Chapter 13
What is the Benefit of a Model-Based Design of Embedded Software Systems in the Car Industry?

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ABSTRACT

Model-based development becomes more and more popular in the development of embedded software systems in the car industry. On the websites of tool vendors many success stories can be found, which report of efficiency gains from up to 50% in the development, high error reductions and a more rapid increase of the maturity level of developed functions (The Mathworks, 2010) (dSPACE 2010) just because of model-based development. Reliable and broadly spread research that analyze the status quo of model-based development and its effects on the economics are still missing. This chapter describes the results of a global study by Altran Technologies, the chair of software and systems engineering and the chair of Information Management of the University of Technology in Munich which examines the costs and benefits of model-based development of embedded systems in the car industry.

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INTRODUCTION

In the last 20 years the value chain in the car industry has changed drastically. All car producers and suppliers worldwide have worked on improvements in the area of mechanics, the improvement of quality requirements, and improvements in the logistic area. A lot of the potential in these areas is already exploited. A main differentiation factor turns out to be the electronics area, where a change from hardware to software development is carried out. The meaning electronics will have in the next years has been analyzed by a study of Mercer Management Consulting (Mercer, 2004). The study focuses mainly on the question how the cost factors in the development of a car will change until the year 2015 in comparison to the year 2002. In 2015 the costs for the development of electronics will have a value of 35% of the total car production costs. Whereas areas as power train and body have small increases, the costs for the development of electronic systems will be almost tripled. The predicted increases result from a variety of innovations which are being expected in this area. The majority of innovations are realized with embedded systems and especially with software. „90 percent of the future innovations in the car will be based on electronics and from that 80 percent will be realized by software" (Lederer, 2002). However, today's software development has big challenges to master like shortened development times for the cars in total versus longer development times for the software, high safety requirements and especially the growing complexity because of the rising number of functions and the increasing interaction between the functions. To master these challenges car producers and suppliers conduct a paradigm change in the software development from hand-coded to model-based development.

A model-based development process is specifically attractive in embedded domains like Automotive Software due to the fact that development in these domains is driven by two strong forces: On the one side the *evolutionary* development of automotive systems, dealing with the iterated integration of new functions into a substantial amount of existing/legacy functionality from pervious system versions; And on the other side *platform-independent* development, substantially reducing the amount of reengineering/ maintenance caused by fast changing hardware generations. As a result, a model-based approach is pursued to enable a shift of focus of the development process on the early phases, supporting a function-based rather than a code-based engineering of automotive systems. Thus, the pragmatic question arises whether *a model-based approach – focusing on model of functionality as the most stable asset – is an economic approach in a domain driven by functional evolution as well as by hardware revolutions*.

On the one hand model-based development promises considerable productivity increases, improvements in quality and cost savings. On the other hand, it brings challenges since the use of model-based design results in a major process redesign. The introduction of model-based development influences established development processes, required resources and thereby also the organizational structure. In addition, high investment costs for tools and for training of the employees are necessary.

There is a controversy in the automotive industry about the benefit of model-based software development. Some companies seem to benefit of a model-based design and some don´t. Although model-based development is used by several car producers and suppliers, no major empirical investigations of the costs and benefits of model-based development have been conducted yet. Our aim is to analyze the costs and benefits of model-based development of embedded software systems in the car industry in detail, identify criteria how to optimize the costs and benefits of a model based development and give an outlook about the potential of further model-based development in development phases like requirements engineering