Research on Quality Model of Industrial Application Software

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***Abstract*—The issue of quality of industrial application software has been widely concerned, so there is a clear need for a common set of characteristic for assessing available practices. However, the task is ususally done by experts and there is no consistent way to assess these practices and to optimally select one for a specific system. This paper proposes an assessment approach as well as a model to enable the use case for industrial application software, based on the SQuaRE series of International Standards.**

***Index Terms*—software quality; quality model; industrial application software; international standards;**

I. INTRODUCTION

Industrial application software is a collection of application programs, processes, methods and algorithms for construction contractors that can aid in collection, manipulation and management of information in sectors such as mining, chemical, food processing, oil, textile mill, gas and other manufacturing domains on an industrial scale. Industrial application software is available in a large variety ranging from forecasting, job costing, management and scheduling to highly specialized solutions for aircraft design and other processes in manufacturing industry.

Generally speaking, industrial application software is different from general software in the following ways. First, industrial application software is developed to perform a specific task in a specific environment. It is designed for the instructed specialists other than the ordinaries. Second, interaction is an important characteristic in the operation of industrial application software. Typically, industrial application software operates in, and interacts with, an external environment by collecting data through sensors and reacting to the controlled object or process through actuators. The third trait of industrial application software is the development practice, where many various interfaces and supporting platforms take part in. The last distinction of industrial application software is timeliness, meaning that the system must react within certain deadlines [1]. In the context of recent trends such as Industry 4.0, smart sensors, Cyber-Physical Systems, or Internet of Things, the amount and complexity of industrial application software has significantly increased. The concept of industrial application software has widespread into different domains like factory automation, power and energy systems and building automation [2].

The software industry has long been discussed with quality problems, because what exactly constitutes the quality of a product is vague. Throughout the years, many researchers have proposed their own version of software quality model. The latest revision of the international software product quality standards is the SQuaRE series of standards. However, assessing the quality of industrial application software still remains a highly challenging issue. There are several factors casuing industrial software failures. While not everybody agrees on the definition of a quality model, there is no doubut as to the importance of assessing industrial application software in a systematic and repeatable way. In other words, a key issue is the lack of an easy and consistent way to assess the quality of industrial application software and to select the most appropriate one for a particular use case. Based on the software quality model defined by ISO/IEC 25010:2011 [3], this paper provides a model for industrial application software assessing quality.

II. QUALITY MODEL

Industrial application software is an important achievement of software format of industrial technology. It carries industrial knowledge and experience to meet the specific need of the industrial sector, and helps to ensure the industrial Internet convergence application and enhance the intelligent development of manufacturing.

The importance can be summarized into the following three aspects. Firstly, industrial application software strengthens the capability of industrial Internet for demand-oriented applications, and drives the establishment of industrial internet application ecology. Secondly, industrial application software serves as a carrier of knowledge aggregation, improving the efficiency of industrial technology convergence application and the resource aggregation capability of industrial Internet. Thirdly, industrial application software can realize the flexible integration of industrial knowledge and manufacturing system, and implement the resource integration, massive heterogeneous data mining and deep learning through the embedding of data analysis algorithms. It can fully release the huge energy

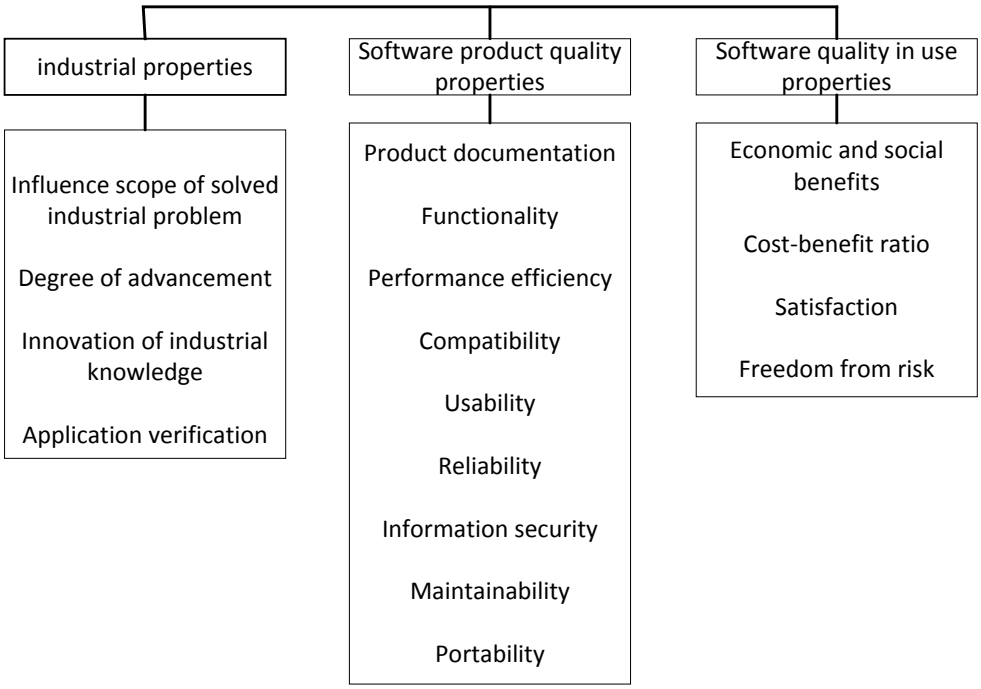

Fig. 1. The overview of quality characteristics

of cloud computing and big data, and strengthen the service capability of industrial internet platform.

A simple methodology is given as follow. Firstly, analyze the characteristics of software for the given industry. Secondly, a key step of the process is to select the characteristics upon which the evaluations can be done. Thirdly, having the characteristics defined and contextualized, the next step is to acquire feedback from the stakeholders. To do so, a survey can be conducted, where the stakeholders can provide their feedback in a quantitative form. A quantitative assessment linked to the characteristics enables their statistical assessment. Fourthly, the statistical analysis of the survey, reveals the views of the stakeholders, and provides insights on what is important and should be prioritized when selecting the approach to follow. For instance, from the quantitative values given to each characteristic, weights can be calculated that show the impact of that specific characteristic of the product quality model. Finally, the last step is to get the quality model of industrial application software.

III. QUALITY CHARACTERISTICS

The basis of this work is on the ISO/IEC 25010:2011 product quality model. Industrial application software has both industrial product attributes and software product attributes at the same time. On the one hand, as the product requirements of industrial products, the requirements of solving industrial problems and industrial knowledge embodied in the industrial application software are mainly considered. The evaluation of such characteristics are mainly on the basis of the relevant descriptions provided by materials, application verification reports, accreditation certificates and so on to assess conformity. On the other hand, as the product requirements of software products, the characteristics are divided into two groups. One is to evaluate the conformity of the industrial application software as the software itself, mainly through the software test method. The other is to evaluate the software capabilities presented by industrial application softwares in use, mainly through relevant application reports and user certificates. Relationship between all characteristics are showed in Figure 1.

A. Industrial properties

The quality model of industrial application software categorizes industrial properties into four characteristics: influence scope of solved industrial problem, degree of advancement, innovation of industrial knowledge and application verification.

As technology has advanced, manufacturers find themselves not just in need of employees, but employees with a different set of problems. Manufacturing companies operating machines or plants nowadays have to meet various challenges, including small lot sizes, high variability of product types, and a changing product portfolio during the lifecycle of a machine or plant. In another word, the influence scope of each solved industrial problem is different, from unit level, system level to system of system level.

There are several levels to describe the degree of advancement, such as to realize the functions of similar traditional industrial software; a certain function or performance improvement compared with similar domestic products; obvious advancement compared with similar domestic products; partially

or completely replaceable foreign similar products; beyond foreign similar products.

The innovation of industrial knowledge needs to be proven, including software itself, relevant international certification or recognition.

The low level of application verification is by providing a description of the verification method, test report or other materials. The high level of application verification is by providing professional certification, such as materials or application reports from industry associations, the government authority, and other authority organizations.

B. Software product quality properties

The quality model of software product quality properties categorizes software properties into nine characteristics: product documentation, functionality, performance efficiency, compatibility, usability, reliability, information security, maintainability and portability. This category shares the same characteristics with quality in use in the quality model of ISO/IEC 25010:2010, except product documentation.

The low level of product documentation is with corresponding product descriptions and user documentation, and clearly statements about all features and functions, as well as specific technical indicators. And some necessary features required in the relevant laws and regulations should be stated. The high level of product documentation is that necessary information about industrial application software on functionality, performance efficiency, and effectiveness should be given to potential demanders in the product description and user documentation.

C. Software quality in use properties

The quality model of software quality in use properties categorizes software properties into four characteristics:economic and social benefits, cost-benefit ratio, satisfaction and freedom from risk.

The essence of industrial application software is scenario requirements of business related industrial products in the entire product lifecycle, including design, production, experimentation, usage, security, trading, services. It carries knowledge about industrial product and related technology in process, best practices, all of those embedded in software. The focus of industrial application software is the modeling, modularization, standardization and software format of enterprise knowledge and technology, which can effectively promote the explicitness, socialization, organization and systematicness, with greatly convenience for the application and reuse of knowledge.

Comparing to traditional industrial software, industrial application software is lightweight, customized, specialized, flexible and reusable. In the environment of industrial internet platform, it is conducive to promote the development, application and sharing of industrial application software, forming an ecological environment, promoting the dissemination and reuse of knowledge, and pushing the knowledge economy to a new era. In a nutshell, the research on quality of industrial application software is necessary and urgent.

IV. CONCLUSION

The model is supported by a robust set of quality characteristics described in ISO/IEC 25010:2011 software product quality model, which has been adapted for use in industrial application software in this paper. Future research directions to this work include expanding the characteristics to measurable quality attributes, a wider empirical validation of the quality characteristics, and studying the specific strengths in use and benefits of the various practices for industrial application software.

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