Chapter 39

Improving Project Management of Healthcare Projects through Knowledge Elicitation

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ABSTRACT

This chapter describes a case study where Bayesian Networks (BNs) were used to construct an expert-based software effort and risk prediction model for use by a large healthcare organisation in Auckland (New Zealand) to manage healthcare software projects delivered on the Web. This model was solely elicited from expert knowledge, with the participation of seven project managers, and was validated using data from 22 past finished projects. The model led to numerous changes in process and also in business. The company adapted their existing effort and risk management process to be in line with the model that was created, and the use of a mathematically based model also led to an increase in the number of projects being outsourced to this company by other company branches worldwide. Their predictions improved significantly too. The results suggest that the use of a model that allows the representation of uncertainty, inherent in effort estimation, can outperform expert-based estimates.

INTRODUCTION AND BACKGROUND

Healthcare projects, similarly to software projects in other domains, need to be managed effectively so to enable the corresponding applications to be delivered on time and within budget. However, for a project to be managed effectively, it is important that a realistic estimate of the amount of effort (in person hours) needed to develop a software application be obtained and used as basis to predict project costs and to allocate resources (e.g. developers). This estimate is generally derived
taking into account the characteristics of the new project, and corresponding application, for which an estimate is needed, and also the characteristics of previous ‘similar’ projects, and corresponding applications, for which actual effort is known. The project and application characteristics employed herein are only those assumed to be relevant in determining effort.

The process of deriving an effort estimate is presented in Figure 1. The input to this process comprises the following:

1. Data and/or knowledge on past finished projects, for which actual effort is known, represented by project and application characteristics (independent variables) believed to have an effect upon the amount of effort needed to accomplish a task/activity/process. Whenever a company does not have either data or experience on similar projects or their corresponding applications, these tend to be replaced by an “educated guess” based on prior experience with dissimilar projects.

2. Data relating to the new project for which effort is to be estimated (estimated size and other factors), which is estimated based on the new application’s requirements (e.g. what functionality the application should offer to users). Such data also uses the same project characteristics employed in 1 above.

The output of this process is an effort estimate (dependent variable), which is then used to allocate resources, and to estimate project duration and costs.

The most widely used mechanism to derive an effort estimate is still expert judgement. However, despite the expertise of those involved in obtaining the estimate, the means of obtaining it are not explicit as the knowledge employed is only tacit. This means that the factors that are taken into account by the expert(s) are not known, and therefore repeating past successes becomes practically an impossible task. Given this situation, the research in this field started to investigate ways to model the relationship between effort and project & application characteristics. Numerous techniques have been used in order to build such models, such as statistical multivariate regression, case-based reasoning, classification and regression trees, neural networks, and Bayesian networks. Further details on each of these techniques are given in (Mendes & Mosley, 2008). Figure 2 shows this situation, where the estimation process itself includes two sub-processes, detailed below:

1. **Effort Model Building:** This sub-process represents the use of techniques to help with the construction of a tangible representation of the association between project & application characteristics and effort using data/knowledge from past finished projects for which actual effort is known. Such representation can take several forms, as above-mentioned, e.g. an Equation, a binary tree, an acyclic graph. This sub-process is shown using a dashed line because in some instances no concrete model representation exists, as for example, when employing a technique such as case-based reasoning.

**Figure 1. Effort estimation process**
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