Quality Patterns for Conceptual Modelling

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Abstract. Patterns have generated a large interest during last years. In software engineering, a pattern is a reusable solution based on the capitalization of well known and agreed practices. The role of a pattern is to speed up development process. The aim of this paper is twofold: it first proposes a concept of quality pattern. The latter is used to structure and to package predefined solutions for evaluation of conceptual modelling quality. The second contribution is related to the combination of two concepts, namely quality patterns and design patterns in a three-step process aiming at i) guiding the quality evaluation by the use of quality patterns, ii) helping designers improve conceptual models using design patterns, iii) evaluating the improvement by quality measurement.

Keywords: Conceptual model quality, quality patterns, design patterns, development process guidance, quality measurement.

1 Introduction

With increasing costs of software development and the growing centrality of information systems (IS) within organizations, building patterns is becoming widely recognized as an important activity. However, despite its importance, it is often ignored or carried out inefficiently. The reason lies within the complexity of the task related to the development of patterns. Building patterns, and more specifically quality patterns, is still considered as problematic. Moreover, choosing design patterns associated with specific quality patterns remains a difficult task. Although a number of patterns, especially design patterns, are available, none of them integrates quality evaluation. We argue that the accurate capture of quality factors and metrics plays a critical role in the elicitation of effective and usable quality patterns that could be used further to assist IS developers in the choice of the appropriate design patterns. The process of quality patterns engineering and the choice of the associated design patterns is still not well defined. In particular, the initial investigation and elicitation of the quality patterns relevant to the choice of design patterns is not supported by current development methods.

The work described in this paper takes the premise that adopting a three-phase engineering approach to conceptual modelling will offer a promise, especially for helping the activities of quality pattern-driven conceptual modelling. Our aims are threefold:
1. To draw upon information systems quality factors to develop a quality attributes specification, specifically incorporating i) quality goals relevant to conceptual modellers, ii) sufficient formality to allow the identification of quality attributes related to the quality goals.

2. To perform quality measurements leading to quality patterns.

3. To perform a design pattern-driven phase, based on quality patterns, and leading to conceptual model quality improvement.

In this paper, we propose a knowledge-based approach that helps in quality pattern-based development, combining quality and design patterns, leading to a better information system design.

The paper is organized as follows. Section 2 briefly reviews conceptual modelling quality and patterns research. Section 3 presents our knowledge-based approach including the underlying meta-model. Section 4 defines more precisely the content of quality patterns and design patterns. Section 5 illustrates our proposal for quality patterns driven in conceptual modelling. It combines quality goals, quality patterns, and design patterns in order to guide the conceptual modelling process. Finally, Section 6 presents the limitations and conclusions.

2 State of the Art

The issue of quality in conceptual modelling can be related at least to two problems: 1) quality evaluation, which includes quality definition and quality measurement, and 2) quality improvement. In this paper we propose to step forward by referring to a common concept: the pattern. This literature review is therefore composed of two main parts. First we summarize the findings in conceptual modelling quality. Then we synthesize the main results related to the application of patterns in information system design.

Quality in conceptual modelling has attracted much attention for more than ten years. [1] has laid the foundations allowing computer scientists i) to isolate the specificity of conceptual modelling quality vs. software quality, and ii) to clearly differentiate between quality goals and quality means. [2] provided a comprehensive state-of-the-art and argued that it is time to propose an international standard for evaluating the quality of conceptual modelling, in the same way as ISO/IEC 9126 has defined a framework for evaluating the quality of software products. We have proposed a framework enabling the evaluation of conceptual model quality according to three viewpoints: the designer, the user, and the developer. Each viewpoint is associated with a set of quality attributes which can be measured using several metrics [3]. These metrics have been validated through a survey to which have taken part 120 computer professionals [4]. Numerous meta-models have been presented to define quality concepts and to implement them [5,6].

Patterns originated as an architectural concept by Alexander [7]. In computer science, they have been applied to programming by [8]. However, we argue that their main impact has been achieved later with design patterns. Reuse of design patterns when building software is now admitted as a way to improve software reusability and maintainability [9]. A design pattern encapsulates a proven solution for a class of recurring design problems. Gamma distinguishes between creational, structural, and behavioural patterns. They respectively cope with class instantiation, class and object composition, and communication between objects. Research about patterns is orientated towards: i) the