

Possible extension of ISO/IEC 25000 quality models to Artificial Intelligence in the context of an international Governance

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Abstract— This paper examines the possibility of extending the principles of ISO/IEC 25000 (SQuaRE) to a quality model for Artificial Intelligence. Some results are described by comparing ISO/IEC 25000 product quality models to unstructured documents and guidelines concerning quality aspects of Artificial intelligence. The analysis shows some possible reuse of the models examined in the context of AI. The emerging important need of a general Governance of AI, including management, processes and organizational aspects, are outside the scope of SQuaRE.

Keywords: quality model, quality characteristics of product, software quality, data quality, service quality, quality in use, governance, standard, artificial intelligence.

I. INTRODUCTION

In this paper we examine the results of the analysis produced in six documents and guidelines concerning AI recently published by the European Commission, CEN CENELEC, ETSI, IEEE, the Italian authorities AGID and MISE [1]. The aspects of quality related to products and governance derive from shared considerations arisen by various kinds of experts and organizations. The goal is to encourage further reflections and research works.

Some of these documents have been presented at the Conference “Artificial Intelligence: for human governance. Educational and social perspectives” [2] held online in Italy on September 2020 25-26th. During the conference, the speakers introduced the issue of the need of including technological aspects into a governance schema for the various application fields. The purpose of this analysis is to promote the collection of new quality characteristics that could be considered for an extension of the ISO / IEC 25000 quality models [3], hoping for the harmonization of products with processes, management, organization and Governance. In this document we will focus mainly on the quality aspects of the products, while being aware of how much these aspects are influenced by the above factors. We will focus on the importance of the quality aspects of the product defined by SQuaRE, with particular reference to software [4], data [5], services [6] and quality in use [4]. It intends also to focus on aspects around quality management, quality measurement, quality requirements, quality evaluation. This approach was used to classify the numerous quality characteristics mentioned in the analyzed documents.

The aspect of product quality is emerging in the series of ISO/IEC 25000 series developed by ISO/IEC

JTC1/SC7 [7] Working Group 6 "Software product and system quality ". In the field of Artificial Intelligence (AI), the specific sub-committee ISO/IEC JTC1/SC42 [8] is developing an extension of SQuaRE to a “Quality model for AI-based systems”, with which the sub-committee SC7 WG 6 is collaborating. An exemplary attempt to use the ISO/IEC 25000 quality characteristics for AI has already been studied for the conference IWESQ 2019 [9].

II. QUALITY CHARACTERISTICS CONSIDERED

The methods adopted consists in the logic comparison between SQuaRE quality characteristics and characteristics mentioned in the documents analysed [1].

The number of characteristics defined in SQuaRE for each model are:

- Software product: 8
- Data: 15
- IT Services: 8
- Quality in use: 5

The number of quality characteristics mentioned in the documents analysed [1] are:

- Software product: 11
- Data: 7
- IT Services: 2
- Quality in use: 3

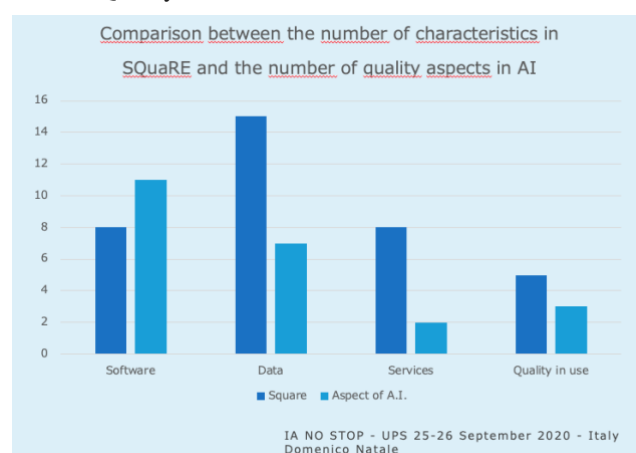


Figure 1. Number of SQuaRE characteristics and number of further quality aspects detected by Guidelines examined

The different numbers (SQuaRE and Aspect of AI) suggest taking more into account the data characteristics and services in future documents concerning AI and in ongoing projects. In fact, during the mentioned conference, the

majority of the speakers (in total about 100) pointed out the importance of data management and data quality, particularly within machine learning and specific algorithms. It is also true that not all SQuaRE quality characteristics for software, services and quality in use have been considered in the documents and that new features have been added.

The Conference was born as a cultural and interdisciplinary proposal inspired by a polyphony of knowledge and skills, with the aim of stimulating the broadest possible debate on AI. For these reasons have been involved sociologists, philosophers, educators, psychologists, students, programmers, technicians, managers, exponents of private companies and public institutions.

The topics covered by the speakers (the most part by Italy) have been:

- Ethics, communication, culture, education (28%)
- Technology, quality aspects, security (22%)
- Governance (17%)
- Health, therapy, pharmacology application (17%)
- Legislation, laws, economy, social aspects (16%)

The diversity of themes suggests new perspectives of standardization with multiple group and experts.

III. ELICITATION OF NEW ASPECTS OF QUALITY FOR PRODUCTS AND GOVERNANCE ACTIVITY

In the following list are reported the SQuaRE quality characteristics and the aspects of quality detected by experts and organizations mentioned in the Guidelines for software, data, services, quality in use and government.

Software and systems quality

<p>ISO/IEC 25010 (par. 4.2):</p> <ul style="list-style-type: none"> - Functional suitability - Performance efficiency - Compatibility - Usability - Reliability (Maturity) - Security (Accountability) - Maintainability (testability) - Portability
<p>Guidelines:</p> <ul style="list-style-type: none"> - Sustainability - Equity - Accountability - Transparency - Reliability - Safety - Robustness - Compliance - Testing
<p>Aspects in common between ISO/IEC 25010 and Guidelines:</p> <ul style="list-style-type: none"> - Reliability

Table 1. Comparison between SQuaRE and Guidelines about software

Data quality

<p>ISO/IEC 25012:</p> <ul style="list-style-type: none"> - Accuracy - Completeness - Consistency - Credibility - Currentness - Accessibility - Compliance - Confidentiality - Efficiency - Precision - Traceability - Understandability - Availability - Portability - Recoverability
<p>Guidelines:</p> <ul style="list-style-type: none"> - Analyzability - Accessibility - Confidentiality - Data strategy - Role of data - Acquisibility - Provenance
<p>Aspects in common between ISO/IEC 25012 and Guidelines:</p> <ul style="list-style-type: none"> - Accessibility - Confidentiality

Table 2. Comparison between SQuaRE and Guidelines about data

Service quality:

<p>ISO/IEC TS 25011:</p> <ul style="list-style-type: none"> - Suitability - Usability - Security - IT service reliability - Tangibility - Responsiveness - IT service adaptability - IT service maintainability
<p>Guidelines:</p> <ul style="list-style-type: none"> - Velocity of the network - 5G - Use of IoT
<p>Aspects in common between ISO/IEC TS 25011 and Guidelines:</p> <ul style="list-style-type: none"> - none

Table 3. Comparison between SQuaRE and Guidelines about Service

Quality in use

<p>ISO/IEC 25010 (par. 4.1):</p> <ul style="list-style-type: none"> - Effectiveness - Efficiency - Satisfaction (Trust) - Freedom for risk (Economic, Health,

Environment) - Context coverage
Guidelines - Trustworthy - Health and well-being - Environment - Economic impacts
Aspects in common between ISO/IEC 25000 and Guidelines: - Freedom for risk (Economic, Health, Environment)

Table 4. Comparaision between SQuaRE and Guidelines about Quality in use

In addition to the quality aspects of the product counted in previous Tables, have been highlighted in the documents analyzed many elements useful for a definition of the activity of Governance, management and processes, issues that are outside the scope of ISO/IEC 25000 SQuaRE series.

Governance, management, process

ISO/25000: Governance and process are out of the scope, except some aspects related to quality management.
Guidelines: - evaluation of the impact of algorithms - law and regulations - software engineering processes - human vigilance - data governance - legality - ethics - non-discrimination and fairness - responsibility - human and machine roles - decision making - digital sovereignty
Aspects in common between ISO/IEC 25000 and Guidelines: - laws and regulations (limited to data quality characteristic about compliance)

The software/systems life cycle processes are the main working area which SC7/WG7 actively is working including integration and acquisition processes. In addition, the related tools and methodologies are run by SC7/WG26 and WG4, thus activities for AI related quality have to be considered by work products developed by other SCs and SC7/WGs including SC42 also.

IV. FURTHER STUDIES

It may be interesting in the future to extend SQuaRE quality models to new technologies and to a deepen relationships and definitions between models by examining synonyms as well of the new specific quality characteristics for AI. Works under development [10] could benefit from

models comparisons and researches. To clarify the relationships between the various element involved in AI, it could be useful to distinguish all the items described in in the Glossary prepared for the mentioned Conference, and published in the section “Shared knowledge” [11], distinguishing:

- the constraints that influence the development of an AI system such as: Ethics, Human governance, standards, laws, quality models;
- the technologies and platforms, used in AI systems: Big data, Cloud computing, Quantum computer, Neural Network, Machine Learning, Robot.

Using for example the SADT (Structural Analysis and Design Technique) method [12], it is possible to put constraints on the top, and technology mechanism to the bottom of the following Figure 2 simulating a simplified representation of an “AI Ontology” schema.

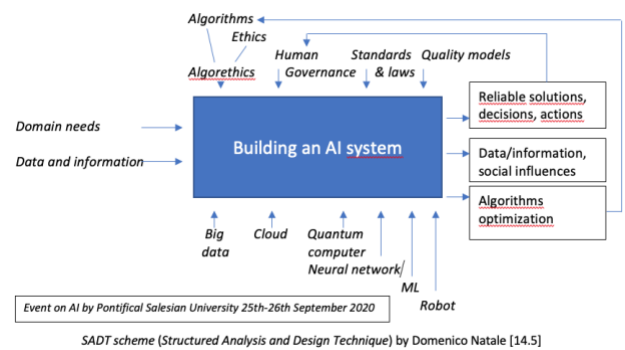


Figure 2. AI Ontology schema

It should be noted in the figure how the optimization activities in the real environment of the running system could generate autonomous changes in algorithms to be kept under control with governance activities.

V. CONCLUSION

The components of AI are multiple, sometimes considered independently of each other, sometimes seen as a whole. In many sectors, efforts are being made to incorporate further quality characteristics by experts that could be included in the quality models being prepared by the ISO commissions, particularly by ISO/IEC JTC1 SC42 Working Group 3 with the support of SC7 liaison.

Many organizations are active for a systemic accepted worldwide view of AI (European Commission, International and national Authorities, Industries, Universities and Associations).

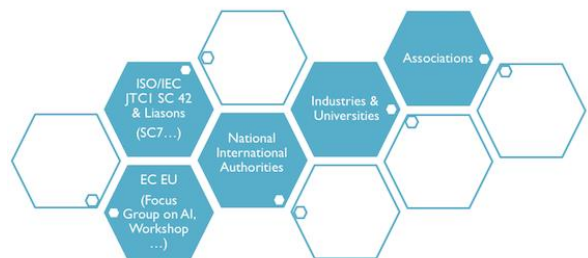


Figure 3. Stakeholders involved in AI standardization activities

Many experts and institutions are seeking to build a foundation of trust for this new technology, aiming at improving IT services in the area of the economy, health and environment.

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