Comparing the Effect of Use Case Format on End User Understanding of System Requirements

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ABSTRACT

The effective analysis and specification of requirements is critical in software development. Faults in the requirements may have significant impact on the quality of the software system. Use cases describe and analyze requirements in many current Object Oriented (OO) development methodologies, and can serve as a means for developers to communicate with different stakeholders. However, issues concerning use case format and level of detail are unclear and debatable. This study uses theories from cognitive psychology on how humans understand text and diagrams to investigate the effect of use case model format on end user understanding. An experiment to assess the performance of novices when using different use case formats indicated that for tasks that required only surface understanding of the use case model, the provision of diagrams along with the textual use case descriptions significantly improved comprehension performance in both familiar and unfamiliar application domains. However, the author found no statistically significant difference in performance between simple and detailed diagrams, suggesting that the provision of simple diagrams along with textual use case descriptions might be sufficient to support the negotiation and communication on system requirements between novice end-users and system analysts.

Keywords: Cognitive Psychology, Laboratory Experiment, Requirements Analysis, UML, Use Case Model, User Comprehension

1. INTRODUCTION

Numerous studies have indicated the importance of identifying correct, adequate and unambiguous requirements for the success of software systems development (Lamsweerde, 2001; Vessay & Conger, 1994; Yeo, 2002; Valenti et al., 1998). Shemer (1983) stated that “Requirements specification should reflect an understanding of a system, guide the subsequent design and programming phases, and serve as a basis for all communications concerning the software system being developed (e.g., users should be able to verify that their needs are answered and to plan acceptance tests”). Various methods and techniques have been developed for requirements specification and many research suggest the need for empirical evidence of the ease of
interpretation and understandability of these methods (Wand & Weber, 2002).

The unified modeling language (UML) is the modeling language for object oriented systems development. It is widely acknowledged that UML has become the standard for modeling object oriented software systems since its adoption by the Object Management Group (OMG) in 1997 (Kobryn, 2002). Use cases are the technique in the unified modeling language that is used to capture the functional requirements of software and validate them with the system users in the early phases of system development. Use case models serve as basis for deriving other UML conceptual models. Thus, it is important to ensure the quality of these models. Little empirical research is found on how we can make the best use of use case modeling (Dobing & Parsons, 2006).

In order to make full use of these, establishment of communication and understanding between the system developers and the novice users is of paramount significance. This points to the need to investigate how the current formats of use case models assist user’s understanding of system requirements.

There was a variety of formats for use cases (Schneider & Winter, 2001; Cockburn, 2001; Constantine & Lockwood, 2000). Some researchers used use case narratives (either structured or unstructured text) while others used diagrams with the text. The use case diagram does not show the step by step interactions within use cases, but it provides an overview of the use cases and the relationships between them. Little attention has been paid to the role of use case diagrams in supporting user understanding when accompanying the text. Although the effect of pictures on facilitating text comprehension is well known in literature, few empirical work has been undertaken to investigate the cognitive processes underlying the understanding of use case models. In a survey on UML current usage, Dobing and Parsons (2005) found that use case narratives had the highest score for verifying and validating requirements with client representatives on the project team. Their results also showed that clients were often involved in developing, reviewing and approving use case narratives and the use case diagram, and much more so than for other kinds of UML diagrams. They pointed out to the fact that how UML diagrams were used among non-experts remains unexplored.

Our objective in this paper is to demonstrate how using diagrams with the text description in a use case model can be studied by combining theoretical considerations and empirical methods. To accomplish this, we have chosen to consider an intra-grammar comparison (Wand & Weber, 2002) of three informationally equivalent formats of Use Case model. In one format, a text description is used. In the other two formats, text with diagrams of different levels of detail is used. In this study, we use cognitive considerations to suggest why there are differences in users’ understanding when presented different formats of use case model. The other objective is to explore whether a simple diagram may be more understandable than detailed one for novice users. There is one independent variable with three levels, corresponding to three different formats of use case model used in this study. The dependent variable is the performance (in terms of effectiveness and efficiency) of subjects performing comprehension and verification tasks using the models. To explain why differences in performance might exist, we use the Cognitive Load theory (Sweller, 1988), and the Multimedia Learning theory (Mayer, 2001).

Our first hypothesis is that when there are two alternative representations of the requirements (e.g., a text and a diagram) combined in one model, the model viewer can use both types of presentation to improve his/her understanding. The second hypothesis is that using simple diagrams with the text may improve the comprehension and verification task performance of novice users more than a detailed diagram do. The remainder of this paper is organized as follows. Section 2 provides a brief description of the use case models. Section 3 presents related work on the empirical evaluation of UML diagrams comprehension and specifically with regard to use cases. Section 4 provides a
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