INTERNATIONAL STANDARD

ISO/IEC 25023

First edition
2016-06-15

Systems and software engineering — Systems and software Quality Requirements and Evaluation (SQuaRE) — Measurement of system and software product quality

Ingénierie des systèmes et du logiciel — Exigences de qualité et évaluation des systèmes et du logiciel (SQuaRE) — Mesurage de la qualité du produit logiciel et du système

Reference number
ISO/IEC 25023:2016(E)

© ISO/IEC 2016



COPYRIGHT PROTECTED DOCUMENT

© ISO/IEC 2016, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

Foreword ..... **v**
Introduction ..... **vi**
1 Scope **1**
2 Conformance **2**
3 Normative references **2**
4 Terms and definitions **2**
5 Abbreviated terms **4**
6 Use of system and software product quality measures **4**
6.1 System/software product quality measurement concepts 4
6.2 Approach to quality measurement 5
7 Format used for documenting the quality measures **7**
8 System and software product quality measures **7**
8.1 General 7
8.2 Functional suitability measures 8
8.2.1 Functional completeness measures 8
8.2.2 Functional correctness measures 8
8.2.3 Functional appropriateness measures 9
8.3 Performance efficiency measures 9
8.3.1 Time behaviour measures 10
8.3.2 Resource utilization measures 11
8.3.3 Capacity measures 12
8.4 Compatibility measures 13
8.4.1 Co-existence measures 13
8.4.2 Interoperability measures 13
8.5 Usability measures 14
8.5.1 Appropriateness recognizability measures 14
8.5.2 Learnability measures 15
8.5.3 Operability measures 16
8.5.4 User error protection measures 18
8.5.5 User interface aesthetics measures 18
8.5.6 Accessibility measures 19
8.6 Reliability measures 19
8.6.1 Maturity measures 20
8.6.2 Availability measures 20
8.6.3 Fault tolerance measures 21
8.6.4 Recoverability measures 22
8.7 Security measures 22
8.7.1 Confidentiality measures 22
8.7.2 Integrity measures 23
8.7.3 Non-repudiation measures 24
8.7.4 Accountability measures 24
8.7.5 Authenticity measures 24
8.8 Maintainability measures 25
8.8.1 Modularity measures 25
8.8.2 Reusability measures 25
8.8.3 Analysability measures 26
8.8.4 Modifiability measures 27
8.8.5 Testability measures 27
8.9 Portability measures 28
8.9.1 Adaptability measures 28
8.9.2 Installability measures 29

© ISO/IEC 2016 – All rights reserved

8.9.3 Replaceability measures 30
Annex A (informative) **Considerations for the use of quality measures** **31**
Annex B (informative) **QMEs used to define product or system quality measures** **36**
Annex C (informative) **Detailed explanation of measurement types** **39**
Bibliography **45**

 © ISO/IEC 2016 – All rights reserved

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of 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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/IEC JTC 1, *Information technology*, SC 7, *Software and systems engineering*.

This first edition of ISO/IEC 25023, which is a part of the SQuaRE series of standards, cancels and replaces ISO/IEC TR 9126-2:2003 and ISO/IEC TR 9126-3:2003, with the following changes:

— the quality measures contained in ISO/IEC/TR 9126-2 and ISO/IEC/TR 9126-3 are reviewed and adopted or rejected according to the practical usefulness;

— in addition, the other quality measures are given for the revised system/software product quality model in ISO/IEC 25010;

— the internal and external measures are aggregated and represented with a simplified format in one table.

The SQuaRE series of International Standards consist of the following divisions, under the general title *Systems and software Quality Requirements and Evaluation (SQuaRE)*:

— *ISO/IEC 2500n — Quality Management Division*

— *ISO/IEC 2501n — Quality Model Division*

— *ISO/IEC 2502*n — *Quality Measurement Division*

— *ISO/IEC 2503n — Quality Requirements Division*

— *ISO/IEC 2504n — Quality Evaluation Division*

— *ISO/IEC 25050 to ISO/IEC 25099 — SQuaRE Extension Division*

Annexes A, B and C are for information only.

© ISO/IEC 2016 – All rights reserved

Introduction

This International Standard is a part of the SQuaRE series of International Standards. It provides a set of quality measures for the characteristics of system/software products that can be used for specifying requirements, measuring and evaluating the system/software product quality, in conjunction with other SQuaRE series of International Standards, especially ISO/IEC 25010, ISO/IEC 25030, ISO/IEC 25040 and ISO/IEC 25041.

The set of quality measures in this International Standard were selected based on their practical value and are categorized into two levels of reliability. They are not intended to be exhaustive and users of this International Standard are encouraged to refine them if necessary.

Quality measurement division

This International Standard is a part of the ISO/IEC 2502n series that currently consists of the following International Standards:

— ISO/IEC 25020 — **Measurement reference model and guide**: provides a reference model and guide for measuring the quality characteristics defined in ISO/IEC 2501n quality model division.

— ISO/IEC 25021 — **Quality measure elements**: provides a format for specifying quality measure elements and some examples of quality measure elements (QMEs) that can be used to construct software quality measures.

— ISO/IEC 25022 — **Measurement of quality in use**: provides measures including associated measurement functions for the quality characteristics in the quality in use model.

— ISO/IEC 25023 — **Measurement of system and software product quality**: provides measures including associated measurement functions for the quality characteristics in the product quality model.

— ISO/IEC 25024 — **Measurement of data quality**: provides measures including associated measurement functions for the quality characteristics in the data quality model.

Figure 1 depicts the relationship between this International Standard and the other International Standards in the ISO/IEC 2502n division. Developers, evaluators, quality managers, acquirers, suppliers, maintainers and users of target system/software product can select measures from these International Standards for the measurement of quality characteristics of interest. This could be for defining requirements, evaluating system/software products, performing quality management activities or for other purposes.

© ISO/IEC 2016 – All rights reserved

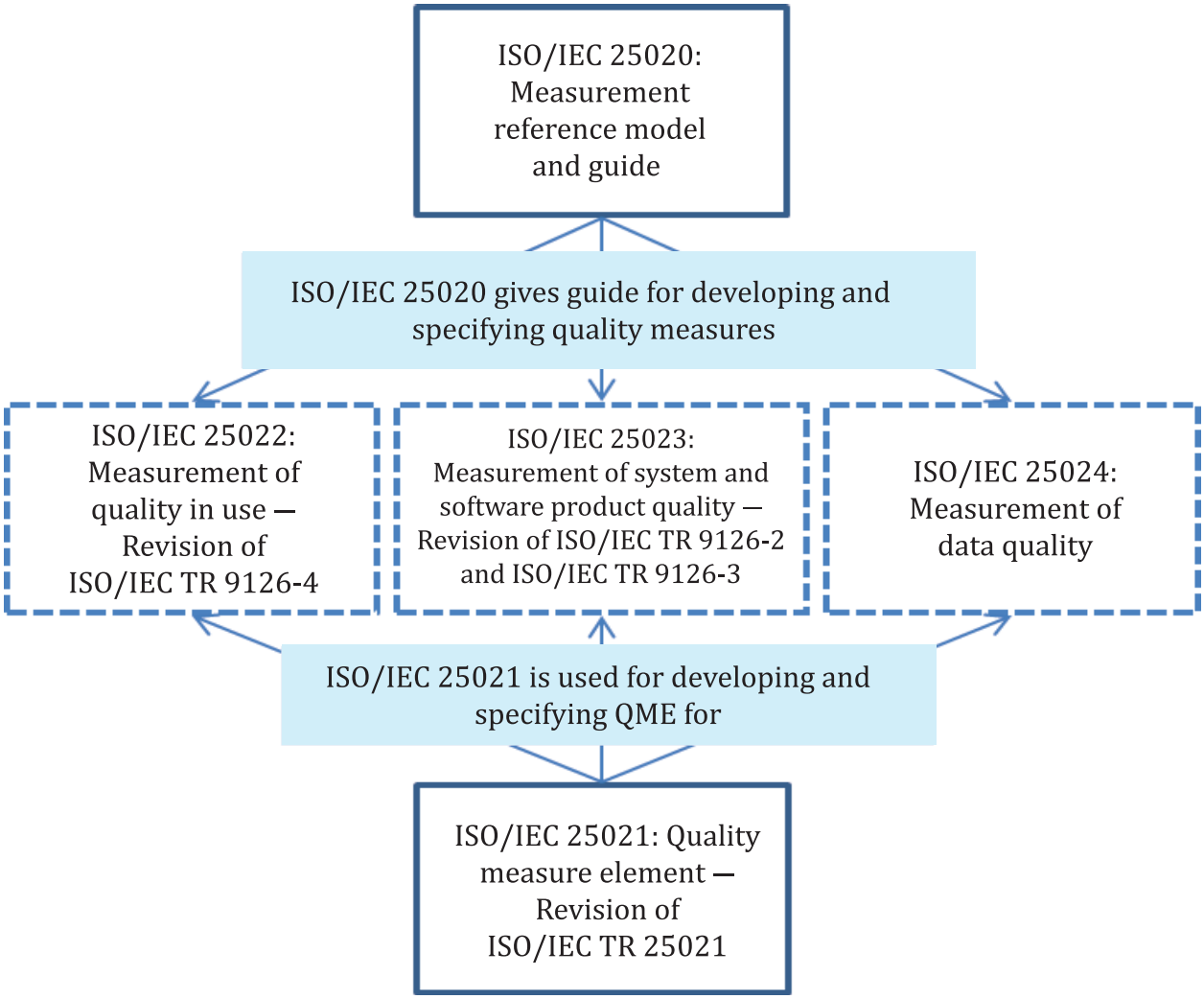


Figure 1 — Structure of the Quality Measurement Division

Outline and organization of SQuaRE series

The SQuaRE series consists of five main divisions and extension division. Outline of each divisions within SQuaRE series are as follows.

— 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. 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, and data. A service quality model is under development. 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, quality in use 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 standards that form this division help specify quality requirements. These quality requirements can be used in the process of quality

© ISO/IEC 2016 – All rights reserved

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 ISO/IEC 25051 and ISO/IEC 25060 to ISO/IEC 25069.

© ISO/IEC 2016 – All rights reserved

Systems and software engineering — Systems and software Quality Requirements and Evaluation (SQuaRE) — Measurement of system and software product quality

1 Scope

This International Standard defines quality measures for quantitatively evaluating system and software product quality in terms of characteristics and subcharacteristics defined in ISO/IEC 25010 and is intended to be used together with ISO/IEC 25010. It can be used in conjunction with the ISO/IEC 2503n and the ISO/IEC 2504n standards or to more generally meet user needs with regard to software product or system quality.

This International Standard contains the following:

— a basic set of quality measures for each characteristic and subcharacteristics;

— an explanation of how to apply software product and system quality measures.

It includes, as informative annexes, considerations for the use of quality measures (Annex A), QMEs used to define product or system quality measures (Annex B), and detailed explanation of measurement types (Annex C).

This International Standard does not assign ranges of values of the measures to rated levels or to grades of compliance because these values are defined based on the nature of the system, product or a part of the product, and depending on factors such as category of the software, integrity level, and users' needs. Some attributes could have a desirable range of values, which does not depend on specific user needs but depends on generic factors; for example, human cognitive factors.

The proposed quality measures are primarily intended to be used for quality assurance and improvement of system and software products during or post the development life cycle process.

The main users of this International Standard are people carrying out quality requirement specification and evaluation activities as part of the following:

— development: including requirements analysis, design specification, coding and testing through acceptance during the life cycle process;

— quality management: systematic examination of the software product or computer system, for example, when evaluating system or software product quality as part of quality assurance, quality control and quality certification;

— supply: a contract with the acquirer for the supply of a system, software product or software service under the terms of a contract, for example, when validating quality at qualification test;

— acquisition: including product selection and acceptance testing, when acquiring or procuring a system, software product or software service from a supplier;

— maintenance: improvement of the software product or system based on quality measurement.

© ISO/IEC 2016 – All rights reserved

2 Conformance

Any quality requirement specification or quality evaluation that conforms to this International Standard shall:

a) select the quality characteristics and/or subcharacteristics to be specified or evaluated as defined in ISO/IEC 25010;

b) for each selected characteristic or subcharacteristic, all the Generic (G) quality measures defined in Clause 8 should be used. If any are excluded, then provide a rationale;

c) optionally select any Specific (S) quality measures in Clause 8 that are relevant;

d) if any quality measure is modified, provide the rationale for the changes;

e) define any additional quality measures and QMEs as per ISO/IEC 25021 that are not included in this International Standard.

3 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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, *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 25021:2012, *Systems and software engineering — Systems and software Quality Requirements and Evaluation (SQuaRE) — Quality measure elements*

4 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 25000 and ISO/IEC 25010 and the following apply.

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

4.1
external measure (of system or software quality)
measure of the degree to which a system or software product enables the behaviour to satisfy stated and implied needs for the system including the software to be used under specified conditions

Note 1 to entry: Attributes of the behaviour can be verified and/or validated by executing the system or software product during testing and operation.

EXAMPLE The failure density against test cases found during testing is an external measure of software quality related to the reliability of the computer system. 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.

[SOURCE: ISO/IEC 25000:2014, 4.11, modified]

© ISO/IEC 2016 – All rights reserved

4.2
internal measure (of software quality)
measure of the degree to which a set of static attributes of a software product satisfy stated and implied needs for the software product to be used under specified conditions

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

Note 2 to entry: Static attributes can be verified by review, inspection, simulation 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 measures of software quality made on the product itself.

[SOURCE: ISO/IEC 25000:2014, 4.16, modified]

4.3
job
user-defined unit of work that is to be accomplished by a computer

[SOURCE: ISO/IEC/IEEE 24765:2010, 3.1542, modified]

4.4
measure
variable to which a value is assigned as the result of measurement

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

Note 2 to entry: In this International Standard, whenever the word "measure" is used qualified by a quality characteristic or sub-characteristic, it refers to a quality measure as defined in 4.8 below.

[SOURCE: ISO/IEC 15939:2007, 2.15, modified]

4.5
measurement
set of operations having the object of determining a value of a measure

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

[SOURCE: ISO/IEC 15939:2007, 2.17, modified]

4.6
measurement function
algorithm or calculation performed to combine two or more quality measure elements

[SOURCE: ISO/IEC 25021:2012, 4.7, modified]

4.7
property to quantify
property of a target entity that is related to a quality measure element and which can be quantified by a measurement method

Note 1 to entry: A software artifact is an example of a target entity.

[SOURCE: ISO/IEC 25021:2012, 4.11, modified]

4.8
quality measure
derived measure that is defined as a measurement function of two or more values of quality measure elements

[SOURCE: ISO/IEC 25021:2012, 4.13]

© ISO/IEC 2016 – All rights reserved

4.9
quality measure element
QME
measure defined in terms of a property and the measurement method for quantifying it, including optionally the transformation by a mathematical function

[SOURCE: ISO/IEC 25021:2012, 4.14, modified]

4.10
quality model
defined set of characteristics, and of relationships between them, which provides a framework for specifying quality requirements and evaluating quality

[SOURCE: ISO/IEC 25000:2014, 4.27]

4.11
quality characteristic (of software product or system)
category of quality attributes that bears on software product or system quality

[SOURCE: ISO/IEC 25000:2014, 4.34, modified]

4.12
task
set or sequence of activities required to achieve a given goal

Note 1 to entry: These activities can be physical or cognitive.

Note 2 to entry: Role and responsibilities can determine goals and tasks.

[SOURCE: ISO/IEC 9241-11:1998, 3.9, modified]

5 Abbreviated terms

The following abbreviated term is used in this International Standard.

QME quality measure element

6 Use of system and software product quality measures

6.1 System/software product quality measurement concepts

The quality of a system/software product is the degree to which it satisfies the stated and implied needs of its various stakeholders, and thus provides value. These stated and implied needs are represented in the SQuaRE series of standards by quality models that categorize system/software product quality into characteristics, which in some cases are further subdivided into subcharacteristics. The measurable quality-related properties of a system/software product are called properties to quantify and can be associated with quality measures. These properties are measured by applying a measurement method. A measurement method is a logical sequence of operations used to quantify properties with respect to a specified scale. The result of applying a measurement method is called a quality measure element.

The quality characteristics and subcharacteristics can be quantified by applying measurement functions. A measurement function is an algorithm used to combine quality measure elements. The result of applying a measurement function is called a quality measure. In this way, quality measures become quantifications of the quality characteristics and subcharacteristics. More than one quality measure can be used for the measurement of a quality characteristic or subcharacteristic (see Figure 2).

 © ISO/IEC 2016 – All rights reserved