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Systems and software engineering — Systems and software Quality Requirements and Evaluation (SQuaRE) — Evaluation guide for developers, acquirers and independent evaluators

Ingénierie des systèmes et du logiciel — Exigences de qualité et évaluation des systèmes et du logiciel (SQuaRE) — Guide d'évaluation pour les développeurs, les acquéreurs et les évaluateurs indépendants

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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.

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 25041 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 7, *Software and systems engineering*.

This first edition of ISO/IEC 25041 cancels and replaces ISO/IEC 14598-3:2000, ISO/IEC 14598-4:1999 and ISO/IEC 14598-5:1998.

Introduction

As the use of information technology grows, the number of critical systems also grows. Such systems include, for example, security critical, life critical, economically critical and safety critical systems. The quality of systems and software product of such critical systems is particularly important because software faults may lead to serious consequences.

Evaluation is the systematic determination of the extent to which an entity meets its specified criteria. The evaluation of product quality is vital to both the acquisition and development of software. The relative importance of the various characteristics of software quality depends on the intended usage or objectives of the system of which the software is a part; products need to be evaluated to decide whether relevant quality characteristics meet the requirements of the system.

This International Standard is part of the ISO/IEC 250nn SQuaRE series of standards. ISO/IEC 25040 contains general requirements and recommendations for product quality evaluation as well as associated general concepts. This International Standard provides specific issues related to the developers, acquirers and independent evaluators based on ISO/IEC 25040.

The general goal of creating the SQuaRE set of standards is to move to a logically organized, enriched and unified series covering two main processes: software quality requirements specification and software quality evaluation, supported by a software quality measurement process. The purpose of the SQuaRE set of standards is to assist those developing and acquiring products with the specification and evaluation of quality requirements. It establishes criteria for the specification of product quality requirements, their measurement, and evaluation. It includes a quality model for aligning customer definitions of quality with properties of the development process. In addition, the series provides recommended measures of product properties that can be used by developers, acquirers, and independent evaluators.

SQuaRE provides:

- terms and definitions;
- reference models;
- general guide;
- individual division guides, and
- standards for requirements specification, planning and management, measurement and evaluation purposes.

SQuaRE includes International Standards on quality modes and measures, as well as on quality requirements and evaluation.

SQuaRE replaces the current ISO/IEC 9126 series and the ISO/IEC 14598 series.

The SQuaRE series of standards consists of the following divisions under the general title *Systems and software Quality Requirements and Evaluation*:

- ISO/IEC 2500n - *Quality Management Division*,
- ISO/IEC 2501n - *Quality Model Division*,
- ISO/IEC 2502n - *Quality Measurement Division*,

- ISO/IEC 2503n - *Quality Requirements Division*, and
- ISO/IEC 2504n - *Quality Evaluation Division*.

This International Standard is intended to be used in conjunction with the other parts of the SQuaRE series of standards, and with the ISO/IEC 14598 series and ISO/IEC 9126 series until superseded by the ISO/IEC 250nn series of standards.

The descriptions in this International Standard are mainly based on the descriptions in ISO/IEC 14598-3, ISO/IEC 14598-4, and ISO/IEC 14598-5, which will be replaced by this International Standard.

Figure 1 illustrates the organization of the SQuaRE series representing families of standards, further called Divisions.

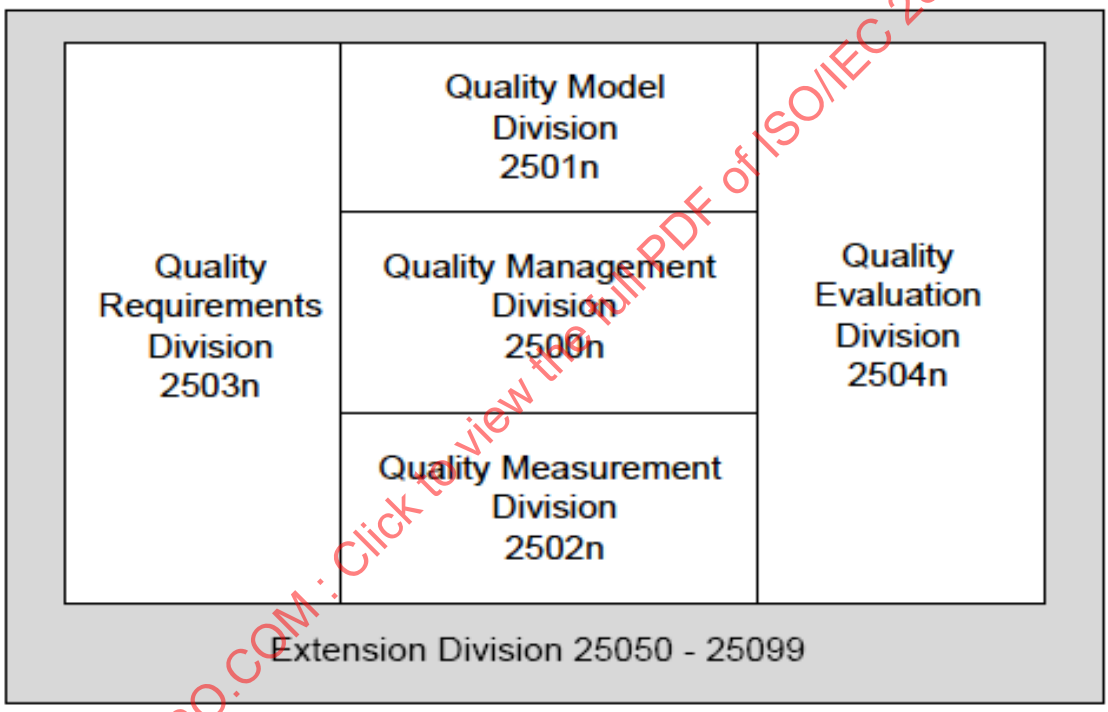

Figure 1—Organization of SQuaRE series of International Standards

The Divisions within the SQuaRE model are:

·**ISO/IEC 2500n - Quality Management Division**. The International Standards that form this division define all common models, terms and definitions referred to by all other standards from the SQuaRE series. Referring paths (guidance through SQuaRE documents) and high level practical suggestions in applying proper standards to specific application cases offer help to all types of users. The division also provides requirements and guidance for a supporting function which is responsible for the management of product requirements specification and evaluation.

·**ISO/IEC 2501n - Quality Model Division**. The International Standard that forms this division presents detailed quality models for software, quality in use and data. Practical guidance on the use of the quality model is also provided.

·**ISO/IEC 2502n - Quality Measurement Division**. The International Standards that form this division include a product quality measurement reference model, mathematical definitions of quality measures, and practical

guidance for their application. This division presents internal measures of software quality, external measures of software product quality and quality in use measures. Measurement primitives forming foundations for the latter measures are defined and presented.

- **ISO/IEC 2503n - Quality Requirements Division**. The International Standard that forms this division helps specifying quality requirements. These quality requirements can be used in the process of quality requirements elicitation for a product to be developed or as inputs for an evaluation process. The requirements definition process is mapped to technical processes defined in ISO/IEC 15288:2008.

- **ISO/IEC 2504n - Quality Evaluation Division**. The International Standards that form this division provide requirements, recommendations and guidelines for 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 to be used for SQuaRE extension International Standards and/or Technical Reports.

This International Standard is part of the 2504n - Quality Evaluation Division that currently consists of the following International Standards:

- **ISO/IEC 25040 - Evaluation process**: contains general requirements for specification and evaluation of software quality and clarifies the general concepts. It provides a process description for evaluating quality of product and states the requirements for the application of this process. The evaluation process is the basis for product quality evaluation for different purposes and approaches. Therefore the process can be used for the evaluation of quality in use, the external measure of software product quality and the internal measure of software product quality, as well as for the evaluation of the quality of pre-developed software product or custom software product during its development process.

- **ISO/IEC 25041 - Evaluation guide for developers, acquirers and independent evaluators**: contains specific requirements and recommendations for developers, acquirers and independent evaluators.

- **ISO/IEC 25045 - Evaluation module for recoverability:** provides the specification to evaluate the subcharacteristics of recoverability defined under the characteristic of reliability of the quality model. It determines the external measures of software product quality of resiliency and autonomic recovery index when the information system composed of one or more software products' execution transactions is subjected to a series of disturbances. A disturbance could be an operational fault (e.g. an abrupt shutdown of an OS process that brings down a system) or an event (e.g. a significant increase of users to the system).

ISO/IEC 25040 is a revised version and replaces ISO/IEC 14598-1.

ISO/IEC 25041 is a revised version and replaces ISO/IEC 14598-3, ISO/IEC 14598-4 and ISO/IEC 14598-5.

The term "product" is used as a simplified term for "systems and software product" throughout this International Standard.

The term "evaluation process" is used as a simplified term for "product quality evaluation process" throughout this International Standard.

The term "evaluation report" is used as a simplified term for "product quality evaluation report" and the term "evaluation plan" is used as a simplified term for "product quality evaluation plan" throughout this International Standard.

Systems and software engineering — Systems and software Quality Requirements and Evaluation (SQuaRE) — Evaluation guide for developers, acquirers and independent evaluators

1 Scope

This International Standard provides requirements, recommendations and guidelines for product quality evaluation specifically for developers, acquirers and independent evaluators. It is not restricted to any specific application area and can be used for quality evaluation of any type of products.

This International Standard provides a process description for evaluating product quality and states the specific requirements for the application of the evaluation process from the viewpoint of developers, acquirers and independent evaluators. The evaluation process can be used for different purposes and approaches. The process can be used for the evaluation of the quality of pre-developed software, commercial-off-the-shelf software or custom software and can be used during or after the development process.

This International Standard is intended for those who are responsible for product quality evaluation and is appropriate for developers, acquirers and independent evaluators of products.

This International Standard is not intended for evaluation of other aspects of products (functional requirements, process requirements, business requirements, etc.).

2 Conformance

Evaluation of product quality conforms to this International Standard if developers conform to requirements of Clauses 6 and 7, if acquirers conform to requirements of Clauses 6 and 8, and if independent evaluators conform to requirements of Clauses 6 and 9.

3 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 25000, *Software Engineering — Software product Quality Requirements and Evaluation (SQuaRE) — Guide to SQuaRE*

ISO/IEC 25001, *Software engineering — Software product Quality Requirements and Evaluation (SQuaRE) — Planning and management*

ISO/IEC 25030, *Software engineering — Software product Quality Requirements and Evaluation (SQuaRE) — Quality requirements*

ISO/IEC 25040, *Systems and software engineering — Systems and software Quality Requirements and Evaluation (SQuaRE) — Evaluation process*

4 Terms and definitions

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

4.1
deliverable product
any unique and verifiable system or software product to perform a service, that is subject to approval by the project sponsor or customer

4.2
dynamic product
system or software product that is measurable during execution in testing and/or operational environment

4.3
evaluation
systematic determination of the extent to which an entity meets its specified criteria

[ISO/IEC 12207:2008]

4.4
evaluation level
rigour to be applied during the evaluation that defines the depth or thoroughness of the evaluation in terms of evaluation techniques to be applied and evaluation results to be achieved

4.5
evaluation records
documented objective evidence of all activities performed and of all results achieved within the evaluation process

4.6
evaluation requester
person or organization that requests an evaluation

4.7
evaluation tool
instrument that can be used during evaluation to collect data, to perform interpretation of data or to automate part of the evaluation

NOTE Examples of such tools are source code analysers to compute code metrics, CASE tools to produce formalized models, test environment to run the executable programs, checklists to collect inspection data or spreadsheets to produce syntheses of measures.

4.8
evaluation stringency
degree required for the product quality characteristics and subcharacteristics to fulfil the expected use criticality of the product

4.9
independent evaluator
individual or organization that performs an evaluation independently from developers and acquirers

NOTE The individual or organization who performs as developer or acquirer for the target system to be evaluated may not become the independent evaluator for the system. The independent evaluator may be an organization. The independent evaluator may belong to the same organization as the developer as long as they are independent from developers and acquirers.

4.10
intermediate product
system or software product of the development process that is used as inputs to other stages of the development process

4.11
product quality
degree to which the product satisfies stated and implied needs when used under specified conditions

NOTE This definition differs from the ISO 9000:2005 quality definition because the software quality definition refers to the satisfaction of stated and implied needs, while the ISO 9000 quality definition refers to the satisfaction of requirements.

[ISO/IEC 25000:2005 definition, rephrased as “degree to which”]

4.12
static product
non-executable system or software product for reviewing

5 Concept of evaluation from the viewpoint of each role

5.1 Framework of the product quality evaluation from the perspective of each role

Developers, acquirers and independent evaluators perform different activities during system product quality evaluation according to each specific role and the category of the evaluation target entity.

Basically, product quality evaluation process of each role is the same, but the target entity of evaluation is different according to purposes of the evaluation depending on the requester’s needs.

Figure 2 is the general framework of the product quality evaluation process.

Product quality evaluation is regarded as a system, which is composed of inputs for, outcomes of, constraints and resources of the evaluation process. They are different for each role and evaluations purpose.

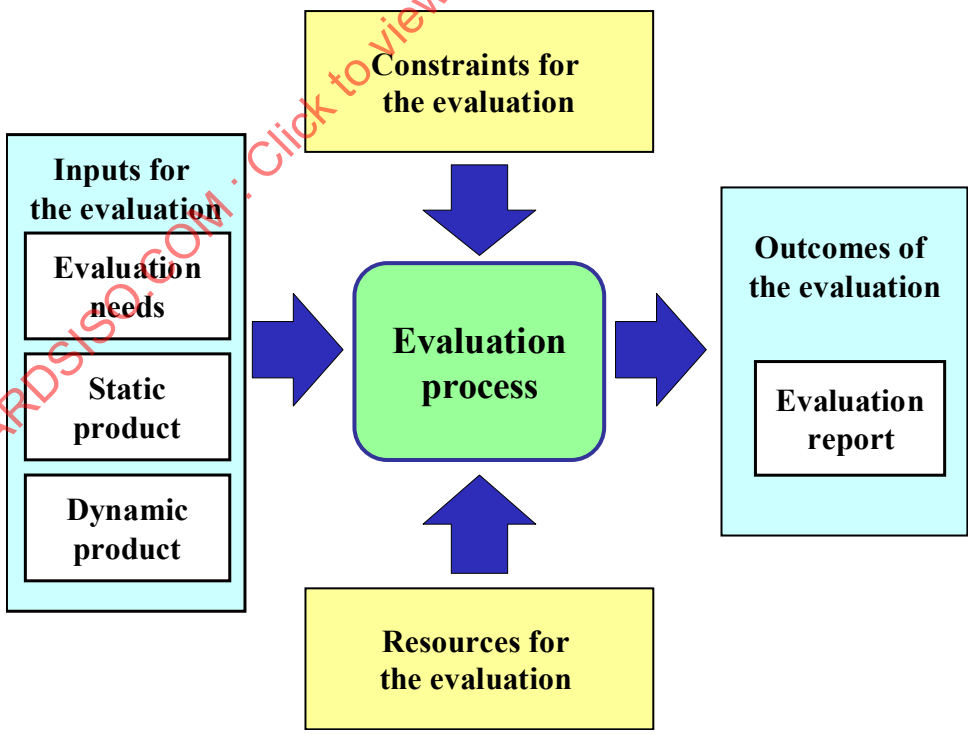

Figure 2 — General framework of the product quality evaluation process

The following are the examples of inputs for and outcomes of an evaluation process.

Inputs for the evaluation process:
-evaluation needs for developers, acquirers and independent evaluators;
-target entities of evaluation such as static products and dynamic products.

NOTE Product quality evaluation needs of each stakeholder, such as developers, acquirers and independent evaluators, are decided from the viewpoint of each role.

Outcomes of the evaluation are the evaluation report, results of improvement of the evaluation process and profit.

In this figure, SQuaRE (ISO/IEC 25010, ISO/IEC 25020, ISO/IEC 2502n, ISO/IEC 25030, ISO/IEC 2504n) are included as resources for the evaluation.

Constraints for the product quality evaluation process can include the following:

a) specific user needs for the evaluation;

b) the evaluation project schedule;

c) the evaluation project budget;

d) the environment used for the evaluation project;

e) the tools and the methods used for the evaluation project;

f) specific requirements for reporting of the evaluation.

Resources for the product quality evaluation process can include the following:

a) applicable measurement tools and method;

b) applicable SQuaRE series of international standard;

c) human resources used for the evaluation;

d) financial resources used for the evaluation;

e) information systems used for the evaluation;

f) knowledge data base used for the quality evaluation.

The software product quality evaluation reference model can be applicable to those responsible for product quality evaluation. It is intended and appropriate for such organizations, in their role, but not limited to, developers, acquirers and independent evaluators.

Product quality evaluation can be performed during or after the development process or acquisition process.

5.2 Target entity of software product quality evaluation

The evaluation purpose is different depending on the role of developers, acquirers and independent evaluators.

The target entity of the evaluation is defined depending on the evaluation purpose.

The target entity of the evaluation is categorized as static products and dynamic products.

Static products, which are either intermediate products or deliverable products, can include the following:
-specification of quality requirements;
-software design specifications;
-program source codes;

-specification of the test planning;
-specification of result of the testing report;
-explanation of the product;
-operation manuals.

Dynamic products can include the following:
-executable intermediate products, which are being executed during dynamic testing in a testing environment;
-deliverable products, which are being executed during operation by an operational environment.

Developers review static products at each development stage of the software life cycle, such as design stage, implementation stage and testing stage in order to evaluate quality of the intermediate product to achieve its role.

Developers test intermediate dynamic products during unit testing stage and deliverable dynamic products during system integration testing stage.

NOTE 1 The target entities of the evaluation according to the developer's viewpoint are static and dynamic intermediate and/or deliverable products.

Acquirers review the static products at the design stage and testing stage for the purpose of product acquisition in order to achieve their role.

Acquirers test the dynamic product at the acceptance or operational testing stage.

Acquirers evaluate both the static and dynamic products in order to compare the quality of some candidate products and to select the higher quality product based on their role.

NOTE 2 The target entities of the evaluation according to the acquirer's viewpoint are static and dynamic intermediate and/or deliverable products.

Independent evaluators may review the static products and test the dynamic products in order to evaluate the quality of the product and make an evaluation report based on their contract with the quality evaluation requesters.

NOTE 3 The target entities of the evaluation according to the independent evaluator's viewpoint are static and dynamic intermediate and/or deliverable products based on the contract with requesters.

Table 1 — Example of target entity of each role

Role	Target entity of the evaluation	
	Static product	Dynamic product
Developers	Intermediate and deliverable products for reviewing	Intermediate and deliverable products for testing
Acquirers	Quality requirements and design documents for reviewing deliverable product	Deliverable products for selection and acceptation
Independent Evaluators	Intermediate or deliverable products for reviewing	Intermediate or deliverable products for testing

Every kind of evaluation activities can be performed from the viewpoint of both static and dynamic product quality evaluation based on the role of developers, acquirers and independent evaluators according to their purpose of evaluation.

5.3 Roles and responsibilities

5.3.1 Roles and responsibilities of developers

.Responsibility of developers concerning product quality evaluation can include the following:

-to assure the quality of developed deliverable product;
-to accept the custom-made software product with a required quality from subcontractors;
-to select suitable off-the-shelf software product with a required quality from vendors;
-to improve the productivity of testing process;
-to train the personnel for product quality evaluation.

When implementing a custom-made software product, developers evaluate the intermediate and deliverable products in order to ensure the quality of the developed software product including the following:
-quality requirements documents in the early stages of development;
-intermediate products, such as design documents and program source codes during implementation;
-deliverable software products that are included in the target system during testing.

When buying an off-the-shelf software product in order to adapt it to the deliverable system, developers evaluate and compare the candidate products, then select a product that satisfies the required quality.

Developers can use the results of product quality evaluation to ensure that products meet required quality criteria, which can be set by the acquirers, or by comparison with other products.

5.3.2 Roles and responsibilities of acquirers

Responsibility of acquirers in charge of quality evaluation includes the following:

-to accept the custom-made software products that satisfy quality requirements;
-to select an off-the-shelf software product of acceptable quality;
-to improve the effectiveness of dynamic products included in the operational target system;
-to improve the productivity of the acquisition process;
-to train the personnel for quality evaluation.

When acquiring a custom-made software product, acquirers evaluate the intermediate or deliverable products in order to ensure the quality of the acquired product.

When acquiring a custom-made software product, acquirers establish quality in use requirements, product quality requirements, specify the requirements to the supplier, and evaluate potential suppliers against these requirements before acquisition.

When acquiring a custom-made software product, the objective of specifying the quality requirements is to ensure that the product meets the stated and implied needs of the users. Possible activities include:

-to review the design documents before requesting a software development;
-to review and test the deliverable products before accepting a custom-made software product.

When acquiring an off-the-shelf software product, acquirers evaluate the candidate deliverable products in order to compare and select the product.

When acquiring an off-the-shelf software product, evaluation can be used to compare the alternative products and to ensure that the selected product meets the quality requirements. Possible activities include the following:

-to review the documents of deliverable products before selecting the product to be acquired;
-to test the deliverable products in order to select the product to be acquired that best fit the quality requirements.

In the acceptance testing stage, acquirers test the products in order to accept a high quality product.

When improving an operational product included in a target system, acquirers evaluate the dynamic product in order to improve the quality of the product. Possible activities include:

-to review the quality of static deliverable product during operation stage;
-to test the quality of dynamic deliverable product during operation stage.

When evaluating an operational product included in a target system, the product is tested and measured by using quality in use measures.

NOTE 1 The operator can be a part of acquirers. The individual or organization, which operates a target system of which the product is a part, can perform software product quality evaluation to validate that the product meets the quality requirements under variable operating conditions, and to specify needs for changes to those responsible for maintenance.

NOTE 2 The maintainer can be a part of acquirers. An individual or an organization, who maintains a target system of which the product is a part, can perform software evaluation to validate whether the product quality still meet quality requirements, and especially requirements for maintainability and portability.

5.3.3 Roles and responsibilities of independent evaluators

Responsibilities of independent evaluators are defined by the contract with the requesters.

The evaluation process can be performed from the viewpoint of either developers or acquirers.

Responsibility of independent evaluators concerning quality evaluation can include the following:
-to evaluate the target product based on the contract with requesters;
-to assure the quality of the product quality evaluation report;
-to improve the quality of the evaluation result;
-to improve the productivity of the evaluation process;
-to improve information systems, which support the quality evaluation process;
-to train the personnel for evaluation.

The independent evaluators review the scope of evaluation based on the contract before performing the evaluation and provide the suitable solution and environment for evaluation.

When evaluating a target product, the independent evaluators evaluate the intermediate or deliverable products in order to ensure the product quality.

This evaluation can be performed by the request from developers, acquirers or some other parties.

6 Organization level requirements and recommendations for software product quality evaluation

6.1 General requirements and recommendations

The software product quality evaluation process reference model describes the process and details the activities and tasks providing their purposes and complementary information that can be used to guide a product quality evaluation (see ISO/IEC 25040).

It is appropriate for organizations in their role as developers, acquirers and independent evaluators.

It is intended but not limited to, developers, acquirers and independent evaluators of products.

The software product quality evaluation process reference model intends that the evaluation should be based on a product quality requirements specification by using ISO/IEC 25030 before the evaluation and making clear the objectives and criteria for evaluations. Product quality requirements express the user's needs for the product under consideration, and are defined prior to the development (see ISO/IEC 25030).

ISO/IEC 25001 is applicable to the evaluation group, which provides the organization-wide support to all product quality evaluation projects during software development, software acquisition and performed by independent evaluators.

ISO/IEC 25001 provides requirements and recommendations for an organization responsible for implementing and managing the product quality requirements specification and software quality evaluation activities through the provision of technology, tools, experiences, and management skills.

Software product quality evaluation can be performed during or after the development process or acquisition process by the developers, the acquirers or the independent evaluators.

As a product is decomposed into major components, the quality requirements derived from the overall product may differ for the different components, and may require different evaluation criteria.

Software product quality can be evaluated within a defined quality structure throughout the life cycle stages relating to implementation process defined in ISO/IEC 12207:2008, software life cycle processes and ISO/IEC 15288:2008, system life cycle processes.

6.2 Documentation of software product quality evaluation

For the product quality evaluation, information about input documents, constraints, resources and results of the evaluation activities shall be specified.

In order to assure the results of evaluation, actual result of the evaluation process and evaluation activities shall be specified.

The evaluation records shall include a detailed description of activities performed and shall contain sufficient information required for the management of the product quality evaluation while executing the product quality evaluation plan.

The evaluation records shall include any intermediate data for clarifying the results of evaluation.

The decisions made during the evaluation process shall also be included in the evaluation records as specified in the evaluation plan.

The evaluation records shall contain sufficient information for each activity for effective performance of subsequent activities of the product quality evaluation.

A product quality evaluation report shall be prepared documenting evaluation activities and results of the evaluation.

When a tool is used to perform an evaluation activity, reference to the tool shall be included in the evaluation report. The reference shall consist of the identification of the tool, its suppliers and the version of the tool.

A more detailed reference to the tools used shall be included in the evaluation records. It shall include the detailed configuration of the tool and any pertinent information needed to be able to repeat the evaluation activity in order to obtain the same intermediate result.

NOTE 1 From perspectives of the developers that include not only designers but also programmers or testers, information to be recorded include the following, since they are used during evaluation:

- results of reviewing of design specification (static intermediate or deliverable product);

- results of testing (program unit test, system integration test, operation test before product release);

- any predictive model specification to be used as a product quality indicator.

- identification of any subcontracted developers or tester's organizations and products or any artefacts produced by such organizations.

NOTE 2 From perspectives of the acquirers, information to be recorded include the following, since they are used during evaluation:

- results of reviewing of design specification (static intermediate or deliverable product);

- results of testing (operational system test during operation stage, demonstration system test before selecting a most suitable product);

- any predictive model specification to be used as a product quality indicator;

- identification of any subcontracted developer's or tester's organizations and products or any artefacts produced by such organizations.

NOTE 3 From perspectives of the independent evaluators, information to be recorded include the following, since they are used during evaluation.

- results of reviewing of design specification (static intermediate or deliverable product);

- results of testing (program unit test, system integration test, operation test before product release, operational system test during operation stage, demonstration system test before selecting a most suitable product);

- any predictive model specification to be used as a product quality indicator.

6.3 Organization level requirements and recommendations to support each role

6.3.1 General requirements

In order to ensure repeatability, reproducibility, impartiality and objectivity of the evaluation results, independent quality evaluation group for managing and supporting evaluation projects within the organization shall act in an organizational context that provides all necessary assurance to obtain sufficient quality for its activities.

Any organization that includes the quality evaluation group shall identify the associated software product quality evaluation responsibilities and incorporate them into an organization policy.

Any organization that includes the quality evaluation group should perform the following:

-to take organizational approach for the purpose of supporting the individual development project and improvement of effectiveness of evaluation process;

-to establish the total quality management system and the supporting information systems in order to control and support specific evaluation projects from the viewpoint of total optimization;

-to establish the resources and infrastructures of evaluation process;

-to define the evaluation constraints from the viewpoint of general evaluation framework shown in Figure 2;

-to provide the common industry format for creating the evaluation plan and report in order to control and support specific evaluation projects;

-to define the common policy, rule and regulations for controlling the specific evaluation projects;

-to establish and maintain supporting systems, standards and guides, including tools and methods for managing and executing evaluation, to be used by projects within the organization.

The roles of any organization include motivating people from the independent evaluation group and training them for the requirements specification activities and the evaluation activities, preparing appropriate documents, identification or development of required methods, and responding to queries on relevant technologies.

Technology management is related to the planning and management of a software quality requirements specification and evaluation process, measures and tools. This includes the management of development, acquisition, standardisation, control, transfer and feedback of requirements specification and evaluation technology experiences within the organization.

6.3.2 Organizational level recommendations for developers

Developers should establish the independent evaluation group for supporting the individual development projects within the organization in order to achieve their role.

Independent evaluation group should perform organizational approaches in order to support individual evaluation projects for the purpose of ensuring the quality of design and intermediate products, assure the quality of delivered products and improve the effectiveness of development and evaluation process.

The set of measurements may imply a change in the organizational structure used to produce the software system.

The quality assurance / control organization or the entire development team may need training for the use of the measurements and data collection procedures.

If the implementation of measurements has caused changes in the development process, the development team may need to be educated about the changes.

Hardware or software tools may have to be located, evaluated, acquired, adapted or developed to implement the measurements.

6.3.3 Organization level requirements and recommendations for acquirers

Acquirers should establish the independent evaluation group for supporting the individual acquisition projects within the organization in order to achieve their role.

The acquirer's organization that include independent evaluation group shall perform the following:

-to provide the standardized common evaluation methods for accepting delivered products;

-to provide the standardized common evaluation methods for controlling the suppliers of products;

-to evaluate the effectiveness and quality of dynamic operational products;

-to take organizational approaches in order to support individual evaluation projects for the purpose of ensuring the quality of accepted product and improving the effectiveness of acquisition process;

-to provide the list or data base of off-the-shelf software products, standardized common comparison method for select the most suitable product from the viewpoint of product quality.

Target control items from the viewpoint of software product quality and quality in use includes the following:

-quality of dynamic operational products to be included in the actual executing operation system;

-effectiveness or productivity of actual using products;

-quality of accepted products;

-technical level of suppliers;

-maturity level of software product development;

-maturity level of software product maintenance;

-human resources of quality evaluation for acquisitions.

6.3.4 Organization level requirements for independent evaluators

The independent evaluator's organization should perform the following:

-to establish the independent evaluation group for supporting the individual evaluation projects within the organization in order to achieve their roles;

-to take organizational approaches in order to support each individual evaluation projects for the purpose of ensuring the quality of submitted results, and improving the effectiveness of the evaluation process;

-to establish the infrastructures and resources of the organization for supporting specific individual evaluation projects based on the needs from evaluation requesters;

-to provide the infrastructures from the viewpoint of developers, acquirers or independent evaluators based on the contract and experience of past similar individual evaluation projects;

NOTE 1 In order to provide effective and reliable evaluation from an expert view with experience and knowledge, the independent evaluation group promotes the adaptation of best methods and tools for executing the product quality evaluation.

NOTE 2 Most typical independent evaluators are experts who work for a different company from acquirers and developers, and who evaluates product objectively, based on the request from any of users, such as acquirers and developers. Then, common information data base for software product quality evaluation is maintained in order to use the information about different stakeholders.

7 Requirements and recommendation for developers evaluation process

7.1 General requirements

This clause defines requirements and recommendations for the practical implementation of product quality evaluation by developers during development life cycle.

It is used by organizations that are planning to develop a new product or enhance an existing product and intending to perform product quality evaluation using members of its own technical staff.

It focuses on the use of indicators that can predict deliverable products quality by measuring intermediate products developed during the life cycle.

When applying the process of development, the evaluators shall take into account the following specific issues.

Product quality evaluation directly supports development of software, which meets user and customer needs.

When developers are planning and conducting software quality measurement and evaluation, the developer's process should be taken into account.

NOTE 1 Related Life cycle processes are described in ISO/IEC 12207:2008. Including activities are described in sub clause 6.4 and 7.1.

NOTE 2 An overview of software product quality evaluation process can be found in ISO/IEC 25040.

Developers shall coordinate evaluation activities with supporting processes and activities.

NOTE 3 Software supporting processes are described in ISO/IEC 12207:2008, including in particular the quality assurance process (sub clause 7.2.3), the software verification process (sub clause 7.2.4), the software validation process (sub clause 7.2.5) and the software audit process (sub clause 7.2.7).

Many data analysis methods require data from previous projects developed under similar conditions and with comparable quality requirements.

Developers should, therefore, apply a development model similar to one that has been used in previous projects in the developer's organization, not excluding additional requirements, in order to achieve the developer's purposes.

7.2 Establish the evaluation requirements

7.2.1 Inputs and outcomes of this process

The following should be inputs for this activity:

a) product quality evaluation needs;

b) product quality requirements specification;

c) applicable measurement tools and methodologies;

d) product to be evaluated including intermediate and deliverable products

The following should be outcomes of this activity:

a) specification of product quality evaluation purposes;

b) specification of product quality evaluation requirements;

c) high level product quality evaluation plan.

All product parts to be included in the evaluation shall be identified and documented.

From the developer's perspective, information about product includes also static artefacts such as the following:

-product specification;
-program source codes;
-production manuals;
-product descriptions.

This activity consists of the following tasks.

7.2.2 Establish the purpose of the evaluation

The purpose of the product quality evaluation shall be documented based on the role of developers as a basis for the further evaluation activities and tasks.

Developers should evaluate both static and dynamic intermediate, as well as deliverable product in order to achieve their role.

The purpose of evaluation of static and dynamic intermediate product quality may include the following:

-to assure the quality of intermediate products design;
-to improve the quality of intermediate products;
-to assure the quality of intermediate products;
-to predict or to estimate deliverable products quality;
-to determine the cause of failures of intermediate products during testing;
-to decide the acceptance of the intermediate products from subcontractors;

-to decide the completion of life cycle stages and when to send products to the next stage;

-to collect information of intermediate products in order to control and manage the development process;

-to access the ongoing feasibility of the development project;

-to improve the productivity of design, implementation and testing process;

-to train a personnel for product quality evaluation project.

The purpose of evaluation of static and dynamic deliverable product quality may include the following:

-to assure the quality of deliverable products;

-to decide when to release the products;

-to assess both positive and negative effects of a product when it is used;

-to select a product from among alternative products in order to use a system product;

-to compare the product with competitive products in order to use a system product.

7.2.3 Obtain the software product quality requirements

The stakeholders of the product development shall be identified.

Prior to software product quality evaluation, quality requirements should be defined in terms of quality characteristics and subcharacteristics (see ISO/IEC 25010) and the product quality requirements specification shall be provided as the following:

-In the case of evaluation of design documents, product quality requirements should be defined by using external quality measures and/or quality in use measures;

-In the case of evaluation of intermediate products, product quality requirements should be defined by using internal quality measures;

-In the case of evaluation of deliverable products, product quality requirements should be defined by using external quality measures and/or quality in use measures.

Evaluators should examine the product quality requirements based on the target entities of the evaluation for each quality characteristics and subcharacteristics.

The extent to which the quality evaluation covers the specified software quality requirements shall be defined, taking into account the product quality requirements, in order to specify the product quality evaluation requirements. This decision should be made based on constraints such as evaluation budget, target date for the evaluation, purpose of the evaluation and use criticality of the product.

At the initial stage of evaluation, these quality requirements should be studied and identified, for planning and implementing the evaluation.

Developers should establish both product quality requirements and quality in use requirements by using each relevant quality characteristics and/or subcharacteristics.

The completeness and correctness of the quality requirements specification should be evaluated to ensure the product quality evaluation that all the necessary requirements are specified and unnecessary requirements are excluded.

The developers need to evaluate the product against these requirements before delivery.

In order to achieve software product quality to satisfy both stated and implied needs, it is important to make every effort for exploring and specifying implied needs in sufficient detail for all relevant quality characteristics.

The quality requirements specification should be assessed by the acquirers, and by the end users to assess the specified implied needs.

User experience with prototypes frequently leads to the more accurate statements of requirements for quality in use.

Software product quality evaluation should be used to predict and verify product quality during development, by specifying requirements for internal measures of software product quality for intermediate products in the development process.

The measured value of software product quality of the deliverable products for specific intended users can subsequently be evaluated against initial requirements.

The goal is to identify problems in achieving the desired product quality at the earliest possible stage in the development process.

Developers should identify requirements for internal measures of software product quality.

When requirements for internal measures of software product quality are used, the developers should identify these using a quality model which relates them to the requirements for external measures of software product quality, and use the requirements for internal measures of software product quality to verify the quality of intermediate products during development.

For the purposes of development, requirements for internal measures of software product quality are defined which enable the quality of intermediate products to be verified.

The properties of target static software product (e.g. the specification or source codes) can be measured by internal measures of software product quality.

Internal measures of software product quality are the most interesting during development process.

Internal measures of software product quality can be used as indicators of external measures of properties.

Test adequacy is an example of quality measures that can be measured by internal measures.

Achievement of the required internal measures of software product quality will contribute to meet the requirements for external measures of software product quality. Internal measures of software product quality can thus be used as indicators to estimate external measures of software product quality.

7.2.4 Identify product parts to be included in the evaluation

Target product parts to be evaluated shall be identified and documented based on the purpose of product quality evaluation.

In the case of quality assurance of deliverable products, the target entities of the evaluation should be static and dynamic deliverable products as the following:

-product specification;

-program source codes;

-production manuals;

-deliverable product descriptions;

-testing results (system integration test, operation test before product release);

-executable program of testing.

In the case of improvement of product quality and productivity of development process, target entities of evaluation should be static and dynamic intermediate products as the following:

-design documents;

-specification of products;

-program source codes;

-testing document (unit test, system integration test);

-executable program of testing.

7.2.5 Define the stringency of the evaluation

The evaluation stringency for each target product part shall be defined based on the product quality requirements specification.

In the case of evaluation of requirements specification during design review stage, the evaluation stringency shall be defined for each product quality characteristics and quality in use characteristics from external view.

In the case of evaluation of intermediate products during implementation stage, the evaluation stringency shall be defined for each product quality characteristics from internal view.

In the case of evaluation of deliverable products quality during unit testing stage, the evaluation stringency shall be defined for each product quality characteristics from internal view.

In the case of evaluation of deliverable products during prototyping or system integration testing stage, the evaluation stringency shall be defined for each product quality characteristics and quality in use characteristics from external view.

The evaluation stringency should be related to a set of characteristics and subcharacteristics that establish expected evaluation levels which define the evaluation techniques to be applied and evaluation results to be achieved.

7.3 Specify the evaluation

7.3.1 Inputs and outcomes of this process

The following should be inputs for this activity:

a) specification of the product quality evaluation requirements;

b) specification of the product quality requirements;

c) high level product quality evaluation plan.

The following should be outcomes of this activity:

a) specification of selected quality measures;

b) specification of decision criteria for product quality measures;

c) specification of decision criteria for product quality assessment;

d) revised high level product quality evaluation plan.

From the developer's perspective, information about the product include also static artefacts such as the following:

-product specification;

-list of target entities that include static and dynamic intermediate products and deliverable products.

This activity consists of the following tasks.

7.3.2 Select quality measures (evaluation modules)

The evaluators shall select quality measures (evaluation modules) to cover all software product quality evaluation requirements.

The product quality measures for each target product parts to be evaluated shall be defined based on the purpose of quality evaluation.

In the case of evaluation of requirements specification during design review stage, the quality measures shall be selected from the set of external quality measures and quality in use measures.

In the case of evaluation of intermediate products during the implementation stage, the quality measures shall be selected from the set of internal quality measures.

In the case of evaluation of intermediate deliverable products during unit testing stage, the quality measures shall be selected from the set of internal quality measures.

In the case of evaluation of deliverable products during system integration testing stage, the quality measures shall be selected from the set of external quality measures and quality in use measures.

Product quality evaluation requirements should be allocated to each product component, to which appropriate quality measures that are used to evaluate the product quality can be assigned.

The product quality evaluation methods shall be documented, taking into account the activities to be performed in order to achieve the evaluation results.

When the specified evaluation methods are based on the use of a software tool, the tool shall be identified in the evaluation plan.

Such identification shall include at least the name of the tool, its version identification and its origins (e.g. the suppliers, the developers).

The description of the evaluation methods shall be completed by the identification of product components on which the methods are to be applied.

When specify the evaluation, expert analysis of the measurement is required in order to interpret the results, the interpretation procedure shall be specified.

Rigorous measurements are required to make reliable comparisons, between measured value of the property of the target products and criterion values.

Measurement procedures should be able to apply a measurement function to the software quality characteristics (or subcharacteristics) they claim to be measuring with sufficient accuracy to allow criteria to be set and comparisons to be made. Data from checklists and expert opinion may not be reliable when comparing products with different properties.

Permissible error range should be specified for possible measurement errors caused by measurement tools or human errors.

The evaluation specification shall comprise the following:

-scope of the evaluation referring to the product components as identified in the product description;

-cross-reference between the information needed to perform the evaluation and the target product components and other related documents listed in the product description;

-specification of measurements and verifications to be performed and references to the target product components;

-mapping between the specification of measurements and verifications and the evaluation requirements together, with the reference to standards or the justification for each measurement or verification listed.

This task is usually executed by iterations, mainly when evaluating quality of intermediate products, since some measures can only be selected as the design of the software artefacts evolve.

Internal measures of properties can be used as quality indicators of intermediate products.

In particular, internal measures of software properties are often used as indicators of deliverable product quality; however, there is no validated general or direct relationship between measured values by internal quality measures and those by external quality measures.

However, it is commonly accepted that quality indicators provide useful guidance when used with care.

Use of quality indicators allows the software developers to identify possible quality problems early in the development and to take corrective actions immediately.

There is no known universal set of quality indicators that is suitable for every software development effort.

There are differences in applications area of target systems and software products, development methods and tools used, project organizations and corporate culture. Therefore, some quality indicators may be useful in one organization, but not in others.

For each requirement for external measures of software product quality, one or more properties are selected to represent that are required during development.

Assigned values by the internal measures to the target software properties are used to control the quality during development.

The evaluators shall define a set of internal measures of software properties that:

- covers every relevant intermediate products and activities,

- is appropriate for the application domain and for the method to be used in the development,

-covers identified product and development risks. Examples of development risks include unstable specifications, identified problems not being resolved, running behind schedule, etc.

Appropriate internal measures as the trend measures for estimate the quality of intermediate products should be included.

When appropriate internal measures are applied periodically, some measures are useful for identifying the trends of the quality of products in the software development process.

Examples of such trend measures are ‘Number of testing completed modules’, ‘Number of resolved problems’, ‘Number of changed requirements’, for every week etc.

The evaluators shall define the set of internal measures to software properties that relate to external measures of software properties, or correspond to quality requirements.

These values of internal measures of properties are used as indicators of product quality characteristics or subcharacteristics. Relevant intermediate products should be analyzed and internal measurement data be collected for the following two purposes:

-to evaluate the quality of the intermediate products to find whether the quality requirements are satisfied;

-to predict the quality of deliverable products.

ISO/IEC 2502n can be used as guidance for selecting quality measures.

The evaluators shall describe the predictive model for the defined quality indicator; i.e., the relationship between the indicators and the external measures of software properties.

An indicator does not require a rigid one to one relationship with the properties it seeks to measure. However, the link between the indicator(s) and the relevant property(s) should be clearly defined.

For efficient management use, the number of indicators should be kept low. Priority should be given to indicators that can be supported by data already collected during existing processes, such as configuration management or system integration testing.

The evaluators shall define conditions under which the measurement is to be performed.

This means identifying other properties whose value influence the measurement and define the values of these properties.

By definition the value of software properties by internal measures can be obtained independently of other properties.

7.3.3 Define decision criteria for quality measures

Decision criteria for defining a mapping from measured values of each selected quality subcharacteristics or characteristics to rating levels shall be defined for the each selected quality measures.

The rated level of each selected quality subcharacteristics or characteristics of the target product shall be determined by a measured value for each selected measure by using the defined mapping.

In the case of evaluation of requirements specifications by design review, the decision criteria for quality measures shall be defined for each product quality characteristics and quality in use characteristics.

In the case of evaluation of intermediate product during implementation stage, the decision criteria for quality measures shall be defined for product quality characteristics.

In the case of evaluation of intermediate executable product during unit testing stage, the decision criteria for quality measures shall be defined for product quality characteristics.

In the case of evaluation of deliverable product during system integration testing stage, the decision criteria for quality measures shall be defined for each product quality characteristics and quality in use characteristics.

7.3.4 Define decision criteria for evaluation

Decision criteria for evaluation of the target product by summarizing the results of rating (quality measures) shall be defined based on the quality requirements for the target product.

The evaluators should prepare a procedure for further summarization, with separate criteria for different quality characteristics, each of which may be in terms of individual subcharacteristics and quality measures, or a weighted combination of subcharacteristics and quality measures.

The summarization results should be used as a basis for the product quality assessment.

In the case of assessment of requirements specifications by design review, the decision criteria for quality evaluation shall be defined for each product quality characteristics and quality in use characteristics.

In the case of assessment of intermediate product during implementation stage, the decision criteria for quality evaluation shall be defined for product quality characteristics.

In the case of assessment of intermediate product during unit testing stage, the decision criteria for quality evaluation shall be defined for each product quality characteristics and product quality subcharacteristics.

In the case of assessment of deliverable product during system integration testing stage, the decision criteria for quality evaluation shall be defined for each product quality characteristics and quality in use characteristics.

7.4 Design the evaluation

7.4.1 Inputs and outcomes of this process

The following should be inputs for this activity:

a) specification of product quality evaluation requirements;

b) specification of product quality requirements;

c) specification of selected quality measures (evaluation modules);

d) specification of decision criteria for product quality measures;

e) specification of decision criteria for product quality assessment;

f) high level product quality evaluation plan.

The following should be outcomes of this activity:

a) detailed product quality evaluation plan;

b) product quality evaluation methods.

All product parts to be included in the evaluation shall be identified and documented.

From the developer's perspective, information about product include also static artefacts such as the following:

-specification of products;

-program source codes;

-production manuals;

-product descriptions.

This activity consists of the following task.

7.4.2 Plan evaluation activities

The identified product quality evaluation activities shall be scheduled, taking into account the availability of resources such as personnel, software tools and computers.

Evaluators should create the product quality evaluation plan based on the purpose of evaluation and the target entities of evaluation.

Developers should create the product quality evaluation plan corresponding to quality requirements of static or dynamic, intermediate or deliverable product by using internal or external measures of software product quality.

The quality evaluation plan for each development stage should include 5W3H (Why, What, When, Who, Where, How to, How much and How many) as the following:

-purpose of the quality evaluation for each product life cycle;

-target product parts to be evaluated;

-evaluation activities, including the schedule and resources involved correspond to each stage of development;

-responsibility of evaluation activities correspond to each stage of development;

-area and environment for quality evaluation;

-measures, method, and measurement tools used for evaluation;

-budget.

In the case that the target entity is a static product, the method of evaluation is a design review based on the internal measures of software product quality.

In the case that the target entity is a dynamic product; the method of evaluation is a testing (unit testing, system integration testing) based on the external measures of software product quality and quality in use measures.

Quality evaluation activity shall be performed at suitable timing during software development life cycle stage.

Evaluation of design document and requirements specification should be performed at the practically earliest stages of development in order to achieve high quality product and improvement of productivity of software development.

Prototyping product should be developed and evaluated for the purpose of the new product development in order to verify the feasibility of high quality product realization that corresponds to the quality requirements.

The evaluation plan should have no duplicating tasks.

The evaluation plan should include the decision points in the evaluation process which determine when and why the evaluation can be completed (i.e. acceptance or rejection criteria) and/or be stopped.

This should be done in order to decrease the risk of errors and to reduce the planned evaluation effort, considering at least the following items:

-evaluation budget;

-evaluation methods and adapted standards;

-evaluation tools;

-evaluation activities, including the schedule and resources involved.

The evaluation plan shall include the evaluation purpose. The evaluation plan should consider the evaluation context within the organization (see in ISO/IEC 25001 the role of an evaluation support group and in ISO/IEC 25001 Annex A: The quality evaluation project plan template). The evaluation plan should include the following:

-purpose of the product quality evaluation;

-organizations involved in the evaluation, such as the independent evaluation organization, product developers and acquirer's organizational units;

-evaluation budget;

-information products expected from the evaluation;

-schedule for the evaluation milestones;

-responsibilities for the parties involved in the evaluation;

-environment for evaluation;

-evaluation methods and tools;

-decision criteria for product quality measures;

-decision criteria for product quality assessment;

-adopted standards;

-activities for evaluation.

During early stages of the evaluation, some of the items of the evaluation plan can only be defined at a high level. Therefore, the evaluation plan shall be revised as the evaluation activities evolve, providing additional information that allows the plan to be adjusted or detailed.

Developers shall define in which life cycle processes and activities the measurement and evaluation of the product properties will be implemented. The measurement and evaluation of the internal properties will normally take place during development process.

Developers shall consider any influences on the software development activities. The set of measurements may imply a change in the development process, through its need for data acquisition.

Developers shall define contingency actions, like extra evaluation, if measurement results are inconclusive or alarming.

Hardware or software tools may have to be allocated, evaluated, accepted, adapted or developed to implement the measurements.

The set of measurements may imply a change in the organizational structure used to produce the software system.

The quality assurance / control organization or the entire development team may need training in the use of the measurements and data collection procedures.

If the implementation of measurements has caused changes in the development process, the development team may need to be educated about the changes.

7.5 Execute the evaluation

7.5.1 Inputs and outcomes of this process

The following should be inputs for this activity:

a) detailed product quality evaluation plan;

b) specification of product quality evaluation requirements;

c) specification of product quality requirements;

d) specification of selected quality measures;

e) specification of decision criteria for product quality measurement;

f) specification of decision criteria for product quality assessment;

g) specification of product quality evaluation methods;

h) product to be evaluated including intermediate products.

The following should be outcomes of this activity:

a) results of measurement of product quality;

b) results of product assessment and evaluation.

From the developer's perspective, information about product include also static artefacts such as the following:

-product specification;

-program source codes;

-production manuals;

-product descriptions.

This activity consists of the following tasks.

7.5.2 Make measurements

Evaluators should measure the quality of static and dynamic products (e.g. requirements specification, design diagrams and testing document, executable product) based on the evaluation plan.

In the case of static product measurement, target entities should be reviewed.

Appropriate person should be assigned for design review.

Measurement value should be recorded based on the result of design review corresponding to the product quality evaluation plan. Additional information about design review should be recorded as the following:

-detected issues list;

-used check list for design review that includes decision criteria for measures.

In the case of dynamic product measurement, target entities of executable product should be tested.

Appropriate person should be assigned for testing.

Measurement value should be recorded based on the result of testing corresponding to the product quality evaluation plan. Additional information about testing should be recorded as the following:

-detected faults list;

-testing plan;

-testing document includes decision criteria for measures.

Result of measurement should be reported to the organization at appropriate timing during development life cycle and be considered at the next stage of development. If result of measurements could not be accepted, activity should not be forwarded to the next stage before resolving the issues.

Evaluation report should be reported before the next stage of development.

Detected issues of product quality should be recorded and resolved before the next stage of development in order to improve the product quality and productivity of development.

Detected Issues of product quality shall be resolved at the earliest possible stages of development in order to avoid remaining issues for further development stages in order to obtain effective improvement of the product quality and productivity of development.

The selected product quality measures shall be applied to the products and components, according to the evaluation plan, resulting in values on the measurement scales.

Quality monitoring and control takes place during development. Actual values for the internal properties are collected. In case of undesirable values, the cause is analysed, thereby allowing the developers to understand and react to problems.

Developers shall collect actual measurement values for defined internal properties according to the defined data collection actions. If the product quality requirements are changed, the developers shall reconsider the specification of the evaluation and the design of the evaluation.

7.5.3 Apply decision criteria for quality measures

The decision criteria for the product quality measures based on the quality requirements shall be applied to the measured values in order to evaluate static and dynamic products (e.g. requirements specification, design diagrams and testing document, executable product) during software development life cycle.

In the case of evaluation of requirements specifications during design review stage, the decision criteria for quality measures shall be applied to the measured values for each product quality characteristics and quality in use characteristics.

In the case of evaluation of static intermediate products, the decision criteria for quality measures shall be applied to the measured values for product quality characteristics.

In the case of evaluation of dynamic deliverable product, the decision criteria for quality measures shall be applied to the measured values for each product quality characteristics and quality in use characteristics.

NOTE 1 In the case of evaluation of static intermediate product, the decision criteria for quality measures can be the limitation of the number of detected issues.

NOTE 2 In the case of evaluation of dynamic deliverable product, the decision criteria for quality measures can be the limitation of the number of detected faults.

7.5.4 Apply decision criteria for evaluation

The decision criteria for the product quality assessment based on the quality requirements shall be applied to the result of the summarised values by using quality characteristics and subcharacteristics, in order to evaluate static and dynamic products (e.g. requirements specification, design diagrams and testing document, and executable product) during software development life cycle.

NOTE 1 In the case of evaluation of static intermediate products, the decision criteria for quality assessment can be the limitation of the summarised values of detected issues based on the results of reviewing.

NOTE 2 In the case of evaluation of dynamic intermediate products, the decision criteria for quality assessment can be the limitation of the summarised values of detected faults based on the results of unit testing.

The set of decision criteria shall be summarised into subcharacteristics and characteristics, producing the assess results as a statement of the extent to which the product meets quality requirements. The evaluation results should:

1. establish an appropriate degree of confidence that the product is able to meet the evaluation requirements;
2. identify any specific deficiencies with regard to the evaluation requirements and any additional evaluations needed to determine the scope of those deficiencies;
3. identify any special limitations or conditions placed on the use of the product;
4. identify any weaknesses or omissions in the evaluation itself and any additional evaluation that is needed;
5. identify any options for the use of the product uncovered by the evaluation.

During software development, it is usual to perform several assessments according to the milestones established in the evaluation plan. The results of the evaluation are important for supporting managerial decisions about next stages in the software development life cycle. For instance, do the requirements have to be changed or are more resources needed for the development process.

Developers should use actual values of defined indicators to estimate deliverable product quality. Experience from the development organization's previous projects with similar quality requirements should be taken into account. Quality prediction is dependent on validated indicators. A development organization will first need to collect indicator values and product measurement values for several projects to get the set of validated indicators.

Developers should use actual values to monitor trends in order to identify development risks.

Quality evaluation of the product takes place when the development has been completed. Actual values for the product properties are collected. If possible, components of the product may be measured before the development is completed.

Developers should appropriately feedback the results of measures and evaluation to successive tasks or stages of development, maintenance of the product or the next software development.

7.6 Conclude the evaluation

7.6.1 Inputs and outcomes of this process

The following are required inputs for this activity:

a) specification of product quality evaluation requirements;

b) actual results of product quality evaluation plan;

c) specification of product quality evaluation methods;

d) results of evaluation.

The following are outcomes of this activity:

a) product quality evaluation report.

From the developer's perspective, information about product includes also static artefacts such as the following:

-product specification;

-program source codes;

-production manuals;

-product descriptions.

This activity consists of the following tasks.

7.6.2 Review the evaluation results

The evaluators and the requesters shall carry out a joint review of the evaluation results.

Evaluators group shall review the results of evaluation of static deliverable products (e.g. requirements specification, design diagrams and testing document).

Target entities of review are the results of static intermediate or deliverable products (e.g. requirements specification, design diagrams and testing document).

Result of the evaluation should be reviewed based on the records of results and the process of evaluation.

Necessary information about evaluation can be taken into account in order to perform suitable review.

Independent evaluation organization should be assigned for reviewing.

Appropriate person should be assigned for reviewing.

Reviewing the results of static product quality evaluation should be performed based on the quality evaluation plan and evaluation report. Additional information about reviewing may be necessary as the following:

-detected issues list;

-used checklist for design review that includes decision criteria for measures.

Reviewing the results of dynamic product quality evaluation should be performed based on the quality evaluation plan and evaluation report. Additional information about reviewing should be necessary as the following:

-detected faults list;

-testing document including decision criteria for measures.

Reviewing the results of product quality evaluation should be performed at suitable timing during development life cycle.

Reviewing report should be submitted before the next stage of development.

Quality of evaluation results should be assured and improved by the reviewing in order to achieve the deliverable product quality and improvement of productivity of development.

Joint review between the persons acting at the previous stage and after stage of development should be performed during development life cycle.

The evaluators group shall review the results of the evaluation and the validity of the evaluation process, indicators and measures applied. Feedback from the review should be used in order to improve the evaluation process and evaluation techniques (evaluation modules).

When it is necessary to improve the evaluation modules, the data collection for extra indicators should be included, in order to validate them for later use.

7.6.3 Create the evaluation report

Evaluators should create the quality evaluation report based on the quality evaluation plan and the final results of evaluation of static and dynamic products (e.g. requirements specification, design diagrams and testing document, executable program).

The quality evaluation report should be created based on the fixed quality evaluation plan.

The quality evaluation report should include the results of both reviewing static product and testing dynamic product based on the quality evaluation plan.

The quality evaluation results shall be reviewed in order to assure the quality of quality evaluation report.

The quality evaluation report is different depending on the target entities of the evaluation.

The quality evaluation report for static product should include the following information:

-detected issues list;

-used check list for design review that includes decision criteria for measures.

The quality evaluation report for dynamic product should include the following information:

-detected faults list;

-testing plan;

-testing document.

The quality evaluation report should be submitted to the organization at suitable timing before the next stage of development.

For example, the quality evaluation report of static intermediate products such as testing specification should be submitted before testing.

The quality evaluation report of static and dynamic deliverable products should be submitted before product release.

The quality evaluation report should be confirmed by the concerning stakeholders.

Joint review for the quality evaluation report between the persons acting at the previous stage and at the next stage should be performed during development life cycle.

Depending on how the quality evaluation report is intended to be used, it should include the following items:

1. the product quality evaluation requirements;
2. the product quality requirements;
3. the product quality evaluation plan;
4. results from the measurements and analysis performed;
5. intermediate results or interpretation decisions, when specified the evaluation plan;
6. any limitations, constraints, deficiencies, or exclusions in an evaluation activity, including their impact on the use, configuration, modification, or general maintenance of the product over time;

7. the evaluators and their qualifications;

8. any differences between the product versions assessed and the corresponding evaluation inputs; i.e., documentation or courses;

9. resolutions or workarounds in the event of a deficiency;

10. any other information necessary to be able to repeat or reproduce the evaluation;

11. results of the evaluation.

As a results of the analysis of the quality evaluation activities, the quality evaluation report should identify:

1. each deficiency, any relevant analysis, and how each deficiency was resolved. Resolution of deficiencies may include the fact that:

   -one of the evaluation methods has provided assurance that the deficiency is not major;

   -a satisfactory "workaround" can be found to alleviate the impact of the deficiency; e.g. modification to the product, disable or remove unneeded functionality, regenerate missing design requirements using reverse engineering;

   -the original requirement is not mandatory and the deficiency can be accepted;

   -the deficiency is acceptable provided that the use of the product will be controlled by specific conditions or limitations;

   -additional evaluation works are required to resolve the deficiency or gaps in the evaluation.

2. any additional quality evaluations performed to resolve any identified deficiencies:

   -to determine the scope or impact of a deficiency;

   -to establish confidence that there is no deficiency;

   -to verify that a workaround is technically feasible and/or suitable and acceptable;

   -to verify the correct and acceptable performance of the software once a design change or changes have been made to correct deficiency.

3. In a case where it is necessary to limit or control the use of the product, whether the limitation:

   -interferes with the product meeting the mandatory requirements of the application;

   -impacts on the application's design, budget, and schedule;

   -requires additional evaluation work;

   -introduces any possibility of failure in the application.

4. any exclusions from scope of quality evaluation and/or restrictions on the results for each evaluation, such as:

   -this evaluation does not include a detailed review of the functionality of the product;

   -this product is deemed to be qualified to the required integrity level provided a full evaluation of the required functionality for the product is completed successfully.

5. the integrated results of all the evaluation activities to allow an overall conclusion for the evaluation of the product to be made.

Comments to the quality evaluation report shall be disposed and included in the final version of the report.

7.6.4 Review quality evaluation and provide feedback to the organization

Evaluators should report the final results of quality evaluation of static and dynamic product (e.g. Quality evaluation report, requirements specification, design diagrams and testing document) to organization in order to reuse the next development or evaluation project.

Evaluators should refer the information about previous similar evaluation project by using common information system that included in database in order to perform next evaluation project.

Evaluators should feedback the information about actual results of evaluation project such as know-how, personnel profile and other useful information in order to reuse and support the next evaluation project.

Developers shall make the data collected available to the organization for use in other evaluation project.

Evaluators shall review the results of the evaluation and the validity of the evaluation process, indicators and measures applied.

Feedback from the review should be used in order to improve the evaluation process and evaluation techniques (evaluation modules).

When it is necessary to improve the evaluation modules, the data collection for extra indicators should be included, in order to validate them for later use.

NOTE 1 Quality evaluation review and feedback is described in ISO/IEC 25001.

NOTE 2 The results of product quality evaluation can be used to obtain feedback on the extent to which different development processes, design methods or CASE tools can be used to meet quality requirement.

7.6.5 Perform disposition of evaluation data

Evaluators should review and dispose the final results of quality evaluation of static and dynamic products (e.g. requirements specification, design diagrams and testing document) in order to reuse at the next development or evaluation project.

Evaluators should refer to the previous actual results of quality evaluation of static and dynamic products by using common information system or data base.

When the evaluation is completed, the data and the evaluation items shall be disposed according to requirements of the requesters.

This shall be done in the one of the following ways, depending on the type of data:

-the documents submitted to the evaluation shall be either returned to the requesters or archived for a specified duration or destroyed in a secure way;

-the evaluation report and the evaluation records shall be archived for a specified duration;

-all other data shall be either archived for a specified duration or destroyed in a secure way.

When the specified archiving duration expires for some data, it shall be either archived again for a specified duration or destroyed in a secure way.

8 Requirements and recommendations for acquirers evaluation process

8.1 General requirements

The quality evaluation process for acquirers approach contains requirements, recommendations and guidelines for the systematic measurement and evaluation of product quality during acquisition of "Commercial-off-the-shelf" products, custom products, or modifications to existing products.

It is used by organizations that are planning to acquire or reuse an existing or pre-developed product. It can be applied for the purposes of deciding on the acceptance of the product or for selecting a product from among alternative products (a product may be self contained, a part of system, or it may be part of larger product).

When applying the process of acquisition, the evaluators shall take into account the following specific issues.

Acquirers should evaluate both static and dynamic product in order to achieve their role.

Acquirers should evaluate static product in order to achieve the following purposes:
-to improve the quality requirements of acquiring product;
-to assure the design specification of acquiring product before an acquisition.

Acquirers should evaluate both static and dynamic product in order to achieve the following purposes:
-to compare and to select the off-the-shelf product;
-to accept the custom-made product supplied from developers;
-to improve the productivity of acquisition process;
-to train the personnel for product quality evaluation.

Acquirers shall coordinate evaluation activities with supporting processes and activities.

Many data analysis methods require data from previous projects acquired under similar conditions and with comparable quality requirements.

Acquirers should, therefore, apply an acquisition model similar to one that has been used in previous projects in the acquirers' organization, not excluding additional requirements, in order to achieve the acquirer's purposes.

Also the same set of properties should be applied in the projects to allow for data analysis.

Product quality requirements express the users' needs for the product under consideration, and are defined prior to the acquisition (see ISO/IEC 25030).

8.2 Establish the evaluation requirements

8.2.1 Inputs and outcomes of this process

(for inputs and outcomes of this process refer to clause 7.2.1).

From the acquirer's perspective, information about product includes static artefacts such as the following:

-product specification;

-production manuals;

-product descriptions.

This activity consists of the following tasks.

8.2.2 Establish the purpose of the evaluation

The purpose of the product quality evaluation shall be documented based on the role of acquirers as a basis for further evaluation activities and tasks.

Acquirers should especially evaluate static and dynamic deliverable product in order to achieve their specific role.

The purpose of evaluation of static intermediate product quality may include the following:

-to improve the quality of requirements specification;

-to improve the productivity of acquisition process;

-to train the personnel for quality evaluation of the product acquisition.

The purpose of evaluation of static and dynamic deliverable product quality may include the following:

-to accept a high quality product;

-to decide on acceptance of a custom-made product from developers;

-to assess both positive and negative effects of a product when it is used;

-to select an off-the-self product from the vendor;

-to select a product from among alternative products;

-to compare a product with competitive products;

-to assess the needs of modification to existing products.

The evaluation process according to the acquirer's perspective is, in general, part of an acquisition process, as defined in ISO/IEC 12207:2008. In such case the purpose of the evaluation should be established as the following:

-the acquisition process to be followed and how evaluation input requirements are to be communicated to the supplier;

-whether the product will be used for a specific application, for a collection of specific applications, or for a generic range of applications;

-whether any evaluation has been done by second or third parties, or whether any evaluation activities are planned to be performed later.

NOTE See examples of a combined evaluation and acquisition process in Figures 3 and 4.

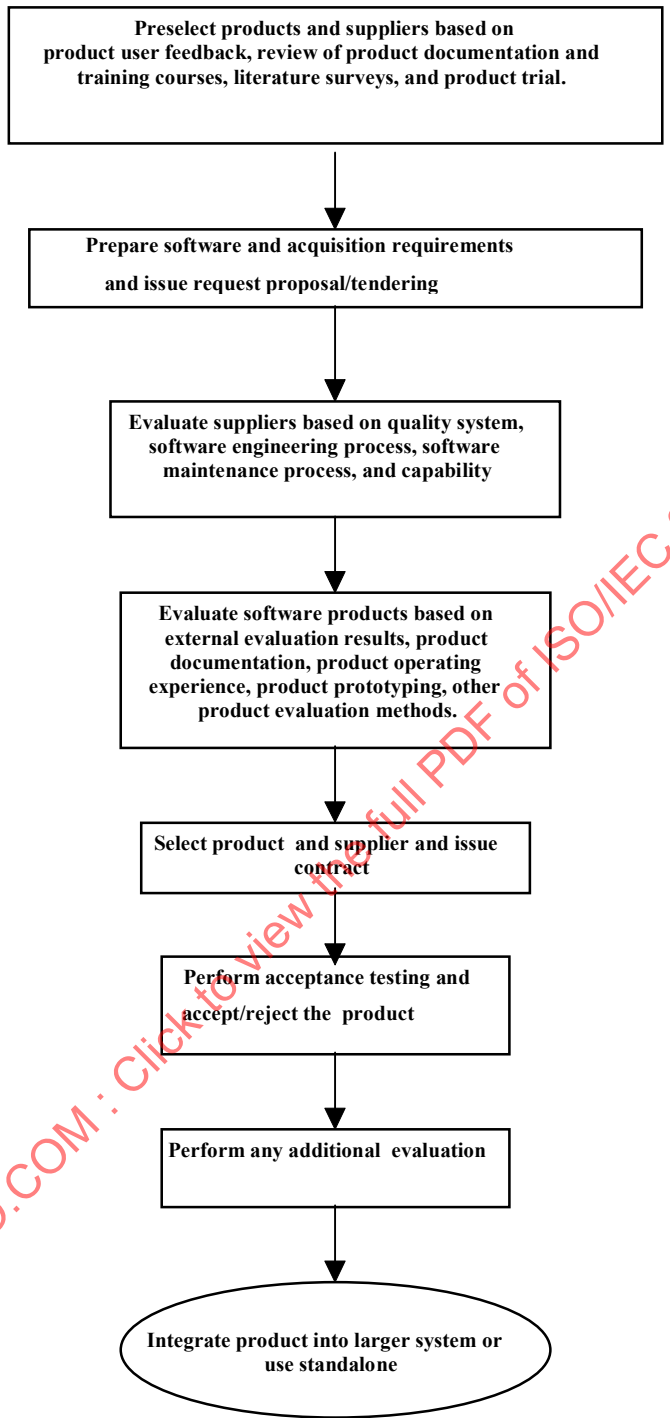

Figure 3 — Example evaluation/acquisition process for "off-the-shelf" products

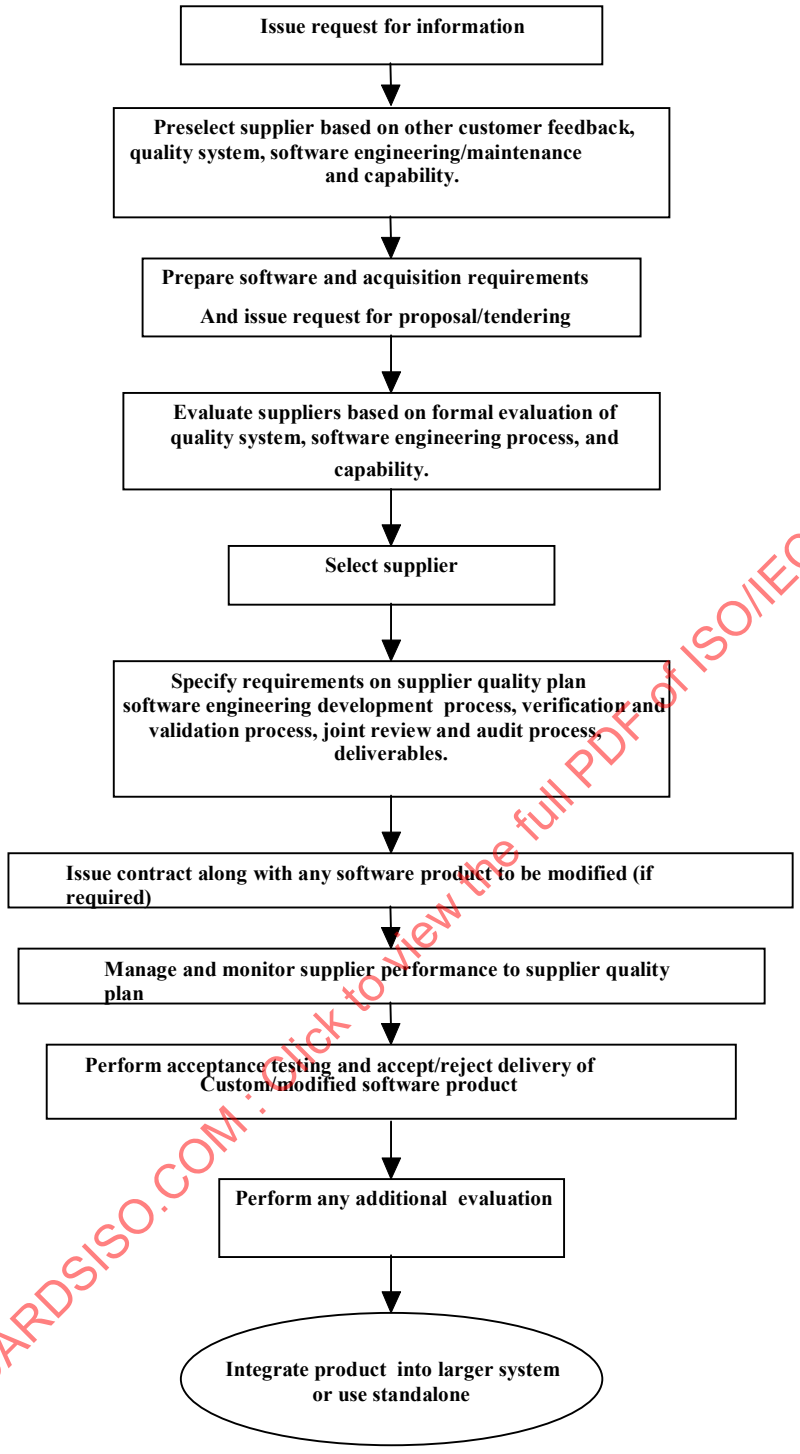

Figure 4 — Example evaluation/acquisition process for custom software or modifications to existing software

The evaluation process may be combined with the acquisition process (defined in ISO/IEC 12207:2008) summarized below, so that the evaluation results can contribute to the final acquisition objectives:

-Initiation - identification of software requirements for the product to be acquired, the acquisition plan, and the acceptance strategy and criteria;

-request-for-proposal (-tender) preparation - specification and documentation of acquisition requirements;

-contract preparation and update - supplier selection, contract preparation and negotiation, and contract change control;

-supplier monitoring - evaluation activities performed during contract execution leading to acceptance and delivery of the product;

-acceptance and completion - activities performed during product acceptance and delivery of the deliverable product.

The acquirer needs to define both the evaluation process and the acquisition process to achieve the evaluation requirements during acquisition. In the context of larger system development, the acquisition and evaluation activities to be followed needs to be integrated with other development and integration activities, and identified in a project measurement plan as specified in ISO/IEC 25001; i.e., specific acquisition implementation considerations for evaluation include the following considerations:

-a product quality requirements specification required for evaluation can form the basis for acquisition requirements required for the request-for-proposal (-tender);

-separate preliminary evaluation activities may be needed to pre-select products and suppliers;

-supplier and product information requirements for evaluation need to be specified in the acquisition requirements or during contract preparation;

-evaluation activities can be executed as part of proposal evaluation, during monitoring of contract execution, as part of product development, as part of formal product acceptance, or after product delivery.

The evaluation process should consider:

-all project management constraints; i.e. Availability of resources and expertise to perform the evaluation activities, schedule and budget allowance, possible dependencies or risks, key assumptions, or assumptions about the evaluation effort itself;

-the acquisition process and information required from suppliers during tendering; evaluations performed by other second (for example, acquirers who evaluate the product provided by supplier) or third parties that could be used to reduce the evaluation effort for the product;

-whether the product will be reused in future applications and the documentation necessary to support any future evaluations of the product;

-whether the evaluation methods are still compatible with the sproduct quality requirements specification;

-the different views of evaluation according to the acquisition perspective as in Figure 5. This figure shows that the evaluation of a product may take into account information from different views such as the product view, the process view and product in use view, resulting in the view of the evaluation results.

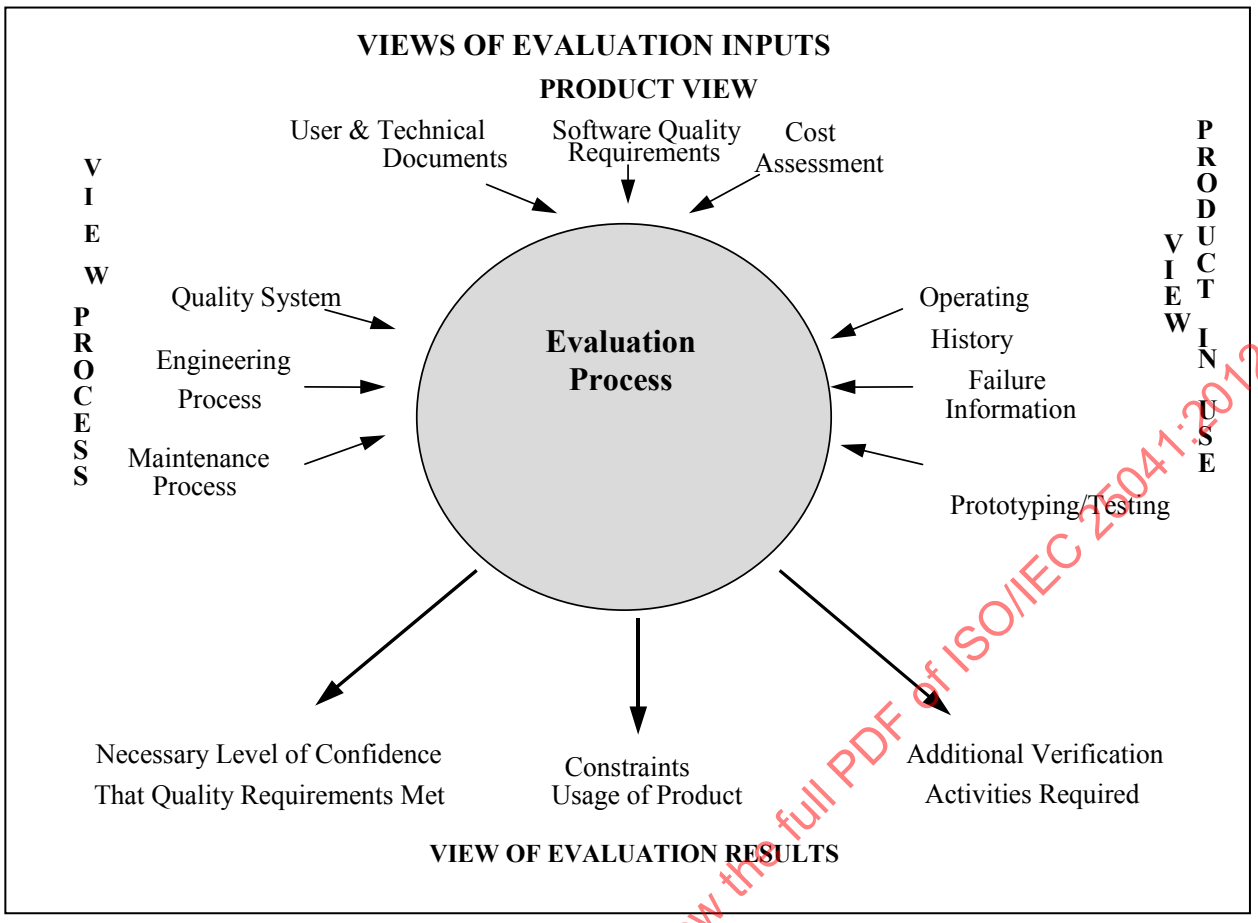

Figure 5 — Product quality evaluation process overview from acquirer's perspective

8.2.3 Obtain the software product quality requirements

(see clause 7.2.3)

The end user of the product shall be identified.

Acquirers should define the product quality requirements based on the target entities of the evaluation.

In the case of evaluation of design documents, product quality requirements should be defined by using internal measures of software product quality.

In the case of evaluation of dynamic deliverable products, product quality requirements should be defined by using external measures of software product quality and/or quality in use measures.

The product quality requirements specification forms the basis for the acquisition requirements used during the tendering step in the acquisition process and the basis against which subsequent product quality evaluation is performed.

8.2.4 Identify product parts to be included in the evaluation

(see clause 7.2.4)

In the case of improvement of accepted product quality or productivity of existing operational product, the target entities of the evaluation should be both static and dynamic deliverable products such as the following:

-product specification;

-production manuals;

-product descriptions;

-executable product during operation stage including in the operable system.

All product parts to be included in the quality evaluation shall be identified and documented.

NOTE 1 From the acquirer's perspective, information about product includes also static artefacts such as the following:

-quality evaluation plan;

-quality evaluation report.

NOTE 2 For instance, if the purpose of the evaluation is the selection of a product among alternative products, the products to be evaluated are mainly deliverable products or components.

Candidates for use and acquisition are products, which can be integrated into a larger system as components or which can be used stand-alone. They are classified as the following:

a) commercial-off-the-shelf products;

b) existing products developed or acquired for other applications, or for a wide range of common applications;

c) custom products or modifications to existing products.

In the case of software configuration items that are to be integrated into a larger system, software requirements need to be defined for each item. In other cases, the system and the software configuration items coincide, and may be considered equivalent.

Hardware configuration items to be acquired may contain software such as an operating system resident in firmware (i.e. ROM, PROM). When the existing software forms an integral part of the hardware in this fashion, it usually needs to be evaluated with the hardware configuration items.

In addition the following shall be taken into consideration:

a) whether the suppliers or acquirers are willing and able to provide access to the required documentations, equipments, tools, software, courses and/or training, and the costs associated with this;

b) whether any conditions associated with the provision of access to any confidential or proprietary information exist or not;

c) whether the suppliers or third parties are willing and able to provide access to individuals with the suitable expertise to answer questions, and what are the costs associated with this, including travel costs;

d) whether the evaluators have the expertise that is required to conduct the evaluation based on the evaluation requirements, and budgets for obtaining the expertise;

e) whether any pre-tests required to establish that a product is fit for full scale testing or not.

8.2.5 Define the stringency of the evaluation

(see clause 7.2.5)

From the acquirer's perspective, information about stringency of the product includes also static artefacts such as the following:

-requirements specification of product.

The scope of the evaluation process can be reduced through access to the results of evaluation activities performed by third parties as long as the results are trustworthy. Such evaluation activities can comprise preexisting certifications, product quality evaluations and/or process assessments. For example:

-software engineering processes for product development may be standardized to meet the requirements of ISO/IEC 12207:2008, ISO/IEC 90003, or other sector-specific standards;

-the supplier's quality system under which the software is developed may be certified to ISO 9001 requirements by a third party;

-the product may be evaluated by third parties to ISO/IEC 25040 or ISO/IEC 25051 conformance;

-the supplier's software process capability for acceptable product development may be assessed by third parties to ISO/IEC 15504 conformance;

-the software may be functionally evaluated as part of a larger system development stage;

-the products may have been previously evaluated for another application with different integrity requirements;

-the level of coverage relative to the evaluation requirements that is necessary after reviewing of any previous evaluations conducted by others;

-evaluations on the products may have been performed by other parties within the organization through informal or formal evaluation activities.

The additional costs and time required to obtain and interpret product quality evaluation results for the target application may affect the feasibility of this method. It may still be necessary to consult the evaluators or suppliers in order to attain adequate confidence in the results of others.

The evaluation process can be applied to a wide range of acquisition requirements, integrity requirements, and evaluator's group objectives; for example:

-acquirers of software packages may wish to evaluate a software package using only ISO/IEC 25051;

-acquirers of products may use ISO/IEC 25040 and independent evaluation;

-a small or sole acquirers may require a less formal evaluation process with minimum documentation of the evaluation;

-for consumer software that the evaluation process objective may simply be to select, test and acquire one product from among other similar products. The formal acquisition process is then reduced to outright purchase, and does not include contract preparation.

The acquisition process can also be tailored as for the evaluation process using the tailoring guidance given in ISO/IEC 12207:2008 and the required integrity level for the specific product to be acquired. Acquisition of complete software systems with high integrity requirements will usually invoke the full set of acquisition activities and tasks, along with corresponding supply process activities and tasks that are specified in ISO/IEC 12207:2008. Generally, as the integrity level increases, so should the amount of rigor, and the number of activities and tasks associated with the acquisition and the evaluation process.

8.3 Specify the evaluation

8.3.1 Inputs and outcomes of this process

(for inputs and outcomes of this process refer to clause 7.3.1)

From the acquirer's perspective, information about the product includes also static artefacts such as the following:

-list of candidate products and suppliers;

-results of actual number of installation;

-target system demonstrated.

This activity consists of the following tasks.

8.3.2 Select quality measures (evaluation modules)

(see clause 7.3.2)

The selection of product quality evaluation methods to be used includes reviewing or assessment of one or more of:

-product user and technical documentation (including on-line documentation);

-product quality evaluation based on supplier's courses and training;

-software engineering process, including intermediate products;

-product operating history with suppliers;

-product operating history with customers;

-suppliers capability, support, and quality system (see ISO/IEC 25040:2011, Annex B.6);

-prototyping or other evaluation methods (see ISO/IEC 25040:2011, Annex B.7);

-product deficiency lists and related information (usually found on web sites).

A combination of evaluation methods should be specified to allow selection of the products or to establish the product's fitness for use. Issues to be evaluated include:

a) whether some of the considerations may be mutually conflicting (e.g. "Are costs of the selected methods within budget?" may not be compatible with "Do the methods collectively address all of the evaluation requirements?"). In this case it is up to the evaluators to make the necessary tradeoffs based on the prioritisation of evaluation requirements.

NOTE ISO/IEC 25040:2011, Annex C shows an example of ranking evaluation methods for software quality characteristics by cost and effectiveness.

b) whether the evaluation provides adequate coverage or scope in the combination of methods chosen considering:

- how to demonstrate that software meets its specifications;
- overlapping of coverage of methods to provide additional confidence;
- whether the set of activities, as a whole, provides an acceptable level of assurance that there is complete coverage for those software quality characteristics of concern;
- the degree to which the methods complement each other;
- the effectiveness and objectivity of each method in addressing a variety of characteristics;
- the variety of distinct approaches among the evaluation methods (e.g. some reviewing, some analysis, and some testing based methods);
- taking credit for any evaluation activities on the application that will ultimately be conducted as part of the overall system development life cycle;

- crediting evaluations performed by others.

c) use of “informal” preliminary evaluation activities like reviews or surveys or peer/user anecdotal experience, trade journal product reviews, accessible product user documentation, or database repositories of product reviews, in order to narrow the selection of products considered functionally suitable for further evaluation.

Before crediting evaluations performed by others, the following should be considered:

a) whether the evaluation addressed the evaluation requirements with a degree of rigor consistent with the integrity level of the application;

b) whether the evaluation report identified the version of the product being assessed, the extent of the evaluation, the decision criteria used, and the conclusions reached;

c) whether the evaluation report identified any deficiencies in the products or the software engineering process, recommended any corrective action to address those deficiencies, and whether the corrective action was carried out;

d) whether the evaluators had appropriate profile, including:

-experience in performing evaluation and analysis;

-experience in software quality relative to internationally accepted standards;

-expertise in software engineering issues;

-total independence from the supplier.

8.3.3 Define decision criteria for quality measures

(see clause 7.3.3)

In the case of evaluation of requirements specifications for the purpose of acquisition, the decision criteria for quality measures shall be defined for each product quality characteristics and quality in use characteristics.

In the case of evaluation of dynamic product during operation stage, the decision criteria for quality measures shall be defined for each product quality characteristics and quality in use characteristics.

8.3.4 Define decision criteria for evaluation

(see clause 7.3.4)

In the case of assessment of requirements specifications for the purpose of acquisition, the decision criteria for quality evaluation shall be defined for each product quality characteristics and quality in use characteristics.

In the case of assessment of dynamic product during operation stage, the decision criteria for quality evaluation shall be defined for each product quality characteristics and quality in use characteristics.

8.4 Design the evaluation

8.4.1 Inputs and outcomes of this process

(for inputs and outcomes of this process refer to clause 7.4.1)

From the acquirer’s perspective, information about product also includes static artefacts such as the following:

-product specification;

-product descriptions;

-list of candidate products and suppliers;

-result of actual number of installations;

-target system demonstrated.

This activity consists of the following tasks.

8.4.2 Plan evaluation activities

(see clause 7.4.2)

The identified product quality evaluation activities shall be scheduled, taking into account the availability of resources such as personnel, software tools and computers.

Acquirers should create the product quality evaluation plan based on the purpose of the evaluation and the target entities of evaluation.

Acquirers should create the product quality evaluation plan corresponding to the product quality requirements by using quality measures.

The quality evaluation plan for the purpose of acquisition should include 5W3H (Why, What, When, Who, Where, How to, How much and How many) as the following:

-purpose of the quality evaluation for product acquisition;

-target product parts to be evaluated;

-evaluation activities, including the schedule and resources involved that for acquisition;

-responsibility of evaluation activities for acquisition;

-area and environment of quality evaluation for acquisition;

-measures, method, and measurement tools used for evaluation;

-budget.

In the case of the target entities are the static products such as the design documents, the method of evaluation is a design review by using the internal quality measures.

In the case of target entities are the dynamic software products such as the executable product; the method of evaluation is a testing by using the external measures of software product quality and quality in use measures.

Quality evaluation activities shall be performed at suitable timing in order to achieve the due date of acquisition, testing, and operation stage.

Product prototyping should be developed and evaluated for the purpose of new product acquisition in order to verify the feasibility of realization of a product with a quality that corresponds to the quality requirement.

The evaluation plan should consider the following aspects that are mainly related to the acquirer's perspective:

a) any costs associated with providing the testing environment (e.g. testing hardware, supporting equipment and tools, specialized personnel) for performing the evaluation;

b) responsibility for the evaluation and the required schedule;

c) any limitation or deficiency in the evaluation method in providing assurance of quality, and whether that limitation or deficiency is covered elsewhere in the plan; e.g. the evaluation method is unable to cover all subcharacteristics for a specific quality characteristic;

d) any interdependencies between the various evaluation methods used; i.e., order dependencies (information obtained in one testing may be useful in another testing), establishing an optimal sequence of evaluation methods;

e) the resources required and the cost for the total evaluation and for each evaluation method;

f) the tie points between evaluation activities and acquisition activities (see examples of combined evaluation and acquisition process in Figures 3 and 4);

g) the decision points in the evaluation process which determine when and why the evaluation should be considered complete (i.e. acceptance or rejection criteria) and should be stopped;

h) whether the rationale, justification, and assumptions behind any unusual or exceptional decisions made in defining the evaluation plan are documented;

NOTE Some of the previous issues may be applied to the general evaluation process, according to the requirements and conditions of each particular product quality evaluation.

8.5 Execute the evaluation

8.5.1 Inputs and outcomes of this process

(for inputs and outcomes of this process refer to clause 7.5.1)

From the acquirer's perspective, information about the product also includes static artefacts such as the following:

-product specification;

-product descriptions;

-list of candidate products and suppliers;

-result of actual number of installations;

-target system demonstrated.

This activity consists of the following tasks.

8.5.2 Make measurements

(see clause 7.5.2)

The results of measurement should be reported to organization at an appropriate time for the purpose of acquisition. If the results of measurement could not be accepted, activity should not be forward to the next stage before resolving the issues.

An evaluation report should be reported before the next stage of acquisition.

Detected issues of product quality should be recorded and resolved before next stage of acquisition in order to improve the accepted product quality and productivity of acquisition.

Quality monitoring and control takes place during development. Actual values of the internal properties are collected. In the case of undesirable values, the cause is analysed, thereby allowing acquirers to understand and react to problems.

Acquirers should collect actual measurement values for defined internal properties according to the defined data collection actions. If the quality requirements are changed, acquirers shall reconsider the specification of the evaluation and the design of the evaluation.

8.5.3 Apply decision criteria for quality measures

(see clause 7.5.3)

8.5.4 Apply decision criteria for evaluation

The decision criteria for the product quality assessment based on the quality requirements shall be applied to the result of the summarised values by using quality characteristics and subcharacteristics, in order to evaluate static and dynamic product (e.g. requirements specification, design diagrams and testing document) for the purpose of acquisition.

NOTE 1 In the case of evaluation of intermediate static products, the decision criteria for quality assessment can be the limitation of the summarised values of detected issues based on the results of reviewing.

NOTE 2 In the case of evaluation of dynamic deliverable products, the decision criteria for quality assessment can be the limitation of the summarised values of detected fault based on the results of testing.

The set of decision criteria shall be summarised into subcharacteristics and characteristics, producing the assess results as a statement of the extent to which the product meets quality requirements. The evaluation results should:

-establish an appropriate degree of confidence that the product is able to meet the evaluation requirements;

-identify any specific deficiencies with regard to the evaluation requirements and any additional evaluations needed to determine the scope of those deficiencies;

-identify any special limitations or conditions placed on the use of the product;

-identify any weaknesses or omissions in the evaluation itself and any additional evaluation that is needed;

-identify any options for the use of the product uncovered by the evaluation.

The conclusions should state whether the product is adequate and appropriate for use in the intended application, taking into consideration the application integrity level and the actual evaluation requirements. If it is not possible to use the product "as is", due to deficiencies discovered or due to lack of evaluation information, then it is necessary to make recommendations to perform further evaluation or to control or limit the use of the product in its target application.

The conclusions may be formalized using a "statement of requirements compliance" which would describe for each of the specific requirements the feature(s), function(s), or service(s) of the product used to meet that requirement, and the evaluation method (s) that provide adequate confidence that the requirement has been met. Potential design strategies such as implementation of design diversity, redundancy in configuration, interface integrity checks and recovery techniques may compensate for deficiencies or potential failures of the product.

It is possible that the evaluation may result in a decision not to accept the product for use, or a decision not to attempt to comply with the evaluation requirements, and provide a recommendation to re-evaluate alternative approaches. The ultimate decision is to buy or not to buy.