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Software Quality Evaluation Models Applicable in Health Information and Communications Technologies. A Review of the Literature

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Abstract. Information and Communications Technologies in healthcare has increased the need to consider quality criteria through standardised processes. The aim of this study was to analyse the software quality evaluation models applicable to healthcare from the perspective of ICT-purchasers. Through a systematic literature review with the keywords software, product, quality, evaluation and health, we selected and analysed 20 original research papers published from 2005-2016 in health science and technology databases. The results showed four main topics: non-ISO models, software quality evaluation models based on ISO/IEC standards, studies analysing software quality evaluation models, and studies analysing ISO standards for software quality evaluation. The models provide cost-efficiency criteria for specific software, and improve use outcomes. The ISO/IEC25000 standard is shown as the most suitable for evaluating the quality of ICTs for healthcare use from the perspective of institutional acquisition.

Keywords. Software Quality Evaluation, ICT, Healthcare.

Introduction

From the perspective of users/ purchasers of software products, healthcare professionals and hospital managers need objective tools to measure software quality. These tools or quality evaluation models should be capable of giving a reliable evaluation of the software as an end-product, thus guaranteeing the most cost-effective investment and the best results when used in healthcare institutions [1]. This literature review sets out to analyse the state of the knowledge regarding software product quality evaluation models applicable to ICTS in healthcare [2].

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1. Review methodology

A systematic review of the literature was conducted with the aim of identifying the models and methods used by investigators and experts to evaluate the quality of software products over the past 12 years, from January 2005 through May 2016, to include papers from the first ISO/IEC25000 version appearance (2005). We attempted to identify, from the perspective of users or acquirers, those most suitable for use by healthcare institutions for the purpose of selecting, acquiring, and using ICTs for clinical, diagnostic, management, and follow-up purposes.

International (MEDLINE (PubMed), Cochrane) health sciences databases, Google Scholar, and international scientific technology databases (CITEseerx, ACMDL, IEEE) were searched. The keywords "software, product, quality, evaluation, health" were used. No other restrictions were applied. Of the 1135 references initially found, after a process of elimination from title (463), abstract (149) and finally whole text (47) based on relevance and content related to the main topic, twenty articles were finally included.

The 20 studies selected were comprehensively summarised by the researchers, and this information formed the basis for the subsequent literature review. The findings that emerged from the review are divided into four main topics based on the authors approach faced to identify the best model to our objective: Software Quality Evaluation Models proposed based on non-ISO models, Software Quality Evaluation Models based on ISO/IEC standards, Analysis of Software Quality Evaluation Models, and Analysis of ISO standards for the evaluation of software quality.

2. Results

The Software Quality Evaluation models based on non-ISO models, presented different perspectives, based on the life cycle of software under development [3]. Other proposal, only for quality requirements assessment, is showed also in healthcare environment for software design documents [4] . Proposals that prioritise usability as a referential hierarchical concept focus on the perspective of the user's opinion, but methods differ, aimed at organisations with limited technological resources [5] in contrast with the end-user emotion evaluation approach, without developing a complete model [6], [7].

As ISO model-based evaluation methods, there's improvement proposals related to quality in use evaluation [8], or tailored theoretical quality evaluation model user-oriented, applicable to different types of software [9]. Some others papers identified the need to adapt evaluation models to the specific needs of the user [10] and highlights the need for customers to evaluate software before selecting the appropriate products [11]. An interesting approach health oriented shows a model ISO/IEC 9126 based, to assess the impact of software quality characteristics on healthcare outcome [1,12]. For quality of products developed using *Component-Based Software Engineering (CBSE*), it is proposed a component certification process [13]. Other authors suggest SQuaRE model for component-based software quality evaluation [14], or ISO-25000 base metrics that can be extended as required by the context [15] .

Papers within an analysis of Quality Evaluation Models show the ISO-25000 standard as the current reference model and the basis for the future development of new models [16]. After their qualitative analysis with several software quality models, authors suggest that users interested in quality analysis must select the quality evaluation model best suited to their needs [17].

Papers developing an analysis of ISO/IEC standards identify ISO/IEC 25000 attempts to harmonise, unify, and update the international ISO/IEC standards for evaluating software quality [18]. It is applicable for development and acquisition process, [19], not limited to any specific area, and can be used for any type of software system and product.

3. Discussion

There were a limited number of studies comparing different software product quality evaluation methodologies aimed at purchasers and end users. All Non-ISO models proposed, lack standardised reference frameworks and references to sources in the literature. Some of them are impractical and inappropriate for healthcare institutions since they base their models on the life cycle of software under development [3].

The ISO models based have not been reproduced by other authors [1,12], even not been oriented to software quality evaluation. CBSE model is not applicable to final products selected for use in healthcare institutions, although it contributes the idea of certification [13]. The ISO/IEC standards 9126, 14598, and recently 25000 (SQuaRE) are widely referred to as standard frameworks for developing complementary or alternative models for evaluating specific software or developing custom models. However, we did not find any reference in the literature to their use in healthcare systems or healthcare-specific software.

Some component-based software quality evaluation models are based on the ISO-9126 model in combination with other general models. These models have a restricted use and very limited applicability, and some of the more traditional models are very general and difficult to apply. Some analysis did not considered the 2007 ISO/IEC 25000 (SQuaRE) standard, which integrates and unifies previous ISO software quality evaluation models[17], [20]

SQUaRE is considered to be widely applicable, both to evaluate the quality of commercial software product as well as custom-built and personalised software [18], [19], best adapted to healthcare institutions requirements. Their suitable measurements, which unify and update the international ISO/IEC software quality evaluation standards, can provide information that enables the healthcare institution software customer or purchaser to make rational business decisions, where the SQuaRE series includes a specific customer/purchaser-focused quality measurement application.

4. Conclusions and Application in the field of interest

The evaluation software should be a useful tool that can help public or private healthcare institutions make cost-effective investment decisions.

The most suitable model for evaluating software quality for healthcare Institutions seems to that proposed by the series of ISO/IEC 25000 standards. This would give healthcare institutions useful information on which to base software acquisition decisions, improve the experience of users and professionals, and with it, the quality of the healthcare provided.

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