

# Extensions of ISO/IEC 25000 Quality Models to the Context of Artificial Intelligence

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## Abstract

This paper reports the extensions of ISO/IEC 25000 (SQuaRE) quality models developed by the Working Group 6 of ISO/IEC JTC1 SC 7 “Software and systems engineering”, to adapt a specific SC7 standard for its use in the field of “Artificial Intelligence” managed by JTC1 SC42. Particular attention is given to the ISO/IEC 25010 as basis of the recent ISO/IEC 25059 for which new quality sub-characteristics have been deemed necessary for the application of the original models to the new technology. The emerging needs are related to the quality of the products to be considered in a complete framework that includes governance, management, implementation processes and evaluation of applications, also quoting some activities on data quality. The article aims to popularize the use of quality models which can mitigate social and ethical risks and increase trust in AI.

## Keywords

Artificial Intelligence, quality model, quality characteristics, software product quality, data quality, quality in use, quality measures.

## 1. Introduction

This paper briefly describes the evolution of the quality characteristics of ISO/IEC 25010 [1] which have been extended with new aspects in the quality model for AI defined in ISO/IEC DIS 25059 [2]. The work was carried out by Working Group 3 of SC42, in liaison with SC7. As described in the paper on possible extension of ISO/IEC 25000 [3] to Artificial Intelligence, presented in the Conference IWESQ 2020, many quality attributes defined by numerous sources were found to be useful as basis for standardizing new specific quality characteristics within the context of AI. Furthermore, in the conference IWESQ 2019 the paper on practical use of ISO/IEC 25000 [4] an example of use of ISO/IEC 25000 for AI had already been hypothesized. In the present document the focus is given on the new quality sub-characteristics that really emerge for AI systems. The eight quality characteristics for the “product quality model” remain the same: functional suitability, performance efficiency,

compatibility, usability, reliability, security, maintainability, portability. For four of them new sub-characteristics have been added to the existing ones: functional adaptability, user controllability, transparency, robustness, intervenability; one sub-characteristic has been modified: functional correctness. For the “quality in use model”, included in ISO/IEC 25010, the quality characteristics also remain the same: effectiveness, efficiency, satisfaction, freedom for risk, context coverage. About these two new sub-characteristics have been added: transparency and societal and ethical risk mitigation.

## 2. New software quality sub-characteristics considered

As mentioned, not all quality sub-characteristics for traditional software and quality in use were found to be satisfactory for the context of AI.

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The following table summarizes the new quality sub-characteristics defined by SC42/WG3 for the relative characteristics.

**Table 1**

New sub-characteristics defined in ISO/IEC DIS 25059 included in the relative characteristics

Product quality model	Quality in use model
<u>Functional suitability:</u> Correctness Adaptability  <u>Usability:</u> Controllability Trasparency  <u>Reliability:</u> Robustness  <u>Security:</u> Intervenability	<u>Satisfaction:</u> Trasparency  <u>Freedom from risk:</u> Societal and ethical risk mitigation

Additional characteristics, such as explainability and safety, are being defined by SC42/WG3 in other complementary standards under development. Also, the evaluation of quality, and related quality measure, is a topic under development in another standard.

Definitions of the new quality sub-characteristics quoted in Table 1 are reported in the clause “Terms and definition” of ISO/IEC DIS 25059 (for the official definitions and more in-deep considerations see Clause 3 and 5). In the following are reported synthesis of the terms:

- functional correctness: related to the correct results with the needed degree of precision
- functional adaptability: the AI system can accurately acquire information from data, or the result of previous actions, and is able to use that information in future predictions
- user controllability: a user can appropriately intervene in an AI system in a timely manner

- transparency: if the appropriate information about the AI system is communicated to relevant stakeholders
- robustness: the AI system can maintain its level of performance under any circumstances
- intervenability: an operator can intervene in an AI system’s functioning in a timely manner to prevent harm or hazard
- societal and ethical risk mitigation: the AI system mitigates potential risks to society

For a general vision of concepts and terminology for AI it is useful to examine the standard ISO/IEC 22989 “Information technology - Artificial intelligence - Artificial intelligence concepts and terminology” [5].

### 3. Activities on data

In the Working Group 2 of ISO/IEC JTC1/SC42 concerning Data, further activities are under development. Considering Data an object complimentary to the Software (years ago data were considered part of software) it is useful to mention the importance of data quality for AI, as appears in the ISO/IEC CD 5259-2 on Data quality measures [6].

Since the text of 5259-2 is still in the CD-Committee Draft phase, it is not possible to describe in detail the standard. However, it is useful to mention that also in this standard some new quality characteristics are added, in comparison with other standards taken as a reference. The main additional characteristics to be considered for AI, are those related to groups of data, i.e. datasets, rather than to single data. Various measures of datasets quality, such as dataset representativeness, are also being defined in 5259-2.

The analysis of quality characteristics included in the data quality model defined in the standard ISO/IEC 25012 [7], part of ISO/IEC 25000 [8], suggests to AI experts to accept almost all of them, adding some characteristics for dataset. The use of data, single or grouped, requires also to consider another standard to look for further data quality aspects related to management. For this, is interesting to pay attention to ISO 8000-1 [9], which declares that ISO/IEC 25000 series provides a view of data quality which complements the ISO 8000 series.

The set of documents under development by SC42/WG2 concerning data for AI consists of these ISO/IEC standards:

- CD 5259-1 Overview, terminology, and examples
- CD 5259-2 Data quality measures
- CD 5259-3 Data quality management
- CD 5259-4 Data quality process framework
- AWI 5259-5 Data quality governance

This articulated vision of the topic confirms the importance of data for AI systems.

## 4. Conclusions

Quality models are important, but it is also necessary to include some of their characteristics in a higher-level meta-model (like the one called “trustworthiness”) to harmonize multiple factors involved in the production: strategy, governance, management, processes, and products.

The meaning of characteristics of ISO/IEC 25059 suggests not only to apply technical solutions for AI systems, but also to pay attention to the expectations of final users that aim to use products with usability and satisfaction.

Many other AI topics are included in the work of organizations and experts, such as: test, measurement, evaluation, certification, ethics, automated algorithms, laws, regulations, sustainability, human vigilance and governance, accountability, non-discrimination, non-biased data, equity, accessibility, decision making, digital sovereignty, robotics.

The main active organizations for a systemic accepted worldwide view of AI, are, in addition to ISO and others, also the European Commission, the CEN-CLC JTC21, National bodies and other international and national Authorities, Industries, Universities and Associations. Experts and institutions are seeking to build a foundation of trust for AI aiming at improving products and services, mitigating risks, promoting, where useful, data interchange and interoperability of systems. Harmonization of further studies is very desirable. All organizations and experts involved, are called to face the difficult task of building AI systems to improve the well-being of society, environmental protection, and many other contexts.

AI will be a long wave and it will lead to the reformulation of many aspects of traditional software engineering. It is probably essential to

carry out research and continuous training at various levels, not only in specific production center but also in the sector of schools and universities.

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