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The Impact of Service-Oriented Architecture on Business Networkability

Falk Kohlmann
Information Systems Institute University of Leipzig, kohlmann@wifa.uni-leipzig.de

Rainer Alt
Information Systems Institute University of Leipzig, rainer.alt@uni-leipzig.de

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Kohlmann, Falk, University of Leipzig, Grimmaische Strasse 12, 04109 Leipzig, Germany, kohlmann@wifa.uni-leipzig.de

Alt, Rainer, University of Leipzig, Grimmaische Strasse 12, 04109 Leipzig, Germany, rainer.alt@uni-leipzig.de

Abstract –

Increased networking among firms has become a competitive necessity in many industries and the ability to efficiently establish, operate and dissolve business relationships has become a competitive advantage. The degree of this networkability is influenced by several factors, such as organizational structure, business processes, people and culture, but also information systems. In fact, current technological developments aim at the efficient and flexible orchestration of standardized modules, referred to as services. Past research has analyzed networkability primarily qualitatively without providing a specific perspective on the concept of service-oriented architecture (SOA) which has only emerged on a broad scale since the beginning of this century. This paper is a first attempt to investigate the impact of SOA on the notion of business networkability. It is assumed that the ability to flexibly link business services among business partners also positively influences the firm's networkability. Empirical evidence will be provided from the financial industry which is currently undergoing a strong vertical disintegration. The results show a moderate, but nevertheless significant impact.

Keywords: service-oriented architecture, business networkability, finance industry.

1 INTRODUCTION

Increased networking among companies (business networking) has become a competitive necessity in many industries. Among the drivers that lead to the (re)design of interorganizational business models are time pressure and know-how intensity in product development, flexibility requirements in meeting customer demands and scale effects in production functions. For example, focussing on core competencies (Prahalad and Hamel 1990) allows individual actors to either concentrate on customer management, product development or infrastructure (Hagel and Singer 1998). At the same time combining all distributed competencies to a unique and consistent customer service implies that not only strategic competencies are aligned across the participating partners, but also the underlying business processes, functions and information systems (IS). The notion of 'agility' has been coined to grasp an organization's abilities to efficiently and effectively adapt in dynamic environments (Schelp and Aier 2009).

While structures in the automotive industry usually comprise several value-adding steps (so called 'tiers') with suppliers, a comparable disintegration process is only now occurring in the banking and insurance industry. For example, many banks have embarked on sharpening their core competencies and the option of offering services to other banks (Homann et al. 2004; Lammers et al. 2004). The competitive, regulatory and technological changes in the financial industry have attracted further attention in view of the recent crisis. It is believed, that this development will require even stronger abilities to efficiently adapt to changing customer and/or business requirements. The notion of networkability has been developed on the level of individual enterprises as well as on the level of entire business networks (Alt and Smits 2007) and 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). Whereas agility describes a firm's adaptability, networkability focuses on a firm's ability to collaborate. Agility may contribute to a firm's networkability.

The concept of service-oriented architecture (SOA) is conceived as a promising instrument to implement networkability. Clearly, SOA by origin is a technological concept which focuses on the integration of applications in heterogeneous environments. Services are conceived as standardized functional modules that may be orchestrated along a specific business process. This perspective prevailed in the past years and explains why many enterprises were unable to identify the immediate implications for the business. Meanwhile, a business perspective on SOA has received increasing attention. It conceives SOA as an enabler for the allocation of business activities among business partners in a value chain (Chesbrough and Spohrer 2006). This also calls for an alignment of the technological and the business perspective (Steen et al. 2005) and the deduction of technological requirements from the business.

This paper assumes that the ability to flexibly link business services among business partners positively influences a firm's networkability. The research question is to determine the impact of SOA on business networkability. For that purpose the paper is structured as follows: Section 2 provides the theoretical foundation and the research model. Section 3 presents the quantitative analysis of the conducted empirical study and its key findings. Section 4 summarizes the results, analyses the limitations and provides an outlook.

2 RESEARCH MODEL

2.1 Overview of the research model

Researching the link between information technology (IT) and firm performance already has a long tradition (Gurbaxani and Whang 1991; Henderson and Venkatraman 1993). It shows that IT can lead to more centralization as well as to more decentralization in organizations. On a very general level,

this implies that IT might sustain inter-organizational structures as well as intra-organizational ones. While this link has neither been researched directly nor associated with SOA, the SOA concept is attributed with benefits in three areas (Schelp and Aier 2009): First, SOA shall support a firm's agility to adapt to new requirements which is increasingly relevant in view of rapidly changing market conditions. Standardized interfaces facilitate the reuse of existing services and the integration of new (external) services. Simultaneously, current infrastructure technologies enhance the use of repositories and reduce the manual search effort for components and documentation. Based on these repositories, system development processes and their quality are increased (Schelp and Aier 2009). According to (Yusuf et al. 1999) both, flexibility and quality are sub-goals of agility. Second, SOA seems to be an instrument to overcome existing boundaries from heterogeneous application environments. New and existing functionalities (services) can be de- and re-composed. Combined with hidden technical implementation complexity, underlying legacy systems can be disguised (Baskerville et al. 2005). Third, SOA appears to have positive implications on fostering business-IT alignment. By providing structural enhancements based on the standardization of services within a network SOA can be seen as an enabler to efficiently operate cross-enterprise value chains. Key requirement is the implementation of a supportive organizational structure (roles, responsibilities) as part of SOA governance (Brown et al. 2006), considering both an enterprise and a network perspective (Kohlmann and Alt 2009b). Such organizational structures incorporate specific roles and boards (Lawler and Howell-Barber 2008) pooling personnel from business and IT enhancing business and IT alignment from a cultural perspective.

Another relevant stream of research has investigated the impact of IT on firm performance from a network perspective (networked organizational performance, *NetOP*). (Straub et al. 2004) empirically validate the variable 'information sharing' on NetOP. The 'New Business Network Approach' (van Heck and Vervest 2007) considers information sharing besides products/services, value creation, coordination/control and infrastructure as the five characteristics to compare traditional and new business network approaches. (Alt and Smits 2007) suggest five design objects for business networkability, but differentiate besides products/services and information systems: processes, organizational structure and employees/culture. Governance is required to manage the intra- and inter-organizational adaptation of each design object.

(Hoogeweegen et al. 1999) propose four phases for virtual organization management as part of modular network design, among them the allocation of process modules or services. They conclude that the performance of these virtual networks is enhanced by using ICT in general. A firm's networkability influences NetOP and describes the capability of an organization to integrate new customers or suppliers at minimum efforts (Smits et al. 2006). (Österle 2001) conceives networkability as a core competence for every enterprise of the information age. Enhancing information sharing is not limited to technical aspects (concerning data exchange and adaptive applications) but includes standardization and transparency of processes and organizational structure (Henderson and Venkatraman 1993; Smits et al. 2006; van Alstyne 1997). This research aims to assess SOA from a business perspective. It enables similar business functionalities such as solvency check across multiple business processes which implicitly contribute to standardization. Transparency, however, is represented as discrete construct within the research model forming a moderator effect as discussed in (Baron and Kenny 1986). Figure 1 provides an overview of the research model.

2.2 Direct effect of SOA on business networkability

Service design is one of the core activities in building any SOA (Bell 2008). This comprises not only structured service identification and the integration into a service typology, but also the availability of a standardized interface. In the following, an integrated service typology that consists of four vertical tiers (Kohlmann and Alt 2009a) is used:

- *Business service clusters* (e.g. customer rating, credit risk management or trading) map several business process steps and provide a connection to the firm's business models (Bell 2008). The clusters are identified using business semantics (such as semantic proximity, autonomy), domain

engineering and graph theory (Aier and Schönherr 2007; Kang et al. 1990; Kohlmann and Alt 2009a).

- *Business services* (e.g. pricingRuleService, foreignCurrencySupplyService, ratingCalculationService) represent functionality of a specific business activity (Bonati et al. 2006; Brown 2007; Erl 2007; Werth et al. 2006).
- *Application services* (e.g. createLoanContract, manageBusinessPartnerRole or checkLegitimatingControl) are focusing on independently usable and elaborately specified functional components (Kohlmann 2007; Rosen et al. 2008).
- *Infrastructure services* (e.g. accessDatabase or checkIPConnection) finally encapsulate technical capabilities independent of any business domain (Brown 2007; Rosen et al. 2008). For reasons of reduced complexity application and infrastructure services will be referred to as technical services.

Following resource-based theory only the use of valuable, rare and appropriable resources lead to unique and sustainable competitive advantage (Barney 1991; Mahoney and Pandian 1992). The literature on business networks and virtual organizations (Grandori 1999) uses these ideas and posits that every network participant specializes on his core competencies which are intricate imitable or adaptable resulting in economies of scale and scope (Prahalad and Hamel 1990). The combination of these networked competencies increases NetOP but requires a minimum networkability on behalf of the engaging firms. Standardized business services and links between business processes and systems allow for analyzing the different strategic positioning of organizations within a network. Another key component in any SOA is a directory that catalogues the available services. While directories list services, service maps structure services along with their relationships and interdependencies (Kohlmann and Alt 2009a).

From a business perspective SOA includes information from roles in the business network as well as from activities in business processes. The alignment with the technological perspective is on the one hand performed by incorporating an integrated service typology and by analyzing the technological feasibility of the identified services based on existing application architecture on the other. This is also consistent with the established view on business and IT alignment suggested by (Luftman and Brier 1999). Starting on the business perspective improves the support and break-down of changing business priorities (Lawler and Howell-Barber 2008; Marks and Bell 2006) and enhances the conversion of recognized value potentials (Becker et al. 2009). Consequently, the emergence of such a SOA should contribute to a firm's business IT alignment. (Schelp and Aier 2009) see business IT alignment as part of agility and conclude that "service oriented architectures have the potential to contribute positively to corporate agility." (Yusuf et al. 1999) posit agility as capability of meeting rapidly changing needs of a marketplace. As the latter implies customers, suppliers and competitors and also forms a firm's business network, the first hypothesis assumes that SOA contributes to business networkability via agility.

Hypothesis 1: SOA is positively associated with business networkability.

2.3 Moderator effect of governance

Governance is key for establishing and operating networks as it explicitly defines the allocation of decision rights (Ross and Weil 2004) and relational governance (Konsynski and Tiwani 2004). Following this definition SOA governance clarifies the organizational ownership for each service, thereby enhancing the transparency in service management (Marks and Bell 2006) and contributing to the sustainability of a SOA. Many networks fall short of this governance due to high maintenance efforts for reusing services and managing service variants (Schelp and Aier 2009). On the network level the complexity for service management increases if a local decision maker for a business service communicates directly with the corresponding provider. Furthermore, decision rights can be allocated to one or more organizations in a network (Anand and Mendelson 1997; Nault 1998). A structured governance process supports the intra- and inter-organizational allocation of decision rights for services, the service lifecycle and the management of service implementation projects. (Rosen et al.

2008) show how organizational governance contributes to the management of service catalogues or service maps when services are added, modified or withdrawn.

Business processes of an organization usually comprise several similar functionalities, such as checking cash account, checking stop orders or authenticating customers. As these processes may be provided by different organizations in a network, the performance in decentralized settings may be lower as in centralized (e.g. shared service centers). (Janssen and Joha 2006) claim that this combination results in flexible and effective alignment of IT and business. The explicit documentation of the business process similarities would enhance the optimization and identification of such shared service centers leading to improved firm and network performance.

(Jones et al. 1997) suggest that rigorously defined network governance has advantages in adapting, coordinating and safeguarding exchanges compared to hierarchical and market solutions. Structured processes for the governance of services (e.g. publication, changes of releases, versioning and discontinuation of services) and documented service ownerships reduce the coordination cost. Managing the collaboration process, service ownerships reveal the relations and responsibilities within a network and can support productive business partner interactions to attain collaborative advantage (Moss-Kanter 1994). Consequently, governance is not considered as mediator but as a moderating effect. This leads to the second hypothesis:

H2: Governance has a moderator effect on the impact of SOA on business networkability

2.4 Moderator effect of process and systems transparency

Designing networks requires the understanding of the underlying strategies, processes and systems (Klein 1996; Österle 1995). Transparent relationships between processes, business partners and/or operational processes and systems facilitate this understanding. Hence. transparency is another important variable that enables the management of any activity (Tapscott and Ticoll 2003). It contains an internal and an external dimension (Street and Meister 2004). First, internal transparency comprises a profound and comprehensive understanding of the business, which encompasses all products, processes and systems. As SOA tries to bridge the gap between processes and systems, a clear understanding about an organizations process and application architecture is a success factor for designing and implementing any services (Bell 2008). An integrated service typology (see section 2.2) can then serve to link business and technological perspective of SOA, enhancing alignment between IT and business.

Second, external transparency refers to the management of inter-firm interdependences (Konsynski and Tiwani 2004) which are addressed in network and sourcing models. A network model describes roles and relationships (information flow, cash flow, equity holdings or operational market relationships) within a community or market, whereas a sourcing model implements a sourcing strategy for one or more business processes of an organization. For example, the sourcing strategy would specify a bank's core competencies and the areas which are subject to outsourcing. The sourcing model then denotes whether a multi- or single-sourcing approach should be followed and the distribution of activities among the partners. Thus, it contributes to inter-organizational process transparency. This transparency can then serve to visualize inter-firm service distributions and ownerships in a service map. Simultaneously, the sourcing strategy can be exemplified in a service map via the covered business functionalities of each business partner to identify redundancies and critical process and IT cuts. Together with a visualization of systems dependencies a service map can be used as an instrument to analyze sourcing implications.

Like all structured models service architectures and service maps enhance the understanding about the allocation of organizational activities ('who does what?') and the link between processes and applications ('which application supports which process?'). They are also the basis for including services in a directory and orchestrating them along a business process definition. The third hypothesis therefore assumes that transparency has a moderating effect on the link between SOA and business networkability:

H3: Process and systems transparency has a moderator effect on the impact of SOA on business networkability

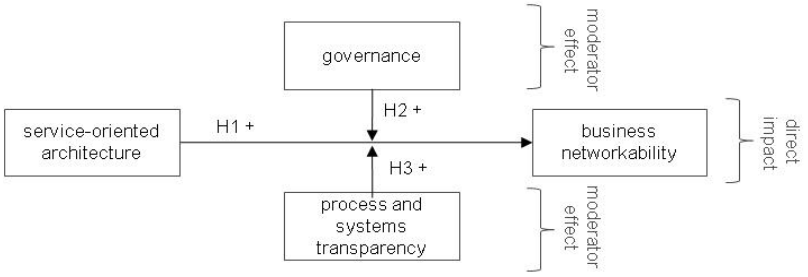

Figure 1: Research model

3 EMPIRICAL ANALYSIS IN THE FINANCIAL INDUSTRY

3.1 Current situation in the financial industry

The (European) financial industry is undergoing a fundamental transformation towards less vertical integration and more networking among banks, insurance firms and service providers. Several drivers are reported for this development (Homann et al. 2004; Hoppermann 2008): (1) *market changes* lead to increased competition based upon globalization and changes in market structures (e.g. regional banks extend their geographical scope, market entry of non-banks) as well as market concentrations (e.g. mergers and acquisitions) and, more recently, the crisis in the finance industry; (2) *regulatory requirements* include a growing number of emerging international guidelines, such as SEPA (single European payment area) or MIFID (Markets in Financial Instruments Directive); (3) *customer expectations* are increasing based upon internet based banking solutions such as online brokerage, higher transparency and more widespread comparison shopping; (4) *product complexity* is growing due to a larger variety and more intricate mechanisms leading to higher costs for product listing; (5) *technology* requires migration from proprietary legacy applications based on mainframes and monolithic application landscapes which are inflexible and expensive to maintain; (6) *competitiveness* in the marketplace in general decreases margins and negatively influence cost income ratios.

3.2 Data description and measurement

The conceptual research model shown in Figure 1 was operationalized using a set of indicators for each hypothesis. The alignment between business and IT is used as a first indicator for business networkability (Alt and Fleisch 2001; Steen et al. 2005). A second indicator for business networkability relies on the economies of skill which reside within a business network (Langlois 1995; Prahalad and Hamel 1990). As specialized service providers usually are further developed on their individual learning curves, the amount of supplied services ceteris paribus enhances the overall capability of an organization to establish and evolve network relations. Business networkability increases with the amount of interaction with external partners (Österle 2001). Consequently both interaction types (with customers and business partners) are used as indicators as well.

An indicator for SOA is service design which is accepted as one of the core activities of building any SOA (Bell 2008; Erl 2007). The availability of a service typology represents the second indicator for SOA (Werth et al. 2006) as it bridges the gap between processes and systems by allowing a structured drill down from business to technical functionalities. Service maps, used as a third indicator for SOA, broaden the information contained within service repositories (Kohlmann and Alt 2009a; Legner and Heutschi 2007). Governance is represented by two indicators: A defined governance process is key for establishing any governance routines (Lawler and Howell-Barber 2008; Marks and Bell 2006), while

the ability to manage SOA projects directly influences the business contribution of SOA (Brown 2007; Rosen et al. 2008). A top-down approach first analyzes the heterogeneous requirements from different stakeholders (customers, sales units, competitors or providers) on the business level. Second the affected business services are analyzed based on a process-service allocation (indicator for transparency). Third, the implications for existing application systems or technical interfaces can be revealed by a decomposing business services to technical services (service-service allocation). An overall business view (second indicator) provides an important basis for understanding the processes and systems (Legner and Heutschi 2007).

Each indicator was measured on a four-point Likert scale (‘strongly disagree’, ‘disagree’, ‘agree’, ’strongly agree’) supplemented by a ‘do not know’ (Dawis 1987). The ‘forced choice’ scale was chosen in order to reduce a cumulative amount of undetermined answers and to increase expressiveness of a positive or negative impact. The questionnaire was pre-tested with consultants and managers from the banking industry to reduce ambiguities which were not included in the final sample. At the outset, the 100 largest banks in Germany according to their total assets in 2007 as well as the largest banks in Switzerland meeting the same size in terms of total assets (equals 11 banks), the 35 largest insurance firms according to their premium income in 2007 and 80 providers from the finance industry, were selected. The providers were chosen based upon the participant directory of two major financial provider fairs in Germany and Switzerland. The survey was conducted within eight weeks between July 1th and August 30th 2008 among IT executives (chief information officer, chief enterprise architect etc.) from the chosen 226 firms. Executives who did not return the questionnaires were contacted which improved the response rate. In total 36 questionnaires were returned representing a response rate of 15.9%. The distribution of the groups (banks, insurance firms, providers) in the sample matches the distribution of the basic population (chi-square 1.2982, P value equals 0.5219). To validate the hypotheses the multiple regression method was applied. Despite PLS (‘partial least squares’) is predominantly in MIS research, (Goodhue et al. 2006) have shown that it does “not have an advantage in terms of detecting statistical significance at small sample size”. Moreover referring to weak effect sizes PLS and multiple regressions have the same statistical power.

Multiple univariate linear regression is applied to verify the effect on each regressand, followed by a multivariate linear regression test to verify the whole research model implying the indicators for the moderator effects. The result of the overall F-test is used to evaluate the significance of the constructed regression model (Cramer 1972). The coefficient of determination R^2 (Allen 1997) is considered to determine the contribution of the regressors on the regressands. In order to calculate the moderator effects each indicator of governance and transparency has been regrouped. This allows for a distinction between a positive and negative impact of each moderator indicator.

3.3 Results

3.3.1 Impact of SOA on business networkability

Regarding the direct effect of SOA on business networkability four out of six tested correlations were significant. A correlation of 0.530 showed a strong link between service maps and business IT alignment. This may be easily explained as the systematic visualization of services and relationships supports business and IT representatives when discussing business requirements and the systems implications (Kohlmann and Alt 2009a; Rosen et al. 2008). Surprisingly, the indicators customer interaction and business partner interaction showed no significant correlations to any other indicator. As continuous customer interaction becomes more critical in many industries (Venkatraman and Henderson 1998) interorganizational information systems (IOIS) provide a competitive advantage by enhancing information sharing (Johnston and Vitale 1988). By providing structural enhancements based on the standardization of services within a network this research suggests that SOA may be seen as an enabler for IOIS. Technical services form the backbone to exchange information, but business services provide the basis for the interaction with customers and business partners. However, a possible reason for the lacking correlations may be that different procedure models are applied for

service identification in practice. So far no unified approach for service design exists which explains that service design leads to different sets of services and heterogeneous service maps among business partners. This necessarily implies a need to map and align different service maps.

Overall, the multiple univariate linear regression followed by multivariate linear regression revealed a moderate, but highly significant influence of SOA on business networkability. The coefficient of determination on the indicator business IT alignment (R^2 0.306) is comparable to the one on supplied services (R^2 0.404). Hence, at least a third of the overall variance of the statistical relation can be explained and H1 is supported.

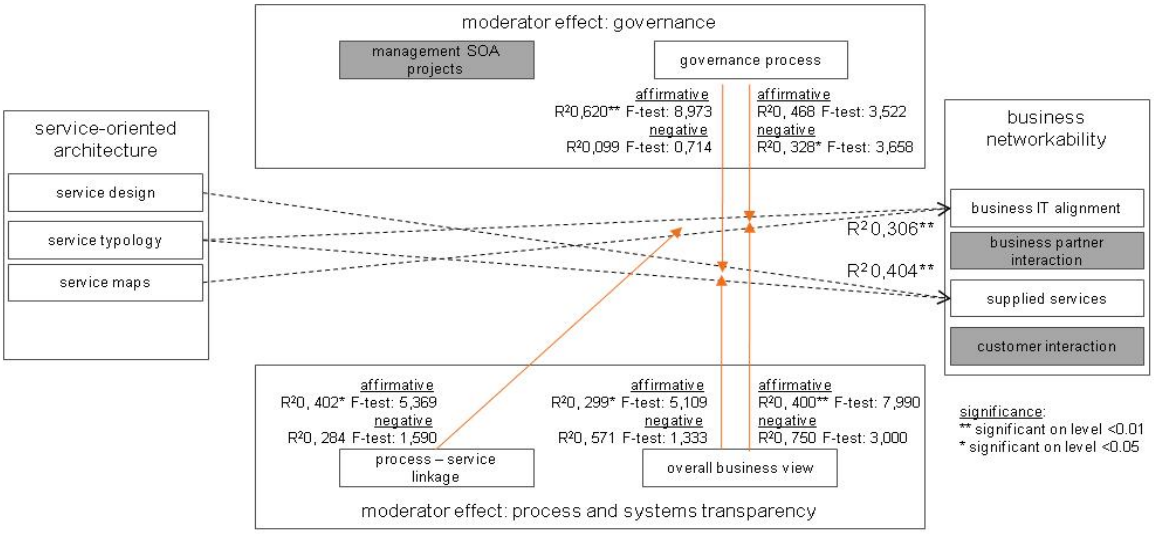

Figure 2: Coefficients in the research model

3.3.2 Moderator effect of governance

Hypothesis 2 suggested that governance has a moderator effect on the impact of SOA on business networkability. According to (Baron and Kenny 1986) two groups were defined for each indicator, representing an affirmative or negative existence. The results show that once governance processes were in place the impact of SOA on the supplied services (R^2 0,620) was significant and that no influence existed when a governance process was missing. Surprisingly, when looking at the moderator effect on business IT alignment, the opposite became significant. The non-existence of a governance process has a positive effect. As current literature (Kajko-Mattsson et al. 2007; Lawler and Howell-Barber 2008) suggests, there is gap between defining a governance process and establishing as well as executing it. The current focus lies mainly on the organizational structure of SOA governance (roles, boards) and not on the governance lifecycle of individual services. Hence, underdeveloped SOA governance may lead to less business IT alignment. Another reason can be found in the vertical disintegration occurring in the financial industry which, especially when compared to other industries, is relatively new (Homann et al. 2004). Redesigned and updated regulations will only emerge. Thus, it is expected that the moderator effect of governance will increase in the future.

Analyzing the results for the second indicator shows no effect at all. It can be assumed that a structured deduction of responsibilities beyond roles and boards based on aligned service typologies is not yet applied in practice. Nevertheless the lacking effect of SOA project management capabilities is contrary to existing literature (Erl 2007; Marks and Bell 2006). Especially the financial industry has to face increased regulations (e.g. banking secret, data privacy protection). Traceable documented allocation of decision rights may ease regulation compliant project management.

3.3.3 Moderator effect of process and system transparency

The third proposed effect suggests that an overall business view on processes and systems positively influences the impact of SOA on business IT alignment. This supports existing approaches (e.g. (Kohlmann 2007), which propose the incorporation of information from network models to enhance the definition of service candidates. Simultaneously applying the moderator effect of the indicator on the impact of SOA on supplied services reveals a significant increase. Regarding services in the wider business context may ease their orchestration to business processes and eventually tap their business value. Consequently, firms are encouraged to extend the amount of supplied services. A further positive effect could be detected for the indicator process-service linkage. If instruments such as a process-service matrix, which exemplifies usage and responsibilities of services according to (sub-) processes exist within a firm it fosters the implementation of SOA especially the application of service design processes.

In summary, statistical relations could be found between all constructs of the research model. Although hypothesis H1 is supported in principle, the significance figures also show that the impact is only moderate. The enhanced impact of SOA on business networkability by the moderator effect transparency validates hypothesis H3. In turn the figures show only partially that governance has a moderator effect. Moreover the effect reveals positive and negative impacts. Consequently hypotheses H2 has to be rejected.

4 CONCLUSIONS

Increased networking among firms has become a competitive necessity in many industries. This includes transformations in market structure, business models and IT-architecture and the focus on core competencies. Business networkability has become essential for firms, in particular, when network relations are changing and require the continuous alignment of business and IT. SOA can be one solution for this value chain decomposition and cross-enterprise collaboration. Besides its technological origin, SOA is conceived as an approach that enables the allocation of business activities among business partners in a business network. This research assumes that a firm's networkability is fostered when business services may be sourced more flexibly among business partners. Regarding the impact of SOA on business networkability several influencing factors on business networkability were developed and enhanced with a variety of indicators. To empirically test the research model a survey among IT executives from 226 firms was conducted in 2008, resulting in 36 usable questionnaires. The banking industry was especially interesting for business networkability since many banks have embarked on sharpening their core competencies and are also pursuing strategies to offer services to other banks.

The study supports that SOA is one element which influences business networkability. However, as already pointed out by (Wigand et al. 1997) a direct link between it and business value does not exist. In addition, a set of other variables such as core competencies, organizational structure and people also influence a firm's business success. Nevertheless, these variables are at least not directly affected by SOA. Especially as SOA does not represent an automatism to a single organizational design and need to be adapted according to a firm's specific conditions. SOA still has a significant positive impact on business networkability although a higher effect of SOA on business networkability was expected. The effect is enhanced by moderator effects of governance and process and systems transparency (see *section 3.3*). However, the figures revealed that the moderator effect governance has positive and negative impacts. Reasons may be found in underdeveloped SOA governance processes and the current focus on establishing organizational structures.

Two limitations come with this research. First, only a moderate overall influence could be detected. The R^2 values are fluctuating between 0.299 and 0.620. Reasons may be found in the ongoing disintegration process in the financial industry and the still prevailing technological perspective of SOA. Therefore, the validity of the measures should be confirmed by replicating the study in the near

future and extending the sample size. Simultaneously, data could be collected from banks and insurance firms of different countries and regions to analyze possible differences. North American banks in particular adopted SOA prior to European banks. Second, the generalizability of the findings may be limited to the financial industry. Data should be collected from other industries to enhance the understanding of the impact on business networkability. Consequently, future research will focus also on the collection of additional data sets.

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