Early Validation of Engineering Artifacts

Valid engineering artifacts are a key success factor for reliable (software) systems. Validity in this sense means that the engineering artifacts are the right ones to completely and correctly describe system properties as desired by stakeholders, and that they are consistent among one another. It is widely acknowledged that the later the engineering artifacts and results are validated, the higher the effort for correcting any defects found will be, leading to serious budget overruns and project delays. In this chapter, we identify major challenges of validation in early phases of the development process, including reducing the ambiguity of natural language, handling complex systems, and the need for a more structured and automated approach to validation. We introduce the requirements quality assessment framework (RQAF) as a structured approach for performing validation systematically. Furthermore, we describe a set of methodological building blocks that instantiate the RQAF and provide exemplary solutions for the stated challenges.
6.1 Introduction

The purpose of validating engineering artifacts is to ensure that the engineering artifacts are of sufficient quality for subsequent development activities. In particular, artifacts must reflect stakeholder intentions completely and correctly with regard to the system under development (SUD) and must be consistent among each other. Hence, these artifacts can be considered as the (requirements) specification and are subject to validation, that is, ensuring that a system is adequate with regard to some operational purpose [Boehm 1981]. There is a plethora of additional quality attributes [ISO/IEC 25010] that artifacts should satisfy. If engineering artifacts do not satisfy these quality criteria, the consequence may be serious project delays or budget overruns [Boehm 1981]. Therefore, it is essential to validate all engineering artifacts at the earliest possible stage during development.

Validation can take many forms. For example, requirements can be validated with regard to the stakeholder’s vision of the finished product, to assess whether the right requirements have been elicited, or to assess whether safety or security measures are adequate [Tenbergen et al. 2015]. Furthermore, intended or unintended interactions between the system and its context (e.g., human users or other systems) can be validated to ensure that the interaction leads to the right outcome, or design decisions documented in logical or technical component models can be validated to see whether they satisfy specific qualities (e.g., performance or security).

This chapter presents a collection of methods which focus on the static and dynamic validation of engineering artifacts at different granularity layers as early as possible in the system development process. More specifically, the methods introduced provide guidance for creating artifacts that can be validated right from their creation. Depending on the specific validation objective, validation faces different challenges. These challenges are briefly discussed in the next section. To meet these challenges, this chapter presents a generic validation framework (Section 6.1.2) that structures validation activities and associates artifacts necessary to validate engineering artifacts of the SPES XT modeling framework (Section 6.2). This is followed by the presentation of a selection of methodological building blocks (see Section 6.3) that produce and/or consume