Anticipating Requirements Changes-Using Futurology in Requirements Elicitation

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ABSTRACT

It is well known that requirements changes in a later phase of software developments is a major source of software defects and costs. Thus, the need of techniques to control or reduce the amount of changes during software development projects. The authors advocate the use of foresight methods as a valuable input to requirements elicitation, with the potential to decrease the number of changes that would be required after deployment, by anticipating them. In this paper, the authors define a process for using a foresight method, namely Futures Wheel, for requirements elicitation. To illustrate the use of this approach, the authors perform a case study using a route planning system.

Keywords: Autonomic Computing, Foresight Methods, Requirements Changes, Requirements Elicitation, Requirements Evolution, Self-Adaptive Systems, Studies of the Future

INTRODUCTION

In the life cycle of a software product, maintenance is considered to be one of the most costly phases (Schach, 2002; Wall & Sinnadurai, 1998). This is largely due to the correction of errors that were introduced in previous phases as well as requirements changes due to the increasingly dynamic context in which the systems run. Moreover, the dynamic business environments and technological improvements lead to the high occurrence of requirements changes. However, requirements evolution may impact other requirements, as well as affect system design, code and test cases. Requirements changes are also one of the main causes of software defects (Javed, Maqsood, & Durrani, 2004; Navarro, Leveson, & Lundqvist, 2000; Oz, 1994; RAE & BCS, 2004). It has been reported that the sooner a change is detected the better, i.e., the costs for dealing with it are reduced (Rosenberg & Hyatt, 1996). Thus, if we can anticipate these changes during the initial development of the
system, we have better chances to minimize their impact on the overall product life cycle.

Nowadays, there is a type of system that is expected to analyze and implement some of these changes at runtime (Lapouchnian, Yu, Liaskos, & Mylopoulos, 2006). Indeed, autonomic and self-adaptive systems are able to monitor the environment on which they are running, in order to identify the need for changing their behavior. In order to do so, it is required that these alternative behaviors are previously identified and defined. Therefore, identifying the expected changes in system requirements and defining how to handle these changes is a key research challenge in information systems engineering.

In this paper we claim that the use of foresight methods can provide valuable inputs for requirements elicitation, with the potential of decreasing the number of changes in the software lifecycle. Some works have already shown the benefits of using and adapting well-established methods from social sciences – e.g., ethnography, for requirements elicitation (Neto, Gomes, Castro, & Sampaio, 2005). Based on these experiences, we believe that elaborating on the current methods of foresight used by social scientists and futurists is a promising way to predict requirements changes. Thus, in this paper we outline a process based on a specific foresight method – Futures Wheel (Glenn, 1972) – to enrich a requirements model. In order to analyze the suitability of the proposed approach, we performed a case study using a route planning system.

**DISCOVERING THE FUTURE**

If discovering the current requirements of a system is already a complex task, what to say about the requirements for the future? We can affirm that it is even more challenging, since we may face several cases in which it is impossible to know for sure if an event expected to happen in the future is really going to happen. On the other hand, the understanding of the future does not have to be as detailed as the understanding of the problem as it is nowadays. This is the case because the study of the future will be an additional source for requirements elicitation, rather than its basis.

**Definition 1 (Future event):** a future event is an event that is expected to take place in the future.

According to Kotonya and Sommerville (1998), there are four dimensions to requirements elicitation, regarding problem analysis: Application domain, Problem to be solved, Business context and Stakeholder needs and constraints. If we aim at eliciting requirements dealing with future events, we need to consider the projection of these four dimensions in the future. For this purpose, some kind of representation of the future becomes necessary.

**Definition 2 (Representation of the future):** a representation of the future is a model that describes a set of future events.

A representation of the future can be either intentionally or accidentally created, and it can be of either a formal or an informal nature (Loveridge, 1996). Hence, it may occupy any position on the axes of Figure 1. The best representations of the future would be obtained if it was possible to create a formal and intentional model of the future, but not every project has sufficient resources or knowledge to create such a model. In these cases, the requirements engineer may collect some clues about the future while using normal elicitation techniques: listening to stakeholder comments during group sessions, reviewing the regulatory environment, analyzing the client plans, among others (Ecklund, Delcambre, & Freiling, 1996). This model would be informal, and could be either accidentally or intentionally created.

In the literature of future studies, futurology, and foresight there are several techniques and methods that support a rational discovery of possible futures (Glenn, 1999; Porter, 2003). These representations of futures may contain
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