

Software engineering — Software measurement process

ICS 35.080

National foreword

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The UK participation in its preparation was entrusted to Technical Committee IST/15, Software engineering, which has the responsibility to:

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- monitor related international and European developments and promulgate them in the UK.

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INTERNATIONAL STANDARD

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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 3.

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 International Standard 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 15939 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 7, *Software and system engineering*.

Annexes A to G of this International Standard are for information only.

Introduction

Software measurement supports the management and improvement of software processes and products. Measurement is a primary tool for managing software life cycle activities, assessing the feasibility of project plans, and monitoring the adherence of project activities to those plans. Software measurement is also a key discipline in evaluating the quality of software products and the capability of organisational software processes. It is becoming increasingly important in two party business agreements, where it provides a basis for specification, management, and acceptance criteria.

Continual improvement requires change within the organisation. Evaluation of change requires measurement. Measurement itself does not initiate change. Measurement should lead to action, and not be employed purely to accumulate data. Measurements should have a clearly defined purpose.

This International Standard defines a software measurement process applicable to all software-related engineering and management disciplines. The process is described through a model that defines the activities of the measurement process that are required to adequately specify what measurement information is required, how the measures and analysis results are to be applied, and how to determine if the analysis results are valid. The software measurement process is flexible, tailorable, and adaptable to the needs of different users.

Software engineering — Software measurement process

1 Scope

1.1 Purpose

This International Standard identifies the activities and tasks that are necessary to successfully identify, define, select, apply, and improve software measurement within an overall project or organisational measurement structure. It also provides definitions for measurement terms commonly used within the software industry.

This International Standard does not catalogue software measures, nor does it provide a recommended set of measures to apply on software projects. It does identify a process that supports defining a suitable set of measures that address specific information needs.

1.2 Field of application

This International Standard is intended to be used by software suppliers and acquirers. Software suppliers include personnel performing management, technical, and quality management functions in software development, maintenance, integration, and product support organisations. Software acquirers include personnel performing management, technical, and quality management functions in software procurement and user organisations.

The following are examples of how this International Standard can be used:

- By a supplier to implement a software measurement process to address specific project or organisational information requirements.
- By an acquirer (or third-party agents) for evaluating conformance of the supplier's software measurement process to this International Standard.
- By an acquirer (or third-party agents) to implement a software measurement process to address specific technical and project management information requirements related to the acquisition.
- In a contract between an acquirer and a supplier as a method for defining the software process and product measurement information to be exchanged.

1.3 Tailoring this International Standard

This International Standard contains a set of activities and tasks that comprise a software measurement process that meets the specific needs of software organisations and projects. The tailoring process consists of modifying the non-normative descriptions of the tasks to achieve the purpose and outcomes of the software measurement process. All normative clauses shall be satisfied. New activities and tasks not defined in this International Standard may be added as part of tailoring.

1.4 Conformance

Conformance to this International Standard is defined as satisfying the purpose and outcomes of the measurement process and all of the normative clauses within the tasks in Clause 5. Any organisation imposing this International Standard as a condition of trade is responsible for specifying and making public all task-specific criteria to be imposed in conjunction with this International Standard.

Throughout this International Standard, “shall” is used to express a provision that is binding on the party that is applying this International Standard, “should” to express a recommendation among other possibilities, and “may” to indicate a course of action permissible within the limits of the International Standard.

It is the responsibility of the organisation to maintain appropriate evidence of satisfaction of the normative clauses for purposes of demonstrating conformance.

1.5 Limitations

This International Standard does not assume or prescribe an organisational model for measurement. The user of this International Standard should decide, for example, whether a separate measurement function is necessary within the organisation, whether the measurement function should be integrated within individual software projects, or across projects, based on the current organisational structure, culture, and prevailing constraints.

This International Standard is not intended to prescribe the name, format, or explicit content of the documentation to be produced. The International Standard does not imply that documents be packaged, or combined in some fashion. These decisions are left to the user of the International Standard.

The measurement process should be appropriately integrated with the organisational quality system. Not all aspects of internal audits and non-compliance reporting are covered explicitly in this International Standard, as they are assumed to be in the domain of the quality system.

This International Standard is not intended to conflict with any organisational policies, standards, or procedures that are already in place. However, any conflict should be resolved and any overriding conditions and situations need to be cited in writing as exceptions to the application of the International Standard.

2 Normative reference

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

ISO, International Vocabulary of Basic and General Terms in Metrology, 1993

3 Terms and definitions

For the purposes of this International Standard, the following terms and definitions apply within the context of software measurement.

3.1

acquirer

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

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

3.2

attribute

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

3.3**base measure**

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

NOTE 1 A base measure is functionally independent of other measures.

NOTE 2 Based on the definition in [International Vocabulary of Basic and General Terms in Metrology, 1993].

3.4**data**

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

3.5**data provider**

individual or organisation that is a source of data

3.6**data store**

organised and persistent collection of data and information that allows for its retrieval

3.7**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

3.8**derived measure**

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

NOTE Based on the definition in [International Vocabulary of Basic and General Terms in Metrology, 1993].

3.9**entity**

object that is to be characterised by measuring its attributes

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

3.10**indicator**

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

3.11**indicator value**

numerical or categorical result assigned to an indicator

3.12**information need**

insight necessary to manage objectives, goals, risks, and problems

3.13**information product**

one or more indicators and their associated interpretations that address an 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.

3.14

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.

3.15

measure (verb)

to make a measurement

[ISO/IEC 14598-1:1996]

3.16

measurable concept

abstract relationship between attributes of entities and information needs

3.17

measurement

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

NOTE Based on the definition in [International Vocabulary of Basic and General Terms in Metrology, 1993].

3.18

measurement analyst

individual or organisation that is responsible for the planning, performance, evaluation, and improvement of measurement

3.19

measurement experience base

data store that contains the evaluation of the information products and the measurement process as well as any lessons learned during the measurement process

3.20

measurement function

algorithm or calculation performed to combine two or more base measures

3.21

measurement librarian

individual or organisation that is responsible for managing the measurement data store(s)

3.22

measurement method

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

NOTE 1 The type of measurement method depends on the nature of the operations used to quantify an attribute. Two types may be distinguished:

subjective — quantification involving human judgement

objective — quantification based on numerical rules

NOTE 2 Based on the definition in [International Vocabulary of Basic and General Terms in Metrology, 1993].

3.23

measurement procedure

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

[International Vocabulary of Basic and General Terms in Metrology, 1993]

3.24**measurement process**

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

3.25**measurement process owner**

individual or organisation responsible for the measurement process

3.26**measurement sponsor**

individual or organisation that authorises and supports the establishment of the measurement process

3.27**measurement user**

individual or organisation that uses the information products

3.28**model**

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

3.29**observation**

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

3.30**operator**

individual or organisation that operates the system

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

3.31**organisational unit**

the part of an organisation that is the subject of measurement

NOTE An organisational unit deploys one or more processes that operate within a coherent set of business goals.

[ISO/IEC TR 15504-9:1998]

3.32**process**

set of interrelated activities that transform inputs into outputs

[ISO/IEC TR 15504-9:1998]

3.33**scale**

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

NOTE 1 The type of scale depends on the nature of the relationship between values on the scale. Four types of scales are commonly defined:

Nominal — the measurement values are categorical. For example, the classification of defects by their type does not imply order among the categories

Ordinal — the measurement values are rankings. For example, the assignment of defects to a severity level is a ranking

Interval — the measurement values have equal distances corresponding to equal quantities of the attribute. For example, cyclomatic complexity has the minimum value of one, but each increment represents an additional path. The value of zero is not possible

Ratio — the measurement values have equal distances corresponding to equal quantities of the attribute where the value of zero corresponds to none of the attribute. For example, the size of a software component in terms of LOC is a ratio scale because the value of zero corresponds to no lines of code and each additional increments represents equal amounts of code

NOTE 2 These are just examples of the types of scales. Roberts [12] defines more types of scales.

NOTE 3 Based on the definition in [International Vocabulary of Basic and General Terms in Metrology, 1993].

3.34

software product

set of computer programs, procedures, and associated documentation and data

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

3.35

software service

performance of activities, work, or duties connected with a software product, such as its development, maintenance, and operation

[ISO/IEC 12207:1995]

3.36

stakeholder

individual or organisation that sponsors measurement, provides data, is a user of the measurement results or otherwise participates in the measurement process

3.37

supplier

organisation that enters into an agreement with the acquirer for the supply of a system, software product or software service under the terms of that agreement

NOTE 1 The term “supplier” is synonymous with “contractor”, “producer”, “seller”, or “vendor”.

NOTE 2 The acquirer may designate a part of its organisation as supplier.

NOTE 3 Based on the definition in [ISO/IEC 12207:1995].

3.38

system

integrated composite that consists of one or more of the processes, hardware, software, facilities and people, that provides a capability to satisfy a stated need or objective

[ISO/IEC 12207:1995]

3.39

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

[International Vocabulary of Basic and General Terms in Metrology, 1993]

3.40

user

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

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

3.41

value

numerical or categorical result assigned to a base measure, derived measure, or indicator