TECHNICAL REPORT

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Information technology — Software measurement — Functional size measurement —

Part 3: Verification of functional size measurement methods

Technologies de l'information — Mesurage du logiciel — Mesurage de la taille fonctionnelle —

Partie 3: Vérification des méthodes de mesure de la taille fonctionnelle

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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.

In exceptional circumstances, the joint technical committee may propose the publication of a Technical Report of one of the following types:

— type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;

— type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard;

— type 3, when the joint technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

Technical Reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

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 TR 14143-3, which is a Technical Report of type 2, was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 7, *Software and system engineering*.

This document is being issued in the Technical Report (type 2) series of publications (according to the Procedures for the technical work of ISO/IEC JTC 1) as a "prospective standard for provisional application" in the field of software measurement because there is an urgent need for guidance on how standards in this field should be used to meet an identified need.

This document is not to be regarded as an "International Standard". It is proposed for provisional application so that information and experience of its use in practice may be gathered. Comments on the content of this document should be sent to the ISO Central Secretariat.

A review of this Technical Report (type 2) will be carried out not later than three years after its publication with the options of: extension for another three years; conversion into an International Standard; or withdrawal.

ISO/IEC 14143 consists of the following parts, under the general title *Information technology — Software measurement — Functional size measurement*:

— *Part 1: Definition of concepts*

— *Part 2: Conformity evaluation of software size measurement methods to ISO/IEC 14143-1:1998*

— *Part 3: Verification of functional size measurement methods*

— *Part 4: Reference model*

— *Part 5: Determination of functional domains for use with functional size measurement*

Introduction

Functional Size Measurement (FSM) is a technique used to measure the size of software by quantifying the Functional User Requirements of the software[1)]. The first published method to embrace this concept was Function Point Analysis, developed by Allan Albrecht in the late 1970s. Since then, numerous extensions and variations of the original method have been developed. The end user may have many variants from which to choose - each with its own advantages in specific situations. This part of ISO/IEC 14143 was developed to provide a process to assist the user in choosing a method appropriate to their needs, by providing a process for verifying the extent to which statements made for certain performance properties of an FSM Method are true.

Tests are carried out according to the provisions of this Technical Report, concerning statements made for performance properties of a particular FSM Method. The results of these tests will be helpful to prospective users of the FSM Method in judging whether it is appropriate to their needs.

ISO/IEC 14143-1:1998 was developed to define the concepts of FSM and provides a basis against which all variants can be compared.

This part of ISO/IEC 14143

a) establishes a framework for verifying certain performance properties of an FSM Method,

b) defines several performance properties against which an FSM Method can be verified,

c) describes the types of tests which can be performed,

d) defines the process for verification of an FSM Method, and

e) provides an example template for the verification report.

Verification is conducted by a verification team that has the competencies described in this part of ISO/IEC 14143. This part of ISO/IEC 14143 assumes familiarity with the concepts and definitions described in ISO/IEC 14143-1:1998.

The verification process is designed to meet the requirements of the verification sponsor and involves

a) identifying the performance properties that need to be verified,

b) identifying the tests that need to be conducted,

c) conducting the tests, and

d) reporting the verification test results.

1) Refer ISO/IEC 14143-1:1998, *Information technology — Software measurement — Functional size measurement — Part 1: Definition of concepts*.

The output from the verification is the verification report, which provides objective evidence of the extent to which an FSM Method exhibits certain performance properties. The verification report consists of the results for each test carried out, and can be used to

a) determine the correctness of the statements made by a particular FSM Method,

b) determine the extent that a particular FSM Method exhibits the particular performance properties tested, and

c) assist prospective users of the FSM Method to make informed decisions about which method best meets their needs.

Information technology — Software measurement — Functional size measurement —

Part 3: Verification of functional size measurement methods

1 Scope

This part of ISO/IEC 14143 establishes a framework for verifying the statements of an FSM Method and/or for conducting tests requested by the verification sponsor, relative to the following performance properties:

— repeatability and reproducibility;

— accuracy;

— convertibility;

— discrimination threshold;

— applicability to Functional Domains.

NOTE Statements and test requests relative to other performance properties are outside the scope of this document.

It aims to ensure that the output from the verification is objective, impartial, consistent and repeatable.

The verification report, produced as a result of applying this part of ISO/IEC 14143, will enable the prospective user to select the FSM Method which best meets their needs.

2 Normative references

The following referenced documents are indispensable for the application 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 14143-1:1998, *Information technology — Software measurement — Functional size measurement — Part 1: Definition of concepts*

ISO/IEC 14143-2:2002, *Information technology — Software measurement — Functional size measurement — Part 2: Conformity evaluation of software size measurement methods to ISO/IEC 14143-1:1998*

ISO/IEC 14143-4:2002, *Information technology — Software measurement — Functional size measurement — Part 4: Reference model*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 14143-1:1998 and the following apply.

3.1
accuracy of measurement
the closeness of the agreement between the result of a measurement and the true value of the measurand

NOTE 1 "Accuracy" is a qualitative concept.

NOTE 2 The term **precision** should not be used for "accuracy".

[International vocabulary of basic and general terms in metrology, 1993, definition 3.5]

NOTE 3 A true value, as defined in the *ISO Vocabulary on basic and general terms in metrology* (1993), is a value consistent with the definition of a given particular quantity and this is a value that would be obtained by a perfect measurement. In contexts where perfect measurement is not practically feasible, a conventional true value is a value attributed to a particular quantity and accepted, sometimes by convention, as having an uncertainty appropriate for a given purpose. 'Conventional true value', in the same reference, is sometimes called assigned value, best estimate of the value, conventional value or reference value. The accuracy should be expressed in terms of the Mean magnitude of relative error.

3.2
applicability to a Functional Domain
the ability of an FSM Method to take into account the characteristics of Functional User Requirements (FUR) which are pertinent to FSM in a Functional Domain

3.3
convertibility
the ability to convert the results from applying two or more FSM Methods in the measurement of a Functional Size of the same set of Functional User Requirements

NOTE Convertibility of an FSM Method is a recommendation of ISO/IEC 14143-1:1998.

3.4
discrimination (threshold)
largest change in a stimulus that produces no detectable change in the response of a measuring instrument, the change in the stimulus taking place slowly and monotonically

NOTE The discrimination threshold may depend on, for example, noise (internal or external) or friction. It may also depend on the value of the stimulus.

[International vocabulary of basic and general terms in metrology, 1993, definition 5.11]

3.5
measurand
particular quantity subject to measurement

EXAMPLE Vapour pressure of a given sample of water at 20 °C.

NOTE 1 The specification of a measurand may require statements about quantities such as time, temperature and pressure.

[International vocabulary of basic and general terms in metrology, 1993, definition 2.6]

NOTE 2 In this part of ISO/IEC 14143, the measurand refers to the FUR.

3.6
measuring instrument
device intended to be used to make measurements, alone or in conjunction with supplementary device(s)

[International vocabulary of basic and general terms in metrology, 1993, definition 4.1]

NOTE In this part of ISO/IEC 14143, the core element of the measurement instrument is the FSM Method.

3.7
owner of the FSM Method
the person or organization that owns the intellectual property rights for the FSM Method

3.8
repeatability (of results of measurements)
closeness of the agreement between the results of successive measurements of the same measurand carried out under the same conditions of measurement

NOTE 1 These conditions are called **repeatability conditions**.

NOTE 2 Repeatability conditions include:

— the same measurement procedure

— the same observer

— the same measuring instrument, used under the same conditions

— the same location

— repetition over a short period of time.

NOTE 3 Repeatability may be expressed quantitatively in terms of the dispersion characteristics of the results.

[International vocabulary of basic and general terms in metrology, 1993, definition 3.6]

3.9
reproducibility (of results of measurements)
closeness of the agreement between the results of measurements of the same measurand carried out under changed conditions of measurement

NOTE 1 A valid statement of reproducibility requires specification of the conditions changed.

NOTE 2 The changed conditions may include:

— principle of measurement

— method of measurement

— observer

— measuring instrument

— reference standard

— location

— conditions of use

— time.

NOTE 3 Reproducibility may be expressed quantitatively in terms of the dispersion characteristics of the results.

NOTE 4 Results are here usually understood to be corrected results.

[International vocabulary of basic and general terms in metrology, 1993, definition 3.7]

3.10
verification method
a method that tests an FSM Method, and provides objective evidence of the extent to which a particular performance property is exhibited

NOTE The purpose of applying this part of ISO/IEC 14143 is to enable the user to select the FSM Method which "best" meets their needs. Therefore, verification of an FSM Method should produce a result that indicates:

— the extent to which a performance property is exhibited, or

— whether a performance property is exhibited to a stated extent.

For this reason, there is no concept of "pass" or "fail". An FSM Method can be considered to be either "verified" or "not verified", for a particular performance property, based on whether or not the appropriate verification has been conducted.

3.11
verification sponsor
the person or organization that requires the verification to be performed and provides financial or other resources to carry it out

4 Verification

4.1 General

4.1.1 The purpose of verification is to provide objective evidence of the extent to which an FSM Method exhibits certain performance properties. The level of acceptability may be dependent on the context and purpose of the verification sponsor, e.g. one level might be acceptable for one purpose, but unacceptable for another purpose.

4.1.2 Verification of an FSM Method shall be performed by a verification team with the objective of

a) determining the correctness of the statements of the FSM Method, and/or

b) applying tests requested by the verification sponsor.

4.1.3 Verification shall consist of the following activities:

a) constitute the verification team (a verification team is constituted based on identified competencies – refer to 4.2);

b) assemble the verification inputs (the verification inputs are identified or produced – refer to 4.3);

c) conduct the verification (verification is conducted – refer to 4.4);

d) compile the verification output (a verification report is produced – refer to 4.5).

NOTE Figure 1 provides a diagrammatic representation (numbering within the diagram refers to clauses in this document).

4.1.4 A verification report shall only be valid for the particular version of an FSM Method that was the subject of the verification. Each version of a method, including a local customization, is considered to be another FSM Method and shall be verified separately. If the verification team can identify the similarities and/or differences between an FSM Method and a previously verified version of the same method, they may use the results of that previous verification as the basis for the new verification. If any verification tests have been reported for a previously verified version of the same FSM Method, then the verification team shall consider such verification tests during the current verification.

NOTE If the verification team bases a verification of an FSM Method on a previously verified FSM Method, then they need to be aware of the risks involved as the two versions may have differences that have not been noted. The verification team must take care that the net effect of all the changes is taken into account during the verification.

4.1.5 The verification team shall verify that the FSM Method Documentation is complete, as defined in 4.3.2, and correct for the version of the FSM Method being evaluated.

4.1.6 The verification team should liaise with the verification sponsor during the verification.

4.1.7 If the owner of the FSM Method can be contacted, then the verification team shall

a) liaise with the owner during the verification, and

b) document the subject of the liaison with the owner within the verification report and, where appropriate, cross-reference the provision or verification activity to which it relates.

4.1.8 The verification team shall determine whether information received, from the owner of the FSM Method during the liaison, would result in a different version of the method than that submitted for this verification. In this case 4.1.4 shall apply.

4.1.9 If the owner of the FSM Method can be contacted, then the owner shall be provided with the opportunity to respond to the findings of the verification and to add comments to the verification report before its publication.

4.10 If the owner of the FSM Method does not respond to the findings of the verification report within a reasonable time period, then the verification team may proceed with publication of the report. This time period should be agreed upon by the owner of the FSM Method and the verification team at the outset of the verification.

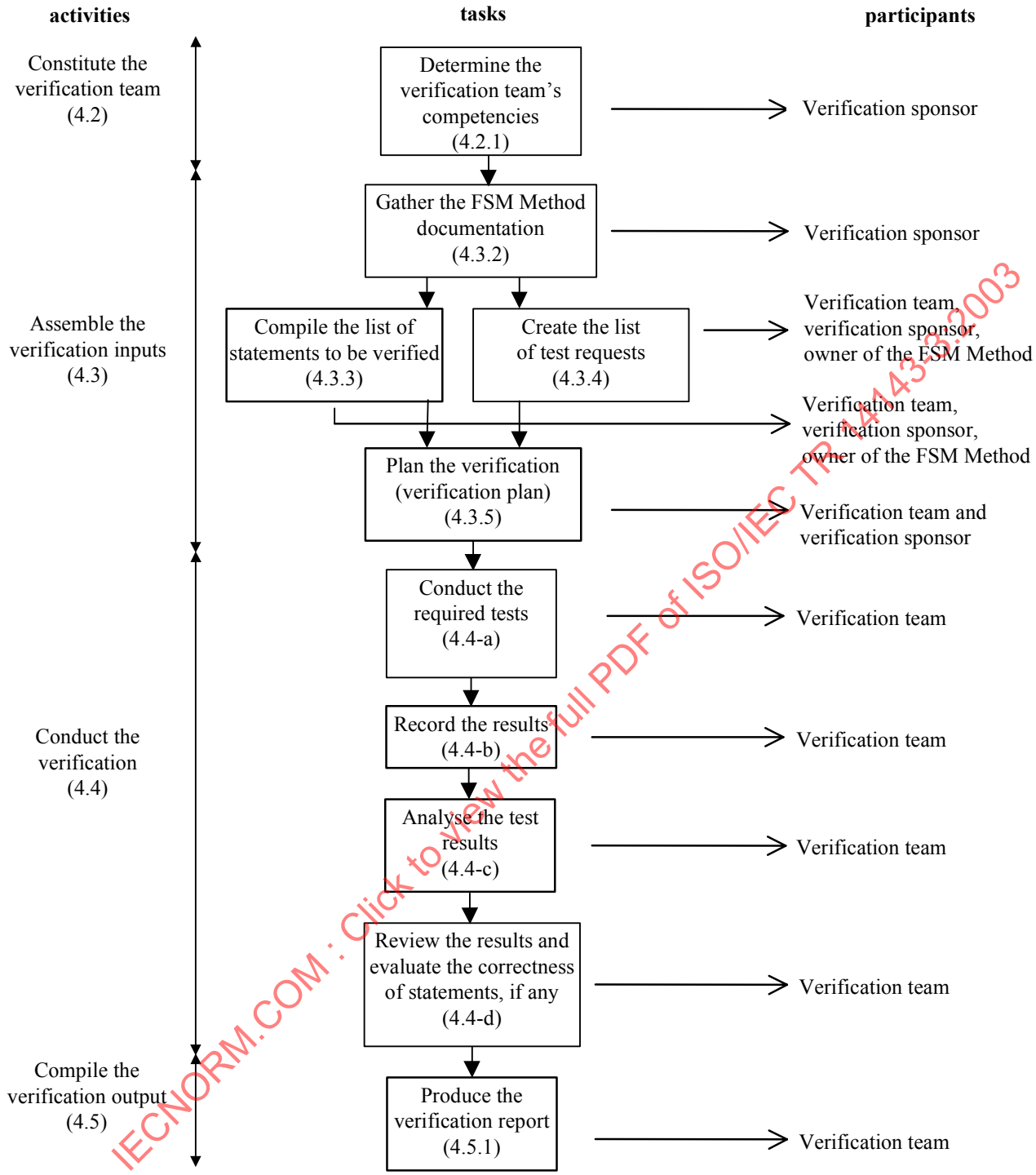

Figure 1 — Verification

4.2 Constitute the verification team

4.2.1 Determine the verification team's competencies

To verify an FSM Method in accordance with this part of ISO/IEC 14143, the verification team should have

a) knowledge of the concepts of all parts of ISO/IEC 14143,

b) a thorough understanding of the details of parts 3 and 4 of ISO/IEC 14143,

c) a thorough understanding of measurement concepts,

d) experience with the FSM Method to be verified, and

e) experience in the conduct of verification tests in accordance with National or International Standards in a software environment (not necessarily under this part of ISO/IEC 14143).

NOTE Measurement concepts include

— statistical methods,

— measurement theory, and

— the concepts of software size measurement.

4.2.2 Verification team responsibilities

The verification team shall be responsible for ensuring that all activities in the verification are completed. These activities shall include the following:

a) develop the verification plan;

b) define the verification procedure;

c) conduct the verification (apply the verification methods, record and analyse the test results, and evaluate the correctness of any statements);

d) produce the verification report.

4.3 Assemble the verification inputs

4.3.1 Prepare the verification input

4.3.1.1 As a minimum, the input to the verification shall include the following information:

a) parts 3, 4 and 5 of ISO/IEC 14143;

b) the FSM Method documentation;

c) evidence that the FSM Method is conformant to ISO/IEC 14143-1:1998 in accordance with ISO/IEC 14143-2:2002;

d) the purpose or scope and context of the verification, as specified by the verification sponsor;

e) a list of statements to be verified and/or a list of test requests;

f) a verification plan;

g) a verification procedure.

4.3.1.2 The input to the verification should also include

a) Reference User Requirements, and

b) Reference FSM Methods.

The Reference User Requirements and the Reference FSM Methods should be appropriate for the Functional Domain for which the FSM Method will be tested for applicability.

The verification team may select to admit the results of tests, performed by independent researchers, that have been carried out according to the provisions of this Technical Report.

4.3.2 Gather the FSM Method documentation

The FSM Method documentation shall include, but not be limited to, all materials that were submitted for conformity evaluation to ISO/IEC 14143-1:1998 using ISO/IEC 14143-2:2002.

4.3.3 Compile the list of statements to be verified

The statements list shall contain the statements of the FSM Method relative to the list of performance properties. Only statements within the FSM Method documentation shall be considered to be statements of the FSM Method. The statements list shall be compiled by the verification sponsor, in consultation with the verification team. Where possible, the owner of the FSM Method should be involved in this process.

4.3.4 Create the list of test requests

The test requests shall only relate to the list of performance properties.

The verification team, in consultation with the verification sponsor, shall develop a test list by reviewing

a) the statements list (if any) and identifying the tests that can be used to verify each statement, and

b) the additional needs (if any) of the verification sponsor and identifying the tests that can be used to satisfy those needs.

Where possible, the owner of the FSM Method should be involved in this process.

NOTE The usefulness of the test results will depend on how the requests are framed. The verification team can assist in the test specification to ensure that the results are of use to the verification sponsor. Correctly framed test requests will also simplify the verification.

EXAMPLE If the verification sponsor asks “How accurate is Method A”, the verification report could contain all of the following statements:

— for 60 % of measurements, Method A produces a Functional Size that is accurate to within 80 %;

— for 70 % of measurements, Method A produces a Functional Size that is accurate to within 75 %;

— for 80 % of measurements, Method A produces a Functional Size that is accurate to within 65 %.

This would not be a very useful result if the verification sponsor required a measurement accuracy of 90 %.

Test requests shall be presented according to the framework prescribed in Annex A.

4.3.5 Plan the verification (Verification plan)

The verification team shall plan the verification in consultation with the verification sponsor. As a minimum, it shall

a) describe the activities, tasks, schedule and resources required for the verification procedure,

b) provide a detailed description of the verification methods to be used,

NOTE Some verification methods are described in Annex B.

c) uniquely identify each of the inputs to the verification procedure,

d) include the names and contact details of the verification team members,

e) include the name(s) and contact details of the verification sponsor(s),

f) describe the roles and responsibilities of all persons or organizations involved in the verification, and

g) describe how the inputs are to be used during the verification to produce the verification output.

4.4 Conduct the verification

Verification shall include the following actions:

— conduct the requested tests;

NOTE Apply the verification methods necessary for conducting each test in the test list.

— record the results of the tests;

— analyse the test results;

— review the results of the tests and evaluate the correctness of the statements, if any.

4.5 Compile the verification output

4.5.1 The verification team shall produce a verification report, which records the detailed evidence supporting the verification results.

The verification team should obtain an acceptance signature from the verification sponsor.

4.5.2 As a minimum, the verification report shall include the following sections:

a) executive summary;

b) purpose or scope and context of the verification sponsor;

c) list of statements to be verified, if any;

d) list of requested tests, if any;

e) verification plan;

f) test results (including all the information which contributed to any decisions made);

g) analysis of the test results;

h) evaluation of the correctness of the statements, if applicable.

4.5.3 As a minimum, the executive summary section shall include the following:

a) full identification details of the FSM Method;

b) the date(s) of the verification;

c) the verification result for each statement;

d) the verification result for each requested test;

e) the names and contact details of the verification team members.

NOTE Annex C contains an example of a verification report that exhibits the minimum requirements of this part of ISO/IEC 14143.

Annex A
(normative)

Presentation of test requests

A.1 General requirements of test requests

Each test request in the list of test requests shall

a) be numbered so that it can be uniquely identified,

b) identify the corresponding statement within the FSM Method, if applicable,

c) identify the performance property to which the test refers,

d) state the verification method to be used for the verification test, and

NOTE Verification methods are described in Annex B.

e) be precisely described in accordance with the provisions of A.2.

A.2 Description of test requests

A.2.1 Tests relating to repeatability and reproducibility of an FSM Method

A request to test the FSM Method for repeatability and reproducibility shall state

a) the Functional Domain(s) for which the FSM Method is to be tested,

b) the size range of FUR for which the FSM Method is to be tested,

c) the conditions under which the FSM Method is to be tested, and

EXAMPLE 1 Such a condition may be – "to be repeatable and reproducible Method A must be applied by measurers certified by Organization C".

d) any other information necessary for the application of the verification method.

EXAMPLE 2 When the FSM Method A is applied repeatedly to the same FUR; belonging to the Functional Domain "management information system" by measurers certified to Method A by Organization C; and the size range is between 100 and 600 Method A units; then what is the standard deviation of the results in Method A units.

EXAMPLE 3 When the FSM Method A Version 3.05 is applied by different measurers to any one set of FUR, from any given Functional Domain, of any size, then what is the dispersion in Method A units of the results obtained.

A.2.2 Tests relating to accuracy of an FSM Method

A.2.2.1 General

A request to test the FSM Method for accuracy shall state any information necessary for the application of the verification test.

EXAMPLE Can we establish the accuracy of the FSM Method B

— by establishing a correlation between the results of FSM Method B and the results of Method A,

— for the Functional Domain “real time systems”,

— for all FUR whose size is less than 600 Method A units, and

— using verification method 2 for accuracy?

A.2.2.2 Statements of accuracy by reference to an external criterion

A statement that the FSM Method is accurate by reference to an external criterion shall state

a) the external criterion used to state accuracy,

b) the conditions under which the correlation between the results of the FSM Method and the values of the external criterion can be, or have been established, and

c) the type of correlation (equation, error rate, etc.) between the results of the FSM Method and the values of the external criterion.

EXAMPLE

— Name of the FSM Method to be verified: Method B.

— External criterion used to state accuracy: Method A.

— Version number: 10.

— Name(s) of author(s): Fred Smith and Ethel Jones.

— Date of publication: 1990.

— Name and contact details of the publisher: B.C Publishing, Mawson, Antarctica.

Statement: When measuring FUR of any Functional Domain, it can be statistically shown that:

A(FURi)≈2*B(FURi) (± 10 Method B units).

where

— A(FURi) is the result obtained by application of FSM Method A to any FURi, and

— B(FURi) is the result obtained by application of the FSM Method B to any FURi.

Because the FSM Method A is 100 % accurate (when tested using this part of ISO/IEC 14143), the accuracy of FSM Method B is about ± 10 Method B units.

A.2.2.3 Statements of accuracy using a theory as a reference

A statement that the FSM Method is accurate by reference to a theory shall state

a) a complete description of the theory used in order to state accuracy of the FSM Method (documentation, authors, etc.), and

b) a complete description of how the theory explains the behaviour of the FSM Method.

A.2.3 Tests relating to convertibility of an FSM Method

A request to test the FSM Method for convertibility shall state

a) the unique identification of the method against which the FSM Method to be verified is to be tested, in accordance with ISO/IEC 14143-2:2002, 4.3.2),

b) the size range of FUR for which the FSM Method to be verified is to be tested,

NOTE The size range may be expressed in the units of the FSM Method to be tested or in the units of the other measurement method.

c) the Functional Domain(s) for which the correlation has been established,

d) the algorithm or derivation that enables the conversion between the FSM Method and the second measurement method, if already defined, and

e) any other information necessary for the application of the verification method.

EXAMPLE 1 Using verification method 'y' for convertibility, determine if the results of FSM Method A are convertible to the results of FSM Method B when both methods are applied to FUR

— belonging to the Functional Domain "electronic banking systems", and

— whose size is less than 600 Method A units.

EXAMPLE 2

Name of the FSM Method to be verified: Method B.

Measurement method for which the correlation has been established:

— Name of the Method: Method A;

— Version number: 10;

— Name(s) of author(s): Fred Smith and Ethel Jones;

— Date of publication: 1990;

— Name and contact details of the publisher: B.C Publishing, Mawson, Antarctica.

Statement: When applied to FUR of any size within the Functional Domain "process control systems" it can be statistically shown that:

$A(FURi) \approx 2*B(FURi)+7$,

where

— A(FURi) is the result obtained by application of FSM Method A to any FURi, and

— B(FURi) is the result obtained by application of the FSM Method B to any FURi.

A.2.4 Tests relating to discrimination threshold of an FSM Method

A request to test the FSM Method for discrimination threshold shall state

a) the Functional Domain for which the test is to be carried out, and

b) any other information necessary for the application of the verification method.

EXAMPLE 1 Using verification method 'z' for discrimination threshold, determine the smallest change in the measured characteristics of the FUR belonging to the Functional Domain "real time systems" which produces a change in the measurement result produced by the FSM Method.

EXAMPLE 2 In the FSM Method K (Version 1.3.1), a change of one Data Element Type on an Input or Output produces a change in size of 0.02 and 0.01 FSM Method K units respectively.

A.2.5 Tests relating to applicability (of an FSM Method) to a functional domain

A request to test the FSM Method for applicability to a Functional Domain shall state

a) the Functional Domain, in conformance with Part 5 of ISO/IEC 14143, for which the FSM Method is to be tested,

b) the size range of FUR for which the FSM Method is applicable,

c) any other constraints on applicability, and

NOTE It may be that the method applies to a subset of the Functional Domain.

d) any other information necessary for the application of the verification method.

Annex B
(normative)

Verification methods

B.1 Verification methods for assessment of repeatability and reproducibility of an FSM Method

B.1.1 Repeatability

To conduct verification for repeatability, the verification team shall

a) select a list of n FUR suitable for the test ($n \geqslant 30$),

NOTE 1 The number thirty (30) is the generally accepted sample size necessary to obtain a statistical mean with a normal distribution.

b) nominate a team of measurers with formal training and experience in the use of the FSM Method,

c) ensure the objectivity of the experiment,

d) ask each measurer to apply the FSM Method to each FUR,

e) examine the results obtained by each measurer in order to ensure that the rules of the FSM Method were properly applied,

f) calculate the mean and the standard deviation of the results obtained, for each FUR, and

g) determine the statistical repeatability of the measurement method.

NOTE 2 The statistics to be used depend on the results obtained. For example, if the results obtained are normally distributed around the mean, then 99.7 percent of the results obtained by the measurers should be within ± 3*(standard deviations). However, care must be taken to identify systematic errors, e.g. many measurers systematically fail to identify certain BFC types relevant to the FSM Method.

	Measurer 1	Measurer 2	…	Measurer m	Mean	Standard deviation	3*standard deviation
FUR 1	123	130	…	128	127	3.109	9.327
FUR 2	250	245	…	254	249	3.741	11.223
…			…		…	…	…
FUR n	417	430	…	425	424	5.35	16.06

B.1.2 Reproducibility

The verification activities for reproducibility are the same as for repeatability, with the exception that some conditions must be changed during the verification.

B.2 Verification methods for assessment of accuracy of an FSM Method

B.2.1 Verification for the accuracy of the application of an FSM Method

To conduct verification for the accuracy of the application of an FSM Method, the verification team shall

a) identify a group of experts in FSM Method A who will establish a consensus on a size based on the best group application of the FSM Method A to a specific set of FUR. Their consensual result will then be taken as the best estimate, or reference value, of the true value of the Functional Size of the set of FUR according to FSM Method A,

b) identify a group of users of the method to independently measure the same set of FUR. Experience of the group of users of FSM Method A should be recorded, and

c) compare the results of the individual measurements against the reference value established by consensus by the experts to establish the accuracy of the FSM method under the set of conditions of the experiment.

B.2.2 Verification with respect to a theory as a reference

To conduct verification for the accuracy of the verification method with respect to a theory as a reference, the verification team shall

a) use the theory to make a prediction, and

b) compare the actual observation against the theory.

B.3 Verification methods for convertibility of an FSM Method

To conduct verification for convertibility, using correlation with a second FSM Method, the verification team shall verify that the FSM Method measures the same quantity as this second FSM Method.

EXAMPLE 1 The distance between two points can be measured by:

— a ruler graduated in metres, or

— a ruler graduated in feet.

The results obtained with the first method (first ruler) can be converted to the results obtained with the second method (second ruler). This conversion is based on the fact that 1 metre = 3.28 feet. The conversion operation is therefore made using the following equation:

Distance in feet = 3.28∗Distance in metres.

EXAMPLE 2 Convertibility may be exact, i.e. by mathematical formula, or by statistical correlation. Where there is a direct mathematical formula conversion, only the conversion formula need be tested. The approach described below applies only where it is assumed there is at best a statistical correlation between the two methods.

To conduct verification for convertibility, the verification team shall

a) select a list of n FUR suitable for the test ($n \geqslant 30$),

b) nominate a measurer with formal training and experience in the use of the FSM Method,

c) nominate a measurer with formal training and experience in the use of the second FSM Method,

d) ensure the objectivity of the experiments,

e) ask the measurers to apply the methods to each FUR,

f) examine the results obtained by the measurers in order to ensure that the rules of the methods were properly applied,

g) determine the correlation equation between the results of the two methods, and

h) determine the correlation coefficient and analyse the covariance of the results obtained.

NOTE Convertibility can be expressed as one of the following:

— full convertibility: The Functional Size can be transformed to another software size measure using an algorithm or a mathematical model, under all conditions;

— restricted convertibility: The Functional Size can be transformed to another software size measure using an algorithm or mathematical model under some conditions; e.g., for a limited range of sizes or within a specified degree of accuracy;

— no convertibility: The Functional Size cannot be transformed to another software size measure.

B.4 Verification methods for discrimination threshold of an FSM Method

To conduct verification for discrimination threshold, the verification team shall

a) select a list of n FUR suitable for the test ($n \geqslant 30$),

b) nominate a measurer with formal training and experience in the use of the FSM Method,

c) ensure the objectivity of the experiment,

d) ask the measurer to apply the FSM Method to each FUR,

e) examine the results obtained by the measurer in order to ensure that the rules of the method were properly applied,

f) determine the minimum threshold by

1) identifying the smallest change in the FUR for which the FSM Method recognises a change in value of the Functional Size, or

2) moving upwards from zero, identifying the largest change in the FUR before which the FSM Method recognises a change in value of the Functional Size, and

EXAMPLE 1 If a scale is graduated in grams, then something smaller than 1 gram cannot be measured.

g) determine the maximum threshold by

1) identifying the largest change in the FUR for which the FSM Method recognises a change in value of the Functional Size, or

2) moving downwards from infinity, identifying the smallest change in the FUR before which the FSM Method recognises a change in value of the Functional Size.

EXAMPLE 2 If a scale is only graduated up to 1 kilo, then something larger than 1 kilo cannot be measured.