A Metamodel for Component-Based Service Modeling

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ABSTRACT
Due to industrialization of services, organizations need to establish new approaches for tackling challenges like increased competition, complexity, and pressure on the market because of prices. It seems promising to use approaches from other domains in the service industry, e.g. Mass Customization from the domain of industrial engineering. This work presents a metamodel implementing standardization and modularization concepts. Furthermore, we provide a formal framework for service modeling and configuration. Thus, it is possible to mass customize services.

Keywords: Competition Increase, Component-Based Service Modeling, Industrialization, Mass Customization, Service Industry

INTRODUCTION
Today, service organizations face challenges in performing successfully on increasingly competitive and international markets. Like customer services, industrial services are more and more affected by increased demand for individualization and pressure on the market because of prices (Papathanassiou, 2004). While market pressure forces organizations into effective and efficient service provision, the demand for individualization increases the complexity of service provision. To meet these challenges, it seems likely to adapt approaches from industrial and software engineering as these domains faced similar problems in the past (McIlroy, 1968; Sundbo, 1994). One of these approaches is called mass customization (Hart, 1995; Pine II, 1999). Its fundamental idea is the decomposition of complex, monolithic structures into more simple, standardized components with precisely defined functionality. This is called modularization and allows for using the advantages of standardization (e.g. economies of scale, simplified maintenance) for customer individual services, too (Böttcher & Klingner, 2011; Heiskala, et al., 2005).

So far, service literature has shown the applicability of modularization and mass customization in the service domain (Sundbo, 1994; Heiskala, et al., 2005; Böttcher & Klingner, 2010). To make these principles work in practice and to develop supporting tools, it is necessary to establish a formal framework.
Thus, in this paper we present a metamodel for describing services based on modularization and standardization. However, the metamodel is not only focused on formal service description but also on supporting the development of customer individual service configurations. For doing so, it is necessary to represent key performance indicators and dependencies between elements of the service description. Based on this description, it is possible to evaluate customer individual services in terms of validity and productivity.

The metamodel we present in this work is the aggregation of different requirements and suggestions gathered in collaboration with industry representatives. The need for methods and tools for structuring complex service portfolios was identified in the context of a qualitative survey of service organizations (Böttcher & Meiren, 2012). Moreover, functional requirements and enhancements were discussed in numerous workshops with project partners (Klingner, et al., 2011). Relevancy to practice was furthermore shown by various workshops dealing with productivity of service systems.

The presented metamodel is focused on the formalization of concepts for modeling complex services. Therefore, this paper is structured as follows. “Concepts for Modeling Services” introduces and describes concepts for modeling services. Applying these concepts, the section “FORMAL METAMODEL” formalizes the metamodel. Since the metamodel aims to support the development of customer individual configurations of services, section “Configuration” presents this process based on a real-world example. For supporting the application of the metamodel in practice, it is necessary to develop software tools implementing the formal metamodel.

Software “Support” shows a prototypical implementation of such a tool. Besides tool support, methodological support is necessary for applying the metamodel. Therefore, in section Supporting Service Development “Phases” we give an overview on service engineering phases and shows ways to use the metamodel in different phases. Finally, the paper is concluded by the sections “Discussion” and “Conclusion” with a critical reflection of the contribution and an identification of future research directions.

CONCEPTS FOR MODELING SERVICES

This section presents necessary concepts for defining and modeling services used in the metamodel. Based on this overview, it is possible to abstract from specific design decisions of the metamodel. Additionally, our approach can be compared with other approaches focusing on similar problems. All used concepts are presented in Table 1 and described in more detail in the following.

Today, services play an increasingly important role for value creation of organizations. Furthermore, more sophisticated customer requirements increase the complexity of services. This results in the fact that a monolithic consideration of services is not feasible anymore. Therefore, approaches for modularization are increasingly recognized in service description. Modular descriptions allow for composition of complex products based on simple components. These components can be developed independently (Baldwin & Clark, 1997).

The metamodel implements a concept of modularization by using service components. A service component represents a well-defined functionality which is provided by logically related activities (Böttcher & Fähnrich, 2009). For providing the functionality of a service component, resources are consumed and modified. The metamodel focuses on the description of single components and the interaction between components. For supporting interaction, the functionality of a component is provided using precisely defined interfaces.

Using components, it is possible to establish a trade-off between increased demand for individualization and necessary service standardization. This allows for implementing mass customization. Individualization is necessary for developing customer individual service offers and, thus, for distinguishing from...
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