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ScienceDirect

Procedia - Social and Behavioral Sciences 221 (2016) 395 – 404

Procedia
Social and Behavioral Sciences

SIM 2015 / 13th International Symposium in Management

Research of Automotive Change Management and Combined Risk-Management Models

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Abstract

An Electronic-Control-Unit embedded within a car environment is constantly under attack of a continuous flow of modifications of specifications throughout the development life cycle until and beyond Start-of-Production. Root cause for modifications are for instance simply software or hardware errors, improvement for robust design or requirement changes to satisfy the forth-coming demands of the market to ensure later commercial success. Thus the pursuit for best in class products and self-preservation drives the need for modifications and effective methods to review all the side effects of changes before delivery. This paper focuses on the issue to tailor an automotive specific mechanism to guide the requirement change through all the stages determined by a typical automotive development until the settled feature meets the customer. The ability to control the requirement modification involves effective and reproducible procedures to deliver the so-called Request-for-Change (RfC, i.e. [1]) as specified. The Change-Management (CM) process should support all stakeholders with information such as the RfC transition status (i.e. reject, planned, implemented) and impact reports to the initial agreed objectives fixed by contract, which are product features, budget, schedule and quality. The research will not be limited, but focus the investigation of impacts of RfC during the early phase of the project, which are the Concept-Validation and Debugging-Phase. The second part of this paper will undertake the construction of risk management models, utilizing the RfC documentations and impact analysis information produced by the CM process. The research will lead to the understanding of the impact caused by a single RfC, and eventually summarizing the total risk faced by the project at any desired instance within the product life cycle. Finally the research will suggest a visualization model, which cultivates the data of continuous flow of requirement changes into early-warning system and fever curve of the project or a particular project milestone.

Peer-review under responsibility of SIM 2015 / 13th International Symposium in Management

Keywords: automotive engineering; change mangement, risk mangement, imapact analysis

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Peer-review under responsibility of SIM 2015 / 13th International Symposium in Management
doi:10.1016/j.sbspro.2016.05.129

1. Introduction

Considering the development of an Electronic Control Units (ECU) in the specific area of automotive engineering and focusing for example on todays Electronic-Infotainment-System, which is divided into several Network-Community partners such as the Main Unit, the Display Unit, the Instrument Cluster Display and several comfort and driver assistance units, as shown in figure 1. Each ECU will be assigned and development by a specialized automotive supplier. It is common practice, not only in the automotive business to develop complex projects with partners "*to respond quickly to the changing need of customers*" (i.e. [7]) or market requirements and concentrate on the core business competency [7].

The objective of this paper is to examine the question how to handle requirement changes in general and taking into account the automotive environment, the development life cycle, the side effects of multi-partner-relationships, and most important to suggest such an automotive specific Change-Management (CM) process. This paper contributes to several papers and books [2-7] dealing already with CM processes, but commonly neglecting the consideration of the faced risk by approved or rejected requirement changes. Thus, the 2nd main focus is deliver a Risk-Assessment-Model embedded within such a CM construction, which is the key to meet the adjusted objectives to be ready as expected. The research will aim to drive a simple to use guided-tour to judge the risk, which is carried by each single change and as well as reviewing the total risk at a particular milestone.

This study will at first clarify the hard facts of an automotive project environment regarding project objectives, project phases, supplier (stakeholder) responsibilities and finally the sources of RfC's. The investigation will simulate along the stated framework (hard facts) the inflow flow of modifications of specifications throughout the development life cycle until SoP. The graphical visualization of the RfC inflow with respect to the development or project timeline will give a description of the critical issues the project is facing and possible remedies to sustain control of the project. The result of the analysis will provide supplementary tools for the state off the art CM Methods described in ITIL [2], [4] Software Engineering or [5] Requirements Engineering.

2. The need for Change Management and Risk-Management

2.1. Requirement Changes arise for a variety of reasons

Pro-actively:

- New requirements due to must have changes to satisfy the (strong) demand of market to ensure the later commercial success. *"Seeking business benefits such as reducing costs or improving services or increasing the ease and effectiveness of support"* [2] (page 54)
- Improvement for robust design. *"Be successful at the first attempt"* [2] (page 54)
- "*Make the changes as early as possible*", i.e. [12] and introduce changes before the Stabilization-Phase (fig.2)

Re-actively:

- Requirement changes due to insufficient or faulty function description of the specification (FRS)
- SW or HW implementation errors. *"Resolving errors and adapting to changing circumstances" [2] (page 54)*.
- Changes of network community partners (as shown in fig. 1) caused by various reasons as stated above.

2.2. The Environment of Research

Automotive developments are broken down into specialized project areas. Considering for example todays Electronic-Infotainment-Systems (see fig. 1), which are divided into several Network-Community partners (see figure 1). Each ECU will be assigned and development by a specialized suppliers (e.g. [7], section "*Requirements for collaborative, multi-company ECM*"). The research assumes that that all partner have proven their potential to meet the project objectives which is part of an initial project launch supplier assessment, proving their "*domain knowledge in your own field*" [11].