Chapter 6.1
Business Process Reengineering in the Automotive Area by Simulator-Based Design

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ABSTRACT

The automotive industry is facing economic and technical challenges. The economic situation calls for more efficient processes, not only production processes but also renewals in the development process. Accelerating design work and simultaneously securing safe process outcome leads to products in good correspondence with market demands and institutional goals on safe traffic environments. The technique challenge is going from almost pure mechanical constructions to mechatronic systems, where computer-based solutions may affect core vehicle functionality. Since subcontractors often develop this new technology, system integration is increasingly important for the car manufacturers. To meet these challenges we suggest the simulator-based design approach. This chapter focuses on human-in-the-loop simulation, which ought to be used for design and integration of all car functionality affecting the driver. This approach has been proved successful by the aerospace industry, which in the late 1960s recognized a corresponding technology shift.

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INTRODUCTION

For the automotive industry, the recent years have been characterized by huge economic losses among some major companies. This occurs from time to time and usually initializes efforts, which can be described as business process reengineering. We have seen much of this concerning the

production parts of the companies and in the flow of components and sub-systems from subcontractors. Just-in-time deliveries and lean production are buzzwords we all have heard. But, has anyone noticed something similar from the R&D side? Of course, most people interested in cars have read about shared platforms and so forth over a number of models. But this is not business process reengineering, this is just technique rationalization. Since a long time ago the design process is computer supported in many ways, but what steps could the automotive industry take now in order to improve the design process? We believe that a more extensive use of virtual prototyping and simulation could be that answer. This statement is supported by the ongoing technology shift for all kinds of ground vehicles; from purely mechanical artifacts to more complex systems with computerized functions, more convenient to implement in a simulated environment than the old mechanical solutions ever were.

The main purpose of this chapter is to give an overview of the ongoing technology shift inside the vehicles (see *Figure 1* as a symbol of this shift) and to couple this to simulation possibilities and thereby introduce the business process simulator-based design (SBD). Our perspective is human-machine interaction (HMI) and therefore we address human-in-the-loop simulators, but we are quite aware on the fact that simulation could and even must be used on other levels in order to optimize and verify more technical functions. This is also a part of the SBD approach, but not specifically addressed in this chapter.

The authors of this chapter have more or less life-long experience from this way to proceed in R&D activities in aircraft design projects. Since the beginning of the 1970s, the SBD approach has been extensively used in the aerospace industry with the initial purpose to get safe design answers at early stages of development in order to avoid late changes at high cost levels. Later on, with more mature simulation tools and expertise, simulator evaluation was introduced also for final system certification, with only a minor part of functionality left for flight tests. The main reason behind this introduction was cost-effectiveness. This way to work has not yet become state-of-the-art in the automotive industry, so the purpose of this chapter is to contribute to this change by sharing our experience. During the last five years we have worked on this theme in our laboratory resources at Linköping University and today our simulator facility for ground vehicle system design has reached a level of effectiveness close to what we have used for aircraft design in the past. Thus, this chapter is more based on our own experience than on other sources.

Concluding this introduction, we would like to give some thoughts on the competence profile in the design departments of the car manufacturers. It is our impression that the technology shift in cars has a rather poor correspondence with the competence profile. Car manufacturing has its roots in mechanical engineering and this still affects the competence profile irrespective of the fact that the new technology represents around 50% of the built-in technique in today's cars. This has opened the market for subcontractors with more IT-based competence and put new demands on the car manufacturer—as system integrator. Simulation is a powerful tool also in system integration work, not the least from the

Figure 1. Concept car from GM (How GM's Hy-wire works, http://auto.howstuffworks.com/hy-wire.htm, January 10, 2006)