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Systems and software engineering — Systems and software quality requirements and evaluation (SQuaRE) — Quality requirements framework

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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.

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

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

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

This second edition cancels and replaces the first edition (ISO/IEC 25030:2007), which has been technically revised.

The main changes compared to the previous edition are as follows:

— extension of the view from software to system;

— enhancement and deployment of quality requirements;

— clarification of quality requirements definition steps:

  — stating them exhaustively by using the quality models;

  — specifying them with the quality measures with criteria for evaluation;

— clarification of how to use quality requirements.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

It is important to identify and specify quality requirements as part of system, software and data requirements, because finding the right balance of quality requirements, in addition to well-specified functional requirements, is a critical success factor to meet the stakeholders' objectives. Quality requirements are needed for:

— specifying the system, including contractual agreements and call for tender;

— planning the project, including feasibility analysis;

— developing the system, including identification of architecture drivers or potential quality problems during development; and

— evaluating the system, including objective assessment and certification of quality.

This document focuses on defining, using and governing quality requirements. If not clearly defined, they can be viewed, interpreted, implemented and evaluated differently by the relevant stakeholders. This can result in systems that are inconsistent with user expectations and of poor quality; and time and cost overruns to rework the system. Therefore quality requirements for the system need to be specified clearly at the earliest stage of the development or acquiring process as possible, to provide a critical input to the development or acquisition.

This document can be used to improve the quality of quality requirements, by providing requirements and recommendations for them, and provides guidance for the steps used to define and use them.

Quality requirements can be categorized into characteristics/subcharacteristics by using the quality models defined in the ISO/IEC 2501n family of standards. Measures of these characteristics/subcharacteristics, which are defined in the ISO/IEC 2502n family of standards, can be used to specify quality requirements and evaluate the quality of the target system or data. After ISO/IEC 25030:2007 was published, several international standards which define these models and measures have been published and so the previous edition has become inconsistent with these standards.

Furthermore many systems are now deeply embedded into social infrastructures used in daily life. This requires the systems to achieve much higher quality; e.g., connected systems need to be interoperable and secure, reliable, maintainable and usable.

This revision updates the quality requirements division of SQuaRE series, aligning it with the other divisions, and furthermore providing more practical guidelines for defining and using quality requirements.

Figure 1 illustrates the organization of the SQuaRE series representing families of standards, further called divisions. The SQuaRE series consists of five main divisions and on extension division. The divisions within the SQuaRE series are:

— **ISO/IEC 2500n — Quality Management Division**. The standards that form this division define all common models, terms and definitions used by all other standards in the SQuaRE series. The division also provides requirements and guidance for the planning and management of a project.

— **ISO/IEC 2501n — Quality Model Division**. The standards that form this division provide quality models for system/software products, quality in use (QIU), data, and IT services. 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 system/software product quality measurement reference model, definitions of quality measures, and practical guidance for their application. This division presents internal measures of software quality, external measures of software quality, QIU measures and data quality measures. Quality measure elements forming foundations for the quality measures are defined and presented.

— **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 system/software product to be developed, designing a process for achieving necessary quality, or as inputs for an evaluation process.

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

ISO/IEC 25050 to ISO/IEC 25099 are reserved for SQuaRE extension International Standards, which currently include in ISO/IEC 25051 requirements for quality of Ready to Use Software Products (RUSP) and instructions for testing, and in ISO/IEC TR 25060 to ISO/IEC 25069 common industry format for usability.

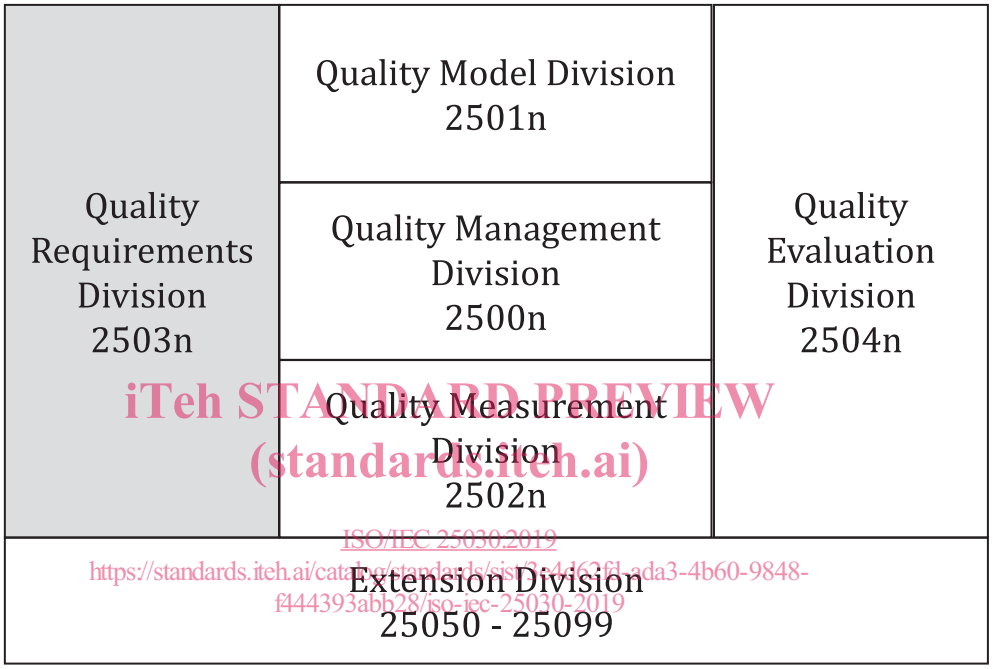

Figure 1 — Organization of the SQuaRE series of International Standards

Systems and software engineering — Systems and software quality requirements and evaluation (SQuaRE) — Quality requirements framework

1 Scope

This document provides the framework for quality requirements for systems, software products and data, which includes concept of the quality requirements, and requirements and recommendations for the processes and methods to elicit, define, use and govern them. Intended readers of this document include, but are not limited to:

— acquirers: evaluate if the system/software products/data fulfills their value proposition, i.e., meets the expected quality,

— developers: design, implement and test the system/software products/data to ensure that it meets the expected quality,

— testers: verify and validate that the system/software products/data meets the expected quality,

— project managers: plan, monitor and control the achievement of the expected quality, and

— independent evaluators: evaluate the system/software products/data with the objective criteria.

This document complies with the technical processes defined in ISO/IEC/IEEE 15288, which are relevant for elicitation of stakeholders' quality needs and for defining, analyzing and maintaining quality requirements. In this document, the quality models in ISO/IEC 25010 and ISO/IEC 25012 are used to categorize quality requirements and to provide a basis for quantifying them in terms of quality measures in the quality measure division of ISO/IEC 2502n.

This document does not cover specification of the other requirements (such as functional requirements, process requirements, etc.), and prescribes neither any specific quality measure nor any specific development process.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 25000:2014, *Systems and software engineering — Systems and software Quality Requirements and Evaluation (SQuaRE) — Guide to SQuaRE*

ISO/IEC 25010:2011, *Systems and software engineering — Systems and software Quality Requirements and Evaluation (SQuaRE) — System and software quality models*

ISO/IEC 25012, *Software engineering — Software product Quality Requirements and Evaluation (SQuaRE) — Data quality model*

ISO/IEC 25022, *Systems and software engineering — Systems and software quality requirements and evaluation (SQuaRE) — Measurement of quality in use*

ISO/IEC 25023, *Systems and software engineering — Systems and software Quality Requirements and Evaluation (SQuaRE) — Measurement of system and software product quality*

ISO/IEC 25024, *Systems and software engineering — Systems and software Quality Requirements and Evaluation (SQuaRE) — Measurement of data quality*

ISO/IEC/IEEE 15288:2015, *Systems and software engineering — System life cycle processes*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 25000 and the following apply.

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

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

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

NOTE The essential definitions from ISO/IEC 25000 and the other ISO standards are reproduced here.

3.1
classification axis
total range of a mapping of systems and software for categorizing them from a particular perspective

[SOURCE: ISO/IEC TR 12182:2015, 3.7]

3.2
context of use
conditions and constraints under which *ICT products* (3.8) are used by specific *users* (3.20) in a specific environment to achieve specific goals as part of the larger *information system* (3.10)

Note 1 to entry: Environment includes physical aspects such as equipment and resources as well as social aspects such as demographics and culture.

3.3
deployment
deployment of requirements
assignment of *requirements* (3.16) along with the system decomposition

3.4
derivation
derivation of requirements
translation and elaboration of *requirements* (3.16) from one type of requirements to another in the same system level

Note 1 to entry: Types of requirements include *quality in use* (3.13) requirements, product *quality requirements* (3.15) and data requirements.

3.5
domain-based requirement
requirement (3.16) originated from its application domain

3.6
functional requirement
requirement (3.16) that specifies a function that a system or system component shall perform

[SOURCE: IEEE 730:2014, 3.2]

3.7
ICT requirement
requirement (3.16) resulting from adoption of some information and communication technologies (ICTs) technical solutions in the design process

Note 1 to entry: ICT technical solutions include web-based technologies, cloud servers, and so on.

3.8
ICT product
product (3.12) which uses information and communication technologies (ICTs) and can be a part of *information system* (3.10)

Note 1 to entry: Figure 3 describes what ICT product consists of and the relationship to information system.

3.9
indirect user
person who receives output from a system, but does not interact with the system

EXAMPLE Executive manager, service acquirer.

[SOURCE: ISO/IEC 25010:2011, 4.3.6, modified — EXAMPLE has been added.]

3.10
information system
system that comprises of software, hardware, communication facility, data and the people who use it in a given environment to satisfy their information processing needs

Note 1 to entry: Figure 3 describes what information system consists of.

3.11
primary user
user (3.20) who interacts with the system to achieve the primary goals

Note 1 to entry: The definition is adapted from ISO/IEC 25010:2011, 3.6.

3.12
product
artifact that is produced, is quantifiable and is deliverable to the *user* (3.20) as either an end item in itself or a component item

Note 1 to entry: This definition is adapted from A Guide to the Project Management Body of Knowledge (PMBOK) Fifth Edition.

Note 2 to entry: Product includes *ICT products* (3.8), software, and software components.

3.13
quality in use
extent to which the behavioral and attitudinal outcomes and consequences of use of a *product* (3.12), system or service meets the needs of *users* (3.20) or other *stakeholders* (3.18) in specific *contexts of use* (3.2)

3.14
quality measure
measure that is defined as a measurement function of two or more values of quality measure elements

[SOURCE: ISO/IEC 25010:2011, 4.3.10]

3.15
quality requirement
requirement (3.16) for quality properties or attributes of an *ICT product* (3.8), data or service that satisfy needs which ensue from the purpose for which that ICT product, data or service is to be used

Note 1 to entry: Quality requirements in this document do not cover quality requirements for service.

3.16
requirement
statement which translates or expresses a need and its associated constraints and conditions

[SOURCE: ISO/IEC/IEEE 15288:2015, 4.1.37]

3.17
secondary user
user (3.20) who interacts with the *product* (3.12) to support the *primary users* (3.11)

EXAMPLE Content provider, system manager, administrator, security manager, maintainer, installer.

[SOURCE: ISO/IEC/IEEE 24765:2017, 3.3651, modified — The word "person" has been replaced with "user"; EXAMPLE has been added.]

3.18
stakeholder
individual or organization having a right, share, claim or interest in a system or in its possession of characteristics that meet their needs and expectations

Note 1 to entry: Stakeholders include *users* (3.20), developers, testers, project managers, acquirers, independent evaluators, data owners, supporters, trainers, regulatory bodies and other people influenced by the system.

[SOURCE: ISO/IEC/IEEE 15288:2015, 4.1.44, modified — The original EXAMPLE and Note 1 to entry have been replaced with a new Note 1 to entry.]

3.19
technical product quality requirement
product (3.12) *quality requirement* (3.15) on its technically identified properties which are used in its development and maintenance processes

3.20
user
individual or group that interacts with a system or benefits from a system during its utilization

[SOURCE: ISO/IEC 25010:2011, 4.3.16, modified — NOTE has been removed.]

3.21
validation
confirmation, through the provision of objective evidence, that the *requirements* (3.16) for a specific intended use or application have been fulfilled

[SOURCE: ISO/IEC 25000:2014, 4.41, modified — Note 1 to entry has been removed.]

3.22
verification
confirmation, through the provision of objective evidence, that specified *requirements* (3.16) have been fulfilled

[SOURCE: ISO/IEC 25000:2014, 4.43, modified — Note 1 to entry has been removed.]

4 Abbreviated terms

ICT	information and communication technology
PQR	product quality requirement
QIUR	quality in use requirement
DQR	data quality requirement
SRS	software requirements specification
StRS	stakeholder requirements specification
SyRS	system requirements specification

5 Conformance

Any quality requirements specification that conforms to this document shall meet all the requirements described in Clauses 6, 7 and 8.

6 Concept of quality requirements

6.1 General

This clause describes the concept of quality requirements, including their target entities for which the quality requirements are to be defined, and important considerations on them.

6.2 Types of quality requirements

Quality in use requirements (QIURs) specify the required levels of quality from the stakeholders' point of view. These requirements are derived from the needs of various stakeholders. QIURs relate to the outcome when the product is used in a particular context of use, and QIURs can be used as the target for validation of the product.

Product quality requirements (PQRs) specify levels of quality required from the viewpoint of the ICT product. Most of them are derived from stakeholder quality requirements including QIURs, which can be used as targets for verification and validation of the target ICT product. Technical product quality requirements are requirements for technically identified attributes (targeting specifications, source code, etc.) to meet the other PQRs. Technical product quality requirements can be used as targets for verification at various stages of development and maintenance.

NOTE 1 PQRs can also be used to specify attributes of deliverable, non-executable software products such as documentation and manuals.

The data quality requirements (DQRs) specify levels of quality required for the data associated with the product. These include requirements derived from QIURs and PQRs of input and output products. DQRs can be used for verification and validation from the data side.

NOTE 2 Many DQRs can be derived from PQRs for the target product, while some DQRs such as data integrity can be derived directly from QIURs.

6.3 Targets for quality requirements

The scope of the three types of quality requirements is shown in Figure 2. QIURs are defined on the information system, which includes not only an ICT product but also its users and relevant environments (e.g., mechanicals monitored/controlled by the ICT product and business processes in which the ICT product is used). PQRs are defined on the ICT product or its constituents (including sub-ICT products, hardware, communication facilities, software and, in some cases, software components), and DQRs are defined on the data inside the ICT product.

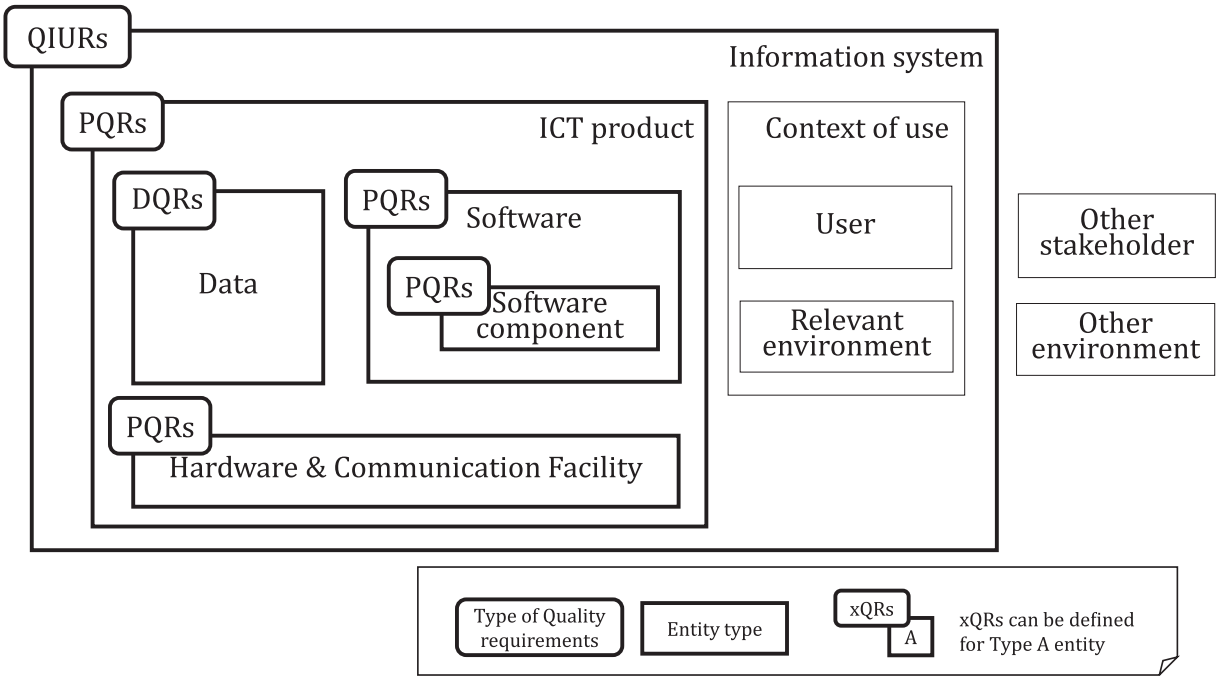

Figure 2 — Scope of quality requirements

Figure 2 describes only the scope of each type of quality requirements, not describing the system hierarchy, which is formally defined in Figure 3.

NOTE 1 Annex K describes how IT service quality requirements are to be treated.

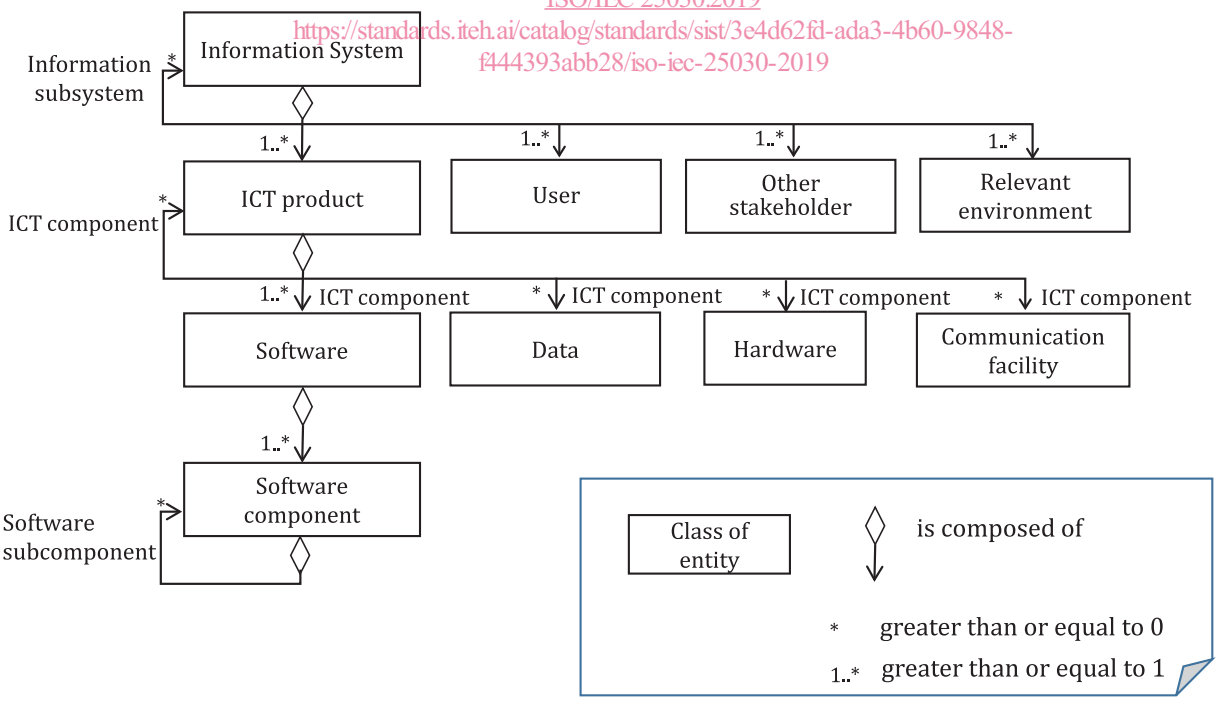

Figure 3 — System hierarchy used in Figure 2

NOTE 2 Users include primary users, secondary users and indirect users. See Table 2.

NOTE 3 A “system of systems” can be considered an information system, which recursively includes some subsidiary information systems.

NOTE 4 An ICT product includes software, and also can include data, hardware, communication facilities, and other ICT products as its ICT components.

6.4 Quality models and measures for quality requirements

Quality requirements are defined by using quality models and quality measures. Table 1 shows which International Standards can be used for defining each type of quality requirements.

Table 1 — Quality models and measures for quality requirements

Quality requirements	Quality model	Quality measure
QIURs	ISO/IEC 25010 Quality in use model	ISO/IEC 25022 Measurement of quality in use
PQRs	ISO/IEC 25010 System and software product quality model	ISO/IEC 25023 Measurement of system and software product quality
DQRs	ISO/IEC 25012 Data quality model	ISO/IEC 25024 Measurement of data quality

ISO/IEC 25022, ISO/IEC 25023 and ISO/IEC 25024 provide a list of quality measures in a tabular form, categorised by quality characteristics and subcharacteristics. The following information is given for each quality measure in the tables.

ID: Identification code of the quality measure.

Name: Quality measure name.

Description: Information provided by the quality measure.

Measurement function: Mathematical formula showing how the quality measure elements are combined to produce the quality measure.

NOTE Each quality measure listed in ISO/IEC 25022 can be used to measure effectiveness, efficiency, satisfaction and freedom from risk in specific contexts of use. Each quality measure listed in ISO/IEC 25023 can be used to measure internal properties (typically static measures of intermediate products), external properties (typically by measuring the behavior of the code when executed) or both. Each quality measure listed in ISO/IEC 25024 can be used to measure inherent or system dependent properties.

6.5 Important considerations of quality requirements

6.5.1 Sources of quality requirements

Two types of requirements for ICT products should be considered based on their sources: domain-based requirements, which are derived directly from stakeholder needs for their domain through requirements analysis processes, and ICT requirements, which are newly introduced by the adoption of some ICT technical solutions through design processes. Quality requirements also have the same types.

An example of ICT requirements is as follows. Adopting a web-based system (ICT technical solution) entails some user requirements like how to behave when clicking the back button on browsers (functional requirement), and self-descriptiveness of its user interface (PQR: learnability), and browser compatibility (PQR).

