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Abstract

SOA and web services are supposed to increase integration capabilities, stimulate inter-organizational processes, and thereby improve coordination in distributed business networks. They also foster the idea of dynamic business networks with quick connect and disconnect relationships. While service-oriented architecture (SOA) concepts are increasingly adopted in practice, they are still mostly applied within company boundaries. Little research has systematically analyzed how SOA is implemented in inter-organizational relationships and business networks. In addition, SOA concepts are not yet sufficiently linked to the mature stream of research on inter-organizational information systems (IOS). Hence, we lack a more fundamental understanding of how SOA is used within business networks.

Our research aims at filling this gap. First, we propose a multi-dimensional classification scheme for assessing SOA adoption in business networks. This scheme is derived from inter-organizational systems (IOS), SOA and business networking literature. Second, we analyze 25 inter-organizational SOA cases to identify focus areas and patterns of SOA adoption in business networks. Third, we compare our findings to the propositions from IOS and SOA literature. While our empirical analysis does not confirm all enthusiastic propositions related to SOA, it underlines the specific contribution of SOA compared to prior forms of IOS.

Keywords: Business-to-Business (B2B), Business Networks, Inter-Organizational Systems (IOS), Service-oriented Architectures (SOA), Web Services.

1 INTRODUCTION

Increasing globalization and specialization have driven companies to align and electronically integrate their business strategies and processes with those of their business partners (Jacobides and Billinger 2006; Österle et al. 2001). Many scholars have predicted that the general acceptance of open Internet-based standards will dramatically reduce interaction costs within and across organizations, and thereby foster the division of labour between organizations (Hagel and Brown 2001). Web services paradigm and service-oriented architectures (SOA) further enhance well-established Internet infrastructures and are about to introduce the next paradigm shift. By establishing service-based communication across heterogeneous platforms and among enterprises (Alonso et al. 2003; Erl 2005; Papazoglou 2007), SOA provide a more flexible and much cheaper platform for external integration than previous forms of inter-organizational systems (IOS), notably electronic data interchange (EDI), which built on proprietary technologies (Bussler 2003; Christiaanse et al. 2004; Gosain et al. 2004; Linthicum 2001; Picot 1982). Consequently, they are supposed to further increase integration capabilities, stimulate inter-organizational process integration, and improve coordination in distributed business networks (Daniel and White 2005). SOA also fosters the idea of dynamic business networks with quick connect and disconnect relationships (Merrifield et al. 2008). Recent practitioner studies in Europe and the US (Forrester Research Inc. 2009) report that current integration technology is not effective in most situations. Despite the fact that 80% of all enterprises are planning to upgrade their internal and B2B integration capability during the next 12 months (Forrester Research Inc. 2009), SOA and web services are still mostly applied within company boundaries. From an academic perspective, it is not yet well understood how companies should leverage the service-oriented paradigm to improve their inter-organizational relationships. Moreover, no classification scheme, taxonomy or conceptual framework for analyzing SOA application in business networks exists in prior research.

This research seeks to bridge this gap and to contribute to the emerging research discussion on “service science” (Buhl et al. 2008; Demirkan et al. 2008) by exploring the adoption of SOA in business networks. It focuses on the following research questions: (RQ1) what are the focus areas of SOA projects that target the inter-organizational domain; (RQ2) which patterns can be identified for SOA adoption in business networks; (RQ3) and, what are the implications of SOA for the external coordination in business networks, in particular in comparison to prior forms of inter-organizational systems?

In order to improve our understanding of SOA’s impact on business networks, we choose an exploratory research approach to find and generalize focus areas of SOA adoption in inter-organizational settings. For this purpose, we collected and reviewed case descriptions of SOA projects and conducted a content analysis. In order to assess SOA adoption in the cases, we reviewed prior literature and came up with a classification scheme that characterizes a business network’s strategy, organization, and its underlying infrastructure and systems. By linking SOA to the established stream of research on inter-organizational systems and business networking, our research seeks to direct future research. It provides insights into the following dimensions of business networking: (D1) the characteristics and configuration of business networks that apply SOA; (D2) the electronic cooperation processes they engage in; and (D3) the design of SOA-based communication and collaboration platforms that link different network stakeholders. Our research addresses researchers as well as practitioners by providing a classification scheme and implications for further development of the service-oriented concept in business networks.

The remainder of this paper is structured as follows: Section 2 outlines the research objectives and process as well as the data collection approach. Section 3 introduces a classification scheme for assessing SOA adoption in business networks, which has been used to classify real-world SOA implementations. In section 4, we summarize our case analysis, before we discuss our findings in the context of prior SOA and IOS literature in section 5. Section 6 closes with the contributions to research and practice as well as the limitations and propositions for future research.

2 RESEARCH DESIGN

2.1 Research objectives and approach

Recent literature describes SOA as a component-based, distributed IS architecture paradigm that encapsulates elements of the IT infrastructure as identifiable, self-described services based on open standards (Demirkan et al. 2008; Erl 2005; Heutschi 2007; Papazoglou and van den Heuvel 2007). Whereas the research on business networks and inter-organizational systems is mature (Frick and Schubert 2009; Robey et al. 2008), there is little knowledge about how web services and service-oriented architectures impact business networks. Given that the academic discussion in this field of research is at an early stage (Zhao et al. 2007), our main research objective is to explore how SOA impacts inter-organizational integration in business networks. More specifically, our goal is to understand why and how companies adopt SOA and identify patterns in the way companies (re-)shape their external relationships with SOA. Our research approach can be characterized as theory of explaining (Type II) according to Gregor (2006), who recommends case study research (Yin 1994), among others, to develop this type of theory. Accordingly, in order to gain an empirical foundation, we use a qualitative content analysis on written SOA case study materials that describe successful real-world implementations. We analyze the descriptions in the case material by coding the arguments in accordance to our classification scheme, which originates from IOS and business networking literature and will be detailed in section 3. In the final step, we conduct a cross-case analysis for deriving patterns in our dataset, and compare them to the propositions we derived from prior literature.

2.2 Data collection and analysis

One of the key difficulties in studying IOS adoption in general is the accessibility of data from real-world implementations. This particularly applies to new technologies and concepts such as SOA. Like other IS researchers (Frick and Schubert 2009; Tafti et al. 2008), we rely on secondary data to get a comprehensive empirical basis. Our data collection originates from a comprehensive case study database[1], consisting of 164 case descriptions of real-world SOA implementations that were acquired from journal databases, print publications, case collections, press coverage, and SOA-related material issued by companies, vendors, consultants and analysts. We restricted our analysis to those SOA projects that target inter-organizational integration by applying two selection criteria: (1) the case describes a current or past implementation of SOA; and. (2) it applies SOA in an inter-organizational relationship between at least two partners (businesses, administrations or individuals). We identified 45 case descriptions that satisfy the two criteria, derived from 34 bibliographic sources. During our coding, we eliminated another 20 cases due to incomplete or partial information. The final data set covers 25 unique case descriptions of 25 different organizations and their respective business networks. The cases cover different industries, such as financial services, insurances, public sector, trade and manufacturing. For case analysis, we used a classification originating from IOS and business networking literature and translated into a coding scheme (cf. section 3). We implemented the coding scheme representing the three layers of our model by means of tables containing the respective elements, and then catalogued the cases accordingly. For cases where we found several valid attribute values in the case description, multiple counting was used. Each case was first analyzed by one of the authors, who coded the cause-and-effect chains. In order to increase the inter-rater reliability, a second author then analyzed each case. If there was agreement on the coding, the classification was accepted. The remaining classifications were subject to further discussions by all the authors. If agreement could not be reached, classifications were excluded from the data set.

[1] A full reference list of all the sources from the case database is available on request.

3 A MULTI-DIMENSIONAL ASSESSMENT OF SOA ADOPTION IN BUSINESS NETWORKS

3.1 The need for a multi-dimensional framework

While SOA and web service technology were initially mostly researched from the perspective of computer scientists (Erl 2005; Papazoglou and van den Heuvel 2007; Zhao et al. 2007), recent publications emphasize the need to address organizational and strategic aspects in order to explain the adoption of SOA in practice (Demirkan et al. 2008; Luthria and Rabhi 2009; Viering et al. 2009). If applied in the inter-organizational context, SOA and web services further enhance and extend Internet-based infrastructures that link two or more business partners. IOS literature generally emphasizes that IT advances are an important factor in the formation of networked forms of organizing. While SOA enthusiasts argue that SOA will significantly increase the dynamism in network formation, intensive studies of EDI and XML demonstrate that IOS adoption is inherently complex. On the one hand, this is due to the patterns of interdependence that exist between multiple economic actors. On the other hand, IT-based strategies may reform these patterns and result in a complete redesign of a given business network. Hence, IOS adoption requires an understanding of the relationships between a business network's strategy and structure, and its underlying infrastructure and systems (Van Heck & Vervest 2007; Österle et al. 2001).

In order to cope with the multiple facets of inter-organizational integration, our classification scheme for analyzing SOA deployments in business networks builds on the electronic business networking methodology and architecture (Fleisch 2001; Österle et al. 2001; Senger 2004). This approach differentiates three layers for describing the alignment of strategic and organizational capabilities with the IS/IT architecture, and has been widely used to analyze the design of IT-supported business relationships: On the business layer, companies define the customers and partners with which they cooperate and the type of linkages they establish with them. This layer covers *what* the company's business network consists of. The approach is further refined on the process layer by process maps covering activities as well as input and output relationships. The process layer therefore describes *how* organizations collaborate within the network. The IS/IT layer covers the means *by which* the processes are carried out by describing the application, integration, and infrastructure architecture. Based on this business networking architecture, we suggest analyzing the SOA's first-order effects that relate to the IS/IT infrastructure from the second-order effects, which are generated by improved IS/IT capabilities on the process and business layers.

In order to develop a coding scheme, we reviewed prior literature in the fields of business networking, IOS and SOA, and collected attributes that characterize business networks at the three layers. We particularly reviewed the extensive coding schemes developed by prior literature for classifying IOS and B2B integration, notably by Klein (1996), Clarke (2001), Senger (2004), Al-Naeem et al. (2004), Löwer (2005) and Rodon (2006). Before coding, we discussed the applicability of these coding schemes to our research and evaluated the defined classification scheme after a first round of coding (Fettke and Loos 2003). Finally, we come up with 24 attributes and 88 values as presented in Table 1. The following three sections will discuss our coding scheme by motivating and describing the attributes that are used to code the SOA case descriptions.

3.2 Assessing the strategic layer in business networks

Within the business networking literature (Österle et al. 2001), the business or strategic layer describes institutional integration (Bauer and Stickel 1998), thereby reflecting the concepts that have been developed by transaction cost theory and the resource-based view. The main design elements are the organizational entities that constitute a business network and their interrelationships.

For our model, we first consider the scope of the business network characterized by *value chain integration*, as the distinction between vertical integration (different levels in the value chain) and horizontal integration (the same level in the value chain) (Robertson and Langlois 1995). Second, we consider the *type of partners* and relationships that constitute the business network. The latter classifies business-to-business (B2B), business-to-consumer (B2C), and administration-to-administration and business (A2A/A2B) relationships as well as administration-to-consumer (A2C). The *heterogeneity of partners* describes whether they are in the same industry or in different ones (Frick and Schubert 2009). Four attributes describe important characteristics of the business network, which define the size and interdependencies between the business partners: *Network topology* can be differentiated as 1:1, 1:n, and m:n relationships (Clarke 2001). Based on the *number of partners*, we distinguish between networks involving a handful of partners (<10), from networks involving a larger number of partners (n>10) and networks involving many clients (n>100). In addition, we characterize the network by its *stability* (stable vs. dynamic) and *governance* (focal vs. polycentric) (Alt et al. 2005; Fleisch 2001).

Since business networks are formed by several organizational entities with specific objectives, we analyze *networking targets* (Kambil 2008) such as sharing of core competencies through strategic partnerships, operational effectiveness, and strategic positioning through new products, new markets or new distribution channels. Additionally, Kambil (2008) differentiate between *network characteristics* according to existing product and existing market (efficiency network), existing product and new market (channel extension network), new product and existing market (innovation network), and new product and new market (venture network). Further, we examine several *strategic pressures*, such as access to customers, improvement of product and/service offering, mergers and acquisitions, and the development of strategic know-how.

3.3 Assessing the process layer in business networks

According to business networking literature (Österle et al. 2001), the process layer refers to organizational integration (Bauer and Stickel 1998). Business processes comprise sequences of activities which may be distributed across various organizational units and are considered the core of IT-based value creation (Melville et al. 2004). According to Österle et al. (2001), process analysis is the starting point for the (re-)design of business networks as it determines the business network's strategic potential and the technical requirements for process implementation. Hence, the process layer connects the strategic focus with the technology layer. SOA literature claims that a process-oriented SOA approach supports seamless process integration within and across company boundaries (Bussler 2003; Dorn et al. 2009; Papazoglou and van den Heuvel 2007).

Within our classification scheme, we consider *cooperation processes* that link the business processes between two or more independent entities. We distinguish between content and community, commerce, product life cycle, supply chain, finance, maintenance and repair *cooperation processes* (Alt and Österle 2004). Another differentiator in our classification scheme is the *output of cooperation processes*, which can be divided into physical product, and virtual product/service, and outtasking (Alt et al. 2005). Intimately connected with cooperation processes is the *span of cooperation*, which can be customer-facing, end-to-end, and supplier-facing. Finally, within our cases we examine a list of *process-related pressures* like capacity utilization, coordination effort and error proneness, redundancies, process complexity, and cost and throughput times (Senger 2004).

3.4 Assessing the IS layer in business networks

The *IS layer (IS architecture)* describes how information is processed and shared electronically within and across organizations from the perspective of technical integration (Bauer and Stickel 1998). This layer can be further deconstructed into application, integration and infrastructure layers (Österle et al. 2001).

Attributes	Attribute Values									
Value Chain Integration	Vertical Integration [#20, 80%]*					Horizontal Integration [#6, 24%]*				
Partner Heterogeneity	Homogeneous [#18, 72%]					Heterogeneous [#7, 28%]				
Partner Type	B2B [#19, 76%]*		B2C [#9, 36%]*			A2A&B [#6, 24%]*		A2C [#6, 24%]*		
Number of Partners	small n (< 10) [#3, 12%]*			n (> 10) [#6, 24%]*			N (> 100) [#17, 68%]*			
Network Topology	1:1 [#1, 4%]			1:n [#19, 76%]			m:n [#5, 20%]			
Network Stability	Stable Network [#20, 80%]					Dynamic Network [#5, 20%]				
Network Governance	Focal [#22, 88%]					Polycentric [#3, 12%]				
Networking Target	Strat. Partnshps. [#9, 36%]*		Op. Effectiveness [#14, 56%]*		New Market [#5, 20%]*		New Product [#8, 32%]*		New Channel [#18, 72%]*	
Network Charact.	Ch. Exten. Network [#9, 36%]*			Venture Network [#5, 20%]*		Efficiency Network [#10, 40%]*			Innovation Network [#2, 8%]*	
Strategic Pressure	Customer Access [#16, 64%]*		Improvement [#13, 52%]*		M&A [#1, 4%]*		Know-How [#0, 0%]*		No Pressure [#7, 28%]*	
Cooperation Process	Ctnt.&Comm [#6, 24%]*		Prod. Lifecy. [#0, 0%]*		Commerce [#13, 52%]*	Supply Chain [#6, 24%]*		Mtnc.&Rep. [#1, 4%]*		Finance [#9, 36%]*
Process Output	Physical Product [#7, 28%]*					Virtual Product, Service & Outtasking [#19, 76%]*				
Cooperation Span	End-to-End [#12, 48%]			Customer-facing [#13, 52%]			Supplier-facing [#0, 0%]			
Process-rel. Pressure	Cap. Utilization [#11, 44%]*		Coor.Eff.&Errors [#17, 68%]*		Redundancies [#1, 4%]*		Complex.,Cost & Time [#8, 32%]*		No Pressure [#4, 16%]*	
SOA Scope	Entire business network [#4, 16%]			Different int. and ext. partners [#17, 68%]			Organization [#4, 16%]			
SOA Implem. Strategy	Heterogeneous [#2, 8%]			Best-of-Breed [#10, 40%]		Single vendor [#8, 32%]			Inhouse Development [#5, 20%]	
SOA affected Application	ERP/ Core App. [#16, 64%]*	eCom.& CRM [#16, 64%]*	CMS/ DMS [#6, 24%]*	Groupw.& Comm [#3, 12%]*	MIS & BI [#1, 4%]*	eProc. & SCM/PLM [#3, 12%]*	HR [#1, 4%]*	Finance [#4, 16%]*	Portal [#15, 60%]*	
Communic. Type	Human-to-Machine [#18, 72%]*					Machine-to-Machine [#25, 100%]*				
Coupling Intensity	Stable (previous agreements) [#21, 84%]					Dynamic (on-the-fly) [#4, 16%]				
Coupling Approach	Centralized (1 instance) [#19, 76%]					Distributed (multiple instances) [#6, 24%]				
Info.-Exch. Style	message-oriented [#23, 92%]*		file / data-oriented [#10, 40%]*			remote method inv. [#6, 24%]*			pipe-and-filter [#8, 32%]*	
Integration Approach	Business Process Layer [#11, 44%]*			Presentation Layer [#16, 64%]*			Function & Data Layer [#24, 96%]*			
Service Granularity	Business Process [#13, 52%]*			Activity & Task [#22, 88%]*			Utility & Entity [#17, 68%]*			
Standardiz. Scope	Pragmatic [#8, 32%]*			Semantic, Syntactic [#23, 92%]*			Technical [#23, 92%]*			
IS-related Pressure	Miss. Interop. & Diff. Integr. [#16, 64%]*	Heterogenity [#13, 52%]*	Redundancies [#1, 4%]*	Security [#2, 8%]*	Legacy & Monolithic [#14, 56%]*	Costs [#5, 20%]*	Miss.&Imp.SW [#2, 8%]*			

Table 1 *Assessing SOA Adoption in Business Networks on Strategy, Process, and IS Layer with [Analysis Results: # of occurrence in cases, percentage of cases] n=25, * denotes multiple counting of cases*

Given our research objectives, we first characterize the SOA implementation itself by means of attributes derived from business networking literature, namely the *scope*, the *implementation strategy*, and the *SOA affected applications* (Alt and Österle 2004): *SOA scope* describes the organizational focus of SOA implementation, which may either span the entire business network, with different internal and external partners, or be restricted to the given organization. *SOA implementation strategy* denotes heterogeneous, best-of-breed and single-vendor solutions as well as in-house development solutions. Typically, SOA covers a number of internal *applications* (including ERP and other core applications, e-commerce and customer relationship management, content and document management, groupware and community management, management information systems and business intelligence, e-procurement, supply chain management and product life cycle management, and human resource, finance and portal applications).

To assess the extent to which SOA is applied in the organization, we use the following six attributes: In terms of *integration approach* (Al-Naeem et al. 2004; Heutschi 2007), we distinguish whether SOA comprises integration at the business process layer, presentation layer, or function and data layer. Besides, *coupling approach* (Al-Naeem et al. 2004) can vary between stable (with previous agreements) and dynamic (on-the-fly) ones. With SOA, different *information exchange styles* can be realized (Al-Naeem et al. 2004), such as message-oriented (e.g. SOAP and WSDL), file and data-oriented, remote method invocation (e.g. DCOM and RPC) as well as pipe-and-filter (using queues). During our analysis, we considered adding portal technology to the *information exchange style* attribute. Based on the integration approach, the *communication type* (McAfee 2005) expresses whether communication is human-to-machine or machine-to-machine interaction. *Service granularity* (Erl 2005) is a key design decision in SOA implementations.

Whereas business process services encapsulate entire workflows, process activity and task services support single process step activities, and utility and entity services support generic infrastructure functionality (e.g., authentication) or operations on data. Lastly, *standardization* is a precondition for any form of electronic business networking (McAfee 2005): Firstly, the transport of data must be agreed on a technical level; secondly, the payload of messages and their meaning must be standardized at a syntactic and semantic level; and, thirdly, the process flows between parties on a pragmatic level. As before, we consider a list of different *IS-related pressures* (Senger 2004) like missing interoperability and different integration mechanisms, heterogeneous technologies and platforms, redundant functionality and master data, security, legacy and monolithic systems, development, operations and maintenance costs as well as missing functionalities and imperfectly packaged software applications.

4 FINDINGS

By analyzing 25 SOA case studies based on the suggested scheme, we gained interesting insights into the focus areas of SOA adoption, which we will present in the following section.

4.1 Strategic focus of SOA implementations

Our examination reveals that SOA is still mainly applied between businesses (76%). However, SOA projects often involve several groups of partners and extend electronic business networking to administrations (A2A/B, 24%) and individuals (B2C, 36%; A2C 24%). In respect of the number of partners, 68% of the cases apply SOA to connect with more than 100 partners, 24% support network settings for several partners (between 10 and 100), and 12% address small partner settings with less than 10 partners. Most of the SOA project involved partners from the same industry, thereby focusing on vertically integrated business networks (80%).

Network governance is mainly dominated by one focal organization (88%), whereas polycentric arrangements remain rare (12%). Networks are mostly stable (84%), with only 16% dynamic

networks. Furthermore, we see that the SOA approach is mainly driven by strategic positioning into new channels (72%), operational effectiveness (56%) and sharing core competencies (#9, 36%). Considering Kambil's (2008) network characteristics, our data set consists of ten (40%) efficiency, nine channel extension (20%), five venture (20%), and two (8%) innovation networks. When looking to pair relationships, we found that vertical, homogenous value chain integration account for 50% of the cases, with focal, stable, 1:n networks and B2B relationships.

4.2 Process focus of SOA implementations

To further evaluate the adoption of service orientation in business networks, we look to the process attributes of our classification scheme. In respect of the cooperation processes, our data set exposes that commerce (52%) and finance processes (36%) are most often covered by inter-organizational SOA projects, followed by supply chain and content and community (24%). In line with the outcomes at the strategic layer, cooperation processes are mainly customer-facing (52%), whereas some examples exist for an end-to-end cooperation span (48%) and none for supplier-facing networks. In addition, our case analysis demonstrates that SOA is most significantly applied to cooperation processes that produce virtual products or services as outputs (76%), whereas physical product outputs (28%) play a secondary role. The process pressure describes the specific drivers of real-world SOA projects. In most cases, error-prone processes or high coordination efforts (68%) represent main challenges that are addressed by SOA implementation. In eleven cases (44%), we can identify capacity utilization, and in eight cases (32%) process complexity and high process costs as the main driver for a better solution.

Looking at pair relationships, we discover, that the seven cases with physical product output relates to either commerce and supply chain cooperation processes, whereas the majority of 19 cases with virtual product and service outputs are derived from finance and commerce cooperation processes.

4.3 IS focus of SOA implementations

Our case analysis confirms that SOA, as of today, is mostly used as an architectural paradigm to build information systems within an organization's boundaries. Although all SOA cases aim at integrating different internal and external partners, 68% of the cases apply SOA within their organization. In these cases, external partners purely integrate with their business partners' SOA, but do not necessarily have to implement an SOA themselves. For 16% in our case material, we identified that SOA supports only intra-organizational networks (e.g., subsidiaries within the same group). A comprehensive SOA covering the entire business network is used only in 16% of our cases. Among the applications that were affected by SOA, we identified e-commerce and CRM as well as ERP and other core applications to dominate (64% each). In addition, CMS and DMS (24%) and financial systems (16%) are integrated by means of SOA. The organizations most often applied best-of-breed (40%) and single-vendor (32%) strategies. In-house development (20%) is another option, especially for first adopters or smaller companies using an open-source approach.

Service orientation in business networks supports different coupling approaches. Most of the couplings are stable, i.e. they require previous agreements (84%), whereas on-the-fly coupling (16%) plays a subordinate role in our cases, to date. From a technology perspective, 92% of our cases apply message-oriented information exchange. On the other hand, file and data-oriented (40%), input queuing (32%), and function and component-based (24%) information exchange styles are still deployed in the service-oriented business networking context. The technology-driven application of SOA is further confirmed by the strong focus on function and data integration (96%,) and presentation integration (64%), compared to only 44% focussing on business process integration. With regard to the integration approach, the scope of standardization has to be considered as, for example, process integration needs a common (pragmatic) understanding of the work flows. Syntactic or semantic standardization is applied in most cases (92%), while we identified only eight cases (32%) that benefit

from business process standardization based on BPEL. Looking at service granularity, the under-represented process coverage can be further confirmed. We identified only 52% business process service implementations. Most organizations use activity and task services (88%), and utility and entity services (68%).

Our case material presents different IS pressures that led to the adoption of SOA. The pressures cited most often are lack of interoperability and multiple integration mechanisms (64%), legacy and monolithic applications (56%), and heterogeneous technologies and platforms (52%). Other important reasons cited for SOA adoption in the business networking context are high IT development, operations and maintenance costs (20%).

5 DISCUSSION ON FINDINGS

In this section we compare our empirical findings to prior IOS and SOA literature. For this purpose, we rely on a set of propositions related to the current state of IOS and the expected impact of SOA which we derived from prior research (cf. Table 2). We then evaluated whether empirical evidence supported the propositions. This analysis is a starting point for a further discussion related to the specific contribution of SOA to business networking.

The first proposition (P1) from SOA literature deals with dynamic business network configurations that are supported through flexible SOA infrastructure (Iyer et al. 2003; Van Heck and Vervest 2007). This proposition is not supported by our analysis. High occurrences of 1:n network topology, stable and focal network configurations as well as stable coupling intensity argue against it.

According to the second proposition (P2), SOA will foster network orchestration with distributed control and decision-making through interoperable platforms, based on open standards (Legner and Vogel 2008; Papazoglou and Georgakopoulos 2003). However, our study provides only limited support for P2. Focal network governance, vertical value chain integration, and 1:n network topology militate in favour for hierarchical instead of market structures with distributed control and decision-making (Malone et al. 1987). Moreover the use of stable, centralized coupling and the restricted scope of SOA inside the organizations negate the second proposition. At the same time, SOA implementations often support several tiers of business partners. It thereby extends the scope in comparison to prior forms of IOS, which mainly focussed on dyadic relationships.

(P3) As a new networking approach, SOA can facilitate customer-facing demand networks through business services that can be called up and executed on demand (Zhao et al. 2007). In our data set, we find empirical evidence that SOA is more often applied in customer-facing processes than in typical supply chain scenarios. This is also reflected by the number of cases where focal companies collaborate electronically with customers, distributors, agents or other distribution network members. However, these networks are still largely governed by the focal company and network initiator.

The fourth proposition (P4), that SOA introduces a process-centric approach to partner integration (Legner and Vogel 2008) is only partly verified by our findings. High support of machine-to-machine integration, a message-oriented information exchange style as well as pragmatic, semantic and syntactic standards are the preconditions for process-centric partner integration. However, in many cases, human-to-machine communication via portals is widely used. Furthermore, we found low support for business process layer integration, process services and process standards. Hence we argue that proposition four has not been entirely fulfilled.

Loosely coupled network platforms are proposed by (P5) to be realized with SOA through the combination of modular, reusable, dynamically discoverable and complementary services (Demirkan et al. 2008). Although this vision is not completely realized, the use of portals, function and data integration approaches as well as services encapsulating process activities and tasks within 1:n network topologies with a larger number of partners (> 100, > 10) tend to be a first step into the direction of the loosely coupled network platform.

Layer	Prior Forms of IOS (EDI, Internet, etc.)	Propositions from SOA Literature	Empirical Findings from SOA Case Analysis
Strategy	Stable, long-term, connected relationships (Daniel and White 2005; Malone et al. 1987)	(P1) Dynamic, quick connect and disconnect relationships (Iyer et al. 2003; Van Heck and Vervest 2007)	(P1) Not confirmed: most SOA-based business networks are still relying on predefined arrangements
	Business networks evolve around focal company with hierarchical and central control (Malone et al. 1987; Son et al. 2008)	(P2) SOA will foster network orchestration with distributed control and decision-making through interoperable platforms, based on open standards (Legner and Vogel 2008; Papazoglou and Georgakopoulos 2003)	(P2) Partly confirmed: focal arrangements still predominate; however, polycentric arrangements are supported by third parties that provide m:n connectivity
Processes	Tight supply chain process integration with existing partners (Daniel and White 2005; Gosain et al. 2004; Zhu et al. 2006)	(P3) SOA maintains customer-facing demand chain integration, through business services, that can be called up and executed on demand (Zhao et al. 2007)	(P3) Mostly confirmed; Focus on customer-facing and information-intense business processes (channel extension networks)
Information Systems	Very rigid document-centric integration (Damsgaard and Truex 2000; Reimers 2001)	(P4) SOA introduces a process-centric approach to partner integration, thereby replacing the document-centric one (Bussler 2003; Dorn et al. 2009; Papazoglou and van den Heuvel 2007)	(P4) Partly confirmed; process-centric integration still lags behind document-centric
	Tight coupling and pre-engaged customization (Damsgaard and Truex 2000; Daniel and White 2005; Reimers 2001)	(P5) Loosely coupled architecture based on modular, reusable, dynamically discoverable and complementary business and technical services (Demirkan et al. 2008; Iyer et al. 2003)	(P5) Mostly confirmed: first steps into the loosely coupled network platform direction
	Silo applications and customized systems are a hindering factor in external integration (Zhu et al. 2006)	(P6) SOA can expose an organization's private computing assets as reusable and dynamically discoverable business services for inter-enterprise collaboration (Demirkan et al. 2008; Hagel and Brown 2001)	(P6) Confirmed

Table 2 Comparison of IOS and SOA Adoption in Business Networks

Our findings support proposition six (P6) – that SOA can expose an organization's private computing assets as reusable and dynamically discoverable business services in inter-organizational collaboration (Demirkan et al. 2008). First, we have a high number of cases which aim to strategically position a new channel and strive for operational effectiveness with their SOA approach. Second, a high number of organizations provide access to internal information via portal technology based on an underlying SOA. Third, nearly all organizations expose process activity and task services, and pursue a function and data layer integration approach.

6 CONCLUSION

The objective of this research was to improve our understanding of SOA adoption in inter-organizational relationships. Given the fact that no classification scheme, taxonomy or conceptual frameworks of service-oriented architectures adoption in business networks exists, a first contribution of our research is the classification scheme suggested in section 3. By linking prior conceptualizations from business networking and IOS literature, with the technology-oriented stream of research on service-oriented architectures, we were able to derive the relevant attributes at strategic, process and IS layer for assessing SOA adoption in business networks.

Through our analysis of 25 real-world SOA cases that sought to improve their external integration capabilities, we were able to identify focus areas (RQ1) and patterns of SOA adoption in business networks (RQ2) based on strategic-, process- and IS-related attributes. These findings were very valuable as a starting point for comparison to prior forms of IOS and to propositions from SOA literature. In doing so, we were able to synthesize the implications of SOA for external coordination in business networks (RQ3). While we were not able to confirm all the enthusiastic propositions related to SOA's impact on business networks, we could clearly identify that SOA adds new aspects to IOS. An important aspect is that additional groups (e.g., smaller businesses, administrations and individuals) participate in electronic business networking. At the same time, SOA extends the scope of IOS from supply chain integration to improve coordination in customer-facing networks, most notably channel extension networks. We also find that SOA provides most companies with a more standardized, scalable and modular platform for internal and external integration. SOA thereby eliminates some severe shortcomings of prior forms of IOS.

Our research and its results cannot be exhibited without taking into account its limitations. The first limitation is that our analysis is based on secondary data that covers case study descriptions of various qualities and of different structures. While this provides us which rich case data, it may constrain the validity of our conclusions. As an example, if certain aspects of SOA were not mentioned in the text, we cannot differ whether it was not listed due to the authors request or was not applied at all. It might also be argued that the quality review process of press, company and vendor descriptions is not as demanding as that of research publications. We argue that companies approve journalistic publications and that they won't mention aspects that do not exist. We also addressed this issue by defining objective criteria according to our classification scheme and deleted case descriptions with too little information. In order to ensure inter-rater reliability, we went through multiple iteration steps and discussions to agree on a classification. Lastly, we recognize that 25 cases do not really allow making any statistically valid conclusions. But from this first exploratory research phase, we gained important insights which may guide future research and be a starting point for large-scale empirical investigations.

As outlined, our conceptual and exploratory work can be helpful to future IS research, by providing systematic insights into SOA deployments in the inter-organizational context and advancing the understanding of how SOA affects business networks. First, our research could be a basis for future empirical studies that build on this classification scheme and validate our findings. Second, it might serve to assess alternative approaches to SOA design and implementation in business networks. Third, researchers should study SOA value in business networks and the various factors that impact SOA adoption in more detail. Fourth, future research should develop design guidelines for service-based architectures that increase networkability and are extensible to different partner segments and levels of process integration.

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