Methods for Service Identification: A Criteria-based Literature Review

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Abstract. Business-driven identification of services is a precondition for a successful implementation of service-oriented architectures (SOA). This paper compares existing identification methods retrieved from related work and discusses the shortcomings. Finally, it proposes a process-oriented method of service identification. This approach incorporates the business point of view, strategic and economic aspects as well as technical feasibility.

1 Service Identification

Service-orientation is a fundamentally new paradigm for the design of enterprise architectures which spread substantially in the last couple of years (e.g. in the financial services sector [1]). A growing number of authors have been looking at the identification of services that are at the heart of service-oriented architectures (SOA). However, there is lack of common understanding of what services are and which goals are to be achieved. Due to this, existing approaches for service identification differ significantly from one another. In section 2 this article presents a framework of several criteria in order to compare various methods of service identification found in related literature. Strengths and weaknesses of existing approaches are discussed in section 3. Based on the findings, requirements of a new methodology to identify services from a business point of view are presented in section 4.

2 Comparison Criteria

In order to compare the approaches for the identification of services, a catalogue consisting of several criteria is applied to give an overview of approaches currently discussed in related literature. Some criteria have already been used by other researchers; others have been added by the author to complement the existing ones. For a better understanding the criteria have been divided into six groups.

- Basic characteristics
- Business aspects
- Technical aspects
- Economic aspects

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- Method-engineering elements
- Principles of design science research

All criteria will be discussed in detail in the following sections.

2.1 Basic Characteristics

First, the basic principles of service-oriented architectures (SOA) are discussed. The *industry sector* is important to understand the background of the approaches discussed. Identified similarities and differences might be grounded in the industry sector in which they are applied. There might be reasons why certain approaches are used in one industry but not in others. Maybe some elements can be transferred successfully from one industry sector to another. The *understanding of services* differs tremendously among the approaches. Some consider a service comprehensively, i.e. it represents a complete business process. On the other extreme authors tend to a workflow-oriented view in which a (fully automated) service represents a single task. However, all authors use a *service hierarchy*. This classification usually consists of two or three levels [2, 3]. The differentiation of basic services and composed services is a common feature although there are differences in detail. The right choice of *granularity* within an SOA is both critical and extremely difficult. In the following, granularity shall describe the functional scope of a service. Obviously, there is no silver bullet for the right granularity. Fine-grained services can easily be reused in different contexts (i.e. for many processes) but this can lead to higher complexity when orchestrating the huge number of services. Coarse-grained services are able to fulfill more complex tasks but they are less flexible and harder to reuse.

The underlying *SOA paradigm* affects the identification and specification of services. It represents the idea of what an SOA actually is and what it can deliver. The *direction of the* analysis (i.e. bottom-up or top-down) has an important effect on the specification of services and is therefore another criterion. The authors use a range of *tools* that can be subsumed into business process modeling (BPM), process decomposition, domain decomposition, asset analysis and portfolio management [3]. Depending on the focus of the respective approach *types of categorization* vary. Whereas technically-driven approaches categorize e.g. by implementation strategy, business-driven approaches might differentiate by service consumer type (i.e. internal or external).

2.2 Business Aspects

The *business aspects* are the second set of criteria to be discussed. First, *consideration of strategic aspects* is very important because implementation of an SOA is not done for its own sake but seeks tangible benefits for the company. Although the strategic relevance might be less critical for the identification of services itself, it is crucial for their design and subsequent sourcing strategies. A categorization by Allen therefore differentiates between three types of services. Commodity services are stable, sufficiently established services every market player must have. They are suitable for outsourcing and standardization. Territory services are fairly wide-spread but less stable and usually represent business rules. Value-added services constitute the special value

of a company's product or service in the market, i.e. a company's core competence. It is this highly innovative service that gives distinction to the company [4].

Both laws and regulations as well as internal rules often limit a service's suitability for outsourcing. Thus, the *governance* of services – well integrated into a company's IT governance framework - including legal compliance, internal policies and service level agreements (SLA) has to be taken into account when services are identified and specified afterwards. SOAs are frequently mentioned as means for standardization and an increase of flexibility without noticing the ambivalence of these *goals*. Most approaches only implicitly hint at which goal should be achieved. Another criterion is the *object supported* by the service. This may be a complete value creating process as well as one single task, i.e. a step in a workflow. Consideration of the *SOA lifecycle* shall ensure the sustained maintenance of identified and implemented services as well as the intake of new services. In order to identify redundant services, existing ones have to be checked for *functional similarity*.

2.3 Technical Aspects

The way services are controlled belongs to the *technical aspects* of services. Basically, there is a differentiation between *orchestration and choreography* of services [5]. Some authors argue that orchestration implies a central instance that coordinates all activities of a process [3]. The result of orchestrated services can itself be described as a service. Choreography then means that services are called by other services and there is not one steering unit. The sequence of services involved in a process is not stored as metadata. However, authors such as Alonso et al. [6] talk about "distributed orchestration" that does not imply a centralized coordinating instance. In this sense, choreography deals with the specification of service coordination protocols. In the following, methods for service identification will be compared on the basis of the former mentioned definition.

Customer interaction is taken into account in different degrees by the approaches presented. As far as services (and not tangible products) are concerned, the inclusion of the external factor "customer" is essential. The same holds true for *employee interaction* because it sets certain limits for standardization, automization and outsourcing. Several *IT criteria* are especially important for the specification of previously identified services. Thus, they are part of most of the presented approaches. The *call frequency* of a service hints at its application. A high frequency can on the one hand point to a service with a small scope of functionality that can therefore be used flexibly in many business processes. On the other hand a sufficient standardization of coarser grained services could be a reason for a high call frequency as well.

2.4 Economic Aspects

Value creation is the added value created through deployment of a service. The customer has to be willing to pay for the result of a process, i.e. services should always increase the value of a product. The degree of value creation depends on an effective and efficient combination and coordination of resources [7] and is subject to an SOA controlling. This could be implemented e.g. through a balanced scorecard [8]. *Main-*

tenance and operation costs correlate strongly with the complexity of an IT infrastructure. An SOA can lead to a significant reduction of complexity. Moreover, well-defined functions and interfaces contribute to the robustness of IT systems which in turn lowers operation costs.

An intake of new services into the IT landscape of a company causes only little *testing effort for new functionality*. Only interfaces of the newly implemented service have to be tested because interactions of other services are untouched. Implementation of an SOA decreases *vendor dependency* because such an architecture is platform independent. Firstly, this leads to immediate savings because the purchase of licenses may be unnecessary when open source products can be used. Secondly, a lock in effect is avoided so the company is not bound to a vendor because of prohibitively high swapping costs. Thirdly, web services can flexibly be used and increase the agility of business processes. These web services can be purchased ad hoc from the cheapest provider respectively.

Flexible orchestration of services enables a *demand-oriented quality of service level* for products. Customers receive exactly the quality they request. Thus, *customer satisfaction* is increased at the same time. This kind of orchestration allows for an *individualization of products* that leads to competitive advantages and thus is another economic aspect. *Specialization on core competencies* plays an ever bigger role in today's competitive environment [9]. Identified service candidates can be classified on the basis of their strategic importance. This leads to implications for further sourcing decisions.

The *product range* can be *widened* by quickly recombining services on the basis of existing core competencies and significantly enhance the *time-to-market*. Originally internal services can be *offered in the marketplace* after being identified as services with such potential. The acquisition of service users generates even more economies of scale and leads to decreasing costs per unit. This, in turn, can boost the market share through decreasing prices for the service. The necessary *scalability* is another strength of SOAs. Due to its agility and flexibility SOAs can react quickly to changing customer requirements.

2.5 Method Engineering and Principles of Design Science Research

The task of method engineering is to guide the development of such methods in order to guarantee a high quality. The most popular approaches in this field identify *activities, roles, results, techniques* and *the sequence of activities* as important components of methods. Thus, a further set of criteria looks at how far these five *components of method engineering* are incorporated into existing methods of service identification. For the evaluation of these components a 5-level Likert scale that ranges from "--" (not fulfilled) via "-", "o" and "+" to "++" (completely fulfilled) is applied.

The same scale is used to evaluate the application of Hevner et al.'s principles of design science research [10]. Documentation, research rigor and evaluation are the three principles discussed here. The documentation has to ensure that results are communicated both technology-oriented as well as management-oriented. Research rigor corresponds to the applied research methodologies (e.g. a sound literature study). Evaluation is ought to guarantee quality and usability of the newly created method.

3 Strengths and Weaknesses of Existing Approaches

The methods found in related literature differ considerably in their methodological approach. Advantages and disadvantages as well as a possible usability for an adequate and process-oriented service identification are subject to discussion in the following.

Table 1 compares the five approaches presented above and facilitates the criteria explained in section two. The most comprehensive *understanding of services* can be found in Böhmann & Krcmar's [11] approach. Their services (modules) represent complete packages of service products offered to customers. Klose et al. [12] and Arsanjani et al. [5] look at process chunks with a smaller scope of functionality. Still, these chunks implement a complete and self-contained business functionality. The change from an object-oriented view to a service-oriented view that is postulated by many authors (e.g. [5]) is not to be found in Winkler's approach [13]. Kohlmann & Alt's services support business processes, too. However, the scope of their services differs significantly as far as functionality is concerned. Thus, a three level *hierarchy* of basis services, composed services and process services is used to classify the types of services. Whereas Böhmann & Krcmar do without any hierarchy, all other authors use a two level structure.

Granularity of services differs immensely among the compared methods. Klose et al. describe mainly composed services. Böhmann & Krcmar and Arsanjani et al. rather look at more encompassing process services. On the contrary, Winkler uses very fine grained, elemental services and thus is fairly close to an object-oriented approach. Kohlmann & Alt vary the granularity of services depending on the situation. The *SOA paradigm* of all five methods is an architectural concept. Actually, an interpretation of SOA as middleware (e.g. only to integrate legacy systems) makes no sense in the context of business-driven service identification. The *direction of the analysis* is usually hybrid, i.e. a top-down approach (which is the focus) is complemented by a bottom-up analysis of existing infrastructure. Only Winkler solely uses a top-down approach. The most common *tools* that are used are BPM and domain decomposition. Different *types of categorization* are facilitated to classify services in various dimensions. Particularly Arsanjani et al. look at services from different points of view. The role within a business model distinguishes basic services from process services. Consumer type categorizes services in internally used ones and those (also) used by partners and customers. The implementation strategy marks composed services or externally sourced ones. The consumer type is a focus in Klose et al.'s and Böhmann & Krcmar's approaches because customer integration and interaction are crucial. Only Klose et al. fail to discuss implementation strategies.

A *consideration of strategic aspects* is omitted from Winkler's method. Klose et al. rarely mention these aspects. Still, their thoughts on line of visibility and line of interaction somehow hint at a link to strategic aspects. Arsanjani et al. advocate the use of reference models and best practices obtained from peer groups. They consider the sourcing potential of identified service candidates. Böhmann & Krcmar examine strategic implications of an SOA and belonging services in much more detail. Threats and opportunities as well as sourcing strategies are part of their identification method. Similarly, Kohlmann & Alt discuss these strategies as well as cuts in processes in inter-organizational networks. *Legal compliance* plays a role when customer data is affected. Klose et al. deal with the sensitivity of such data when it comes to the line

Table 1. Comparison of service identification methods.

	Klose et al. (2007)	Böhmann & Krcmar (2005)	Winkler (2007)	Arsanjani et al. (2008)	Kohlmann & Alt (2007)
Basic characteristics					
Industry sector	Production	IT services	Financial services	Financial services	Financial services
Understanding of services	Business process oriented	As module, very comprehensive	Object oriented	Business process oriented	Business process oriented
Service hierarchy	2 levels, elemental and composed service	Process service	2 levels, basic and composed service	2 levels, elemental and composed service	3 levels, process service, rule service, entity service
Granularity	Middle	Coarse	Fine	Coarse	From coarse to fine
SOA pradigm	Architectural concept	Architectural concept	Architectural concept	Architectural concept	Architectural concept
Direction of analysis	Hybrid	Hybrid with bottom up tendency	Top down	Hybrid with top down focus	Hybrid
"Tools"	Decomposition of business processes (with BPM) and SOA principles	Asset analysis	Decomposition of business processes	Goal service modeling, domain decomposition, asset analysis	BPM, asset analysis
Types of categorization	Consumer type	Consumer type, implementation strategy	Implementation strategy	Business model role, consumer type, implementation strategy	Role in business model, implementation strategy
Business aspects					
Consideration of strategic aspects	Line of interaction & line of visibility	Threats and opportunities of modular service architect., sourcing	not considered	Reference models, best practices, sourcing strategies	Sourcing strategies, inter-organizational cuts
SOA governance	Legal requirements concern. customer data, internal policies considered	Internal policies considered, SLAs are indiv. defined	not considered	"Rules and policy analysis" within process modeling	Customer data remains in own company, naming of services
Goal	Flexibilization	Flexibilization	Standardization	Flexibilization	Not clear
Supported object	Task	Business process	Task	Task	Business process
Functional similarity	Consideration of industry standards	Not considered	Not considered	Self similar fractals, industry standards	Functional and semantic similarity
Technical aspects					
Orchestration vs. choreography	Orchestration	Orchestration	Not clear	Not clear	Orchestration
Customer interaction	Line of interaction & line of visibility	Customer specific configuration, line of visibility	Not considered	Not considered	Not considered
Employee interaction	Automatic, dialogue, manual	Not considered	Not considered	Not considered	Not considered
Criteria of information technology	Design principles for SOA	Reusability, standardization, independence	Reusability, redundancy, frequency	Reusability, flexibility	Reusability
Call frequency	Not considered	Not considered	Calls per time	Not considered	Not considered
Economic aspects					
Value creation, SOA controlling	Not considered	Not considered	Not considered	Not considered	Not considered
Maintenance and operation costs	Not considered	Utilization of common resources	Not considered	Elimination of redundancies	Not considered
Testing effort for new functionality	Not considered	Not considered	Not considered	Not considered	Not considered
Vendor dependency	Not considered	Not considered	Not considered	Not considered	Not considered
Demand-oriented QoS levels	Not considered	Within performance and design analysis	Not considered	Not considered	Not considered
Customer satisfaction	Not considered	Not considered	Not considered	Not considered	Not considered
Individualisation of products/services	Not considered	Included in goal definition	Not considered	Reusable components	Not considered
Specialisation in core competences	Not considered	External sourcing options	Not considered	Not considered	Sourcing models
Product range / Time-to-Market	Not considered	Included in goal definition	Not considered	Not considered	Not considered
Internal services for external customers	Not considered	Not considered	Not considered	Not considered	Not considered
Scalability	Not considered	Not considered	Not considered	Not considered	Not considered
Components of method engineering					
Activities	++	++	++	++	+
(SOA-)Roles	--	--	--	o	--
Results	+	++	+	++	+
Techniques	+	o	+	++	-
Sequence of activities	Sequential	Sequential	Sequential	Iterative, fractal	Sequential, iterative where applicable
Principles of design science research					
Documentation	++	++	+	++	o
Research rigour	++	++	o	-	+
Method evaluation	++	++	-	+	+

of visibility. Kohlmann & Alt also point out that customer data must remain within the company while outsourcing processes. *Internal policies* are only incorporated by Arsanjani et al. and Kohlmann & Alt. The latter for instance make the point of consistent naming of service candidates. Solely Böhmann & Krcmar mention *service level agreements* and stress the necessity of individual definitions.

Goal of the implementaion of an SOA in Winkler's method is standardization. In Kohlmann & Alt's approach there is no clear goal to be identified. The other three methods clearly aim at a flexibilization. In the approaches by Böhmann & Krcmar and Kohlmann & Alt business processes are the *supported object*. The other methods tend to support tasks. Apart from Arsanjani et al., who present a fractal model for service-oriented software development, the *SOA lifecycle* is ignored by other authors. *Functional similarities* are not discussed by Böhmann & Krcmar and Winkler. In contrast, Kohlmann & Alt discuss not only functional but also semantic similarities. Arsanjani et al. use the self-similarity of fractals for service-oriented software development. Apart from Winkler and Arsanjani et al.'s methods that cannot be classified unambiguously, all authors imply an *orchestration* of services by a central instance. *Customer interaction* is a focus in Klose et al.'s and Böhmann & Krcmar's approach although the former originates from a production company. The huge importance of the "customer factor" in service industries is not reflected at all in the three other approaches. *Employee interaction* is only discussed by Klose et al. They differentiate between automated, semi-automated and manually conducted services. Looking at *IT criteria* the nomination of reusability stands out in all approaches. This is not surprising considering the prominence of it in recent SOA literature. Klose et al. use a comprehensive catalogue of design principles of an SOA. Instead, only Winkler focuses on the *call frequency* and redundancy.

The *economic aspects* of services are completely out of scope in Klose et al.'s and Winkler's approaches. With the notable exception of *specialization on core competencies* there is no discussion of economic aspects in Kohlmann & Alt's method. *Maintenance and operation costs* are addressed by Böhmann & Krcmar and Arsanjani et al. The utilization of common resources through reduction of redundancies and multiple calls by the implementation of services is brought forward in both approaches. The only authors considering a *demand-oriented QoS level* are Böhmann & Krcmar with their performance and design analysis. This is plausible because their stakeholder-based approach demands an integration of customers. *Individualization of products and services* is supported by Böhmann & Krcmar's modularization and by the usage of reusable components (Arsanjani et al.). *Specialization on core competencies* is also a postulation in Böhmann & Krcmar's method. Within their goal definition they consider an *increase of the product range* and the *time-to-market* of new products. All other economic aspects, namely *value creation, testing effort for new functionality, vendor dependency, customer satisfaction, internal services offered to external customers, scalability* and *SOA controlling* are not considered in any of the approaches.

As far as *components of method engineering* are concerned all compared approaches do fairly well regarding the described *activities*. *Results* and *techniques* are usually explained in a satisfactory way. Solely *roles* are not explained in any of the approaches. Arsanjani et al. – who mention the components of method engineering explicitly – hint at the existence of roles in their method but do without further detailing. The *sequence of activities* is usually sequential. Kohlmann & Alt allow iteration

at certain points. Exceptionally, Arsanjani et al. present an iterative, fractal procedure. Based on three selected *guidelines for design science research* [10] especially Klose et al. and Böhmann & Krcmar excel with their methods. Both approaches comply entirely with the guidelines concerning *documentation*, *research rigor* and *evaluation*. Winkler particularly misses an evaluation of her method whereas a lack of research rigor is the weakest point in Arsanjani et al.'s approach. Kohlmann & Alt show weaknesses in both documentation and research rigor but have a clear advantage in evaluation though.

4 Conclusions and Further Research: POSI – A Method for Process-Oriented Service Identification

As shown in previous sections approaches for service identification differ in many ways. However, a comparison on the basis of several criteria also identified commonalities both in the existence and the absence of certain aspects. Because business-driven service identification is crucial to a successful SOA implementation a new method for process-oriented service identification (POSI) has to use the strengths of the compared methods and resolve relevant flaws. Thus, aspects that are vital for the design of POSI are to be discussed in the following.

Business processes identified by techniques such as BPM have to be the foundation of the new method. However, no SOA project will create an IT infrastructure from scratch. Therefore, given factors such as existing hardware and software have to be considered. A top-down approach that identifies services with tools like BPM or domain decomposition has to be complemented by a bottom-up analysis to guarantee a successful technical implementation.

The method to be developed has to be configurable in so far that depending on the user's preferences either standardization or flexibilization are the focus of the identification process. Especially the level of composed services is important in this context. Basic services, e.g. retrieval or alteration of data, can only be subject to standardization. In contrast, process services should be flexible in most cases. However, looking at composed services the goal may differ case by case because the complexity of such services varies depending on the situation.

Composed services will most likely be subject to sourcing decisions because neither whole process services (which constitute the existence of an enterprise) nor basic services (that are too small) are suitable for outsourcing. Table 1 shows that economic aspects in particular find little or none adherence in existing methods. For this reason, POSI has to combine the identification of services with the consideration of these aspects. Especially functional similarities shall serve as a basis for identifying standardization potentials. Subsequently, sourcing strategies can be evaluated.

Notably in the service sector the consideration of customer interaction at the runtime of services is indispensable. A selection of critical factors of SOA design principles that determine a high-quality service identification ensures the quality of the method. Summing up, a new method for process-driven service identification has to focus on the following aspects:

- Service identification based on BPM complemented by a bottom-up analysis
- Discovery of functional similarities to evaluate standardization potential

- Customer interaction
- Configuration regarding standardization and flexibilization
- Consideration of economic aspects

In order to comply with the formal requirements of method engineering, activities, roles, results and techniques have to be documented. The striking absence of roles in all presented methods is a major flaw. Experience shows that BPM is not always conducted by business units but by IT departments. Consequently, a new method has to manage rules explicitly. To meet academic standards, development of POSI will be based on Hevner et al.'s principles of design science research.

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