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Quality evaluation for Model-Driven Web Engineering methodologies

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ABSTRACT

Context: There are lots of approaches or methodologies in the Model-Driven Web Engineering (MDWE) context to develop Web Applications without reaching a consensus on the use of standards and scarcity of both, practical experience and tool support.
Objective: Model-Driven Web Engineering (MDWE) methodologies are constantly evolving. Moreover, Quality is a very important factor to identify within a methodology as it defines processes, techniques and artifacts to develop Web Applications. For this reason, when analyzing a methodology, it is not only necessary to evaluate quality, but also to find out how to improve it. The main goal of this paper is to develop a set of Quality Characteristics and Sub-Characteristics for MDWE approaches based on ISO/IEC standards.
Method: From the software products context, some widely standards proposed, such as ISO/IEC 9126 or ISO/IEC 25000, suggest a Quality Model for software products, although up to now, there are no standard methods to assess quality on MDWE methodologies. Such methodologies can be organized into Properties, thus, a methodology has artifacts, processes and techniques. Then, each item is evaluated through a set of appropriate Quality Characteristics, depending on its nature. This paper proposes to evaluate a methodology as a product itself.
Results: This paper recommends a set of Quality Characteristics and Sub-Characteristics based on these standards in order to evaluate MDWE methodologies quality. Additionally, it defines an agile way to relate these Quality Sub-Characteristics to Properties with the sole purpose of not only analyzing, but also assessing and improving MDWE methodologies.
Conclusions: The application of these Quality Characteristics and Sub-Characteristics could promote efficiency in methodologies since this kind of assessment enhances both the understanding of strengths and weaknesses of approaches.

1. Introduction

Quality is a relevant aspect to consider in the Software Engineering context, although there are several different definitions, for example, conformance to user expectations, which is often described as the "fitness for purpose" of a piece of software. Another quality definition attending to software quality measures deals with the high quality of software design (quality of design) and the high level the software conforms with that design (quality of conformance). The definition of quality in ISO 9000:2005, as described in [21], includes the notion of "degree" meaning that quality is not an absolute, but a changeable aspect. The concept of "degree" is illustrated in Fig. 1, showing that needs, requirements and expectations are constantly changing. Therefore, quality is the difference between the model state implied or required, and the model state reached. Thus, satisfactory quality takes place when the state reached is within the range of acceptability defined by the required model; superior quality occurs when the state reached is above the required model and inferior quality appears when the state reached is below the required state.

In the final evaluation, it is the user who sets the quality standards by deciding which products should be purchased and whom they should be purchased. We need to express our relative satisfaction with products and, as a consequence, use subjective terms. When a product satisfies the user's needs, it can be said that the product is either a high quality or a satisfactory quality product and in the same way, when the user is dissatisfied with the product, it can be said that it is either, a poor or a low quality product. When the product exceeds the user's needs, it is considered to be either a high quality or a superior quality product, whereas if it is below the user's expectations, it is considered to be either a low quality or unsatisfactory quality product.

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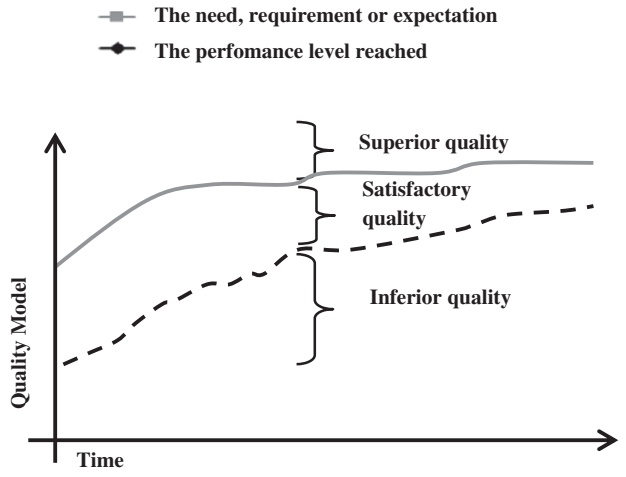

Fig. 1. Quality in ISO/IEC.

The Model-Driven Engineering (MDE) is a software development paradigm dealing with the creation of models or abstractions closer to a particular domain than to concepts or specific syntax. A Web Engineering domain specific to MDE is called MDWE (Model-Driven Web Engineering). A Model-Driven Architecture (MDA) [37] is an architecture platform approach to develop software systems under the MDE paradigm which provides a set of guidelines to structure specifications that are expressed as models.

In recent years, the growing interest in the Internet has generated a high number of MDWE approaches [45] that offer a frame of reference for Web environment. Nowadays, there are many approaches and diverse MDWE methodologies such as OOHDM (Oriented Hypermedia Design Method) [40], UWE (UML-based Web Engineering) [44], WebML (The Web Modeling Language) [48], OOH4RIA [34], RUX-Method [39] or NDT (Navigational Development Techniques) [36], which do not reach a consensus on the use of standards, on the one hand, and show scarcity of both practical experience and tool support, on the other. Thus, each methodology has different tools, such as metamodels (some of them are based on other methodologies) or transformations, which can implement different levels of abstractions, for instance, the Computer Independent Model (CIM), the Platform Independent Model (PIM) and/or the Platform Specific Model (PSM), among others. In this situation, it is necessary to characterize these methodologies in order to analyze and evaluate them.

In addition, it is important to know both, the real needs that designers have to cover regarding users of these approaches and also the Quality Characteristics these needs should guarantee. Thus, designing a clear strategy is essential since it will allow designers to efficiently outline these methodologies. QuEF [13] is a framework which manages quality in MDWE approaches. It is based on quality management, but it focuses on the Quality Model lifecycle. This lifecycle is composed of a set of phases (Strategy phase, Design phase, Transition phase, Operation phase and Quality Continuous Improvement phase) that helps quality management work effectively. In QuEF, the Quality Model is the key element in quality management since it describes all the necessary elements that make the automatic generation of artifacts reduce the estimated time and cost.

The Strategy and Design phase must start with defining all users' needs in general. Once all these needs are customized then, in turn, they are defined with a Quality Model. During the Operation phase, the most appropriate one is selected and both users and designers can analyze, control and evaluate the quality of their approaches, as shown in the sample application included in this paper. Users of methodologies need to find out the most appropriate one for themselves and their work environment. Due to their experience, they would prefer some aspects rather than others

In any case, users have the last word to decide and designers must offer only what users need.

All metrics studied in this paper focus on determining the aspects that must be included in a methodology. Thus, in the Operation phase, users select their preferences by customizing a set of weight values associated to the Quality Characteristics analyzed in this paper as well as the Properties containing users' needs and environmental description of approaches in terms of the importance given.

This paper focuses on developing a set of Quality Characteristics and Sub-Characteristics for MDWE approaches based on ISO/IEC standards. It aims to propose the bases of a set of these Quality Characteristics as part of the Strategy and Design phase of QuEF. We also suggest how to analyze, control and evaluate the quality of MDWE approaches as part of the Operation phase. Besides, this paper deals with defining Quality Characteristics. The idea is to provide an environment that allows users and designers to figure out which of the Quality Characteristics have to be guaranteed when particular users apply these methodologies.

The paper is organized into the following sections: after this introduction, Section 2 presents a global analysis of the situation and all necessary elements to elaborate this work according to some quality standards and contexts. Section 3 proposes quality concepts such as Quality Characteristic and Quality Sub-Characteristic as part of the Strategy and Design phase in QuEF. Section 4 explains how all these concepts are related to a Matrix of Influences (MoIs) as well as how it provides a set of formulas to analyze and evaluate MDWE methodologies as part of the Operation phase in QuEF. In Section 5, a set of Quality Characteristics and Quality Sub-Characteristics are identified. Section 6 provides a sample of the proposed analysis and NDT methodology assessment. Finally, Section 7 and 8 offer a set of conclusions and contributions and suggest possible future work.

2. Work context and related work

Few years ago, several research groups began to analyze the characteristics of new emerging software systems known as hypermedia systems, which have eventually evolved into Web systems. It was the birth of a new line of Software Engineering currently known as Web Engineering [16]. It is a specific domain within MDE (Model-Driven Engineering) paradigm where an application can be used [15]. The application of MDE Engineering to Web sites is called Model-Driven Web Engineering (MDWE) and, as it can be observed in different studies [7,45,15], it is offering very good results. Nowadays, there are several proposals on MDWE in the literature that are very useful for designing such applications. Some of them almost entirely cover every level of abstraction and they even have tools that support transformations automation in development and evaluation processes.

There is a variety of proposals in Web Engineering, as shown in [45]. This range of possibilities and the trend towards using MDE in proposals, open such a wide range of offers that, in many cases, it is difficult to select the most appropriate one. MDE was launched by the Object Management Group (OMG). The OMG has also developed the proposed MDA (Model-Driven Architecture) that provides standard platform architecture for proposals based on the Model-Driven paradigm. MDA was created with the idea of separating a system logical specification from the operational details that define how the system uses the technology platform capabilities to be implemented. In this regard, the goals of MDA are portability, interoperability and reusability through architectural separation.