



Quality evaluation and analysis for domain software: Application to management information system of power plant



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ABSTRACT

Context: Domain software plays an important role in the management of many enterprises; therefore, its quality is critical to these enterprises and impacts its selection, maintenance, and service quality evaluation to a great extent. Consequently, how to evaluate the quality of domain software has become an area that deserves more research. The existing research pays much attention to software for specific purposes and fields, or to specific stage of the software, which is not enough.

Objective: This paper proposes a systematic quality evaluation method, which fully considers the generality, domain features, and application environment of domain software, and also supports subsequent analysis.

Method: The quality evaluation method proposed in this paper defines all aspects of the domain software to be inspected by establishing an attribute model, obtains basic data on evaluation by analyzing and measuring evidence, tailor-makes the computing logic of quality evaluation score by establishing an evaluation model, and classifies domain software quality by establishing level model. This research verifies the applicability of evaluation by applying this method to management information system (MIS) in the field of a power plant.

Results: The case example not only indicates that the proposed method can be applied to the quality evaluation and analysis of the power plant's MIS, but also its ease of usability.

Conclusion: The method is applicable and can be easily used for the quality evaluation and analysis of the MIS in a power plant. Based on mechanisms, such as model customization and weight determination, this method also supports the quality evaluation and analysis of software applied in different fields. In the future, there will be a need to improve the objectivity and automation degree of the evaluation, and to apply and verify the method according to the different types of software in various fields.

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1. Introduction

With the increasing informationization of the society, domain software is playing a more and more important role. Many enterprises use domain software in business administration and production control. As the core of domain informationization, it is able to improve production efficiency, ensure safety production and lower management cost, enhance industry knowledge and business processes, and becomes an effective tool in describing, sharing, and transmitting industry knowledge and business [25,34,36]. Domain software has been widely applied in all the fields of the society and plays an important role. However, issues like domain software quality and quality evaluation have not received much attention [34,36]. Domain software quality is not only closely related to the general attributes but also the domain attributes, and it has to meet general requirements, domain requirements, and specific ap-

plication requirements of software [25,34]. Therefore, a systematic method of sound operability is needed, which should be able to clearly measure domain software quality, conduct contrastive analysis based on evaluation data, so as to select high quality domain software meeting relevant requirements, assist in evolution of applied domain software, and improve the software quality.

Software engineering has been concerned about improving software quality. Research has been conducted on software development method, software development process, software maturity, and software evaluation technology to ensure software quality [1-3]. Software quality evaluation is the key to improve quality, and so far many models have been established to evaluate the quality, and much research targeted at specific domains software or software of specific form has also been done [4,5,9]. However, the existing research on quality evaluation is insufficient. The existing studies focus on the following aspects. First, studying key issues in the process of the software quality evaluation such as attribute selection and weight determination. Second, improving the overall software quality evaluation process or the evaluation

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results of a particular aspect of software quality with specific approach or standard. Studies in these two aspects are very meaningful, but there are some limitations, which are mainly reflected in the lack of supporting to domain characteristics and application requirements in quality evaluation process, which means that the current research cannot fully meet the quality evaluation requirements for domain software. Third, some studies were carried out specifically for software with specific production attributes, such as open source software [25]. However, in practical applications, we often need to compare and evaluate the quality of software in specific scenarios. Therefore, we hold that from the perspective of supporting domain characteristics, it is very meaningful to carry out quality evaluation for domain software. Fourth, part of the studies was performed especially for particular applications or software with a specific function, such as GPS software [33] and open source CRM software [35]. These studies had taken into account the specific details of the application. However, they lacked a systematic quality evaluation method for software in the application domain, and no complete quality evaluation framework was established. Domain software has its own attributes. Attention should not only be paid to attributes of the software but also attributes integrated with domain, for example, domain knowledge support and domain business standardization. Thus the evaluation and analysis of domain software quality require traditional methods and tools, and those closely related to the domain.

In view of quality evaluation issues concerning the domain software, this paper proposes a systematic evaluation method of sound operability, conducts further study based on the existing software quality analysis and evaluation results and fully considers the general attributes and domain attributes of the software. A quality evaluation model based on measured evidence is able to conduct quantitative evaluation and analysis of domain software quality. In this way, users can properly select domain software based on specific domain requirements, or improve software quality by evolving it based on evaluation of applied software. Besides, another case of power plant domain software evaluation briefly illustrates how to evaluate and analyze this method.

The remainder of this paper is organized as follows. Section 2 analyzes existing software quality evaluation methods and tools, and summarizes researches related to domain software quality evaluation. Section 3 provides a quality evaluation method of domain software. Section 4 provides a software application case in power industry, and illustrates the process of evaluating quality of power plant management information system (MIS) with this method. Section 5 is the discussion and Section 6 is the conclusion.

2. Related work

Normally, software quality refers to the degree of consistency between the expected functions of the software and the requirements it actually fulfills. Evaluation of software quality requires the establishment of a uniform reference benchmark, and software quality model covers both the abstraction and generalization of software attributes, which can serve as reference benchmark for evaluation. Traditional Boehm model [4], McCall model [5] and subsequent models [6–8] are often used in software quality evaluation. Many countries and organizations have accordingly set up quality model standards, such as the widely used International Organization for Standardization (ISO) standards [9–12] on software quality management, product lifecycle, quality requirements, and evaluation. Many other standards were set up with reference to ISO ones. All these models define software quality with attributes and standards of hierarchical structures, and further decompose the software quality into lower-level metrics. But domain software quality pays more attention to the domain attributes, such

as domain standard support, industry code support, business process standardization, and presentation and usage of domain knowledge. Traditional methods and models cannot effectively support the evaluation of domain software quality. Therefore, relevant researches on this subject are being carried out.

2.1. Key issues of the quality evaluation

Chiam et al. [13] provided a systematic approach to better select and integrate “Quality Attribute Techniques” into tailored software process models for projects that develop products with specific product quality requirements. In order to evaluate software quality accurately and comprehensively, the weights of customers’ requirements and the weights of technical attributes of the software were determined by ANP and QFD in [14]. Bogado et al. [15] presented a discrete event simulation environment for the software architecture assessment considering both functional and quality aspects, and it is built in a modular and hierarchical way that provides scalability and reusability advantages. The objective of [16] is to provide software developers some metrics to evaluate software quality of a Java program. Studies on software quality requirements, software quality models, and various good design rules are required. A method using expert judgment for the evaluation of software quality is presented. The underlying principle of the approach is the encoding of experts’ tacit knowledge into probabilistic metrics associated with the achievement level of software quality attributes [17]. Svensson, Olsson and Regnell analyzed a sub-contractor specification in the mobile handset domain, and the objective is to understand how quality requirements are specified and which types of requirements exist in a requirement specification from industry [18]. These studies on specific issues in software quality evaluation could provide support for our quality evaluation method. Based on the domain characteristics and application requirements, the introduction of the desired outcomes (mentioned above) to a particular evaluation scenario could improve the evaluation quality of a certain link. However, these studies above also lack support for the entire quality evaluation analytical framework, especially the support for domain characteristics, which fails to sufficiently satisfy the quality evaluation requirements for domain software.

2.2. Improving the evaluation with specific approach or standard

To study the problem of multiple attribute decision making in which the decision making information values are triangular fuzzy number, a relative entropy decision-making method for software quality evaluation is proposed [19]. Li et al. [20] presented a fuzzy regression model with asymmetric triangular fuzzy numbers to express the functional relationships in order to guide us to adjust development strategy to produce high-quality software. A new fuzzy assessment method was proposed to choose a better software quality suitable for end-users [21]. This study presented a model to obtain the integrated software quality for evaluating user satisfaction using fuzzy set theory. Dubielewicz et al. proposed interpretation of the key notions from ISO standards (ISO/IEC 9126, ISO/IEC 25,000) and presented their application in the process of software product evaluation [22]. Toshihiro focused on usability and describes viewpoints on usability evaluation and the metrics of quantitative usability evaluation based on the international standards for software quality evaluation [23]. Diaz-Ley et al. [24] presented a measurement capability maturity model, which supported companies both in defining their measurement programs, as adapted to the measurement maturity of the company, and in detecting measurement improvement suggestions. These studies adopted new algorithms or standards to improve software quality evaluation, or

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