Business Service Description Methodology for Service Ecosystems

Gregor Scheithauer[1,2]

[1] Siemens AG, Corporate Technology
Information & Communication, Knowledge Management
Otto-Hahn-Ring 6, 81739 Munich, Germany
gregor.scheithauer.ext@siemens.com
[2] University of Bamberg
Distributed and Mobile Systems Group
Feldkirchenstraße 21, 96047 Bamberg, Germany

Abstract. Service ecosystems are electronic market places which emerge as a result of a shift toward service economies. The aim of service ecosystems is to enable to trade services over the internet. One obstacle to realize this new form of market place is a missing common description for electronic provisioned services. Additionally, methods and tools must become available which have to realize this description. A *Business Service Description Methodology for Service Ecosystems* allows describing electronically consumed services, offers modeling facilities and ontologies, links professional and technical theories, and provides a methodology which supports domain experts. This will improve to propose services, service discovery & selection, service negotiation & service contracting, service monitoring & profiling, service substitution, and service composition.

Key words: service description, business service modeling

1 Introduction

Tertiarisation describes a structural change in developed countries concerning the sectoral composition. Countries shift from an industry economy toward a service economy. Drivers of this change include globalization, technological change, and an increasing demand for services [24]. Considering this trend, it becomes clear that services and the service economy play an important role in today's and tomorrow's business. In line with this trend, service ecosystems emerge, such as eBay, Google Base, Amazon.com, SalesForce.com, and SAP Business by Design. The vision of service ecosystems is an evolution of service orientation and takes services from merely integration purposes to the next level by making them available as tradable products on service delivery platforms [4]. They aim at trading services over the internet between different legal bodies, compose complex services from existing ones, and IT-supported service provisioning [10].

Figure 1 depicts steps which are involved in service trade: (1) service proposition, (2) service discovery & selection, (3) service negotiation & contracting, and

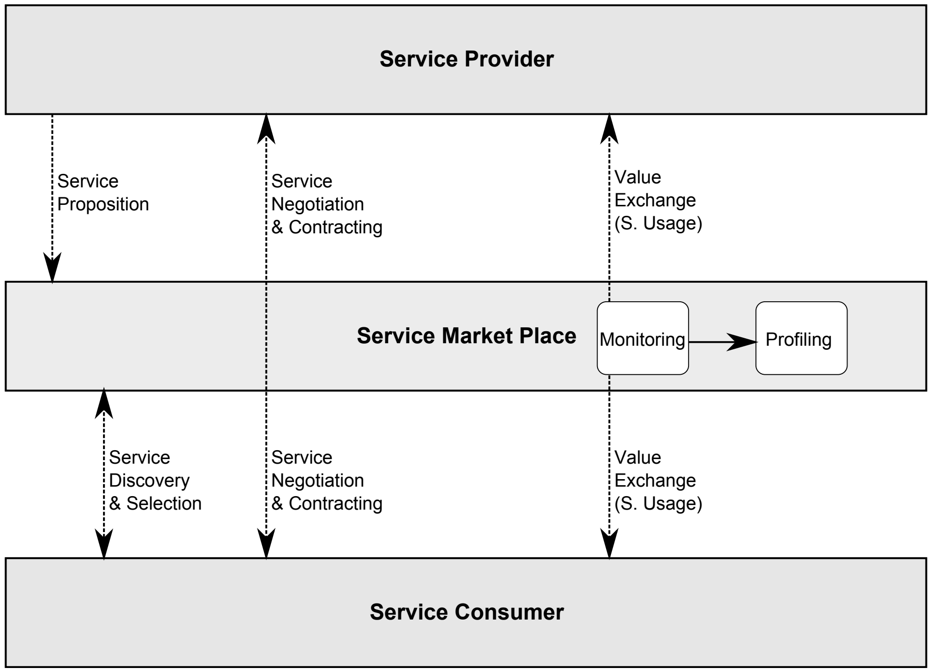

Fig. 1. Trade in Service Ecosystems

(4) service monitoring & profiling (cf. [13]). Midst service proposition, service providers advertise their services toward potential consumers, whereas during discovery & selection, service consumers specify their service preferences toward providers. In the event a service consumer selects an appropriate service, providers and consumers negotiate and finally agree on service levels (SLA) which are monitored throughout service consumption. In the event service levels are not met, compensations must be triggered. During service profiling, valuable information on services' performance is stored, which is gathered while service usage and monitoring.

2 Motivation

In order to enable service trade, a shared and common understanding of services must become available. Nonetheless, no established language exist to define, to agree on, and to monitor service properties [13]. On top of that, Booms and Bittner [5] argue that services are different to goods, that is services are intangible, and thus, can neither be stored, transported, nor resold. Goods are produced at some point, stored, and eventually consumed at a later point. In contrast, production and consumption of services take place at the same time. Goods can be transported from one point to another. Services, on the other hand, are consumed at customers' locations, thus, production and consumption happen in one place. Whereas goods can be resold, services' outcome cannot be sold to another party. Additionally, services can hardly be standardized, since service experience is unique and depends on the individual expectations.

While ample technical specification exists to describe services, conceptual notations to elicit business-relevant domain knowledge are lacking. Suitable technical specifications for service descriptions include: (1) Web Service Description Language (WSDL) [27], (2) Web Ontology Language for Services (OWL-S) [14], (3) Web Service Modeling Ontology (WSMO) [28], and (4) Service Level Agreements for Web Services (WSLA) [11], just to name a few. Currently, semantic concepts to describe web services base on formal approaches, such as first-order logic and predicates. This hinders domain experts to describe services with these concepts. A more sophisticated approach must become available.

Recent work concentrats on the *business service modeling* discipline with a focus on how to formalize the relationship between business operational requirements and to implement them with service-oriented architectures (cf. [6]). However, the focus lies in business process transformation [22]. No attempt has been made for service descriptions.

3 Research Problem

The basic questions that I attempt to answer is (1) how one can extend the semantics of existing modeling notations in order to allow the modeling of service descriptions, and (2) how this can be mapped to technical specifications. This problem can be subdivided into the following questions. Section 6 elaborates on how to answer these questions.

1. What are service ecosystems and their service description requirements?
2. Which service properties are relevant for service ecosystems?
3. How are service properties modeled during service design utilizing process model notations and business model notations?
4. How are service properties implemented with web service technology?
5. How is coherence established between service description design and implementation, and how can service properties be derived from business models and implemented with web service technology?

4 State of the Art

Baida et al. [2] elaborate a notion for the concept of services. It includes real-world services, internet-based services, and web services.

Papazoglou's extended service-oriented architecture [23] comprises a basic service description. It includes the aspects: service capability, service interface, service behavior, and service quality attributes. My research focuses on the service capability and is understood as functional properties, and on the service quality attributes which is understood as non-functional attributes.

Quartel et al. [26] describe a framework for concept service modeling (COSMO). The framework comprises two orthogonal dimensions: service aspects and level of abstractions. Service aspects include: structure, behavior, information, goal, and quality. Single interaction, choreography, and orchestration represent levels of abstraction. Each intersection is a placeholder for models or implementation languages. The quality aspect refers to non-functional properties, goals to functional properties. This framework supports to establish coherence between different service description artifacts.

Oaks et al. [15] write about the lack to specify service capabilities, that is, what services, or agents, can do. They offer a structured and machine interpretable capability description. This approach will be of help to specify a service's functional properties.

O'Sullivan [21] illustrates in his PhD thesis a wide range of quality attributes to describe real-world services. These attributes include availability, obligations, price, payment, and discounts, just to name a few. His work will support the understanding of non-functional properties.

Gordjin et al. [7] offer a structured approach, namely the e^3-Value Model to gather requirements for e-commerce applications. It includes three levels of abstraction and a six steps process for guidance. They argue that current requirement engineering methodologies are inadequate for the e-commerce domain. Their work will guide my understanding for service requirement analysis.

The ontology presented by Osterwalder [20], offers a holistic way to describe business models. It comprises the following concepts: (1) value proposition, (2) target customer, (3) distribution channel, (4) relationship, (5) value configuration, (6) capability, (7) partnership, (8) cost structure, and (9) revenue model. My research focuses on the value proposition, the value configuration, and the capabilities. The value proposition equals services' functional and non-functional properties. The value configuration represents the interplay of different services to meet a value proposition. Capabilities embody the competencies to execute a business model and thus, depict requirements toward services.

The Open-EDI reference model [9] distinguish between a business operational view and a functional service view. Dorn et al. [6] refines the business operational view into business models and process models, and the functional service view into deployment artifacts and software environments. These works helps to categorize models and implementation languages and to correlate them in order to establish coherence.

5 Preliminary Results

To date, I spent most of the time to gain knowledge in the field of "semantic web services" and "services research" in general. Furthermore, I looked into "business models" and "modeling".

As a preliminary result would count the investigation, consolidation, and verification of service properties. Firstly, a literature research was carried out.

Secondly, identified approaches were explored and compared. Additionally, similarly properties from all approaches were consolidated. Thirdly, for a better understanding and reduction of complexity, likewise properties were grouped into sections. Each section was named on the basis of the corresponding properties. Following this, available experts were identified for each section. These experts were questioned about all sections and properties in general and the section regarding the interviewee's expertise in particular. The answers were integrated into the comparison. The properties were used to describe existing services. Lastly, results were published [30, 29].

Additionally, I looked into service engineering methods. Three colleagues and I work on a service engineering methodology on the basis of the Zachman framework and model driven architecture (MDA). Our intermediate results were published at the RESER 2008 conference [12].

Recently, I motivated and extended to use the Zachman Framework as a coherence framework for service description notations and realization languages (cf. Scheithauer et al. [29]).

6 Approach

This section introduces an approach to tackle the challanges mentioned in section 2. I call the final outcome of my research project *Business Service Description Methodology for Service Ecosystems.* It allows describing electronically consumed services, offers modeling facilities and ontologies, links professional and technical theories, and provides a methodology which supports domain experts.

My research approach follows the information system research cycle of Hevner and March [8]. Design science in general follows a five-step process: (1) Problem awareness, (2) suggestion, (3) development, (4) evaluation, and (5) conclusion. This research proposal addresses the following steps: problem awareness (cf. section 3) and suggestions with references to development and evaluation (cf. section 6).

My course of action is subdivided into five steps. Each step illustrates the development part according to Hevner and March's information system research cycle (cf. [8]).

Step 1 - Service Ecosystems: I will investigate existing literature about this phenomenon in terms of stakeholders, drivers, success factors, purposes, challenges, definitions, and technology. I have already identified key sources for this phenomenon [4, 32, 33]. Additionally, the analysis of existing service market places such as Amazon.com, SalesForce.com, Google Base, and StrikeIron.com will improve my understanding.

Step 2 - Service Properties: I will investigate existing literature about service properties. Sources are versatile and include standards (ebXML [16], Dublin Core Meta Data [1], IEEE 830-1998 [31]) and academic publications (O'Sullivan [21], Barbacci et al. [3]). I will develop a set of properties which satisfy service ecosystems requirements. These properties comprise functional and non-functional characteristics.

Step 3 - Modeling Languages: I will investigate existing modeling languages to express service properties. Already identified model languages include the business model ontology [20], the e^3-value model [25], UML Profile and Metamodel for Services (UPMS) [18], UML Profile for Modeling Quality of Service (UPMQoS) [17], and Service Component Architecture (SCA) [19]. Additionally, I will investigate process-oriented modeling languages, such as BPMN, EPC, and petri nets, in order to identify links between service description and process model languages.

Step 4 - Realization Languages: I will investigate existing realization languages to implement service properties. Already identified realization languages include WSDL [27], Web Service Modeling Ontology (WSMO) [28], Web Ontology for Services (OWL-S) [14], and Web Service Level Agreements (WSLA) [11].

Step 5 - Methodology: The methodology to describe services for service ecosystems is the resulting artifact of my research. On the basis of service ecosystem requirements, service properties, and modeling & realization languages, I will develop a cohesive methodology to describe and realize service descriptions.

7 Research Implications

Nowadays, *service engineering* and describing the final product is a decoupled parallel process. My research supports to intertwine these processes into one, allowing an exchange of requirements throughout service engineering, and thus, improves the service outcome - expectations ratio. Identified service properties and a language to model value requirements improve *service discovery*; since service consumer and provider use the same language to discover and propose services, and a modeling language hides technical details and enables domain experts to specify service requirements. Also, my work simplifies *service selection*, since a common set of service properties unifies services and allows to easily compare them. A common set of service properties may serve as a skeleton for *service contracting* and thus, lowering transaction costs. Furthermore, during service provisioning, service consumer and / or service provider may benefit from service properties as key performance indicators (KPI) for *monitoring* purposes.

Acknowledgments

This thesis is supervised by Prof. Dr. Guido Wirtz from the Distributed and Mobile Systems Group, University of Bamberg. This project was funded by means of the German Federal Ministry of Economy and Technology under the promotional reference “01MQ07012”. The responsibility for the content of this publication lies with the authors.

References

1. The Dublin Core Metadata Initiative. http://purl.oclc.org/dc/, 1998.

2. Baida, Z., Gordijn, J., and Omelayenko, B. A shared Service Terminology for Online Service Provisioning. In *ICEC* (2004), M. Janssen, H. G. Sol, and R. W. Wagenaar, Eds., vol. 60 of *ACM International Conference Proceeding Series*, ACM, pp. 1–10.
3. Barbacci, M., Klein, M. H., Longstaff, T. A., and Weinstock, C. B. Quality attributes. Tech. Rep. ESC-TR-95-021, Software Engineering Institute, Carnegie Mellon University, Pittsburgh, Pennsylvania 15213, December 1995.
4. Barros, A. P., and Dumas, M. The Rise of Web Service Ecosystems. *IT Professional 8*, 5 (2006), 31–37.
5. Booms, B., and Bitner, M. Marketing strategies and organization structures for service firms. *Marketing of Services, American Marketing Association, Chicago, IL* (1981), 47–51.
6. Dorn, J., Grun, C., Werthner, H., and Zapletal, M. A Survey of B2B Methodologies and Technologies: From Business Models towards Deployment Artifacts. In *HICSS* (2007), IEEE Computer Society, p. 143.
7. Gordijn, J., Akkermans, H., and Van Vliet, H. Value-based Requirements Creation for Electronic Commerce Applications. *System Sciences, 2000. Proceedings of the 33rd Annual Hawaii International Conference on* (2000), 10.
8. Hevner, A. R., and March, S. T. The Information Systems Research Cycle. *IEEE Computer 36*, 11 (2003), 111–113.
9. International Organization for Standardization (ISO). Open-edi reference model, iso standard 14662, second edition, 2004.
10. Janiesch, C., Ruggaber, R., and Sure, Y. Eine Infrastruktur für das Internet der Dienste. HMD - Praxis der Wirtschaftsinformatik (45:261), 2008, pp. 71-79, June 2008.
11. Keller, A., and Ludwig, H. The WSLA framework: Specifying and monitoring service level agreements for web services. *J. Network Syst. Manage 11*, 1 (2003).
12. Kett, H., Voigt, K., Scheithauer, G., and Cardoso, J. Service Engineering for Business Service Ecosystems. In *Proceedings of the XVIII. International RESER Conference* (Stuttgart, Germany, September, 25 - 26 2008).
13. Kuropka, D., Troeger, P., Staab, S., and Weske, M., Eds. *Semantic Service Provisioning*. Springer Berlin Heidelberg, 2008. ISBN 978-3-540-78616-0.
14. Martin, D. L., Paolucci, M., McIlraith, S. A., Burstein, M. H., McDermott, D. V., McGuinness, D. L., Parsia, B., Payne, T. R., Sabou, M., Solanki, M., Srinivasan, N., and Sycara, K. P. Bringing Semantics to Web Services: The OWL-S Approach. In *SWSWPC* (2004), J. Cardoso and A. P. Sheth, Eds., vol. 3387 of *Lecture Notes in Computer Science*, Springer, pp. 26–42.
15. Oaks, P., ter Hofstede, A. H. M., and Edmond, D. Capabilities: Describing What Services Can Do. In *ICSOC* (2003), M. E. Orlowska, S. Weerawarana, M. P. Papazoglou, and J. Yang, Eds., vol. 2910 of *Lecture Notes in Computer Science*, Springer, pp. 1–16.
16. OASIS ebXML Collaboration Protocol Profile and Agreement Technical Committee. Specification: Collaboration-protocol profile and agreement, version 2.0. http://www.oasis-open.org/committees/download.php/204/ebcpp-2.0.pdf, September 2002.
17. Object Management Group (OMG). Specification: UML Profile for Modeling Quality of Service and Fault Tolerance Characteristics and Mechanisms, v 1.1. http://www.omg.org/technology/documents/formal/QoS_FT.htm, May 2005.
18. Object Management Group (OMG). Specification: UML Profile and Metamodel for Services RFP UPMS Services Metamodel. http://www.omg.org/cgi-bin/doc?soa/2006-09-09, September 2006.

19. Organization for the Advancement of Structured Information Standards (OASIS). Specification: Service Component Architecture (SCA). http://www.oasis-opencsa.org/sca.
20. Osterwalder, A. *The Business Model Ontology: A Proposition in a Design Science Approach*. PhD thesis, Universite de Lausanne Ecole des Hautes Etudes Commerciales, 2004.
21. O'Sullivan, J. *Towards a Precise Understanding of Service Properties*. PhD thesis, Queensland University of Technology, 2006.
22. Ouyang, C., van der Aalst, Dumas, M., ter Hofstede, and M., A. H. From business process models to process-oriented software systems: The BPMN to BPEL way. ePrint: http://eprints.qut.edu.au/archive/00005266/, October 2006.
23. Papazoglou, M. P. Service-Oriented Computing: Concepts, Characteristics and Directions. In *WISE* (2003), IEEE Computer Society, pp. 3–12.
24. Peneder, M., Kaniovski, S., and Dachs, B. What Follows Tertiarisation? Structural Change and the Role of Knowledge-based Services. *The Service Industries Journal 23 Issue 2*, 146 (March 2003), 47–66.
25. Pijpers, V., and Gordijn, J. Bridging Business Value Models and Process Models in Aviation Value Webs via Possession Rights. In *HICSS* (2007), IEEE Computer Society, p. 175.
26. Quartel, D. A. C., Steen, M. W. A., Pokraev, S., and van Sinderen, M. COSMO: A conceptual Framework for Service Modelling and Refinement. *Information Systems Frontiers 9*, 2-3 (2007), 225–244.
27. Roberto Chinnici, Jean-Jacques Moreau, A. R. S. W. Specification: Web Services Description Language (WSDL) Version 2.0 Part 1: Core Language. W3C Recommendation, 6 2007.
28. Roman, D., Keller, U., Lausen, H., de Bruijn, J., Lara, R., Stollberg, M., Polleres, A., Feier, C., Bussler, C., and Fensel, D. Web Service Modeling Ontology. *Applied Ontology 1*, 1 (2005), 77–106.
29. Scheithauer, G., Augustin, S., and Wirtz, G. Describing Services for Service Ecosystems. In *ICSOC Workshops* (Sidney, Australia, December, 1 2008), G. Feuerlicht and W. Lamersdorf, Eds., vol. 5472 of *Lecture Notes in Computer Science*, Springer, pp. 242–255.
30. Scheithauer, G., and Winkler, M. A Service Description Framework for Service Ecosystems. Bamberger Beiträge zur Wirtschaftsinformatik 78, Bamberg University, October 2008. ISSN 0937-3349.
31. Software Engineering Standards Committee of the IEEE Computer Society USA. IEEE Guide for Software Requirements Specifications 830-1998, 1998.
32. Spohrer, J., Maglio, P. P., Bailey, J., and Gruhl, D. Steps Toward a Science of Service Systems. *IEEE Computer 40*, 1 (Jan. 2007), 71–77.
33. Tapscott, D., Ticoll, D., and Lowy, A. *Digital Capital: Harnessing the Power of Business Webs*. Harvard Business School Press, May 2000.