4.2 Product quality model

The product quality model categorizes product quality properties into eight characteristics (functional suitability, reliability, performance efficiency, usability, security, compatibility, maintainability and portability). Each characteristic is composed of a set of related subcharacteristics (Figure 4 and Table 4).

(Sub)Characteristic
Functional suitability
Functional completeness
Functional correctness
Functional appropriateness
Performance efficiency
Time behaviour
Resource utilization
Capacity
Compatibility
Co-existence
Interoperability
Usability
Appropriateness recognizability
Learnability
Operability
User error protection
User interface aesthetics
Accessibility

Reliability
Maturity
Availability
Fault tolerance
Recoverability
Security
Confidentiality
Integrity
Non-repudiation
Accountability
Authenticity
Maintainability
Modularity
Reusability
Analysability
Modifiability
Testability
Portability
Adaptability
Installability
Replaceability

4.2.1
functional suitability
degree to which a product or system provides functions that meet stated and implied needs when used under specified conditions
Note 1 to entry: Functional suitability is only concerned with whether the functions meet stated and implied needs, not the functional specification (see C.6).
4.2.1.1
functional completeness
degree to which the set of functions covers all the specified tasks and user objectives
4.2.1.2
functional correctness
degree to which a product or system provides the correct results with the needed degree of precision
4.2.1.3
functional appropriateness
degree to which the functions facilitate the accomplishment of specified tasks and objectives
EXAMPLE:
A user is only presented with the necessary steps to complete a task, excluding any unnecessary steps.

Note 1 to entry: Functional appropriateness corresponds to suitability for the task in ISO 9241-110.

4.2.2

performance efficiency

performance relative to the amount of resources used under stated conditions

Note 1 to entry: Resources can include other software products, the software and hardware configuration of the system, and materials (e.g. print paper, storage media).

4.2.2.1

time behaviour

degree to which the response and processing times and throughput rates of a product or system, when performing its functions, meet requirements

4.2.2.2

resource utilization

degree to which the amounts and types of resources used by a product or system, when performing its functions, meet requirements

Note 1 to entry: Human resources are included as part of **efficiency** (4.1.2).

4.2.2.3

capacity

degree to which the maximum limits of a product or system parameter meet requirements

Note 1 to entry: Parameters can include the number of items that can be stored, the number of concurrent users, the communication bandwidth, throughput of transactions, and size of database.

4.2.3

compatibility

degree to which a product, system or component can exchange information with other products, systems or components, and/or perform its required functions, while sharing the same hardware or software environment

Note 1 to entry: Adapted from ISO/IEC/IEEE 24765.

4.2.3.1

co-existence

degree to which a product can perform its required functions efficiently while sharing a common environment and resources with other products, without detrimental impact on any other product

4.2.3.2

interoperability

degree to which two or more systems, products or components can exchange information and use the information that has been exchanged

Note 1 to entry: Based on ISO/IEC/IEEE 24765.

4.2.4

usability

degree to which a product or system can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use

Note 1 to entry: Adapted from ISO 9241-210.

Note 2 to entry: Usability can either be specified or measured as a product quality characteristic in terms of its subcharacteristics, or specified or measured directly by measures that are a subset of quality in use.

4.2.4.1

appropriateness recognizability

degree to which users can recognize whether a product or system is appropriate for their needs

SEE: 4.2.1.3

Note 1 to entry: Appropriateness recognizability will depend on the ability to recognize the appropriateness of the product or system's functions from initial impressions of the product or system and/or any associated documentation.
Note 2 to entry: The information provided by the product or system can include demonstrations, tutorials, documentation or, for a web site, the information on the home page.

4.2.4.2

learnability

degree to which a product or system can be used by specified users to achieve specified goals of learning to use the product or system with effectiveness, efficiency, freedom from risk and satisfaction in a specified context of use

Note 1 to entry: Can be specified or measured either as the extent to which a product or system can be used by specified users to achieve specified goals of learning to use the product or system with effectiveness, efficiency, freedom from risk and satisfaction in a specified context of use, or by product properties corresponding to suitability for learning as defined in ISO 9241-110.

4.2.4.3

operability

degree to which a product or system has attributes that make it easy to operate and control

Note 1 to entry: Operability corresponds to controllability, (operator) error tolerance and conformity with user expectations as defined inISO 9241-110.

4.2.4.4

user error protection

degree to which a system protects users against making errors

4.2.4.5

user interface aesthetics

degree to which a user interface enables pleasing and satisfying interaction for the user

Note 1 to entry: This refers to properties of the product or system that increase the pleasure and satisfaction of the user, such as the use of colour and the nature of the graphical design.

4.2.4.6

accessibility

degree to which a product or system can be used by people with the widest range of characteristics and capabilities to achieve a specified goal in a specified context of use

Note 1 to entry: The range of capabilities includes disabilities associated with age.

Note 2 to entry: Accessibility for people with disabilities can be specified or measured either as the extent to which a product or system can be used by users with specified disabilities to achieve specified goals with effectiveness, efficiency, freedom from risk and satisfaction in a specified context of use, or by the presence of product properties that support accessibility.

4.2.5

reliability

degree to which a system, product or component performs specified functions under specified conditions for a specified period of time

Note 1 to entry: Adapted from ISO/IEC/IEEE 24765.

Note 2 to entry: Wear does not occur in software. Limitations in reliability are due to faults in requirements, design and implementation, or due to contextual changes.

Note 3 to entry: Dependability characteristics include availability and its inherent or external influencing factors, such as availability, reliability (including fault tolerance and recoverability), security (including confidentiality and integrity), maintainability, durability, and maintenance support.

4.2.5.1

maturity

degree to which a system, product or component meets needs for reliability under normal operation

Note 1 to entry: The concept of maturity can also be applied to other quality characteristics to indicate the degree to which they meet required needs under normal operation.

4.2.5.2

availability

degree to which a system, product or component is operational and accessible when required for use

[SOURCE: ISO/IEC/IEEE 24765]

Note 1 to entry: Externally, availability can be assessed by the proportion of total time during which the system, product or component is in an up state. Availability is therefore a combination of maturity (which governs the frequency of failure), fault tolerance and recoverability (which governs the length of down time following each failure).

4.2.5.3

fault tolerance

degree to which a system, product or component operates as intended despite the presence of hardware or software faults

Note 1 to entry: Adapted from ISO/IEC/IEEE 24765.

4.2.5.4

recoverability

degree to which, in the event of an interruption or a failure, a product or system can recover the data directly affected and re-establish the desired state of the system

Note 1 to entry: Following a failure, a computer system will sometimes be down for a period of time, the length of which is determined by its recoverability.

4.2.6

security

degree to which a product or system protects information and data so that persons or other products or systems have the degree of data access appropriate to their types and levels of authorization

Note 1 to entry: As well as data stored in or by a product or system, security also applies to data in transmission.

Note 2 to entry: Survivability (the degree to which a product or system continues to fulfil its mission by providing essential services in a timely manner in spite of the presence of attacks) is covered by **recoverability** (4.2.5.4).

Note 3 to entry: Immunity (the degree to which a product or system is resistant to attack) is covered by **integrity** (4.2.6.2).

Note 4 to entry: Security contributes to **trust** (4.1.3.2).

4.2.6.1

confidentiality

degree to which a product or system ensures that data are accessible only to those authorized to have access

4.2.6.2

integrity

degree to which a system, product or component prevents unauthorized access to, or modification of, computer programs or data

[SOURCE: ISO/IEC/IEEE 24765]

4.2.6.3

non-repudiation

degree to which actions or events can be proven to have taken place, so that the events or actions cannot be repudiated later

[SOURCE: Adapted from ISO 7498-2:1989.]

4.2.6.4

accountability

degree to which the actions of an entity can be traced uniquely to the entity

Note 1 to entry: Adapted from ISO 7498-2:1989.

4.2.6.5

authenticity

degree to which the identity of a subject or resource can be proved to be the one claimed

Note 1 to entry: Adapted from ISO/IEC 13335-1:2004.

4.2.7

maintainability

degree of effectiveness and efficiency with which a product or system can be modified by the intended maintainers

Note 1 to entry: Modifications can include corrections, improvements or adaptation of the software to changes in environment, and in requirements and functional specifications. Modifications include those carried out by specialized support staff, and those carried out by business or operational staff, or end users.

Note 2 to entry: Maintainability includes installation of updates and upgrades.

Note 3 to entry: Maintainability can be interpreted as either an inherent capability of the product or system to facilitate maintenance activities, or the quality in use experienced by the maintainers for the goal of maintaining the product or system.

4.2.7.1

modularity

degree to which a system or computer program is composed of discrete components such that a change to one component has minimal impact on other components

[SOURCE: ISO/IEC/IEEE 24765]

4.2.7.2

reusability

degree to which an asset can be used in more than one system, or in building other assets

Note 1 to entry: Adapted from IEEE 1517-2004.

4.2.7.3

analysability

degree of effectiveness and efficiency with which it is possible to assess the impact on a product or system of an intended change to one or more of its parts, or to diagnose a product for deficiencies or causes of failures, or to identify parts to be modified

Note 1 to entry: Implementation can include providing mechanisms for the product or system to analyse its own faults and provide reports prior to a failure or other event.

4.2.7.4

modifiability

degree to which a product or system can be effectively and efficiently modified without introducing defects or degrading existing product quality

Note 1 to entry: Implementation includes coding, designing, documenting and verifying changes.

Note 2 to entry: **Modularity** (4.2.7.1) and **analysability** (4.2.7.3) can influence modifiability.

Note 3 to entry: Modifiability is a combination of changeability and stability.

4.2.7.5

testability

degree of effectiveness and efficiency with which test criteria can be established for a system, product or component and tests can be performed to determine whether those criteria have been met

Note 1 to entry: Adapted from ISO/IEC/IEEE 24765.

4.2.8

portability
degree of effectiveness and efficiency with which a system, product or component can be transferred from one hardware, software or other operational or usage environment to another
Note 1 to entry: Adapted from ISO/IEC/IEEE 24765.
Note 2 to entry: Portability can be interpreted as either an inherent capability of the product or system to facilitate porting activities, or the quality in use experienced for the goal of porting the product or system.

4.2.8.1
adaptability
degree to which a product or system can effectively and efficiently be adapted for different or evolving hardware, software or other operational or usage environments
Note 1 to entry: Adaptability includes the scalability of internal capacity (e.g. screen fields, tables, transaction volumes, report formats, etc.).
Note 2 to entry: Adaptations include those carried out by specialized support staff, and those carried out by business or operational staff, or end users.
Note 3 to entry: If the system is to be adapted by the end user, adaptability corresponds to suitability for individualization as defined inISO 9241-110.

4.2.8.2
installability
degree of effectiveness and efficiency with which a product or system can be successfully installed and/or uninstalled in a specified environment
Note 1 to entry: If the product or system is to be installed by an end user, installability can affect the resulting functional appropriateness and operability.

4.2.8.3
replaceability
degree to which a product can replace another specified software product for the same purpose in the same environment
Note 1 to entry: Replaceability of a new version of a software product is important to the user when upgrading.
Note 2 to entry: Replaceability can include attributes of both installability and adaptability. The concept has been introduced as a subcharacteristic of its own because of its importance.
Note 3 to entry: Replaceability will reduce lock-in risk: so that other software products can be used in place of the present one, for example by the use of standardized file formats.