

Troubleshooting Large-Scale New Product Development Embedded Software Projects

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Abstract. Many modern new product development (NPD) embedded software projects are required to be run under turbulent conditions. Both the business and the technological environments are often volatile. Uncertainty is then an inherent part of the project management. In such cases, traditional detailed up-front planning with supporting risk management is often inadequate, and more adaptive project management tools are needed. This industrial paper investigates the typical problem space of those embedded software projects. Based on a literature survey coupled with our practical experiences, we compose an extensive structured matrix of different potential project problem factors, and propose a method for assessing the project's problem profile with the matrix. The project manager can then utilize that information for problem-conscious project management. Some industrial case examples of telecommunications products embedded software development are illustrated.

1 Introduction

Most new electronic products contain embedded software in particular to enable more intelligent features and flexibility [1]. Thus, there will be more and more software projects developing embedded software for such new product development (NPD) markets.

Managing those modern industrial NPD projects successfully requires situation-aware control with the possible and oncoming troubles, taking the anticipated and even unexpected situational conditions into account [2]. Uncertainty is inherent [3, 4]. Project risk management is a traditional way of handling the obstacles, which may affect the project success adversely [5-7].

In this paper our premise is that in turbulent industrial business environments the product development projects must typically work under imperfect conditions. For example, it is hardly ever possible to avoid all external schedule pressures. In other words, the project management faces some problems all the time, and the project may be in some trouble even from the very beginning. This is sometimes referred to as project issue management [8]. In practice both proactive risk management as well as reactive problem (issue) management are needed [9].

The first step of problem-aware project management is to be able to recognize the current project problem factors. Project problems and uncertainties should be actively searched [10, 11]. There are no standard solutions, since the actual unique project context has to be taken into account.

The purpose of this paper is to propose focused aids for identifying and evaluating the typical problem factors of large-scale NPD embedded software projects (such as telecommunications equipment). The rest of the paper is organized as follows. Chapter 2 explores the background and related work, and sets the exact research questions. Chapter 3 then describes our solution ideas, while Chapter 4 evaluates them. Finally, Chapter 5 makes some concluding remarks, and outlines further research ideas.

2 NPD Embedded Software Project Problems

2.1 Typical Software Project Problem Factors

Over the years, there have been numerous investigations about typical software project problems and failure factors. Table 1 lists some of the known ones (ordered by the year of publication). For more, see for example [6, 8, 12-19].

Table 1. A survey of software project problems, risks, and failure factors

Investigation	Distillation
Brooks [20]	Fundamental problems of software engineering management
Curtis, et al. [21]	Human and organizational factors affecting productivity and quality of large projects (including embedded systems)
Boehm [5]	Top 10 general software project risk items
McConnell [22]	36 “classic” software project mistakes; Common schedule risks
McConnell [23]	Software project “survival test”; Checklists
Royce [24]	Top 10 risks of “conventional” process
Brown [25]	Typical software project management malpractices and pitfalls
Ropponen, et al. [26]	Categories of software project risks and their influencing factors
Schmidt, et al. [27]	Systematic classification of empirically observed project risk factors
Smith [28]	40 root causes of software project failure
May, et al. [29]	Common characteristics of dysfunctional software projects
Fairley, et al. [30]	10 common software project problem areas and some antidotes

It is possible to categorize different project problem factors from various different points of view. For example the classic SEI taxonomy defines one way of categorizing common risk factors under project environment, product engineering, and program constraints [31]. Other alternatives are for example in [22, 26, 27, 32].

It is in addition important to understand that in complex (multi)project environments the project problems do not usually manifest themselves in isolation, but there are often multiple overlapping problems at the same time. Furthermore, there are often complex cause-effect relationships of the different problem factors, i.e., a single problem may have adverse additional consequences [32/Ch. 5, 33/Ch. 3].