Software Product Family Evaluation

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Abstract. This paper proposes a four-dimensional evaluation framework for software product family engineering. The four dimensions relate to the software engineering concerns of business, architecture, organisation, and process. The evaluation framework is intended for use within software developing organisations to determine the status of their own software product family engineering and the priorities for improving. The results of the evaluation can be used for benchmarking, roadmapping, and developing improvement plans. An initial evaluation of a real industrial case is presented to show the validity of the framework.

1 Introduction

The main arguments for introducing software product family engineering are to increase productivity, improve predictability, decrease the time to market, and increase quality (dependability). To improve the overall system family engineering capability in Europe, a series of Information Technology for European Advancement (ITEA) projects on this topic is being executed, namely if99005 ESAPS (1999-2001), if00004 CAFÉ (2001-2003), and if02009 FAMILIES (2003-2005). We are involved in all or some of these projects. The initial evaluation framework for software product family engineering was prepared during the ITEA project called From Concepts to Application in System-Family Engineering (CAFÉ). In this paper, we provide an improved framework as well as a more extensive explanation of the different development concerns in relation to software family engineering. Within the recently started FAMILIES project, an improved and refined version will be produced and tested. The framework has been developed based on experiences with a wide variety of software product families and is illustrated in this paper using a case within Philips Medical Systems.

The focus of this paper is on embedded systems. Software product family engineering originated from embedded systems development, where product families
already existed. Software in embedded systems was introduced originally to improve the flexibility and later for the introduction of more functionality. When the amount of software was growing, the family engineering approach had to be applied on software as well. As software behaves differently than other product assets, it was initially not clear how to deal with it. In this paper, we look at all the concerns around software product family engineering. Below, we often denote products built by software product family engineering. We refer then to embedded systems that have software inside produced in a family-wise way. Our approach works, however, also for pure software systems, but we have not seen many examples of such systems.

The remainder of the paper is organised as follows. In the next section, the Business, Architecture, Process, Organisation (BAPO) model is introduced. BAPO is used as the basis of the evaluation framework. Subsequently, the four evaluation dimensions are discussed. Then, we give a validation example, discuss related work, and finally, provide our conclusions.

2 The Business, Architecture, Process, Organisation (BAPO) Model

Within the ITEA project called Engineering Software Architectures, Processes, and Platforms for system family Engineering (ESAPS), we identified four interdependent software development concerns, BAPO 1:
1. Business, how to make profit from your products
2. Architecture, technical means to build the software
3. Process, roles, responsibilities, and relationships within software development
4. Organisation, actual mapping of roles and responsibilities to organisational structures

Figure 1 gives an overview of the BAPO concerns. Links denote the interrelationships between the concerns that exist between all pairs. In principle, applying changes in one concern is though, because it induces changes in the others. Arrows denote a natural order to traverse the concerns, giving an order to the acronym as well. The Business is the most influential factor: it has to be set up right in the first place. The architecture reflects the business concerns in software structure and rules. The process is set up to be able to build the products determined by the architecture. Finally, the organisation should host the process.

Through the clarification of these dimensions, the ESAPS, CAFÉ, and FAMILIES projects consider all the concerns in the context of software product family engineering. In fact, although architecture is an important topic for family engineering, the process had a much larger emphasis in these projects, since it was often neglected in earlier approaches. Due to the realisation that it is crucial for software family engineering to address the business and organisation well, effort was also directed to these dimensions, resulting in a more complete view of what is necessary for software product family engineering.