Research Planning, Assignment 2

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1. Requirement development in product models – a PREPARE project

1.1 The PREPARE initiative and project partners

PREPARE is a cooperation between Mälardalen University and industry. The purpose of PREPARE is to let employees in the industry develop their individual competence, as well as contributing to business of the company and collected knowledge of academia, by undertaking a one year research school roughly corresponding to the first year of a PhD program. During this year the PREPARE participants shall do research of a topic that is of interest for the company and present the results in an academic style report. Stretch targets of the individual PREPARE projects are to publish a paper and/or apply for funding for further doctoral studies.

Partners of this particular PREPARE project are Mälardalen University and Volvo Construction Equipment AB.

1.2 Background

The use of embedded electric and electronic (E/E) technology in modern construction equipment is constantly increasing. More and more features of the machines are realized with the help of E/E technology and software, both replacing old solution of existing features, for example with a X-by-wire solution, as well as enabling new ones. The situation is to a high degree similar as to that of E/E systems in the automotive domain (particularly for a company like Volvo CE). For a high-end product in the automotive domain as much as up to third of development cost can stem from E/E system development [10] and 80% of the innovation is software related [8]. At the same time up to 35% of the failures can be traced to the E/E system [6]. While introducing more electronics in machines offers the opportunity to lower product cost (by replacing obsolete technologies) and enhancing the product offerings (enabling new features), the increased complexity of both the E/E system and the associated development situation can lead to higher development costs and greater project risks (such as quality issues). A new approach to E/E system development is needed to handle the complexity.

A critical aspect of the development process of E/E systems is management of engineering information, from the first statement of a need for a service the E/E system shall provide to the machine it is build into, to the detailed description of the implemented solution. One
envisioned strategy to master complexity is to try to capture all relevant engineering information in a single product model (with product it is here meant he E/E system) with a well defined structure [6, 9]

A sub-set of the engineering information to be managed is the requirements on the E/E system that states what the system shall do. The development of any system following a sound Systems Engineering process starts with a requirements analysis phase, e.g. as described in [7], or as Buede puts it in his SE text book, “Defining the Design Problem” [5]. The next step would be to start the actual design by defining the functional architecture of the embedded system. Defining the design problem for an embedded E/E system corresponds to specifying the services needed from it by the surrounding environment. The amount and complexity of the services the E/E system shall provide in modern construction machine increases the risk of miss understanding and “loss” of requirements when translating them from the problem space to the design space in the requirement engineering processes. This is something that has also been observed at the projects industrial partner (Volvo CE).

1.3 Objectives and Scope

The objective of this project is to investigate what methods to “define the design problem” of an E/E system utilizing a single product model that exist today and to investigate if any of these methods can be used to support the development of E/E systems for construction equipment.

2. Research method

The first step of the research that will be undertaken in this project will be a survey of literature to see what methods that exist today. The second step will be an analysis of the result from the survey and to identify one candidate method to proceed with. The third and last step will be to try to validate the result in the context of E/E systems in construction equipment. This will likely include a two case study at the projects industrial partner. One were the current situation is mapped for reference, and one were the results from the survey and analysis in implemented.

3. Current research issues

In the domain of automotive E/E-systems which is highly related to the construction equipment domain, [4] identifies the follow open research issues:
• E/E system architecture and modelling and description of architecture
• Managing complexity of E/E-system and the associated process
• Improvement of development processes
• A seamless model based development
• Integrated tool support
• Learning from other domains
• Improvement of quality and reliability

4. Research Area Overview

Investigation of the research area is currently on-going and is a major part of the PREPARE project. In this section the findings so far is presented.

4.1 EAST-ADL2

EAST-ADL2 is a domain specific Architecture Description Language for modelling of automotive E/E systems [6]. EAST-ADL was originally developed in the EAST-EEA project and has been further developed into EAST-ADL2 in the ATESST project [1]. EAST-ADL2 provides a well defined structure for the engineering information covering both hardware and software aspects.

4.2 The MeMVaTEx requirement engineering methodology

In the MeMVaTEx project a Model based methodology for Requirements Engineering has been developed [3]. This method utilizes concepts both from EAST-ADL and SysML.

4.3 AutoMoDe

The goal of the AutoMoDe project is to develop an integrated method for model based development of automotive [2]. AutoMoDe has similar goals and purpose as EAST-ADL

5. Key conferences and leading research groups

Non identified so far.
6. References


