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# A Framework for the Design of Service Maps

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## ABSTRACT

The concept of service-oriented architecture (SOA) is recognized as an important enabler for business transformation and application integration. Service maps emerge when individual services are (pre)configured on various architectural levels. For example, business-oriented service maps sustain the communication and coordination among participants within and between businesses. Difficulties occur when, based on different service design strategies, heterogeneous service maps are created which need to be aligned. A methodological approach to establish a systematic design process for such service maps within companies or business networks is needed.

## Keywords

Service map, service-oriented architecture, service governance

## INTRODUCTION

SOA is recognized as an important concept for business transformation and is discussed from a technological and a business perspective. Whereas the technical view conceives SOA as a "paradigm that supports modularized exposure of existing application functionality to other applications as services" (Nadham 2004, p.41) the business perspective denotes the ability of reusing tasks and processes by providing them at one location (OASIS 2006). SOA presents itself as a suitable option for improving the integration of heterogeneous application environments as well as the sourcing of entire or fractional business processes in a business network (Baskerville et al. 2005). For the implementation and governance of SOA, different instruments emerged. Among them are service maps which structure services by visualizing them along with their relationships. Based on different SOA design strategies the risk of various incompatible service maps increases. Consequently, methodologies integrating these different service maps are required (Kohlmann and Alt 2009a). A contribution to such methodologies would be a framework which incorporates influencing factors for the design of a service map to facilitate the understanding of the basic ideas behind a specific service map, such as its goal or its focus. The Banking Industry Architecture Network (BIAN) e.g. develops a service map whose structure is influenced by the boundaries of common core banking solutions. Therefore (reference) data (information about business partners or market data) is visualized as one out of five parts of the service map. Contrary business departments of a bank would typically organize a service map according to the supported business processes. Integrated in SOA and service design procedures (Erl 2007; Kohlborn et al. 2009) such a framework would further foster a systematic and comprehensible design of service maps for a specific context (e.g. application integration, industry reference). The framework proposed in this paper is a first attempt to obtain such a systematic design support.

For the purpose of this paper a multi-method research design was chosen based on a design science approach (Galliers 1992). Design science is a problem-solving paradigm (Hevner et al. 2004) that creates innovative artifacts such as models, methods, prototypes (Simon 1996) or – in this case – a framework. These artifacts are to-be models and cannot be validated with existing, i.e. historical data. This research follows the seven guidelines for design science research proposed by (Hevner et al. 2004), e.g. it designs an artifact (i.e. a framework) that helps to solve an existing problem (systematic design of service maps)

and contributes to research in the field of service-oriented architectures. Finally, the framework is evaluated by a case study which was conducted based upon the recommendations elaborated by (Dubé and Paré 2003) and the four requirements of MIS case study design according to (Lee 1989). As data source for the single case study direct observation in combination with 12 structured interviews, six workshops and project documentation was used.

Section 2 provides the theoretical foundation for SOA and briefly discusses related work. Section 3 proposes a framework for designing service maps. Section 4 presents the case study of a Swiss universal bank exemplifying the applicability of the framework. Section 5 summarizes the results and provides an outlook.

## SERVICE-ORIENTED ARCHITECTURE AND SERVICE MAPS

Services, the core of any SOA, provide modular business-oriented functionalities which may be bundled along business processes (Erl 2007; Kohlborn et al. 2009; Kohlmann and Alt 2009b). By using standardized interfaces and centralized repositories, services may be flexibly recombined and efficiently reused. Legacy systems can be integrated or replaced by a modularization brought about by SOA (Papazoglou and Georgakopoulos 2003). This improved *agility* of business processes is generally linked to increased competitive advantage (Schelp and Aier 2009). Combined with standardization of interfaces this contributes to inter-organizational cooperation between service providers and service users. However, as the granularity of services differs, various service layers and typologies emerged to structure SOA (Bell 2008; Erl 2007; Rosen et al. 2008). Well-defined interfaces (i.e. input, output, protocols) enable an outsourcing of services. Consequently, preconfigured service reference models (e.g. from software vendors such as SAP or IBM or communities such as BIAN) are established to reduce initial costs and to indicate reusable services. Still such initiatives provide mainly industry-specific solutions.

In this context service maps are regarded as instruments to structure services by visualizing them within a specific domain. Furthermore, they can be used to exemplify relationships and dependencies. However service maps neither imply the rules for the design nor the specification of the services as an architecture would be. Due to different service design strategies (e.g. top-down, bottom-up) the risk of the emergence of heterogeneous service maps is increased. Nevertheless, service maps on different granularity levels such as presented in (Kohlmann and Alt 2009a) are necessary as they (1) support the analysis and design of business models, (2) provide a comprehensive understanding among IT and business and/or (3) reduce integration costs of applications. As service maps reduce complexity by structuring services and exemplifying relationships, business and IT representatives obtain an instrument that structures business requirements and their implications on IT systems (Kohlmann and Alt 2009a; Rosen et al. 2008).

Despite the broad discussion of SOA, current literature features a lack of contributions which provide in-depth insights into the value of service maps. (Kullvén and Mattsson 1994) propose a (process-oriented) service map as structural basis for an economic model to assign costs and revenues. In turn, (Jiang and Willey 2005) propose a service map as data structure with deployment information to support the discovery of web services. Moreover, several communities and initiatives evolved trying to define service maps for different industries, such as the above mentioned BIAN (Bills 2009). Consequently, prior research (Kohlmann and Alt 2009a) suggested a procedure as part of a possible methodology to align these heterogeneous service maps. However, no attempt has been made so far to provide a framework for a structured service map design.

## FRAMEWORK FOR THE DESIGN OF SERVICE MAPS

This section proposes a framework for the design of service maps based on different contingencies. The framework is based on the assumption that an appropriate design of a service map fits external factors such as organizational size. E.g. the classification of service ownerships can be limited in small firms compared to large firms. Similar dependencies have been outlined by the contingency theory of organizational design. Following (Donaldson 2001), an organizational structure (e.g. hierarchical, functional) which "fits" (internal and external) contingency factors, such as size or strategy, is more effective with regard to profitability, efficiency or innovation rate. Based on contingencies an organization is able to adapt its organizational design. Hence, a "misfit" between contingencies and organizational design results in a negative impact on a company's performance. Accordingly, the design of a service map should "fit" its contingencies. The proposed framework consists of two dimensions: (1) a building block dimension differentiating relevant design elements for building service maps and (2) a design dimension incorporating contingencies on these design elements.

### Building block dimension

To enhance existent and prospective service and SOA design methodologies the framework should reflect current perspectives and granularities (Erl 2007). Hence, the building block dimension considers perspective and typology supplemented by relationships such as dependencies between services. Moreover to support governmental issues (Börner et al. 2009) being key for the introduction of SOA (Aier et al. 2008) the framework incorporates an ownership building block.

As the development of the SOA concept as well as any specific SOA is characterized by the attempt to bridge business and technology orientation the structure of a service map can incorporate a <u>business-</u> and/or <u>technology-</u>oriented **perspective**. The basis for a business-oriented service design can be business processes and business networks. Besides using service maps at design time to structure services and their interdependencies, several approaches are aiming at dynamic service integration at runtime using ontologies (Vitvar et al. 2007). Besides business processes (e.g. payments, sales) and business networks (e.g. SWIFT-*Society for Worldwide Interbank Financial Telecommunication*), specific business domains (e.g. financial or automotive industry), or within a firm group commonly expressed as business departments (e.g. trade, human resources), can be used to structure the service map. These business domains can be organized using a shared service center approach (Janssen and Joha 2006). In turn basis for a technological-oriented service map is the application architecture of a company or business network comprising application domains and system boundaries.

Following the distinction between a business and a technological perspective on SOA two service categories may be distinguished (see Figure 1). <u>Business services</u> ('tier 2' services) represent functionality of a specific business activity or transaction (e.g. *PricingRuleService*, *ForeignCurrencySupplyService*) (Bonati et al. 2006; Kohlborn et al. 2009). Due to the entitlement of SOA as intermediate architecture layer between business and technological architecture an alignment with processes and strategy is required. This involves not only cataloguing all services in a directory with little structure but also preconfigured bindings of business services in so-called <u>service clusters</u> (Bell 2008). The clusters or 'tier 1 services' combine several services of finer granularity due to their logical and functional proximity (e.g. *Rating, LoansManagement*). These business service clusters provide a connection to the company's business models. Focusing on technical services a differentiation between services covering domain independent IT functionality and services comprising domain specific basic functionalities would enhance transparency, reusability and governance. Consequently, <u>application services</u> ('tier 3' services) are focusing on independently usable and elaborately specified functional components (e.g. *CreateLoanContract, ManageBusinessPartnerRole* for the introduction of SOA) (Kohlmann and Alt 2009b; Rosen et al. 2008). <u>Infrastructure services</u> ('tier 4' services) finally encapsulate technical capabilities independent of any business domain, such as *accessDatabase* or *checkIPConnection* (Rosen et al. 2008).

Service maps express **relationships.** These <u>service-to-service</u> relations can bridge the service tiers (vertical relation) or remain on the same level (horizontal relation) (see Figure 1). A horizontal relation relates to the fact that a service may need another service in order to execute its function whereas a vertical relation incorporates the concept that a service of higher granularity composes several services of lower granularity. Besides these relationships within a service-layer, a service map is able to exemplify the linkage to <u>systems</u> (implementing a specific service), <u>processes</u> (using a specific service) or <u>business roles</u> (providing a specific service within a business network).
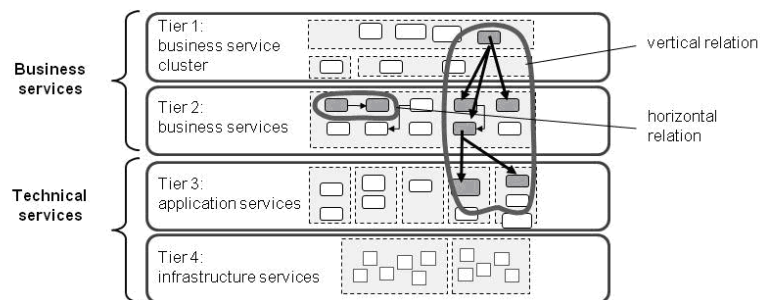


**Figure 1. Service typology and service-to-service relationships**

A key requirement for SOA is the implementation of a supportive organizational structure (roles, responsibilities) as part of SOA governance (Brown et al. 2006), which should consider both the enterprise and the network view (Kohlmann and Alt 2009b). Current contributions depict high maintenance efforts and lower reusability for service variants (Schelp and Aier 2009). Defined ownerships would enhance transparency in service management and therefore contribute to sustainability. Already a service map as governmental instrument can visualize associated ownerships. The building block **ownership** comprises the four types commonly used within a RACI matrix (<u>responsibility</u>, <u>accountability</u>, <u>consulted</u>, <u>informed</u>) extended by the three types <u>realization</u>, <u>utilization</u> and <u>coordination</u> as proposed by (Kohlmann and Alt 2009b).

**Design dimension**

Instantiations of the four building blocks of a service map, namely perspective, typology, relationship, and ownership are influenced by contingencies. The latter form the so called design dimension of the matrix shown in Figure 2. In the

following, SOA goals, focus, company size and SOA maturity level as the most influential factors (Kohlborn et al. 2009; Papazoglou et al. 2006, p. 3) will be explained and their effect on the design of service maps will be outlined.

Design dimension (contingencies)

| **Designing service maps** | SOA Goal | Focus | Company size | SOA Maturity level |
|---|---|---|---|---|
| Perspective | | | | |
| Typology / Granularity | | | | |
| Relationships | | | | |
| Ownership | | | | |

(left side label: Building block dimension)

**Figure 2. Dimensions of the framework**

SOA implementation may follow different **goals** (see e.g. (Arsanjani et al. 2008; Erl 2007). A frequent goal is the optimization of the IT architecture in the sense of legacy systems integration (Legner and Heutschi 2007). Using SOA to evolve a standardized integration infrastructure (Zimmermann et al. 2004) includes a documentation of interfaces and integration of platforms as necessary preconditions. Eventually, this leads to enhanced interoperability of existing legacy systems. To optimize IT architecture, SOA can also be applied to decouple application domains. Thus, small changes concerning functionality can be implemented locally without affecting other domains. A higher degree of reusability leads to cost savings and helps to avoid redundancies. On the other side the business perspective focuses on the centralization of business functionalities in order to flexibly bundle business processes (Papazoglou and Georgakopoulos 2003) and to align business processes and IT (Becker et al. 2009). A process-oriented identification of services supports this transition (Börner and Goeken 2009). Agile and flexible business processes are the foundation for an effective handling of process variants. Furthermore, they provide a competitive advantage enhancing a company's sustainability (Becker et al. 2004). Depending on the implementation goal, the design of the building blocks differs (see Table 1). Applying the contingency e.g. to the required relationships IT architecture optimization visualizes system-to-services-relations whereas business functionality centralization concentrates on process-to-services-relations.

Companies are increasingly reducing their vertical integration to focus on core competencies by sourcing business functionalities. Hence, a company's business networkability becomes a crucial success factor. For instance, many banks have embarked on sharpening their core competencies and the option of offering services to other banks (Homann et al. 2004). The notion of networkability refers to "both the internal and external capability of organizations to collaborate with each other at the level of both business processes and underlying ICT infrastructure" (Wigand et al. 1997). Depending on the internal or external perspective, the design of a service map may differ. Given an internal focus, the design will concentrate on business domains within a company e.g. to assign responsibilities for certain services. Here, the relationships between business processes and IT infrastructure are crucial. From the technological perspective the concept of SOA represents a promising instrument to implement networkability on the network level. By separating application functionality into modules and using standardized interfaces for invoking these modules (or services) SOA has the potential to link functionality from various providers within a business network. Thus, given an external focus, attention is drawn to the roles companies adopt within a network. (Terlouw et al. 2009) regard "**focus**" as an influential factor on the delivery strategy of SOA. Service maps are influenced by the choice of the focus especially as far as vertical and horizontal relationships are concerned.

The patterns behind the concept of SOA are relevant to companies of all sizes and industries (Aier et al. 2008). Nevertheless, the resources available for implementing and governing SOA as well as the size of the application architecture depend on a **company's size**. (Ciganek et al. 2006) conclude that company size is an influencing factor for the adoption of new technologies. (Sedera 2008) has empirically shown the influence of a company's size at the case of ERP systems. The study reveals that "larger organizations receive higher benefits compared to their small and medium counterparts", whereas small organizations express a higher reliance on their systems. It is common to classify small, medium and large enterprises (Brooksbank 1991). However, the differentiation base differs. (Brooksbank 1991) proposes the following criteria: (1) number of employees (100 to 400 equals medium) and (2) sales turnover ($3.75 million to $30 million equal medium). Thus, the design of a service map depends not only on the fundamental goal of a SOA implementation but also on a company's characteristics such as size. Implementing SOA in small companies requires scaling down leading to different service maps. Issues related to the ownership of services e.g. are less complex and less challenging in small companies (see Table 1).

Finally, **maturity** influences the delivery strategy of SOA (Terlouw et al. 2009). SOA maturity models are used to classify the status of SOA implementations within a company. Broadly accepted models are the SOA Maturity Model (SOAMM) comprising five levels and being introduced by Sonic Software (Bachman 2005) and the Service Integration Maturity Model (SIMM) differentiating seven levels and being published by (Arsanjani and Holley 2006). The latter will be used to demonstrate how the maturity of SOA influences the design of service maps. The first three levels of SIMM focus on function-orientation, whereas the latter four focus on service-orientation (Arsanjani and Holley 2006). Hence, only level 4 to 7 (simple services, composite services, virtualized services and dynamically reconfigurable services) are considered as the contribution of service maps are limited in function-oriented businesses (level 1 to 3). Particularly the perspective and relationships are strongly influenced by the maturity level. E.g. level 4 (simple services) tend to a technological perspective and system-to-service or service-to-service-relations. Table 1 shows a detailed view on how the contingencies influence properties of the building blocks.

| Building block dimension | | SOA Goal | | Focus | | Company size | | | SOA Maturity level | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Design dimension | Optimization IT architecture | Business functionality centralization | Company (internal) | Network (external) | Small | Medium | Large | Simple Services | Composite Services | Virtualized Services | Dynamically reconfigurable services |
| **Perspective** | Business | | x (PM) | x (BD) | x (NM) | x (BD) | x (PM,BD) | x (NM, PM,BD) | | x (PM, SCC) | x (PM, CDC) | x (BO) |
| | Technology (IT systems) | x | | | | verf. | x | | x | | | |
| **Typology** | Business services | | x (tier2) | x (tier2) | x (tier2) | x (tier1,tier2) | x (tier2) | x (tier1,tier2) | | x tier2 | x tier2 | x (tier2) |
| | Application services | x (tier3) | x (tier3) | x (tier3) | x (tier3) | | x (tier3) | x (tier3,tier4) | x (tier4) | x (tier3) | x (tier3) | x (tier3) |
| **Relationships** | Role-service | | | | x | x | | | | | | |
| | Process-service | | x | x | | | | x | | x | x | |
| | Service-service | | x (vert.,hor.) | | | x (vert.,hor.) | x (vert.,hor.) | | | | | x (vert.) |
| | System-service | x | | | | | | x | x | x | | |
| **Ownership** | | R,RE | CO,A | RACI, RE,U,CO | RACI, RE,U,CO | RA | RA,CO | RACI, RE,U, CO | R,RE | RA | RA | RACI, RE,U,CO |

**Legend:**

In general: x = applied; verf.= used for verification;

Structure: NM = network model; BD = business departments/business domains; PM = process model; BO = business ontology; SCC = supplemented by shared service center concept; CDC = supplemented by centralized data center

Typology: tier 1 = business service clusters; tier 2 = business services; tier 3 = application services; tier 4 = infrastructure services;

Relationships: hor. = horizontal; vert. = vertical;

Ownership: R = responsible; A = accountable; C = consulted; I = informed; CO = Coordinated; RE = realized; U = utilized

**Table 1. Framework for the design of service map**

## APPLICATION AT A SWISS UNIVERSAL BANK

### General setting at the Swiss universal bank

The bank used for the case study is a vertically integrated bank with a multi channel approach. Its business processes include loans, payments and securities as well as most of the transaction related business processes (such as monitoring), transaction spanning processes (such as product development), and support processes. The bank already has elaborated process architecture with business processes documented on different granularity levels. However, consolidated cross-bank business process architecture is still missing. Current challenges are the integration of legacy systems and heterogeneous business processes. A first step towards establishing a service-oriented architecture has been made by identifying business services mainly based on 80 business processes and 37 business objects. Services are seen as a possibility to reduce costs and complexity, to integrate heterogeneous application landscapes, and to standardize and enhance sophisticated pricing models. A service map constitutes the key element in building a business-oriented service architecture in this case.

### Designing the service map

Based on the general requirements, a project consisting of IT and business representatives was launched to develop a service map bridging existing IT business boundaries. The application of the framework followed the process exemplified in Figure 3. Before designing the service map, the relevant business architecture models such as process, application or sourcing models, were analyzed (step I.1), followed by a consideration of existing strategies (step I.2). The analysis phase revealed several criteria and general conditions for the design of the service map: (1) the bank aims to develop a cross-functional service model by applying a business-oriented service design approach; (2) service design is based upon business processes, business models, regulations and sourcing capabilities; (3) service design includes bottom-up verification by linking the business services with application services or systems functionalities; (4) the design approach supports a hierarchical service typology and (5) the structure of the service map shall facilitate the linkage of services on different granularity levels and/or sources.
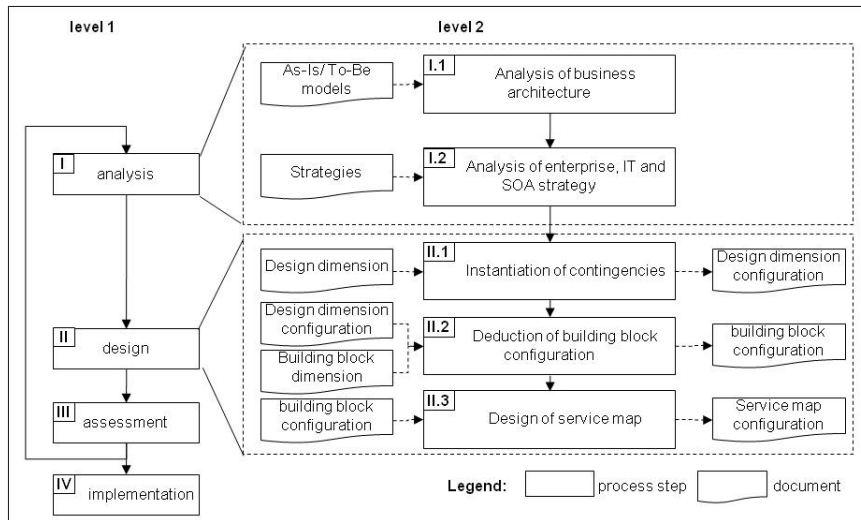


**Figure 3. Service map design process**

Based on these characteristics the bank was able to instantiate the contingency factors of the design dimension (step II.1). As primary goal centralization of business functionalities excelled IT optimization. The perspective of SOA as well as the service map has a clear internal focus due to the in-house provision of significant functionalities, In terms of size the bank belongs to the largest banks in Switzerland. Maturity finally does not influence the service map as the bank is function-oriented comparable to level 3 of SIMM. Following this setting the bank deduced the configuration of the building block dimension using the matrix in Table 1 (step II.2). Table 2 shows the associated design elements.

| | | Goal | Focus | Company size | SOA Maturity |
|---|---|---|---|---|---|
| | | Centralization of business functionalities | Company (internal) | Large | |
| Perspective | Business | ● (PM) | ○ (BD) | ◗ (NM,PM,BD) | |
| Typology | Business services | ● (tier2) | ● (tier2) | ● (tier1,tier2) | |
| | Application services | ● (tier3) | ● (tier3) | ◗ (tier3,tier4) | |
| Relationship | Process-service | ◗ | ◗ | ◗ | |
| | Service-service | ● | | ● | |
| | System-service | | | ○ | |
| Ownership | | ○(CO,A) | ◗ (RACI,RE,U,CO) | ◗(RACI,RE,U,CO) | |
| <u>Legend</u> (abbreviations see Table1): | | ○ Not applied ◗ Partially applied ● Fully applied | | | not applicable |

**Table 2. Application of the design view to the service map of the Swiss bank**

The perspective of the service map is business-oriented based on the bank's goal to develop a cross-functional service model by applying a business-oriented service design approach, Consequently, the structure of the bank's service map reflects the structure of the bank's process architecture: (A) governance/management, (B) sales and (C) support. The remaining parts of the process architecture (1) money transactions, (2) finance and real estate, (3) assets and investment management as well as (4) trade and capital market have been restructured to (D) transaction-specific and (E) transaction-spanning as services can be used in several business processes. Although business department boundaries (BD) should influence the structure of the service map, they had no implications due to the banks current change in the organizational structure (see cell 4.3 in Table 2). According to the proposed framework, business and application services were differentiated. To establish a banking specific SOA framework the business services were identified and specified at first. The identification and specification of the 137 business services took eight months in total. A follow-up project will define application services. Therefore, a comprehensive service map as implied by the framework has not been achieved yet. Nevertheless, the horizontal extent of the service map has been reached as it covers all core business processes of the bank. Contrary to the framework, infrastructure services are not incorporated in the service map (see cell 5.5 in Table 2).

The developed service map was used to structure business services along with their relationships and dependencies. The process-service relations were documented in a separate service catalogue and not in the service map itself (see cells 3.6 to 5.6). Same applies to the different ownerships. **RE**alization and **U**sage are exemplified in the service map whereas RACI is documented in a separate spreadsheet. **CO**ordination has not been used due to the internal focus of the project and the bank's internal SOA initiative. Figure 4 shows tier 1 of the service map.
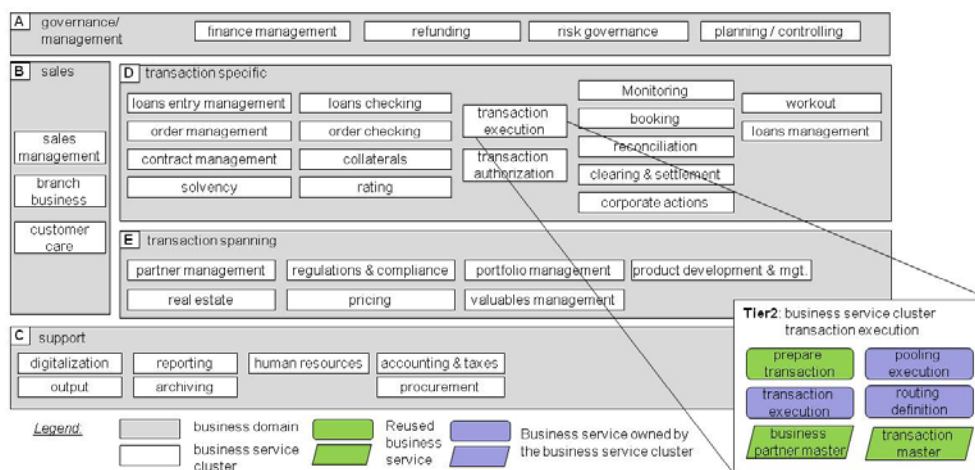


**Figure 4. Tier 1 of the bank's service map**

## CONCLUSIONS

In order to successfully implement service-oriented architectures, service maps are seen as instruments to visualize relationships and interdependencies of services. They can be used as a common basis for business and IT departments to structure services in companies or networks. Structuring these services by using an appropriate service map for the specific context can effectively support agility and flexibility of business processes. However no attempt has been made so far to provide a framework for a structured service map design. Therefore this paper developed a framework to design structure and content of service maps (see s*ection 3*). It incorporates four building blocks for the design of a service map and exemplifies relevant contingencies such as SOA goal, focus, company size and SOA maturity. A case study of a Swiss bank demonstrated the applicability of the framework (see s*ection 4*). Based on different criteria the bank was able to deduce a service map according to the proposed framework. The bank's process architecture is thus reflected in the service map. Nevertheless the case study showed the application from a business-oriented perspective and focused on an internal use of a service map due to the banks characteristics and goals. Thus, further case studies have to be conducted in order to underpin the usability of the proposed framework also for different settings. Such a multi case study has not to be limited to the banking industry. Furthermore the proposed content according to the framework could only be partially considered in the banks final service map. Reasons are the limitations of the subjacent project and contrary interests of different stakeholders. Hence the consideration of visibility (Klose et al. 2007) by applying the framework could improve the applicability. Subsequently, a next step is the integration of the framework into more comprehensive methods for service map integration and design.

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