specific function

NOTE Users may include operators, recipients of the results of the software, or developers or maintainers of software.

[ISO/IEC 15939:2002]

4.62
validation
confirmation, through the provision of objective evidence, that the requirements for a specific intended use or application have been fulfilled

NOTE 1 "Validated" is used to designate the corresponding status.

[ISO 9000:2000]

NOTE 2 In design and development, validation concerns the process of examining a product to determine conformity with user needs.

NOTE 3 Validation is normally performed on the final product under defined operating conditions. It may be necessary in earlier stages.

NOTE 4 Multiple validations may be carried out if there are different intended uses.

4.63
value
number or category assigned to an attribute of an entity by making a measurement

4.64
verification
confirmation, through the provision of objective evidence, that specified requirements have been fulfilled

NOTE 1 "Verified" is used to designate the corresponding status.

[ISO 9000:2000]

NOTE 2 In design and development, verification concerns the process of examining the result of a given activity to determine conformity with the stated requirement for that activity.

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5 SQuaRE: Software product Quality Requirements and Evaluation – the series of standards on product quality requirements and evaluation

This clause presents an overview of the structure and the contents of SQuaRE series of standards. The objective is to give the users of this series of standards necessary information allowing the efficient choice of applicable documents.

5.1 Organisation of SQuaRE series of standards

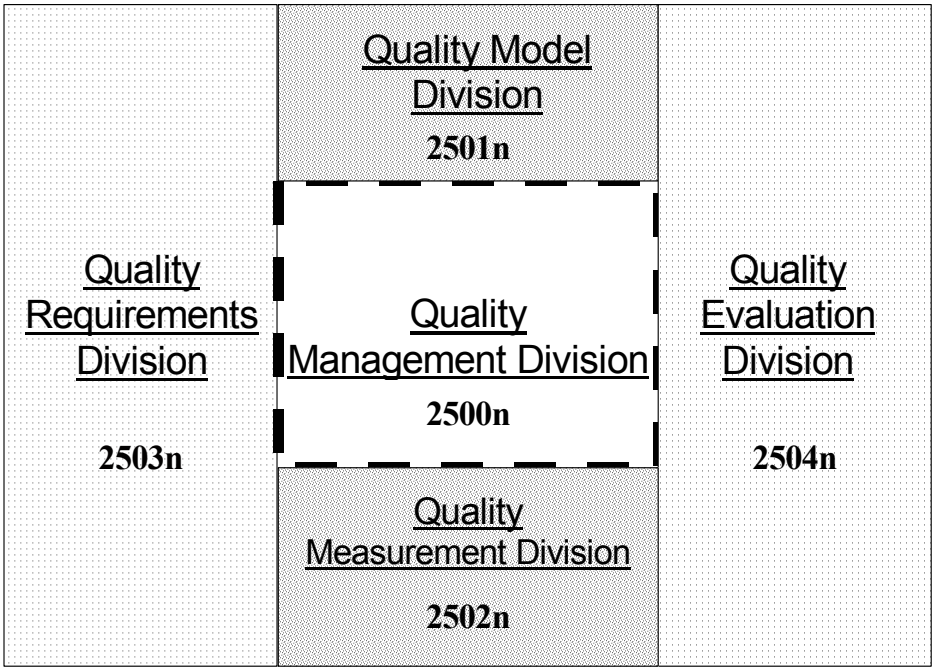

Figure 1 — Organisation of SQuaRE series of standards

Figure 1 illustrates the organisation of the SQuaRE series representing families of standards, further called Divisions.

The Divisions within SQuaRE model are:

- **ISO/IEC 2500n - Quality Management Division**. The standards that form this division define all common models, terms and definitions referred further by all other standards from SQuaRE series. Referring paths (guidance through SQuaRE documents) and high level practical suggestions in applying proper standards to specific application cases offer help to all types of users. The division provides also requirements and guidance for a supporting function which is responsible for the management of software product requirements specification and evaluation.

- **ISO/IEC 2501n - Quality Model Division**. The standard that forms this division presents a detailed quality model including characteristics for internal software quality, external software quality and software quality in use. Furthermore, the internal and external software quality characteristics are decomposed into subcharacteristics. Practical guidance on the use of the quality model is also provided.

- **ISO/IEC 2502n - Quality Measurement Division**. The standards that form this division include a software product quality measurement reference model, mathematical definitions of quality measures, and practical guidance for their application. Presented measures apply to internal software quality, external software quality and quality in use. Quality measure elements forming foundations for the latter measures are defined and presented.

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- **ISO/IEC 2503n - Quality Requirements Division**. The standard that forms this division helps specifying quality requirements. These quality requirements can be used in the process of quality requirements elicitation for a software product to be developed or as input for an evaluation process. The requirements definition process is mapped to technical processes defined in ISO/IEC 15288 – Information Technology - Life Cycle Management - System Life Cycle Processes.

- **ISO/IEC 2504n - Quality Evaluation Division**. The standards that form this division provide requirements, recommendations and guidelines for software product evaluation, whether performed by evaluators, acquirers or developers. The support for documenting a measure as an Evaluation Module is also presented.

SQuaRE extension (ISO/IEC 25050 to ISO/IEC 25099) is designated to contain software product quality International Standards and/or Technical Reports that address specific application domains or that can be used to complement one or more SQuaRE International Standards.

5.2 SQuaRE: overview of documents within series

The SQuaRE series of standards consists of 14 documents grouped in 5 Divisions within SQuaRE model. This clause presents a short overview of all documents with their classification to Divisions. The documents incorporate provisions from documents mentioned in brackets.

5.2.1 ISO/IEC 2500n - Quality Management Division

- 25000 - Guide to SQuaRE: Provides the SQuaRE architecture model, terminology, documents overview, intended users and associated parts of the series as well as reference models (ISO/IEC 9126-1 and 14598-1),

- 25001 - Planning and management: Provides requirements and guidance for a supporting function which is responsible for the management of software product requirements specification and evaluation. (ISO/IEC 14598-2).

5.2.2 ISO/IEC 2501n - Quality Model Division

- 25010 - Quality model: describes the model for software product internal and external software quality, and software quality in use. The document presents characteristics and subcharacteristics for internal and external software quality and characteristics for quality in use (ISO/IEC 9126-1 and 14598-1).

5.2.3 ISO/IEC 2502n - Quality Measurement Division

- 25020 - Measurement reference model and guide: presents introductory explanation and a reference model that is common to quality measure elements, measures of internal software quality, external software quality and quality in use. Also provides guidance to users for selecting or developing, and applying measures from the International Standards (ISO/IEC 9126-1, 9126-2, 9126-3, 9126-4 and 14598-1),

- 25021 – Quality measure elements: definitions and specifications of a set of recommended base and derived measures, which are intended to be used during the whole software development life cycle. The document describes a set of measures that can be used as an input for the internal software quality, external software quality or software quality in use measurement (ISO/IEC 9126-1, 9126-2, 9126-3, 9126-4 and 14598-1),

- 25022 – Measurement of internal quality: defines internal measures for quantitatively measuring internal software quality in terms of characteristics and subcharacteristics (ISO/IEC 9126-3),

- 25023 – Measurement of external quality: defines external measures for quantitatively measuring external software quality in terms of characteristics and subcharacteristics (ISO/IEC 9126-2),

- 25024 – Measurement of quality in use: describes a set of measures for measuring quality in use. Provides guidance to use the measures of software quality in use (ISO/IEC 9126-4),

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5.2.4 ISO/IEC 2503n - Quality Requirements Division

- 25030 – Quality requirements: provides requirements and guidance for the process used to develop quality requirements, as well as requirements and recommendations for quality requirements (ISO/IEC 9126-1, 9126-2, 9126-3, 9126-4, 14598-1, 14598-3, 14598-4 and 14598-5).

5.2.5 ISO/IEC 2504n - Quality Evaluation Division

- 25040 – Evaluation reference model and guide: contains general requirements for specification and evaluation of software quality and clarifies the general concepts. Provides a framework for evaluating quality of software product and states the requirements for methods of software product measurement and evaluation (ISO/IEC 9126-1 and 14598-1),

- 25041 - Evaluation modules: defines the structure and content of the documentation to be used to describe an Evaluation Module (ISO/IEC 14598-6),

- 25042 – Evaluation process for developers: provides requirements and recommendations for the practical implementation of software product evaluation when the evaluation is conducted in parallel with the development (ISO/IEC 14598-3),

- 25043 – Evaluation process for acquirers: contains requirements, recommendations and guidelines for the systematic measurement, assessment and evaluation of software product quality during acquisition of "off-the-shelf0148 software products, custom software products, or modifications to existing software products (ISO/IEC 12119 and 14598-4),

- 25044 – Evaluation process for evaluators: provides requirements and recommendations for the practical implementation of software product evaluation, when several parties need to understand, accept and trust evaluation results (ISO/IEC 14598-5).

5.2.6 ISO/IEC 25050 to 25099 - SQuaRE extension

- 25051 – Requirements for quality of Commercial Off-The-Shelf (COTS) software product and instructions for testing: establishes quality requirements for COTS software product; requirements for test documentation for the testing of COTS software products, including test requirements, test cases, and test reporting; and instruction for conformity evaluation of COTS software products.

- 25062 – Common industry format for usability test reports: specifies how to report the results of a test of usability in a specified context of use.

5.3 SQuaRE common models

5.3.1 General

The following subclauses present all common models used within the SQuaRE series of standards. As these models form a basis for practical navigation through the series they are further referred by all dedicated and/or detailed standard documents. The following models are presented:

- SQuaRE general reference model – navigation guide through SQuaRE series of standards as a function of user's task(s),

- Software product quality life cycle model - the views of internal software quality, external software quality and software quality in use during the software life cycle,

- Quality model structure – categorisation of software quality attributes into characteristics, subcharacteristics and quality attributes.

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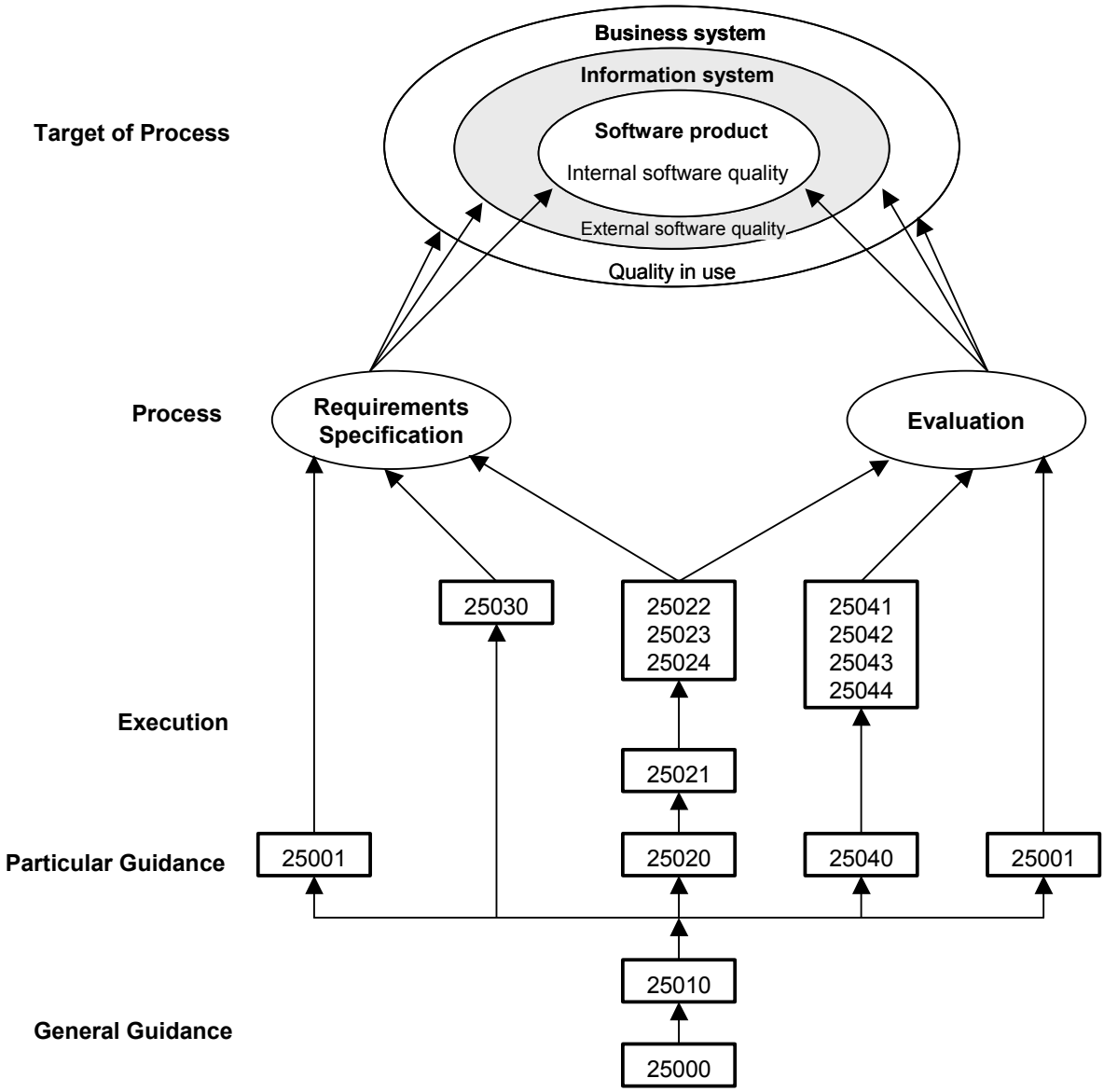

Figure 2 — SQuaRE general reference model

5.3.2 SQuaRE general reference model

SQuaRE general reference model (Figure 2) was created to help the users navigate through SQuaRE series of standards.

The choice of the appropriate standards and documents from the SQuaRE series depends upon the user's role and information needs. It is recommended that all users initially consult the general guidance (ISO/IEC 25000) in addition to the parts that are relevant to their specific information need and role.

5.3.3 Software product quality life cycle model

The software product quality life cycle model (Figure 3) addresses software product quality in three principal phases of software product life cycle: product under development, product in operation and product in use.

- The phase of a product under development is the subject of internal software quality
- The phase of a product in operation is the subject of external software quality, and
- The phase of a product in use is the subject of software quality in use.

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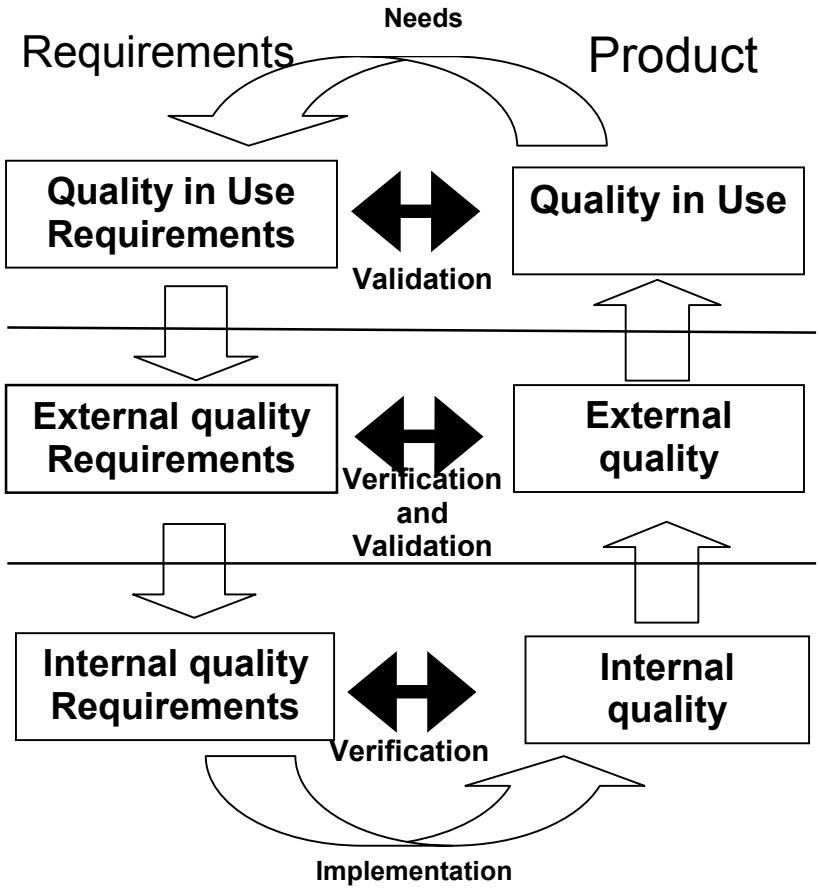

Figure 3 — Software Product Quality Life Cycle Model

The software product quality life cycle model also indicates that the implementation of software quality requires a process similar to the software development process for each type of quality: requirements, implementation and validation of the results

Quality in use requirements specify the required level of quality from the end user's point of view. These requirements are derived from needs of each context of use. Quality in use requirements are used as the target for validation of the software product by the user. Requirements for quality in use characteristics should be stated in the quality requirements specification using quality in use measures and used as criteria when a product is evaluated

NOTE Quality in use requirements contribute to identify and to define external software quality requirements.

External software quality requirements specify the required level of quality from the external view. They include requirements derived from user quality requirements, including quality in use requirements. External software quality requirements are used as the target for technical verification and validation of the software product. Requirements for external software quality characteristics should be stated quantitatively in the quality requirements specification using external measures and used as criteria when a product is evaluated.

NOTE 1 External software quality requirements contribute to identify and to define internal software quality requirements.

NOTE 2 External software quality evaluation can be used to predict quality in use.

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Internal software quality requirements specify the level of required quality from the internal view of the product. They include requirements derived from external software quality requirements. Internal software quality requirements are used to specify properties of intermediate software products. Internal software quality requirements may also be applied to deliverable, non-executable software products such as documentation and manuals. Internal software quality requirements can be used as targets for verification at various stages of development. They can also be used for defining strategies of development and criteria for evaluation and verification during development. This includes the use of additional measures (e.g. for reusability), which are outside of the scope of SQuaRE series of standards. Internal quality requirements should be specified quantitatively in terms of internal measures.

NOTE 1 Internal software quality evaluation can be used to predict external software quality.

5.3.4 Quality model structure

SQuaRE quality model categorises software quality into characteristics which are further subdivided into subcharacteristics and quality attributes (Figure 4).

SQuaRE quality model consists of two parts, the model for External and Internal Software Quality and the model for Quality in Use, being presented in details in ISO/IEC 25010 - Software engineering: Software product Quality Requirements and Evaluation (SQuaRE) - Quality model. In this document the detailed definitions for each quality characteristic and the subcharacteristics of the software product are given.

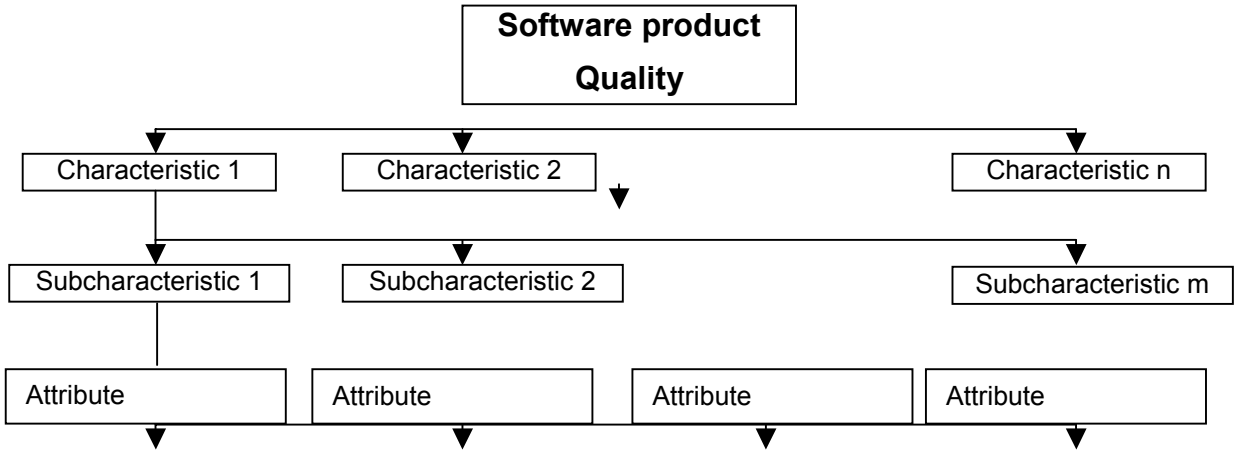

Figure 4 — Quality model structure

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Annex A
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Relationship between SQuaRE series and other ISO Standards

A.1 ISO/IEC 12207:1995/Amd 1:2002

This standard establishes a common framework for software life cycle processes, with well-defined terminology. It contains processes, activities and tasks that are to be applied during the supply, development, operation and maintenance of software products.

During the development process, the developer shall establish and document software requirements, including the quality characteristics specifications. Guidance for specifying quality characteristics may be found in ISO/IEC 25010. ISO/IEC 25022, 25023 and 25024 can be used to support assigning quantitative target values for the quality requirements. SQuaRE series of International Standards can also be used during the development process in order to evaluate intermediate and final software products.

A.2 ISO/IEC 15504

ISO/IEC 15504 is a 5 part standard based on experiences gained in the SPICE Project. It can be used for software process assessment and process capability determination.

The first basic assumption is that the quality of a software product is largely influenced by the process used to develop it. Therefore, to improve the quality of a software product, the quality of the software process needs to be improved. The second assumption is that the quality of a software process is the extend to which this process is explicitly defined, managed, measured and continuously improved. This is represented by the capability of a process.

The assessment inputs are defined in ISO/IEC 15504-2 – Performing an assessment. ISO/IEC 25000 series of standards may be used as a reference when assessing the measurement and quality process of the organisation. The standard provides guidance and identifies the Measurement Framework for process capability and the requirements for:

a) performing an assessment;

b) Process Reference Models;

c) Process Assessment Models;

d) verifying conformity of process assessment.

A.3 ISO 9000 family of standards

The ISO 9000 family of standards, listed below, were developed to assist organisations, of all types and sizes, and regardless of product provided, to implement and operate effective quality management systems:

- ISO 9000 describes fundamentals of quality management systems and specifies the terminology for quality management systems;

- ISO/IEC 90003 provides guidance for organisations in the application of ISO 9001:2000 to the acquisition, supply, development, operation and maintenance of computer software;

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- ISO 9001 specifies requirements for a quality management system, where an organisation needs to demonstrate its ability to provide products that fulfil customer and applicable regulatory requirements, and aims to enhance customer satisfaction;

- ISO 9004 provides guidelines that consider both the effectiveness and efficiency of the quality management system. The aim of this standard is improvement of the performance of the organisation and satisfaction of customers and other interested parties;

- ISO 19011 provides guidance on auditing quality and environmental management systems.

Together they form a coherent set of quality management system standards facilitating mutual understanding in national and international trade.

The quality management system requirements specified in these International Standards are complementary to requirements for products, such as those specified in ISO/IEC JTC1/SC 7 Software and System Engineering standards.

The quality management system approach encourages organisations to analyse customer requirements, define the processes that contribute to the achievement of a product, which is acceptable to the customer, and keep these processes under control. A quality management system provides the framework for continual improvement, to increase the probability of enhancing customer satisfaction and improve the competitive advantage of the organisation. It provides confidence to the organisation and its customers that it is able to provide products that consistently fulfil requirements.

ISO 9000 describes fundamentals of quality management systems, which form the subject of the ISO 9000 family of standards, and defines related terms.

This International Standard is applicable to the following:

a) organisations seeking advantage through the implementation of a quality management system,

b) organisations seeking confidence from their suppliers that their product requirements will be satisfied,

c) users of the products,

d) those concerned with a mutual understanding of the terminology used in quality management (e.g. suppliers, customers, regulators),

e) those internal or external to the organisation who assess the quality management system or audit it for conformity with the requirements of ISO 9001 (e.g. auditors, regulators, certification/registration bodies),

f) those internal or external to the organisation, who give advice or training on the quality management system appropriate to that organisation, and

g) developers of related standards.

ISO/IEC 90003 provides guidance for organisations in the application of ISO 9001:2000 to the acquisition, supply, development, operation and maintenance of computer software.

The guidance applies to computer system:

a) as part of a commercial contract with another organisation;

b) as a product available for a market sector;

c) in support of the business processes of the organisation;

d) as software embedded in a hardware product; and

e) for provision of software operations, maintenance and support services

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Frequent references are provided, to additional guidance in the standards for Software Engineering defined by ISO/IEC/JTC1/SC7, in particular, ISO/IEC 9126, 12207, 15939 and 15504.

This International Standard identifies the issues which should be addressed and is independent of the technology, life cycle models, development processes, sequence of activities, or organisation structure used by an organisation. The guidance and identified issues are intended to be comprehensive but not exhaustive. Where the scope of an organisation's activities includes areas other than computer software development, the relationship between the computer software elements of that organisation's quality management system and the remaining aspects should be clearly documented within the quality management system as a whole.

ISO 9001 specifies requirements for a quality management system where an organisation:

a) needs to demonstrate its ability to consistently provide product that meets customer and applicable regulatory requirements, and

b) aims to enhance customer satisfaction through the effective application of the system, including processes for continual improvement of the system and the assurance of conformity to customer and applicable regulatory requirements.

All requirements of this International Standard are generic and are intended to be applicable to all organisations, regardless of type, size and product provided. Where any requirement(s) of this International Standard cannot be applied due to the nature of the organisation and its product, these can be considered for exclusion, but such exclusions are limited to a specified subset of the requirements. Such exclusions must be justified, and cannot affect the organisation's ability, or responsibility, to provide product that meets customer and applicable regulatory requirements.

The year 2000 edition of this International Standard promotes the adoption of a process approach, when developing and implementing a quality management system. This approach, coupled with the increased emphasis on continual improvement, requires objective monitoring and measurement of the processes, in order to make effective, factual-based decisions on improvements. Consideration should be given to the information available from the application of metrics in software product evaluations, in assessing the effectiveness of the quality management system processes. SQuaRE series of standards can also be used with ISO 9001 when defining quality requirements as a means to specifying customer needs and expectations.

ISO 9004 provides guidelines beyond the requirements given in ISO 9001, in order to consider both the effectiveness and efficiency of a quality management system, and consequently the potential for improvement of the performance of the organisation. When compared to ISO 9001, the objectives of customer satisfaction and product quality are extended to include the satisfaction of interested parties and the performance of the organisation.

NOTE In the context of this International Standard, "interested parties" is defined as a person or group having an interest in the performance or success of the organisation (e.g. customers, owners, people in the organisation, suppliers, bankers, unions, partners or society).

This International Standard is applicable to the processes of the organisation and consequently, the quality management principles on which it is based can be deployed throughout the organisation. The focus of this International Standard is the achievement of ongoing improvement, measured through the satisfaction of customers and other interested parties.

This International Standard consists of guidance and recommendations and is not intended for certification, regulatory or contractual use, or as a guide to the implementation of ISO 9001.

ISO 19011 provides guidance on the principles of auditing, the management of audit programs, the conduct of quality management system audits and environmental management system audits as well as the competence of quality and environmental management system auditors.

It is applicable to all organisations having a need to conduct and manage internal or external software quality and/or environmental management system audits.

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The application of this International Standard to other types of audits/evaluations/assessments is possible, in principle, but special consideration should be paid to defining the competence needed by the audit team members in such cases.

A.4 ISO/IEC 15939

SQuaRE series of standards has a close relationship with ISO/IEC 15939 since the measurement related definitions have been harmonised and the measurement process from ISO/IEC 15939 can be tailored for the evaluation process defined in SQuaRE.

ISO/IEC 15939 defines the common processes and activities that are necessary to successfully identify, define, select, apply, validate, and improve software measures within an overall project or organisational measurement structure. It will also identify those principles and characteristics of the measurement process required to effectively address software technical and managerial information needs within a project or organisational context.

The purpose of ISO/IEC 15939 standard is to:

- provide a commonly defined but tailorable measurement process, which supports the implementation of specific measures required by software engineering domains,
- establish the characteristics of a measurement process which support the aggregation of process and product measurement data into meaningful information,
- establish a basis for the collection and use of measurement data over a range of projects to support project estimation and tracking, product evaluation, and process assessment and improvement requirements,
- define common measurement terminology applicable to all users and to the entire life cycle.

A.5 ISO/IEC 15288

ISO/IEC 15288 establishes a common framework for describing the life cycle systems created by humans. It defines a set of processes and associated terminology. These processes can be applied at any level in the hierarchy of a system's structure. Selected sets of these processes can be applied throughout the life cycle for managing and performing the stages of a system's life cycle. The difference between ISO/IEC 12207 and 15288 is the emphasis to Stakeholder Requirements Definition Process. The purpose of ISO/IEC 15288 specifically in the Technical Process is to:

- define the requirements for a system that can provide the services needed by users and other stakeholder in a defined environment,
- transform the stakeholder, requirement-driven view of desired services into a technical view of a required product that could deliver those services,
- synthesise a solution that satisfies system requirements by architectural design,
- produce a specified system element,
- assemble a system that is consistent with the architectural design,
- confirm that the specified design requirements are fulfilled by the system,
- establish a capability to provide services specified by stakeholder requirements in the operational, environment;

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- provide objective evidence that the services provided by a system when in use comply with stakeholder, requirements;

- sustain the capability of the system to provide a service.

The process used for developing quality requirements in ISO/IEC 25030 is based on the technical processes in ISO/IEC 15288. By the other hand, the evaluation process defined in SQuaRE can be used to help the “Validation process” in ISO/IEC 15288.

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Annex B
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Overview of ISO/IEC 14598 and ISO/IEC 9126

B.1 Overview of ISO/IEC 14598 and ISO/IEC 9126

B.1.1 Structure of ISO/IEC 14598 and ISO/IEC 9126

ISO/IEC 9126 series of International Standards and Technical Reports define a general-purpose quality model, quality characteristics and give examples of metrics. The ISO/IEC 14598 series of International Standards gives an overview of software product evaluation processes and provide guidance and requirements for evaluation. Parts 2 and 6 relate to corporate or departmental level for evaluation management and support, while parts 3, 4 and 5 give requirements and guidance for evaluation at the project level. Figure B1 shows the relationship between these standards and technical reports.

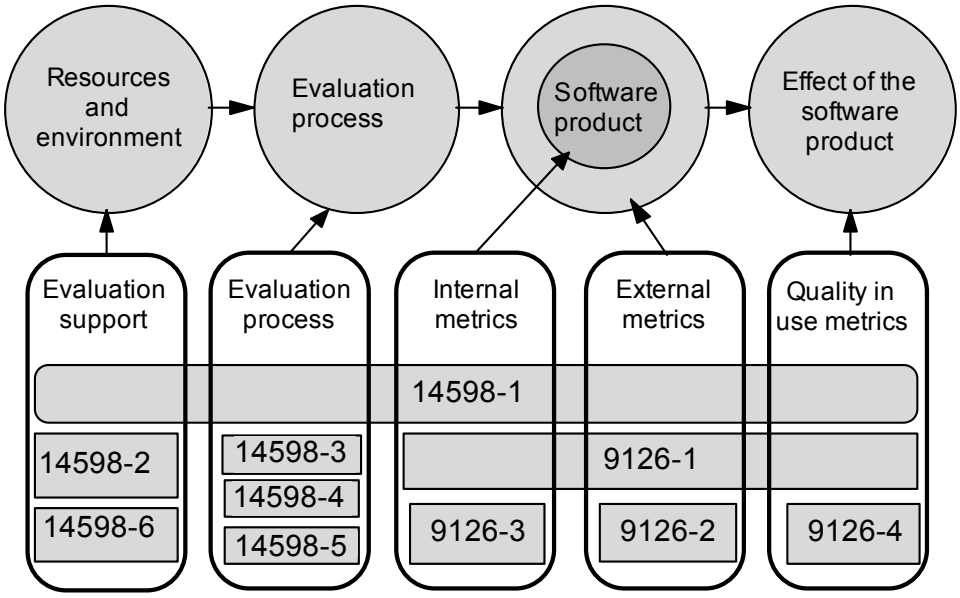

Figure B.1 — Relationship between ISO/IEC 9126 and ISO/IEC 14598 International Standards

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B.2 Quality model framework

This clause describes a quality model framework, which explains the relationship between different approaches to quality.

B.2.1 Approaches to quality

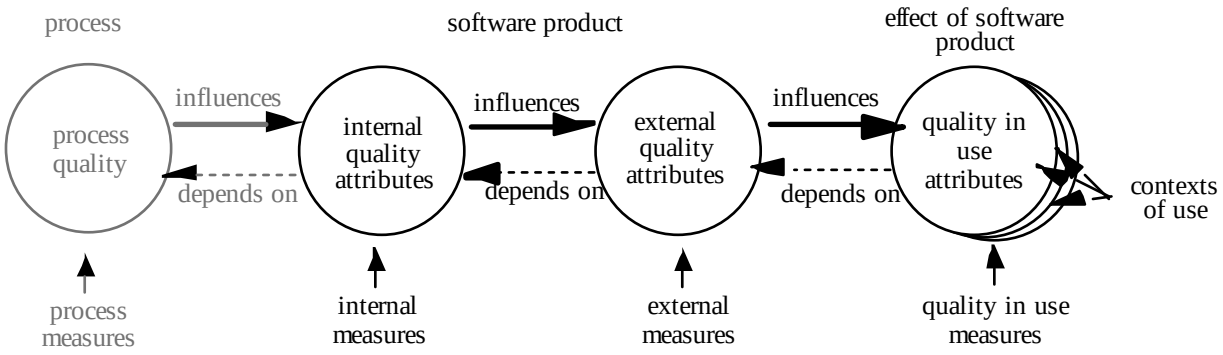

Figure B.2 — Quality in the life cycle

User quality needs include requirements for quality in use in specific contexts of use. These identified needs can be used when specifying external and internal software quality using software product quality characteristics and subcharacteristics.

Evaluation of software products in order to satisfy software quality needs is one of the processes in the software development life cycle. Software product quality can be evaluated by measuring internal software quality (typically static measures of intermediate products), or by measuring external software quality (typically by measuring the behaviour of the code when executed), or by measuring software quality in use. The objective is for the product to have the required effect in a particular context of use (Figure B2).

Process quality (the quality of any of the life cycle processes defined in ISO/IEC 12207) contributes to improving product quality, and product quality contributes to improving quality in use. Therefore, assessing and improving a process is a means to improve product quality, and evaluating and improving product quality is one means of improving quality in use. Similarly, evaluating quality in use can provide feedback to improve a product, and evaluating a product can provide feedback to improve a process.

Appropriate internal attributes of the software are a pre-requisite for achieving the required external behaviour, and appropriate external behaviour is a pre-requisite for achieving quality in use (Figure B2).

The requirements for software product quality will generally include assessment criteria for internal software quality, external software quality and quality in use, to meet the needs of developers, maintainers, acquirers and end users. (See ISO/IEC 14598-1:1999, clause 8.)

B.2.2 Product quality and the life cycle

The views of internal software quality, external software quality and quality in use change during the software life cycle. For example, quality specified as quality requirements at the start of the life cycle is mostly seen from the external and users' view, and it differs from the interim product quality, such as design quality, which is mostly seen from the internal and developers view. The technologies used for achieving the necessary level of quality, such as specification and evaluation of quality, need to support these diverse points of view. It is necessary to define these perspectives and the associated technologies for quality, in order to manage quality properly at each stage of the life cycle.

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The goal is to achieve the necessary and sufficient quality to meet the real needs of users. ISO 8402 defines quality in terms of the ability to satisfy stated and implied needs. However, needs stated by a user do not always reflect the real user needs, because: (1) a user is often not aware of his real needs, (2) needs may change after they are stated, (3) different users may have different operating environments, and (4) it may be impossible to consult all the possible types of user, particularly for off-the-shelf software. So quality requirements cannot be completely defined before the beginning of design. Yet, it is necessary to understand the real user needs in as much detail as possible, and represent these in the requirements. The goal is not necessarily to achieve perfect quality, but the necessary and sufficient quality for each specified context of use when the product is delivered and actually used by users.

Measurement scales for the metrics used for quality requirements can be divided into categories corresponding to different degrees of satisfaction of the requirements. For example, the scale could be divided into two categories: unsatisfactory and satisfactory, or into four categories: exceeds requirements, target, minimally acceptable and unacceptable (see ISO/IEC 14598-1). The categories should be specified so that both the user and the developer can avoid unnecessary cost and schedule overruns.

B.3 Evaluation process

The ISO/IEC 14598 series of International Standards provides guidance and requirements for the evaluation process in three different situations:

- development (enhancement) (ISO/IEC 14598-3),
- acquisition (ISO/IEC 14598-4),
- independent evaluation (including third-party evaluation) (ISO/IEC 14598-5).

B.3.1 Process for developers

ISO/IEC 14598-3 should be used by organisations that are planning to develop a new product or enhance an existing product and intending to perform product evaluation using members of its own technical staff. It focuses on the use of indicators that can predict end product quality by measuring intermediate products developed during the development life cycle.

As ISO/IEC 14598-3 focuses on the evaluation process during the software product development, it also may be used by a acquirer of a custom software product, in case the acquirer intend to come along with the evolution of quality along the software development. In this case, the ISO/IEC 14598-3 may be used as a complement to ISO/IEC 14598-4.

NOTE The use of software product evaluation during its development may be a powerful managerial tool since it may leverage development process adjustments. These improvements are possible comparing the obtained measurements against previously established requirements, which may indicate corrections to be implemented before the next steps.

B.3.2 Process for acquirers

ISO/IEC 14598-4 should be used by organisations that are planning to acquire or reuse an existing or pre-developed software product. It can be used to decide on the acceptance of the product or for selecting a product among alternative products (a product may be self contained, part of a system, or it may be part of larger product). The document addresses the acquisition of commercial off-the-shelf software products, as well as of custom software products, pointing out the evaluation process particularities in each case.

B.3.3 Process for evaluators

ISO/IEC 14598-5 should be used by evaluators carrying out an independent assessment of a software product. This evaluation could be performed at the request of a developer, acquirer or some other party. This part is intended for those who perform independent evaluation. Often they work for third party organisations.

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The document is recommended to organisations intending to evaluate software product using the service provided by independent evaluators. Note that ISO/IEC 14598-5 establishes the contractual conditions, responsibilities and products to be delivered during the evaluation. It is useful when several parties need to understand, accept and trust the evaluation results. So, the process defined in this standard intends to guarantee the process evaluation characteristics of repeatability, reproducibility, impartiality, and objectivity.

The evaluation process can be complemented by the use of ISO/IEC 14598-3 and ISO/IEC 14598-4, considering the particularities just present in the processes for developers and acquirers.

B.4 Support for evaluation

Each of the evaluation process standards can be used in conjunction with ISO/IEC 14598-2 (Planning and management) and ISO/IEC 14598-6 (Documentation of evaluation modules).

B.4.1 Planning and management

ISO/IEC 14598-2 Planning and Management contains requirements and guidance for supporting functions for software product evaluation. The support is related to planning and management of a software evaluation process and associated activities, including development, acquisition, standardisation, control, transfer and feedback of evaluation expertise within the organisation. This part of ISO/IEC 14598 can be used by managers to produce a quantitative evaluation plan, which may be used to support the management process of an evaluation project, also addressed by the same document.

B.4.2 Evaluation modules

ISO/IEC 14598-6 provides guidance for documenting evaluation modules. These modules contain the specification of the quality model (i.e. characteristics, subcharacteristics and corresponding internal or external metrics), the associated data and information of the planned application of the model and the information about its actual application. Appropriate evaluation modules are selected for each evaluation and, in some cases, it may be necessary to develop new evaluation modules. This part of ISO/IEC 14598 can be used by organisations producing new evaluation modules and also reusing pre-existent evaluation modules.

An evaluation module collects all information necessary to perform an evaluation of a specific aspect of a quality characteristic applying a specific evaluation technique. It clarifies which specific aspect of a software quality characteristic is being measured. The procedure for performing the measurement is defined as well as the preconditions and accuracy of the measurement.

The annexes of ISO/IEC 14598-6 show the development process of an evaluation module, as well as provide some illustrative examples of evaluation modules.

The use of evaluation modules during the evaluation process depends on the characteristics of the evaluation organisation. The existence of these evaluation modules may improve the evaluation process. Otherwise, additional effort is required to build an evaluation module library. Evaluation modules can either be developed while evaluating a product; or with the specific purpose of generating them to be reused in later evaluations.

B.5 Software quality characteristics and metrics

Each part of ISO/IEC 14598 should be used in conjunction with the planned parts of ISO/IEC 9126 describing software quality characteristics and metrics:

- ISO/IEC 9126-1: Quality characteristics and subcharacteristics,
- ISO/IEC 9126-2: External metrics,
- ISO/IEC 9126-3: Internal metrics,
- ISO/IEC 9126-4: Quality in use metrics.

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Part 1 defines quality characteristics, associated subcharacteristics and the relations between the top three levels (characteristics, subcharacteristics and attributes) of the ISO/IEC 9126 two-part quality model (external and internal software quality and quality in use). Parts 2, 3 and 4 of ISO/IEC 9126 are related to metrics applicable to software quality. They define each type of metric, describe metrics desirable properties and provide a set of metrics that can be used. Parts 2 and 3 of ISO/IEC 9126 identify the relationships of each metric (internal and external) to their corresponding characteristics and subcharacteristics. Note that some internal metrics have corresponding external metrics. Part 4 describes quality in use metrics to measure the effect of the use of the software product for its user.

B.5.1 Quality characteristics and subcharacteristics

ISO/IEC 9126-1 defines a set of quality characteristics and corresponding subcharacteristics. These subcharacteristics are manifested externally when the software is used as a part of a computer system, and are a result of static attributes of the software product. ISO/IEC 9126-1 is used as the foundation for constructing the top three levels of the quality model. Thus, quality in use represents the overall objective of quality from the users' perspective.

ISO/IEC 9126-1 describes a two-part model for software product quality: a) internal software quality and external software quality, and b) quality in use. The first part of the model specifies six characteristics for internal and external software quality, which are further subdivided into subcharacteristics. These subcharacteristics are manifested externally when the software is used as a part of a computer system, and are a result of the static attributes of the software product. This part of ISO/IEC 9126 does not elaborate the model for internal and external software quality below the level of subcharacteristics.

The second part of the model specifies four quality in use characteristics, but does not elaborate the model for quality in use below the level of characteristics. Quality in use is the combined effect for the user of the six software product quality characteristics.

The software product quality model described in ISO/IEC 9126-1 may be used at the requirements definition process of a software product, as well as a reference to software product quality evaluation.

B.5.2 External metrics

ISO/IEC 9126-2 describes those metrics that represent the external perspective of software quality when the software is in use. They measure the behaviour of the system of which the software product is part. The external measures are taken over some predefined period while the software is in use. Values for quantities like time and effort are used as the basis for these external measures, which apply in both the testing and operation phases. When used during test they are meant to be early predictors of the levels of quality that can be expected once the software is used and operated. These measures generally represent the quality in terms that are relevant to users.

Target values for the external software quality requirements can be defined quantitatively by using external metrics. These target values could be derived from those assigned to the quality in use target values, so that they can be used to predict quality in use.

B.5.3 Internal metrics

ISO/IEC 9126-3 describes those metrics that measure internal attributes of the software related to its architecture. These early measures are used as indicators to predict what can be expected once the software system is in test and operation. Therefore the internal measures are most important to development managers since they are a valuable tool for forestalling down stream problems. Internal measures are used to predict the values of corresponding external measures. ISO/IEC 9126-3 shows which internal metrics have corresponding external metrics.

Target values for the internal software quality requirements can be defined quantitatively by using internal metrics. These target values should be derived from those assigned to the quality in use and external metrics target values, so that they can be used to predict the external software quality and quality in use.

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B.5.4 Quality in use metrics

ISO/IEC 9126-4 describes quality in use metrics that measure the extent to which a product meets the needs of specified users to achieve specified goals with effectiveness, productivity, safety and satisfaction in a specified context of use. Quality in use is assessed by observing representative users carrying out representative tasks in a realistic context of use. The measures may be obtained by simulating a realistic working environment (for instance in a usability laboratory) or by observing operational use of the product. When measuring quality in use it is important that users are only given the type of help and assistance that would be available to them in the operational environment.

Quality in use requirements represent the expected result of the task to be executed using the software product within specified context of use. This is the requirements highest level of abstraction, from where internal and external software quality requirements can be derived.

B.6 The evaluation process

Figure B3 (from ISO/IEC 14598-1) represents the steps of the evaluation process used in all ISO/IEC 14598 series of standards, synthesised in the following sub-clauses.

The evaluation process is detailed by the documents: ISO/IEC 14598-1, which establishes the conceptual basis of the process; ISO/IEC 14598-3, which adapts the process to be applied during the software product development, emphasising intermediate measurements aiming to get indicators for the final quality of the product; ISO/IEC 14598-4, which adapts the process to acquirers of off-the-shelf software products, as well as of custom software products; ISO/IEC 14598-5 using the same evaluation process, emphasising the evaluation resulting products and the relationship between requester and evaluator.

B.6.1 Establish evaluation requirements

B.6.1.1 Establish the purpose of evaluation

The purpose of software product evaluation is, in general, to compare the quality of a software product against quality requirements that express user needs, or even to select a software product by comparing different software products, or ranking a product with regard to its competitors. This general objective may be better specified when considering the point of view of the software product evaluation, such as acquisition, during development, or under operation conditions.

ISO/IEC 14598-1: presents a good explanation on the purpose of evaluation under different evaluation situations. So, even if the evaluation is supported by ISO/IEC 14598-3, 14598-4, or 14598-5, it is recommended the reading of the additional information provided by ISO/IEC 14598-1.

ISO/IEC 14598-3: has not any specific consideration concerned to the purpose of evaluation.

ISO/IEC 14598-4: does not follow the three steps according to ISO/IEC 14598-1. It addresses the purpose and scope of the evaluation as a unique clause. In this clause one can find prescriptions on how to define requirements and the rigor or detail required in the evaluation activities. The scope and the purpose of the evaluation are also considered.

ISO/IEC 14598-5: gives some examples of the level of the evaluation according to the software product's intended use and its associated risks, considering the system and software integrity levels. It shows some tables with different evaluation levels related to safety, economy, security and environment aspects.

Other aspects: the purpose and the scope of the evaluation will contribute to the tailoring of the process to be adopted during the next steps of the evaluation. So the evaluator shall support the user in defining these issues.

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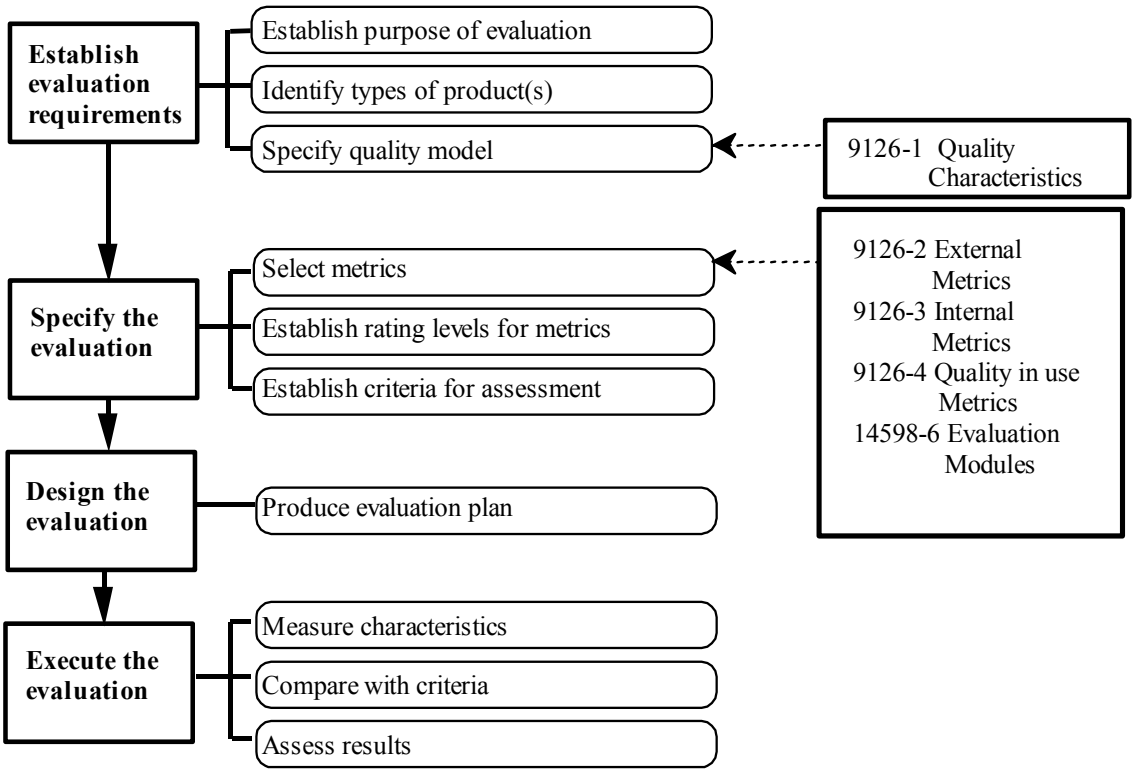

Figure B.3 — Evaluation process view according to ISO/IEC 14598-1

B.6.1.2 Identify types of product(s) to be evaluated

The types of products to be evaluated depend on the purpose of the evaluation. As a first step, the evaluator should define the products to be evaluated as intermediate (during the development life cycle) or final products. Products to be evaluated can be measured using: external metrics, when the product is a part of complete hardware/software system under operation; internal metrics that can be applied to measure internal properties of the software (e.g. specification or source code); and quality in use metrics, that measure the effect of the use of the software in a specified environment.

ISO/IEC 14598-1: explains the concepts of internal software quality, external software quality and quality in use, as well as the respective metrics associated to each case. It also shows the types of quality requirements and measurements applicable during the software development life cycle.

ISO/IEC 14598-3: has not any specific consideration concerned to the types of product(s) to be evaluated.

ISO/IEC 14598-4: has not any specific consideration concerned to the types of product(s) to be evaluated.

ISO/IEC 14598-5: considers the product to be evaluated as a set of components in which the measurements will be applied.

Other aspects: at this evaluation process step the identification of the products to be evaluated is still preliminary. During the further steps more information are obtained, contributing to better detail the products to be evaluated. Some issues should be considered during this evaluation step:

- When dealing with final product evaluation and according to the purpose of the evaluation, it is possible to select the whole software product or only some of its components. This definition takes place when, at least, the basic quality requirements have been defined,

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- When evaluating intermediate software products, the development life cycle adopted by the organisation is a base to define the type of products to be evaluated. Besides, it is important to consider that the internal metrics to be chosen should reflect the expected external software quality of the product. In such case, it is first necessary to establish the external requirements to derive which internal metrics are applicable to which type of intermediate product, in order to achieve an effective evaluation.

B.6.1.3 Specify quality model

The quality model specified for the evaluation is the reference for the software product requirements definition. At this evaluation step the requirements are described for relevant quality characteristics, being prioritised according to the user needs.

ISO/IEC 14598-1: explains the subdivision of the quality model into characteristics and subcharacteristics, possibly being able to be refined in terms of attributes that can be measured. The ISO/IEC 9126-1 model is mentioned as a preferential reference to be adopted in conjunction with the evaluation process defined by the ISO/IEC 14598 series of International Standards.

ISO/IEC 14598-3: highlights the requirements definition process, the searching for a consensus among the parties in an evaluation with respect to the requirements priorities, considering the experience from other evaluation projects with similar requirements. It emphasises that the requirements need to be technically feasible, reasonable, complementary, reachable and verifiable.

ISO/IEC 14598-4: highlights the different types of requirements to be considered. It also mentions some acquisition process aspects (according to ISO/IEC 12207), for instance, the assessment of the service provided by the suppliers, as well as the information that is required from the suppliers during the evaluation process.

ISO/IEC 14598-5: explains the need of the requester to provide an initial version of the evaluation requirements. The evaluator shall support the requester when specifying and analysing the importance of each requirement and the impact of this choice at the evaluation level and how extensive the coverage of the evaluation should be. The evaluation proceeds only if requester and evaluator agree about the requirements.

Other aspects: the ISO/IEC 14598 Series of International Standards does not prescribe any specific quality model but, since the evaluation process defined is strongly related to the ISO/IEC 9126-1 model, it is easier to apply this process when using that model.

During the specification of the quality model there is an emphasis on the quality requirements definition for each relevant quality characteristic. However, at this point the external metrics to be used have not yet been defined and this makes it difficult to define the requirements, since it is not possible to deal with quantitative aspects. This means that the quality requirements identification process must be refined during the further evaluation steps. Checklists based on ISO/IEC 9126-1 can be useful for requirements identification.

B.6.2 Specify the evaluation

B.6.2.1 Select metrics

The quantitative specification and measurement of the software product quality requirements can only be made by using metrics, which are associated to desired quality characteristics. Metrics may be: (i) internal, associated to the software product architecture and allowing to predict the final product quality; (ii)] external, measurable when the product is under operation; and (iii) of quality in use, that evaluate software product use effect.

The choice of metrics to be used during the software product evaluation depends on the purpose of the evaluation, the selected quality characteristics and on how easy and economical it is to apply the measurements. The metrics used for comparisons should also be valid and sufficiently accurate to allow reliable comparisons to be made. This means that measurements should be objective, empirical using a valid scale, and reproducible.

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ISO/IEC 9126-1: presents some properties that should be followed by metrics used for comparison. It also describes how to derive external and internal software quality requirements from user quality needs.

ISO/IEC 9126-2, 9216-3 and 9126-4: address, respectively, external, internal and quality in use metrics, presenting some examples that can be used as a reference for the metrics selection.

ISO/IEC 14598-1: explains different types of measurements applicable to software evaluation, according to the purpose of evaluation. It also highlights the importance of selecting metrics that allow accuracy, mainly when comparing products with different attributes. Some requirements for measurements are briefly stated.

ISO/IEC 14598-3: explains how to select attributes to represent the quality requirements, showing external software quality requirements and internal software quality requirements in different sections and highlighting that internal attributes are selected to represent the external requirement during the development.

For the internal software quality requirements, it guides the developer to: identifying when the measurements are to be performed and under which conditions; defining which entities are to be measured and evaluated; defining which attributes are to be measured and the respective metrics; analysing the feasibility of the requirements expressed by the attributes.

For the external software quality requirements, it guides the developer to: identify when the measurements are to be performed and under which conditions; define which entities are to be measured; define which attributes are to be measured and the metrics for each relevant combination of attributes and entities; select internal attributes that can be used as indicators to all external attributes.

ISO/IEC 14598-4: initially states the need to selecting external and quality in use metrics and provides tables with examples, in an informative annex. It also points the need to identifying available evaluation modules. In addition to these basic recommendations, the document also provides some examples that can support the identification of evaluation methods (and, as a consequence, the respective metrics), such as checklists, review or assessment of software product user and technical documentation, product operating history with customers, product deficiency lists, etc. Following, it provides some recommendations to be considered when selecting evaluation methods, such as: cost to apply the methods and coverage of the requirements.

As that International Standard can be used for selecting a product, the use of “informal” preliminary evaluation activities like reviews or surveys or peer/user anecdotal experience, trade journal product review, accessible product user documentation, or database repositories of product reviews, can narrow the selection of products considered functionally suitable for further evaluation.

ISO/IEC 14598-5: addresses the specification of the evaluation adapting the general evaluation process, dividing this activity into three sub-activities:

— Analysing the product description,

— Specifying the measurements to be performed on the product and its components, and

— Verifying the specification produced with regards to the evaluation requirements.

The goals of these three sub-activities are: i) to identify the components to be considered for the evaluation with the necessary information about these components; ii) to allocate the evaluation requirements on the product itself and the various components identified. This allow to the evaluator to specify the measurements intended to be used to assess the characteristics, subcharacteristics and attributes of the product and the selected components, as well as to provide a formalised specification of metrics to be applied. iii) to check whether all the necessary information for the evaluation are available and also whether the measurements and verifications specified are sufficient to meet the objectives of the evaluation as expressed in the evaluation requirements.

NOTE The process of selecting metrics in 14598-5 may require more than one interaction of the cycle define requirements and selecting metrics, since after selecting some metrics it is likely to find missing requirements that need to be defined and measured using a metric.

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B.6.2.2 Establish rating levels for metrics

For each selected metric it shall be defined the rating values for the related scale, where the required level of the attribute to be measured can be expressed. The adopted scale can indicate limits for each attribute, identifying if the measured value is, for instance, unacceptable, minimally acceptable, in the target range, or exceeds the requirements.

ISO/IEC 14598-1: explains how to build the scale with the rating levels, where the measured values can be represented.

ISO/IEC 14598-3: states that the developer shall define target values for each external metric, which are the quantitative representation of the quality requirements. These values are used as the evaluation criteria. For the internal attributes the developer shall set target values when appropriate. Notice that using internal attributes as indicators of the external software quality it is possible to estimate external software quality attributes during the life cycle using a predictive model. These estimated quality attributes could be compared with the external requirements.

ISO/IEC 14598-4: does not address this issue in particular. The requirements selection is quite more detailed in the previous step (establish evaluation requirements). It is possible to understand from the IS that the chosen metrics should map and cover all the already identified requirements. As the metrics are selected, they support providing quantitative values for the previously identified requirements.

ISO/IEC 14598-5: does not address this issue in particular.

Other aspects: After selecting the metrics, the target values to the requirements shall be established, finishing the requirements definitions for the known requirements. Sometimes it is necessary to deploy the initially defined requirements, so that they can adhere to the measurements characterised by the selected metrics.

When mapping the measured values on the measurement scale it should be taken into account that each metric needs to be related to a specific scale. A great number of metrics implies careful work in order to establish and document all the scales. Moreover, it is necessary to establish a method to summarise the evaluation results, mainly to support decisions such as “to acquire or not to acquire the software product”.

The rating levels or even the scale limits may not be known in advance. These levels are specific for each evaluation and for each organisation. During initial evaluations it may be difficult to establish these values, but after some experience there will be historic data so that organisations can start establishing their quality criteria more accurately.

B.6.2.3 Establish criteria for assessment

ISO/IEC 14598-1: states that to assess the quality of the product, the evaluator should prepare a procedure for this, with separate criteria for different quality characteristics, each of which may be in terms of individual subcharacteristics, or a weighted combination of subcharacteristics. This includes other aspects such as time and cost that contribute to the assessment of quality of a software product in a particular environment.

ISO/IEC 14598-3: does not address the establishment of criteria for assessment considering, for instance, the weighted combination of subcharacteristics. It only states that target values for each metric are used as evaluation criteria.

ISO/IEC 14598-4: address the need to identifying: the methods for assessing the evaluation results; suitable methods of ranking the assessments to allow selection, when selecting a product from among similar products; and any rating schemes useful for comparing more than one software product. The rating scheme may be weighted in accordance with the priority of the quality characteristics.

ISO/IEC 14598-5: does not address this issue in particular.

Other aspects: the assessment criteria do not obligate to have the measurements values summarised to get an unique indicator which represents the product quality, since the quality is characterised by the adherence

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to established requirements. In such manner, the cost and schedule may be sensible to each established requirement and its measured value. When the evaluation process is used to make a choice among different products, it may be necessary to establish a model that represents the perceived commercial value of each product from the measured values, in order to make more objective comparisons.

B.6.3 Design the evaluation

B.6.3.1 Produce evaluation plan

ISO/IEC 14598-1: states that the evaluation plan describes the evaluation methods and the evaluator tasks schedule.

ISO/IEC 14598-2: presents the concepts of an evaluation plan and what should be considered when such a plan is prepared. A quantitative evaluation plan example is provided in an annex. This template can be useful when used in addition to information available in the other standards, because some information can only be found in this document.

ISO/IEC 14598-3: states that the developer shall plan the external the evaluation (concerned to the external software quality requirements) and the internal evaluation (concerned to the internal software quality monitoring and control during development). The document also gives some more details related to the measurement plan, advising that the set of measurements may imply a change in the development process, through its need for data acquisition.

ISO/IEC 14598-4: presents the most complete explanation of this evaluation step, addressing issues such as: conditions to perform evaluation, cost aspects, characteristics of the evaluation methods, when to stop the evaluation, what to plan for each evaluation activity and the need for identifying procedures for developing and validating metrics and for standardising the evaluation process, metrics and measures.

ISO/IEC 14598-5: describes three sub-activities stated as necessary to produce the evaluation plan:

- Documenting evaluation methods and producing a draft plan, addressing issues such as:
  - Technical constraints related to the measurements or verifications,
  - Evaluation methods for each measurement or verification that shall be documented,
  - Identification of software tools used for measurements,
  - Identifications of products components on which the method is to be applied,
  - Specification of interpretation of results, when necessary, and
  - Description of the environment.
- Optimising the evaluation plan addressing issues such as:
  - The revision of the draft evaluation plan to avoid duplicating evaluator actions.
- Scheduling evaluation actions with regard to available resources, addressing issues such as:
  - The process of measurement and the schedule of planned actions, considering the delivering schedule for the product and components, the relation between the evaluator and the developer and the access to development and operational sites.

Other aspects: the user of this Series of International Standards when intending to prepare an evaluation plan may consider useful to collect information from documents 14598-1, 14598-2, 14598-3, 14598-4 and 14598-5 in order to have a broader comprehension of this issue. It is recommended to start reading the related clauses from ISO/IEC 14598-2.

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B.6.4 Execute the evaluation

B.6.4.1 Take measures

ISO/IEC 14598-1: states that the selected metrics is applied to the software product resulting in values on the scales of the metrics

ISO/IEC 14598-3: considers the execution of evaluation for intermediate products as well as for the end product. When applying metrics for internal attributes, the developer shall take necessary actions to ensure the quality of the collected data; when undesirable values are obtained, the developer is able to understand and react to problems.

ISO/IEC 14598-4: addresses the measurement step considering two different issues: a) the purpose of the evaluation, such as identifying deficiencies on the evaluation requirements, limitations on the use of the software product and options for the use of the software product uncovered by the evaluation; b) the records for the execution of the evaluation that should identify, for instance: the stepwise execution of evaluation procedures; limitations, constraints, deficiencies or exclusions in an evaluation activity; and the evaluators and their qualifications.

ISO/IEC 14598-5: addresses the measurement mainly from a management perspective. It states that the evaluator shall:

— Manage the product components provided by the requester: the products should be delivered by the requester according to the schedule and the evaluator shall register all the products and components,

— Manage the data produced by the evaluation actions: the intermediate data shall be protected in the same way as that of original components and documents. These data used for interpretation shall be included in the evaluation records, and

— Manage the tools to be used to perform the evaluation actions: the tools used for evaluation shall be referenced in the Evaluation Report.

Other aspects: the execution of the evaluation can be totally or partially done by the developer organisation. In this case it shall occur according to the evaluation specification and plan.

B.6.4.2 Compare with criteria

ISO/IEC 14598-1: states that the measured values are compared to the criteria established in the specification.

ISO/IEC 14598-3: considers the measurement values for internal evaluation and for evaluation of the end product. For internal evaluation the measured values of defined indicators are used to predict final product quality. The standard also addresses the occurrence of outlier values. For end product measurements the standard just states that the values shall be compared with target values.

ISO/IEC 14598-4: addresses this step as an analysis task, considering that the measured values are used to identify:

— Each deficiency of the product and how each deficiency can be resolved. The standard provides some examples of how deficiencies can be resolved,

— Any additional evaluations needed to be performed to resolve any identified deficiencies. This additional evaluation can, for instance, confirm that there is no deficiency, or be used to verify the correct and acceptable performance of the software product once a design change or changes have been made to correct deficiency,

— Whether it is necessary to limit or control the use of the software product and, in this case, whether the limitation, for instance, impacts the mandatory requirements, requires additional evaluation work or impacts on the application design, budget or schedule,

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— Any exclusions from scope of evaluation and/or restrictions on the results for each evaluation, such as "this evaluation does not include a detailed review of the functionality of the product", and

— The integrated results of all the evaluation activities to allow an overall conclusion for the evaluation of the software product to be made.

NOTE The approach used by ISO/IEC 14598-4 for this step is broader than the specified in ISO/IEC 14598-1 being very close to the last step called "Assess Results", since ISO/IEC 14598-4 addresses mainly analysis tasks.

ISO/IEC 14598-5: very briefly addresses this step. It states that the evaluation results shall be included in the evaluation report and, when specified in the evaluation plan, some intermediate results or interpretation decisions shall also be included in the evaluation report.

Other aspects: This step is typically an intermediate task performed in order to get to an evaluation conclusion. Therefore it is possible to read that each document of the ISO/IEC 14598 Series of International Standards has a specific approach for this step, but they all drive to the final evaluation conclusion. Although summarised results are necessary for a general conclusion, the comparison of each measurement result with the specified criteria is important to establish constraints, limitations, or actions to be performed following managerial criteria.

B.6.4.3 Assess results

ISO/IEC 14598-1: states that In the assessment activity a set of rated values are summarised and a statement of the extent to which the software product meets quality requirements is made. So this summary is compared to other aspects, such as time and cost. Finally, based on managerial criteria a managerial decision is made on the acceptance or rejection or on the release or no-release of the software product. The evaluation results influence the next software development life cycle steps as, for instance, "should the requirements be changed, or more resources to the development process are necessary?".

ISO/IEC 14598-3: presents the same activities for this step as in ISO/IEC 14598-1, according to a developer perspective.

NOTE 1 When evaluating software product during development, this step can be performed one or more times and it should be used to predict the final quality of the product in operation and, as a consequence, allowing managerial decisions along the software development life cycle.

NOTE 2 Keeping records of the evaluation results during the software development life cycle, it could be possible to follow the software quality evolution. Therefore final quality trends can be mapped as, for instance, efficiency and usability tendency diagrams.

ISO/IEC 14598-4: names this step as "Draw conclusions". The conclusions are explained by two complementary approaches: a) formalising the conclusions using a "statement of requirements compliance" that clarify how each requirement has been met; b) making a final decision of to accept or not to accept a software product for use and possible alternatives to consider, for instance, if the decision is not to accept, consider modifying the product or changing the requirements.

ISO/IEC 14598-5: does not address this step according to the ISO/IEC 14598-1 concept. The Evaluation Report contains the results of the evaluation, but final conclusions are left for the requester. The final evaluation step described in this Standard deals with the delivering of the Evaluation Report and the disposition of evaluation data and documents.

Other aspects: The evaluator is responsible for the evaluation conclusion, but he will do the final assessment only if this is stated in the evaluation specification. The evaluator usually delivers the evaluation report to the requester, which may contain some conclusion, and then the requester finish the assessment based on this report. This occurs because the final assessment can take into consideration strategic decisions for the organisation, such as cost, adaptations to be implemented and time to deliver.

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Annex C
(informative)

History and transition process between ISO/IEC 9126, ISO/IEC 14598 and SQuaRE series of standards

C.1 History

This document was originally created at the WG6 Kanazawa meeting in 1999, and revised at the Madrid meeting. The need for such a unified document has been verified by the analysis of existing 9126 and 14598 series that have been concluded, by the list of several necessary improvements as well as by lack of clarity in using these documents.

The proposal after first adjustment and further building a necessary framework was approved at JTC1/SC7 Madrid plenary meeting.

During WG6 Prague meeting, in November 2000, the version was revised and some detailed content was defined.

During JTC1/SC7 Nagoya plenary meeting in May 2001, new numbers were assigned to the SQuaRE documents and compatibility among different guides was discussed and addressed in the new version. This version was issued to WD and CD registration.

During JTC/SC7 Busan, Korea plenary meeting in May 2002, the final numbering of the series has been approved and applied. The major revisions of all the documents within the series have also been commenced. This version was issued to Committee Draft registration.

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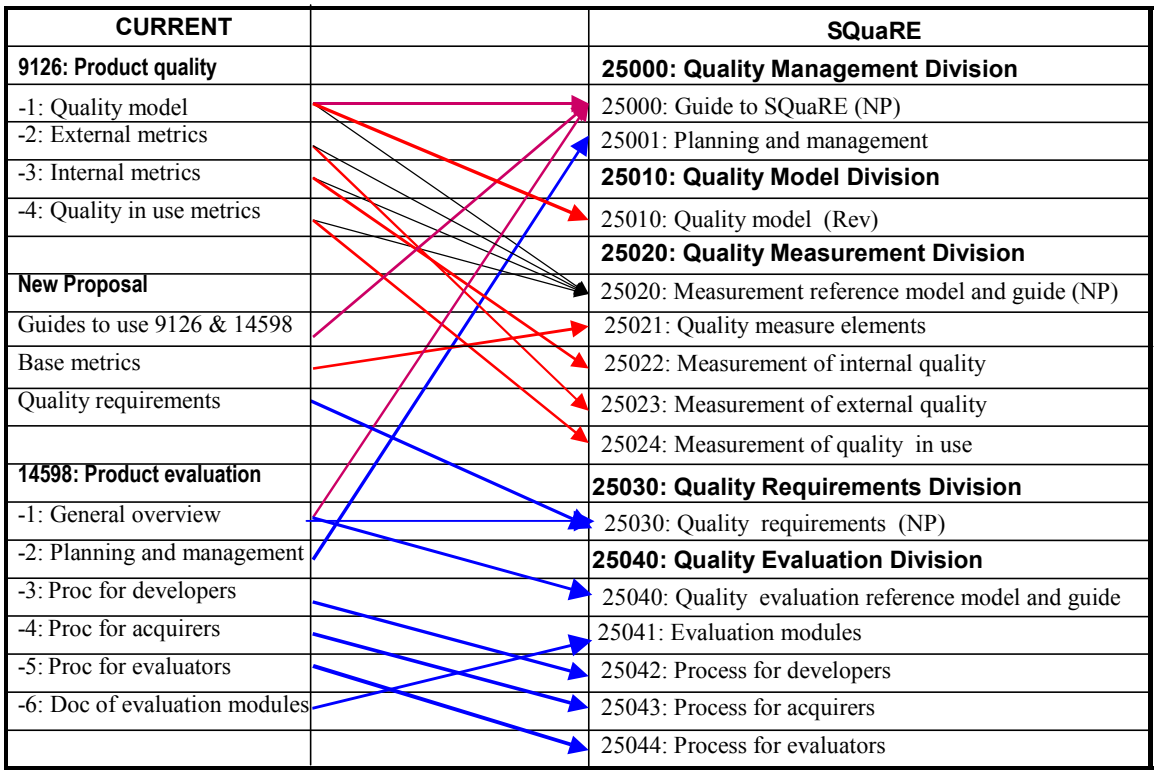
C.2 Relationship between ISO/IEC 9126 and ISO/IEC 14598 series and SQuaRE series of standards

The purpose of information presented in Table 1 is to give a clear guidance to experienced users of ISO/IEC 9126 and ISO/IEC 14598 in order to help easily translate their existing practice into seamless use of SQuaRE series of standards.



CURRENT	SQuaRE
9126: Product quality	**25000: Quality Management Division**
-1: Quality model	25000: Guide to SQuaRE (NP)
-2: External metrics	25001: Planning and management
-3: Internal metrics	**25010: Quality Model Division**
-4: Quality in use metrics	25010: Quality model (Rev)
	25020: Quality Measurement Division
New Proposal	25020: Measurement reference model and guide (NP)
Guides to use 9126 & 14598	25021: Quality measure elements
Base metrics	25022: Measurement of internal quality
Quality requirements	25023: Measurement of external quality
	25024: Measurement of quality in use
14598: Product evaluation	**25030: Quality Requirements Division**
-1: General overview	25030: Quality requirements (NP)
-2: Planning and management	**25040: Quality Evaluation Division**
-3: Proc for developers	25040: Quality evaluation reference model and guide
-4: Proc for acquirers	25041: Evaluation modules
-5: Proc for evaluators	25042: Process for developers
-6: Doc of evaluation modules	25043: Process for acquirers
	25044: Process for evaluators

Table C.1 — Relationship and transition process between ISO/IEC 9126, ISO/IEC 14598 and SQuaRE series of standards

The column titled “Current” lists all existing standards from series being currently in use (ISO/IEC 9126 and ISO/IEC 14598) and new proposed standards.

The column titled “SQuaRE” lists a complete set of standards forming SQuaRE series of standards.

Arrows illustrate precise relationship between relevant standards from previous and new series as well as indicate the transition process, as some of new standards are the results of concatenation, unification and revision of more than one document from previous series.

The following changes were applied to ISO/IEC 9126 and ISO/IEC 14598 in order to create SQuaRE series of standards:

- New standard documents:
  - ISO/IEC 25000 – Guide to SQuaRE (Software product Quality Requirements and Evaluation) as the concatenation, unification and revision of issues addressed by ISO/IEC 9126-1- Product quality - Quality model and ISO/IEC 14598-1 – Software product Evaluation – General overview,
  - ISO/IEC 25020 – Measurement reference model and guide as the concatenation, unification and revision of relevant common parts from ISO/IEC 9126-1- Product quality -Quality model, ISO/IEC 9126-2 - Product quality – External metrics, ISO/IEC 9126-3 - Product quality – Internal metrics, and ISO/IEC 9126-4 - Product quality – Quality in use,

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- ISO/IEC 25021 – Quality measure elements as a completely new standard document with basic information input from ISO/IEC 9126-2 - Product quality – External metrics, ISO/IEC 9126-3- Product quality – Internal metrics, and ISO/IEC 9126-4 - Product quality – Quality in use,

- ISO/IEC 25030 – Quality requirements as a completely new standard document with partial input from ISO/IEC 14598-1 - Software product evaluation - General overview.

- Major revisions:

  - ISO/IEC 25010 – Quality model as a major editorial revision of relevant parts of ISO/IEC 9126-1- Product quality - Quality model,

  - ISO/IEC 25022 – Measurement of internal quality as a major editorial revision of ISO/IEC 9126-3 - Product quality – Internal metrics,

  - ISO/IEC 25023 – Measurement of external quality as a major editorial revision of ISO/IEC 9126-2 - Product quality – External metrics,

  - ISO/IEC 25024 – Measurement of quality in use as a major editorial revision of ISO/IEC 9126-4 - Product quality – Quality in use,

  - ISO/IEC 25040 – Evaluation reference model and guide as a major editorial revision of ISO/IEC 14598 – 1 – Software product evaluation – General overview.

- Minor revisions

  - ISO/IEC 25001 – Planning and management as a minor editorial revision of ISO/IEC 14598-2 – Product evaluation - Planning and management,

  - ISO/IEC 25041 – Evaluation modules as a minor editorial revision of ISO/IEC 14598-6 – Product evaluation - Documentation of evaluation modules,

  - ISO/IEC 25042 – Evaluation process for developers as a minor editorial revision of ISO/IEC 14598-3 - Product evaluation - Process for developers,

  - ISO/IEC 25043 – Evaluation process for acquirers as a minor editorial revision of ISO/IEC 14598-4 - Product evaluation - Process for acquirers,

  - ISO/IEC 25044 – Evaluation process for evaluators as a minor editorial revision of ISO/IEC 14598-5 – Software product evaluation - Process for evaluators.

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Annex D
(informative)

Examples of the application of SQuaRE series of standards

The particular examples are presented in form of matrix where the column defines the TYPE OF USER, the row the TYPE OF TASK and fields of intersection contain standards that support execution of the TASK

TASK	USER: Developer	USER: Acquirer	USER: Evaluator
Definition of general quality requirements	ISO/IEC 25000 ISO/IEC 25010 ISO/IEC 25030 ISO/IEC 25042 (optional)	ISO/IEC 25000 ISO/IEC 25010 ISO/IEC 25030 ISO/IEC 25043 (optional)	ISO/IEC 25000 ISO/IEC 25010 ISO/IEC 25030 ISO/IEC 25044 (optional)
Definition of user quality requirements	ISO/IEC 25000 ISO/IEC 25010 ISO/IEC 25020 ISO/IEC 25021 ISO/IEC 25022 ISO/IEC 25023 ISO/IEC 25024 ISO/IEC 25030 ISO/IEC 25042 (optional)	ISO/IEC 25000 ISO/IEC 25010 ISO/IEC 25020 ISO/IEC 25021 ISO/IEC 25022 ISO/IEC 25023 ISO/IEC 25024 ISO/IEC 25030 ISO/IEC 25043 (optional)	ISO/IEC 25000 ISO/IEC 25010 ISO/IEC 25020 ISO/IEC 25021 ISO/IEC 25022 ISO/IEC 25023 ISO/IEC 25024 ISO/IEC 25030 ISO/IEC 25044 (optional)
Validation of completeness of quality requirements definition	ISO/IEC 25000 ISO/IEC 25010 ISO/IEC 25020 ISO/IEC 25021 ISO/IEC 25022 ISO/IEC 25023 ISO/IEC 25024 ISO/IEC 25041 ISO/IEC 25030 ISO/IEC 25042 (optional)	ISO/IEC 25000 ISO/IEC 25010 ISO/IEC 25020 ISO/IEC 25021 ISO/IEC 25022 ISO/IEC 25023 ISO/IEC 25024 ISO/IEC 25041 ISO/IEC 25030 ISO/IEC 25043 (optional)	ISO/IEC 25000 ISO/IEC 25010 ISO/IEC 25020 ISO/IEC 25021 ISO/IEC 25022 ISO/IEC 25023 ISO/IEC 25024 ISO/IEC 25041 ISO/IEC 25030 ISO/IEC 25044 (optional)

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Evaluation of software product during development	ISO/IEC 25000 ISO/IEC 25001 ISO/IEC 25010 ISO/IEC 25020 ISO/IEC 25030 ISO/IEC 25040 ISO/IEC 25021 ISO/IEC 25022 and/or ISO/IEC 25023 ISO/IEC 25041 ISO/IEC 25042	NA	ISO/IEC 25000 ISO/IEC 25001 ISO/IEC 25010 ISO/IEC 25020 ISO/IEC 25030 ISO/IEC 25040 ISO/IEC 25021 ISO/IEC 25022 and/or ISO/IEC 25023 ISO/IEC 25041 ISO/IEC 25044
Evaluation of software product after development	ISO/IEC 25000 ISO/IEC 25001 ISO/IEC 25010 ISO/IEC 25020 ISO/IEC 25030 ISO/IEC 25040 ISO/IEC 25021 ISO/IEC 25023 ISO/IEC 25041 ISO/IEC 25042	NA	ISO/IEC 25000 ISO/IEC 25001 ISO/IEC 25010 ISO/IEC 25020 ISO/IEC 25030 ISO/IEC 25040 ISO/IEC 25021 ISO/IEC 25023 ISO/IEC 25041 ISO/IEC 25044
Evaluation of results of using the software product	NA	ISO/IEC 25000 ISO/IEC 25001 ISO/IEC 25010 ISO/IEC 25020 ISO/IEC 25030 ISO/IEC 25040 ISO/IEC 25021 ISO/IEC 25023 ISO/IEC 25024 ISO/IEC 25041 ISO/IEC 25043	ISO/IEC 25000 ISO/IEC 25001 ISO/IEC 25010 ISO/IEC 25020 ISO/IEC 25030 ISO/IEC 25040 ISO/IEC 25021 ISO/IEC 25023 ISO/IEC 25024 ISO/IEC 25041 ISO/IEC 25044

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Acquisition of custom software product with evaluation during development	NA	ISO/IEC 25000 ISO/IEC 25001 ISO/IEC 25010 ISO/IEC 25020 ISO/IEC 25030 ISO/IEC 25040 ISO/IEC 25021 ISO/IEC 25022 ISO/IEC 25023 ISO/IEC 25024 ISO/IEC 25041 ISO/IEC 25043	ISO/IEC 25000 ISO/IEC 25001 ISO/IEC 25010 ISO/IEC 25020 ISO/IEC 25030 ISO/IEC 25040 ISO/IEC 25021 ISO/IEC 25022 ISO/IEC 25023 ISO/IEC 25024 ISO/IEC 25041 ISO/IEC 25044
Acquisition of commercial-off-the-shelf software product	NA	ISO/IEC 25000 ISO/IEC 25001 ISO/IEC 25010 ISO/IEC 25020 ISO/IEC 25021 ISO/IEC 25023 ISO/IEC 25030 ISO/IEC 25040 ISO/IEC 25024 ISO/IEC 25041 ISO/IEC 25043	ISO/IEC 25000 ISO/IEC 25001 ISO/IEC 25010 ISO/IEC 25020 ISO/IEC 25021 ISO/IEC 25023 ISO/IEC 25030 ISO/IEC 25040 ISO/IEC 25024 ISO/IEC 25041 ISO/IEC 25044
Maintenance of software product NOTE The role of Maintainer may be played either by Developer or Acquirer (Acquirer's dedicated entity)	ISO/IEC 25000 ISO/IEC 25010 ISO/IEC 25020 ISO/IEC 25030 ISO/IEC 25021 ISO/IEC 25022 ISO/IEC 25023 ISO/IEC 25041	ISO/IEC 25000 ISO/IEC 25010 ISO/IEC 25020 ISO/IEC 25030 ISO/IEC 25021 ISO/IEC 25022 ISO/IEC 25023 ISO/IEC 25041	NA

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ISO/IEC 25023(new) *Software engineering: Software product Quality Requirements and Evaluation (SQuaRE) — Measurement of external quality*

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