Formalizing the conceptualization of services and their relationships with software components

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Abstract — **The conceptualization of services and the relationships between services and software components reduces the gap between the business process life cycle and their executable versions. A conceptualized service may be considered as both, a new business service implemented to realize an activity of a business process or as a business function of an existing application that will be reused as a service. The aim of our research work is to improve the SOA/BPM methodology by linking business processes with software services and formalizing each step of the methodology to enable automatic generation of robust and reliable software products. Within this research frame, this paper proposes the use of meta-models as a means to define the syntax of the models used at each step of the methodology as well as to define the transformation rules between steps. In our previous work, we presented a conceptualization of the service meta-model integrated with the BPMN meta-model. Enhancing such conceptualization, this paper proposes a formalization of the central stages of the proposed methodology. The formalization relies on: 1) the application of two well-known standards - the Service Component Architecture (SCA) standard for describing how to create and combine components, and the Web Services Description Language (WSDL) standard for specifying network services as a set of endpoints operating on messages, and 2) the integration between the service meta-model conceptualization of the SOA/BPM methodology with the SCA and the WSDL meta-models. The main contribution of this work is to provide an approach to formalize a methodology linking business processes and software artifacts and providing a step forward towards automatic transformation of models into executable software.**

Keywords - **Business Processes; Web Services; BPMN; WSDL; SCA; Meta-Model; Components; MDD**

I. Introduction

Service Oriented Architecture (SOA) is an approach to design and build flexible and adaptable systems, where services can be shared and reused in many business processes. A strategy to manage and improve business performance, Business Process Management (BPM) optimizes business processes through modeling, execution and performance measurement of business activities. Our previous work [1], proposed the SOA/BPM methodology integrating the modeling of business processes and software services. To formalize the interactions between different modeling elements, the methodology proposes the use of meta-models. In particular, we focus on formalizing the relationships between: 1) Processes - modeled as refinement steps from the business model [8]; 2) Services - conceptualized to respond to processes activities [13]; and 3) Components - implemented to run processes and services. Following such aim, this paper proposes a formalization of the central stages of the SOA/BOM methodology.

II. Related work

To assess the contribution of this work, we analyzed the state of the art on the application of Model Driven Architecture (MDA) to achieve executable versions of processes through the composition of services.

Based on MDA, [4] proposes a new method to compose web services, using UML scenarios specified through sequence diagrams. The proposed method generates the code of the composite service in BPEL (Business Process Execution Language). To understand in depth the WSDL meta-model, [11] proposes an extension to the WSDL standard to integrate profile characteristics on the description of web services. Based on MDA and model transformations, [14] introduces a development process for web application interfaces. The process combines SOA and Service-Oriented Development Method (SOD-M) to generate web services interfaces in WSDL and WS-BPEL.

Compared with the approach proposed in this paper, [4] uses MDA to derive BPEL from web services using a reverse approach – from web services to business processes. Although [14] follows a similar approach, it is only used to develop web application interfaces.

II. Modeling – From Processes to services

The process enabling to specify services from business process activities is the key modeling task to formalize the interaction between processes and services. To formalize such interaction, we propose a meta-model called P2S [8]. The proposed meta-model is based on adapting and integrating the SOAF service conceptualization meta-model [2] and the BPMN meta-model [3]. The underlying idea is to consider each process as a set of activities, where each activity is seen as an abstraction of certain functionality that will be performed by a service. The meta-model establishes that the meta-class Service "performs" an Activity and conceptualizes services as a generalization of external services – new functionality to be delivered, or as internal components – existing functionality to be reused. The meta-model is built as an instance of the standard language MOF (Meta Object Facility) [5], which is the most abstract layer in the 4-layer architecture of the OMG modeling [7] [6].

III. Modeling – From Services to Components

To obtain the executable implementations of services and eventually to design their orchestration, we propose to apply the SCA standard. The SCA architecture defines a general approach to create components and describe how they work together [9]. The SCA meta-model defines a specification language for the Component Definition stage [1]. Thus, to formalize interactions between services and components, we propose to integrate the P2S and SCA meta-models [13]. The challenge for such integration is that Component in the P2S meta-model is a specialization of Service, while in SCA, both Component and Service are part of Composite. Therefore, Service does not share the same level of abstraction in the two meta-models. To disambiguate the Service concept, we define that Service in the P2S meta-model is a model of service and not the service itself, meaning that is a conceptual service that may be a component or an external service. In this sense, the meta-class Service of P2S is renamed as ConceptualService. In this way, we link both meta-models through the meta-class Component. In turn, the meta-class Component which is used to link the two meta-models can also be renamed as ConceptualComponent in P2S and related with Component in SCA (see Figure 1).

Finally, to formalize the specification for implementing components, we propose the use of Web Service Definition Language [10]. Web Services technologies are an alternative to compose and deploy based standard services. WSDL [10] documents describe web services functionality and contain information about the service location, methods and protocols. The WSDL language has a meta-model [11] [12] that is integrated with the others. Therefore, it provides a mechanism to formalize the Component Implementation stage [1]. Figure 1 shows the proposed integration between the meta-models applied – P2S, SCA and WSDL.

IV. Conclusions

This paper presented our approach to use and integrate three meta-models - P2S, SCA y WSDL to formalize major steps of the SOA/BPM methodology. The main contribution of this work is to provide an approach to linking business processes and software artifacts and providing a mechanism for automatic transformation of models into executable software. Future work includes completing the formalization of the remaining steps of the methodology and comparing the application of the methodology to different domains.

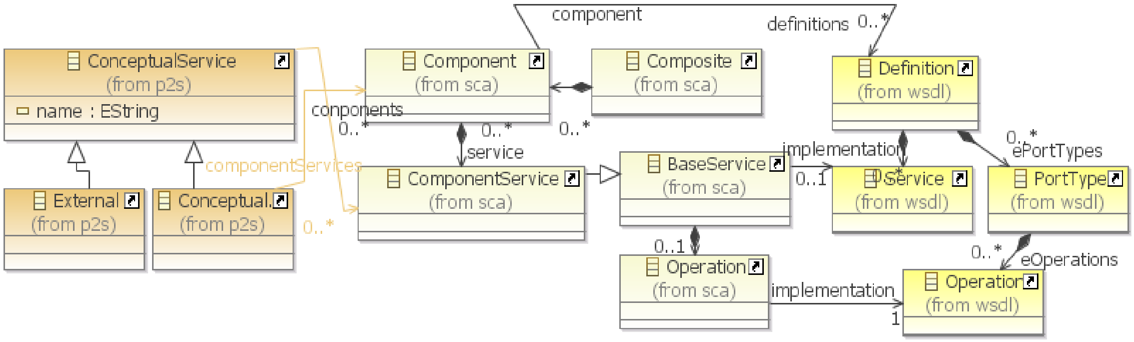

Figure 1. Integration between P2S, SCA and WSDL metamodels

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