Initial Framework for Software Quality Evaluation based on ISO/IEC 25022 and ISO/IEC 25023

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***Abstract*—Quality measured and evaluated based on organization-specific quality models cannot be compared to the quality of other software products. To alleviate this problem, ISO/IEC defined international standards called the SQuaRE (Systems and software Quality Requirements and Evaluation) series for comprehensive quality measurement and evaluation; however, these standards include ambiguous measurements, making them difficult to apply. Herein an initial comprehensive quality measurement framework, which includes a clear measurement plan based on ISO/IEC 25022 and 25023, is proposed. A case study confirms the usefulness of the framework. As future work, we will introduce the framework to various domains. And then, we revise and refine measurements and evaluation plans to improve feasibility and usefulness.**

***Index Terms*—Software Quality Management, Quality Assurance, SQuaRE series**

I. Introduction

Measurement issues and ambiguities about the understanding limit the evaluation methods [4]. In particular, software quality managers struggle to define the quality of software products due to ambiguities in the evaluation methods. According to S. Wagner et al.[8], only 28% of companies apply the ISO/IEC standard to their software products. This is because the ISO/IEC standard has too general and ambiguous metrics, measurements, inputs, and outputs to apply practically to software development project and products [4] [2].

On the other hand, more than 70% of companies apply their own quality models [8]. Moreover there are various frameworks such as [10], [11], [12], [13] proposed for quality evaluation. However, non-standard organization-specific quality models and frameworks cannot be compared to others because they are often constructed with different standards and focus on only the quality characteristics of interest.

Therefore, we propose a comprehensive quality measurement framework that includes clear metrics and a measurement based on the latest standards ISO/IEC 25022:2016[5] and 25023:2016[6] in the SQuaRE series.

II. Initial Framework

The purposes of our framework are to develop a framework based on an international standard by establishing a comprehensive framework for all quality (sub-)characteristics of ISO/IEC 25022 and ISO/IEC 25023, reduce ambiguous metrics and measurements, and define the inputs and outputs for quality measurements clearly.

Using the framework, which was developed with input of the ISO working group members, project stakeholders can recognize how to measure their own software product quality, evaluate whether their software product has high/low quality based on an international standard, identify sufficient/insufficient quality (sub-)characteristics, determine weak qualities compared to other software products, and develop an objective interpretation. The results of a quality evaluation based on the framework help project stakeholders identify areas for improvement.

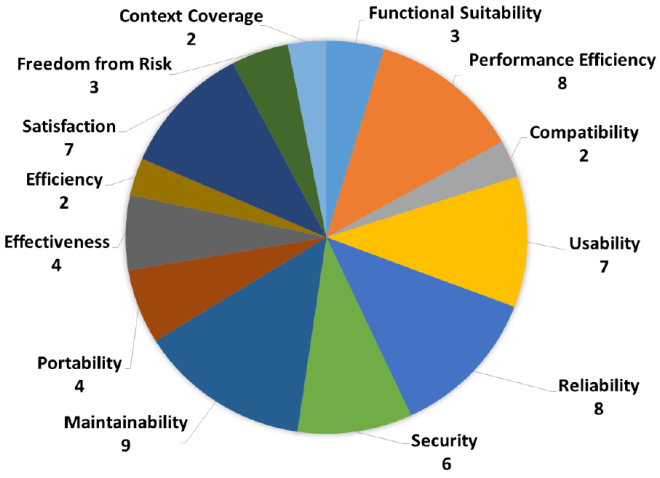

Fig. 1. Number of metrics for each quality characteristic

The framework consists of two parts: ”Product Quality” and ”Quality in Use”. The former contains internal and external product quality characteristics, metrics, and measurements based on ISO/IEC 25023, whereas the latter has quality characteristics, metrics, and measurement of quality in use based on ISO/IEC 25022. Product quality influences quality in use. That is, quality in use depends on the product quality. Thus, ”Product Quality” measures and ”Quality in Use” measures are connected. Therefore, if either product quality or quality in use is absent, the software quality is insufficient.

In the framework, there are 47 product metrics and 18 metrics of quality in use. Figure 1 shows the number of metrics of each quality characteristic. These metrics cover around 51.2% of the ISO/IEC metrics.

The overview of procedure to use the framework is shown in Figure 2. To measure and evaluate the product quality, the framework requires some information such as manual, specifications, test specifications, and bug information. To measure

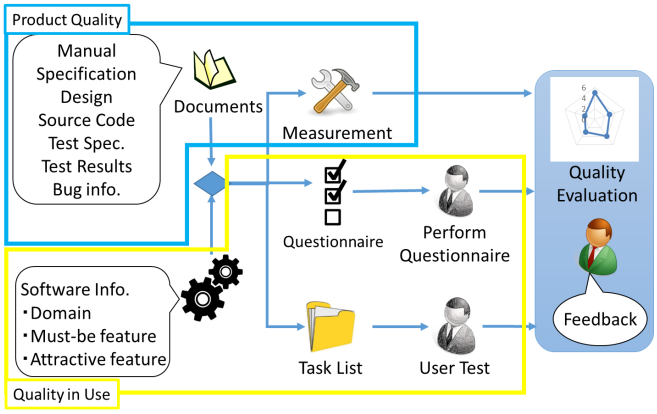

Fig. 2. Framework overview

and evaluate quality in use metrics, information should be collected and evaluated using a questionnaire and a user test. Based on the results, software quality is assessed, identifying what quality characteristics are sufficient/insufficient from the viewpoint from the international standards.

III. Case Study

We applied the framework to a commercial software product. In the case study, 30 product metrics and six quality in use metrics were measured. Additionally, we performed a user test. The list of user test tasks was developed by its vendor based on their scenario test. In addition, we developed abnormal tasks based on the task list. The subjects of the user test are several students belonging to our laboratory. Because these subjects are not the target of the software, developers in the vendor helped them perform user test tasks.

It took 4-6 hours to measure the product metrics and another 2-4 hours to complete the user test. The results reveal several problems, such as "There may be some potential bugs.".

Although the vendor indicates that the evaluation results based on the framework is very useful, some metrics and measurements may be unnecessary for other software domains. Moreover, a lot of time is needed to measure and evaluate metrics and quality. Thus, the framework might not have enough feasibility from the viewpoint of time cost.

IV. Related Work

AENOR provides ISO 25000 Software Product Quality Certification [1] based on the SQuaRE series. The certification evaluates maintainability and functional suitability based on the results of functional tests, source code, and a third party library. Our framework investigates other quality characteristics in addition to those two characteristics.

In the project Quamoco, a quality meta model was developed for specific operationalized quality models [9]. Because Quamoco is used to create an appropriate and introduce-able quality model based on meta model, it cannot be used to compare to other software product's quality.

To identify the software quality, some quality models, quality measurement methods, and metrics have been defined, such as COQUALMO [3] and HDCE [7]. However, these models/approaches have only rely on a specific quality focus and require subjective expert judgments.

V. Conclusions and Future Works

To evaluate the product quality, we defined 47 quality metrics and 18 quality in use metrics, and their clear measurements based on documents, user test, and questionnaire. Our contributions are (1) defining a framework for quality measurements and evaluations based on ISO/IEC 25022 and ISO/IEC 25023, (2) establishing a procedure of using the framework to evaluate the software quality, (3) incorporating feasible metrics and measurements into the proposed framework, and (4) demonstrating the effectiveness of the framework for project stakeholders through the case study.

As future work, we will introduce the framework to various domains. And then, we revise and refine measurements and evaluation plans to improve feasibility and usefulness. Additionally, we will build the GQM model to combine clearly the quality characteristics and metrics to clear interpretation of software quality. Then, we define relationships between metrics and characteristics obviously, and verify the validation of these relationships thorough some case studies.

Acknowledgments

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References

[1] Aenor. ISO 25000 software product quality certification. http://www.en.aenor.es/aenor/certificacion/calidad/calidad_software_25000.asp.
[2] A. Abran et al. Usability meanings and interpretations in ISO standards. *Software Quality Journal*, 11(4):325–338, Nov. 2003.
[3] S. Chulani et al. Modeling software defect introduction and removal: COQUALMO. Technical report, USC-CSSE, 1999.
[4] J. Heidrich et al. Model-based quality management of software development projects. In *Software Project Management in a Changing World*, pages 125–156. Springer, 2014.
[5] ISO/IEC. *ISO/IEC 25022:2016 Systems and software engineering - Systems and software Quality Requirements and Evaluation (SQuaRE) - Measurement of quality in use*. 2015.
[6] ISO/IEC. *ISO/IEC 25023:2016 Systems and software engineering - Systems and software Quality Requirements and Evaluation (SQuaRE) - Measurement of system and software product quality*. 2015.
[7] M. Kläs et al. Managing software quality through a hybrid defect content and effectiveness model. In *ESEM '08*, pages 321–323. ACM, 2008.
[8] S. Wagner et al. Software quality models in practice - survey results-. https://mediatum.ub.tum.de/doc/1110601/1110601.pdf, 2010.
[9] S. Wagner et al. The quamoco product quality modelling and assessment approach. In *ICSE '12*, pages 1133–1142, 2012.
[10] H. Washizaki et al. Experiments on quality evaluation of embedded software in japan robot software design contest. In *ICSE*, pages 551–560, 2006.
[11] H. Washizaki et al. A framework for measuring and evaluating program source code quality. In *PROFES*, pages 284–299, 2007.
[12] H. Washizaki et al. A metrics suite for measuring quality characteristics of javabeans components. In *PROFES*, pages 45–60, 2008.
[13] H. Washizaki et al. Reusability metrics for program source code written in C language and their evaluation. In *PROFES*, pages 89–103, 2012.