Chapter X

Requirements Engineering for Technical Products: Integrating Specification, Validation and Change Management

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Abstract

Over the last few years the functionality and complexity of technical products has increased dramatically. This is reflected in the complexity of the development process. In this chapter we discuss in detail the resulting challenges that have to be faced by requirements engineering. We identified these challenges in interviews conducted at a German car manufacturer. The main part of this chapter presents the QUASAR requirements engineering process that faces all identified challenges. In particular, it supports: (1) a set of views and abstraction levels tailored to the stakeholders, (2)
communication about these views through understandable notations, (3) efficient
access based on tools and traces that make relationships between views explicit, (4)
explicit feedback based on inspection and simulation, and (5) overall quality by
integrating a formal specification technique with informal, textual specification
techniques as well as through guidelines, checklists and tailored review
techniques.

Introduction

Technical products, such as automobiles, washing machines, or video recorders, play
an important role in our daily lives. Over the last few years the functionality and
complexity of these products increased dramatically. Reasons for this are a technology
push through reduced costs for hardware but also growing shares of software. Technical
products are specific sociotechnical systems. Typical sociotechnical systems, for
example, service engineer support systems, are characterized by many stakeholders in
different roles that interact with the system. To understand and design such a system
adequately, stakeholders and their relationships, as well as the influence of the system
on the usage environment, have to be analyzed in detail (Sutcliff & Minocha, 1998). For
a technical product, typically, there is only a small set of users. In addition the context
of the user is already well known because products are typically developed in series.
Therefore requirements engineering (RE) can concentrate on the interaction of the users
with the new functionalities of the product. However the development process has to
be reflected during RE. Technical products are sold on the market. They integrate
hardware, software, and mechanics. And for complex technical products such as cars
several suppliers are involved. Thus viewpoints of various stakeholders with differing
backgrounds have to be elicited and integrated. Typically these stakeholders are
distributed over several companies and locations and work in a fast-changing environ-
ment. This induces challenges for the whole product development process, and in
particular for identifying, collecting, managing, and validating requirements (Grimm,
2003). In terms of the onion model of stakeholder relationships proposed in Alexander
& Robertson (2004), this means that most stakeholders are found in the outer-most layers.
Roles and often even persons involved in the development process of technical products
are typically quite stable and well-known because of the series development. To reflect
this situation, the emphasis during RE of technical products is on fostering long-term
relationships based on efficient communication between the stakeholders and not so
much on identifying the stakeholders.

In the following we discuss in detail the challenges that have to be faced by RE for
technical products. We identified these challenges in interviews that we conducted at
a German car manufacturer. The main part of this chapter presents a prescriptive RE
process that faces all identified challenges. This process has been developed and
evaluated during the last three years and is the major result of the QUASAR project
funded by the German ministry for research. Throughout this chapter we use an example
(that is, the development of a door control unit of a car) to illustrate the challenges and
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