

Australian/New Zealand Standard™

Systems and software engineering— Measurement process



AS/NZS ISO/IEC 15939:2013

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Australian/New Zealand Standard™

Systems and software engineering— Measurement process

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee IT-015, Software and Systems Engineering, to supersede AS/NZS 15939:2003, *Software engineering—Software measurement process*.

The objective of this Standard is to specify the activities and tasks that are necessary to successfully identify, define, select, apply and improve measurement within an overall project or organizational measurement structure. It also provides definitions for measurement terms commonly used within the system and software industries.

This Standard is identical with, and has been reproduced from, ISO/IEC 15939:2007, *Systems and software engineering—Measurement process*.

As this Standard is reproduced from an International Standard, the following applies:

- (a) In the source text ‘this International Standard’ should read ‘this Australian/New Zealand Standard’.
- (b) A full point substitutes for a comma when referring to a decimal marker.

The term ‘informative’ has been used in this Standard to define the application of the annex to which it applies. An ‘informative’ annex is only for information and guidance.

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INTRODUCTION

Measurement supports the management and improvement of processes and products. Measurement is a primary tool for managing system and software life cycle activities, assessing the feasibility of project plans, and monitoring the adherence of project activities to those plans. System and software measurement is also a key discipline in evaluating the quality of products and the capability of organizational 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 organization. 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 measurement process applicable to system and software 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 measurement process is flexible, tailorable, and adaptable to the needs of different users.

The measurement process defined in this International Standard, while written for system and software domains, can be applied in other domains.

AUSTRALIAN/NEW ZEALAND STANDARD

Systems and software engineering—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 measurement within an overall project or organizational measurement structure. It also provides definitions for measurement terms commonly used within the system and software industries.

This International Standard does not catalogue measures, nor does it provide a recommended set of measures to apply on 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 suppliers and acquirers. Suppliers include personnel performing management, technical and quality management functions in system and software development, maintenance, integration and product support organizations. Acquirers include personnel performing management, technical and quality management functions in procurement and user organizations.

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

- by a supplier to implement a measurement process to address specific project or organizational information requirements;
- by an acquirer (or third-party agents) for evaluating conformance of the supplier's measurement process to this International Standard;
- by an acquirer (or third-party agents) to implement a 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 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 measurement process that meets the specific needs of organizations, enterprises and projects. The tailoring process consists of modifying the non-normative descriptions of the tasks to achieve the purpose and outcomes of the measurement process. All normative clauses need to 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 4. Any organization 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 organization to maintain appropriate evidence of satisfaction of the normative clauses for the purposes of demonstrating conformance.

1.5 Limitations

This International Standard does not assume or prescribe an organizational model for measurement. The user of this International Standard should decide, for example, whether a separate measurement function is necessary within the organization and whether the measurement function should be integrated within individual projects or across projects, based on the current organizational 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. This International Standard does not imply that documents be packaged or combined in some fashion. These decisions are left to the user of this International Standard.

The measurement process should be appropriately integrated with the organizational 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 organizational 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 this International Standard.

2 Terms and definitions

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

2.1

acquirer

stakeholder that acquires or procures a product or service from a supplier

[ISO/IEC 15288:2002]

NOTE Other terms commonly used for an acquirer are buyer, customer, owner and purchaser.

2.2

attribute

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

2.3

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 of “base quantity” in the International Vocabulary of Basic and General Terms in Metrology, 1993.

2.4

data

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

2.5**data provider**

individual or organization that is a source of data

2.6**data store**

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

2.7**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

2.8**derived measure**

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

NOTE Adapted from the definition of “derived quantity” in the International Vocabulary of Basic and General Terms in Metrology, 1993.

2.9**entity**

object that is to be characterized by measuring its attributes

NOTE An entity can be a process, product, project or resource.

2.10**indicator**

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

2.11**indicator value**

numerical or categorical result assigned to an indicator

2.12**information need**

insight necessary to manage objectives, goals, risks and problems

2.13**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.

2.14**measurable concept**

abstract relationship between attributes of entities and information needs

2.15**measure**, noun

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

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

2.16**measure**, verb

make a measurement

[ISO/IEC 14598-1:1999]

2.17**measurement**

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

NOTE Adapted from the International Vocabulary of Basic and General Terms in Metrology, 1993.

2.18**measurement analyst**

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

2.19**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

2.20**measurement function**

algorithm or calculation performed to combine two or more base measures

2.21**measurement librarian**

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

2.22**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 can be distinguished:

- subjective: quantification involving human judgment;
- objective: quantification based on numerical rules.

NOTE 2 Based on the definition of “method of measurement” in the International Vocabulary of Basic and General Terms in Metrology, 1993.

2.23**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]

2.24**measurement process**

process for establishing, planning, performing and evaluating measurement within an overall project, enterprise or organizational measurement structure

2.25**measurement process owner**

individual or organization responsible for the measurement process

2.26**measurement sponsor**

individual or organization that authorizes and supports the establishment of the measurement process

2.27**measurement user**

individual or organization that uses the information products

2.28**model**

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

2.29**observation**

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

2.30**operator**

entity that performs the operation of a system

2.31**organizational unit**

part of an organization that is the subject of measurement

NOTE Adapted from ISO/IEC 15504-1:2004.

2.32**process**

set of interrelated or interacting activities which transforms inputs into outputs

[ISO 9000:2005]

2.33**product**

result of a process

[ISO 9000:2005]

NOTE There are four agreed generic product categories: hardware (e.g. engine mechanical part), software (e.g. computer program), services (e.g. transport), and processed materials (e.g. lubricant). Hardware and processed materials are generally tangible products, while software or services are generally intangible. Most products comprise elements belonging to different generic product categories. Whether the product is then called hardware, processed material, software or service depends on the dominant element.

2.34**project**

endeavour with defined start and finish dates undertaken to create a product or service in accordance with specified resources and requirements

NOTE 1 Adapted from ISO 9000:2005.

NOTE 2 A project may be viewed as a unique process comprising coordinated and controlled activities and may be composed of activities from the Project Processes and Technical Processes defined in this International Standard.

2.35**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 scale are commonly defined:

- nominal: the measurement values are categorical;
- ordinal: the measurement values are rankings;

- interval: the measurement values have equal distances corresponding to equal quantities of the attribute;
- 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.

These are just examples of the types of scale. Roberts [17] defines more types of scale. Annex A contains examples of each type of scale.

NOTE 2 Based on the definition of “scale (of a measuring instrument)” in the International Vocabulary of Basic and General Terms in Metrology, 1993.

2.36 service

performance of activities, work or duties associated with a product

2.37 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 Within this International Standard, an individual or organization that sponsors measurement, provides data, is a user of the measurement results or otherwise participates in the measurement process.

2.38 supplier

organization or individual that enters into an agreement with the acquirer for the supply of a product or service

NOTE 1 Other terms commonly used for supplier are contractor, producer, seller and vendor.

NOTE 2 The acquirer and the supplier may be part of the same organization.

2.39 system

combination of interacting elements organized to achieve one or more stated purposes

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

2.40 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]

2.41 user

individual or group that benefits from a system during its utilization

2.42 value

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

3 Application of this International Standard

This clause presents an overview of the measurement process. The objective is to orient the users of this International Standard so that they can apply it properly within context.

3.1 Purpose and outcomes of the measurement process

The purpose of the measurement process defined in this International Standard is to collect, analyze, and report data relating to the products developed and processes implemented within the organizational unit, to support effective management of the processes, and to objectively demonstrate the quality of the products. As a result of successful implementation of the measurement process:

- organizational commitment for measurement is established and sustained;
- the information needs of technical and management processes are identified;
- an appropriate set of measures, driven by the information needs are identified and/or developed;
- measurement activities are identified;
- identified measurement activities are planned;
- the required data is collected, stored, analyzed, and the results interpreted;
- information products are used to support decisions and provide an objective basis for communication;
- the measurement process and measures are evaluated; and
- improvements are communicated to the measurement process owner.

3.2 Overview of this International Standard

This International Standard defines the activities and tasks necessary to implement a measurement process. An activity is a set of related tasks that contributes towards achieving the purpose and outcomes of the measurement process (see Clause 3.1). A task is a well-defined segment of work. Each activity is comprised of one or more tasks. This International Standard does not specify the details of *how* to perform the tasks included in the activities.

The properties of the activities of the measurement process that are defined in this International Standard are the same properties defined in ISO/IEC 15288:—¹⁾ and ISO/IEC 12207:—²⁾. This means that other properties such as entry and exit criteria for each of the activities are *not* defined in this International Standard.

NOTE 1 This measurement process supports the measurement requirement defined in ISO 9001:2000, 8.2.

NOTE 2 This International Standard provides an elaboration of the measurement process from ISO/IEC 15288:—¹⁾ and ISO/IEC 12207:—²⁾. More detail is provided via additional activities and tasks. As part of this elaboration, one additional outcome (commitment is established and sustained) is added, with associated activities and tasks. This outcome is addressed in ISO/IEC 15288:—¹⁾ and ISO/IEC 12207:—²⁾ at the enterprise level.

The measurement process consists of four activities as illustrated in the process model in Figure 1. The activities are sequenced in an iterative cycle allowing for continuous feedback and improvement of the measurement process. The measurement process model in Figure 1 is an adaptation of the Plan-Do-Check-Act cycle commonly used as the basis for quality improvement. Within activities, the tasks are also iterative.

1) Under preparation. Technical revision of ISO/IEC 15288:2002.

2) Under preparation. Technical revision of ISO/IEC 12207:1995.

The “Technical and Management Processes” of an organizational unit or project are not within the scope of this International Standard, although they are an important external interface to the measurement activities that are included in this International Standard.

Two activities are considered to be the Core Measurement Process: Plan the Measurement Process, and Perform the Measurement Process. These activities mainly address the concerns of the measurement user. The other two activities, Establish and Sustain Measurement Commitment and Evaluate Measurement, provide a foundation for the Core Measurement Process and provide feedback to it. These latter two activities address the concerns of the measurement process owner.

Figure 1 shows that the Core Measurement Process is driven by the information needs of the organization. For each information need, the Core Measurement Process produces an *information product* that satisfies the information need. The information product is conveyed to the organization as a basis for decision-making. The link between measures and an information need is described as the *Measurement Information Model* in Annex A. This annex also includes examples.

Performance of the normative activities and tasks defined in this International Standard satisfies *at least* the Capability Level 1 requirements in ISO/IEC 15504-2:2003. However, the guidance included in this International Standard provides the basis for implementing the measurement process at progressively higher levels of capability.

The process defined in this International Standard includes an evaluation activity, as shown in Figure 1. The intent is to emphasize that evaluation and feedback are an essential component of the measurement process, and should lead to improvements of the measurement process and measures. Evaluation can be simple, and performed in an ad hoc manner when capability is low, or it can be quantitative with sophisticated statistical techniques to evaluate the quality of the measurement process and its outputs when capability is high. Measures should be evaluated in terms of the added value they provide for the organization, and only deployed where the benefit can be identified.

Included in the cycle is the “Measurement Experience Base”. This is intended to capture information products from past iterations of the cycle, previous evaluations of information products, and evaluations of previous iterations of the measurement process. This would include the measures that have been found to be useful in the organizational unit. No assumptions are made about the nature or technology of this “Measurement Experience Base”, only that it be a persistent storage. Artefacts (for example, information products, historical data, and lessons learned) stored in the “Measurement Experience Base” are intended to be reused in future iterations of the measurement process.

Since the process model is cyclical, subsequent iterations may only update measurement products and practices. This International Standard does not imply that measurement products and practices need to be developed and implemented for each iteration of the process. The wording used in this International Standard adopts the convention that one is implementing the measurement process for the first time (i.e., the first iteration). During subsequent iterations, this wording should be interpreted as updating or changing documentation and current practices.

The typical functional roles mentioned in this International Standard are: stakeholder, sponsor, measurement user, measurement analyst, measurement librarian, data provider, and measurement process owner. These are defined in Clause 2 of this International Standard.

A number of work products are produced during the performance of the measurement process. The work products are described in Annex B, and mapped to the tasks that produce them.

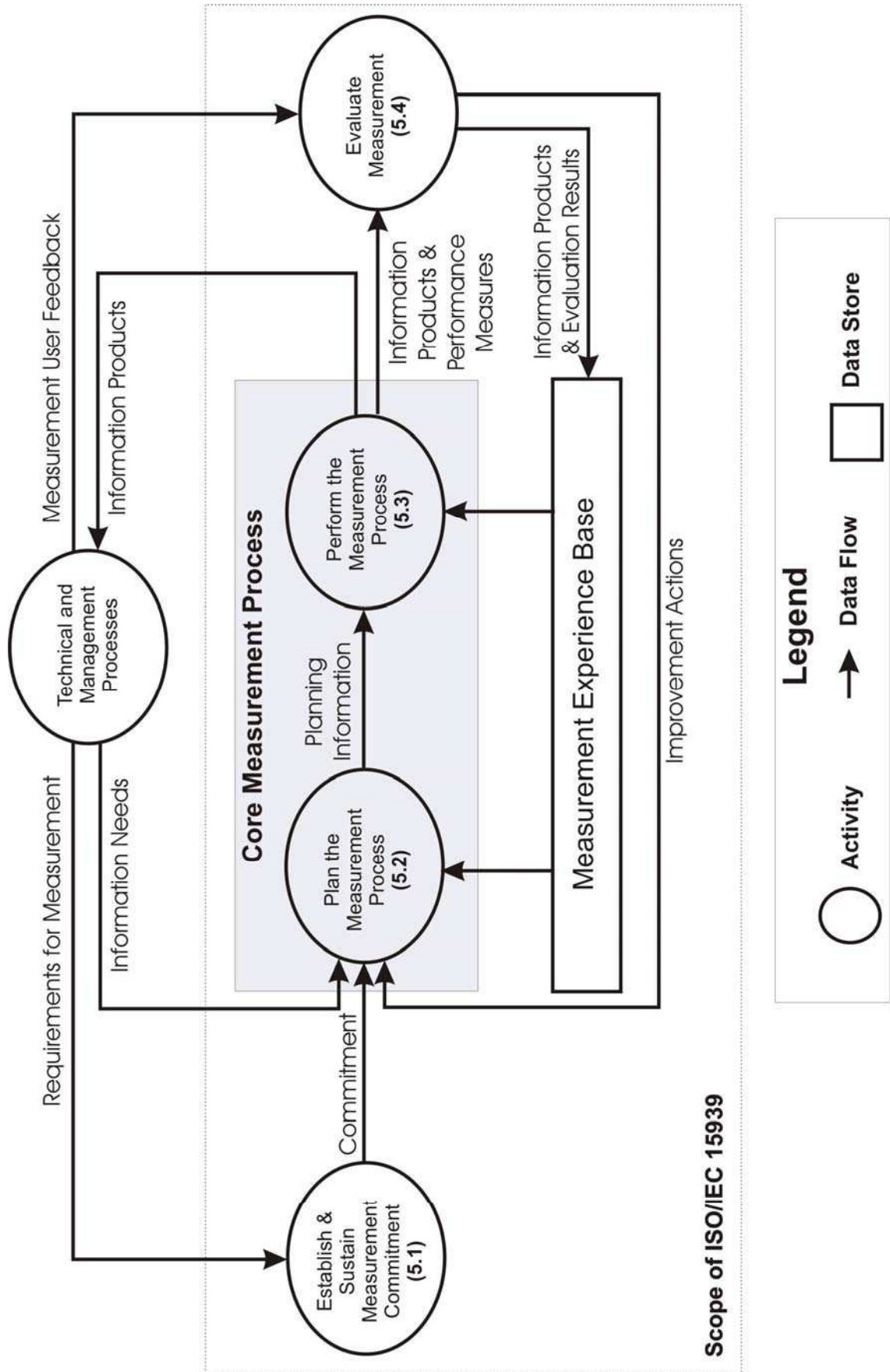


Figure 1: Measurement Process Model.