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Investigating the Antecedents and Benefits of SOA Implementation: A Multi-Case Study Approach

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Abstract

Service-oriented architecture (SOA) is an emerging IT strategy. It is an architectural style for building loosely coupled distributed systems that deliver application functionality as services. Currently there is little academic research published on SOA. As a result, we know little about what factors affect SOA implementation such that reported benefits can be achieved. To fill this gap, we study multiple cases to investigate factors key to successful SOA implementation. Our preliminary findings suggest that SOA requires extremely high levels of organization-IT alignment to achieve reported benefits. Other factors key to successful SOA implementations include SOA registries, governance, effective pilot projects, top management support, trust among business units, personnel training, and change management. A model is proposed as a basis for future SOA diffusion study; implications for both practice and research are discussed.

Keywords: Service-Oriented Architecture (SOA), SOA implementation, realized benefits, diffusion, multiple case study

1. Introduction

In every industry, today's business environment is more complex, fast paced, and unpredictable. These market dynamics give rise to a need for business flexibility in order to cope with continual change and get ahead of the competition. To achieve business agility, organizations require a flexible information technology (IT) architecture that supports dynamic change in response to customer preference, technological innovation, and competitive landscape. Many companies are moving to a Service-Oriented Architecture (SOA) as a means to attain IT architecture flexibility.

SOA is an architectural style for building loosely coupled distributed systems that deliver application functionality as services, which are used for end-user applications, (Ho, 2003). SOA enables organizations to leverage and reuse existing assets across multiple technical and organizational boundaries, delivering value rapidly, while supporting today's constantly-evolving business environment. Given these benefits, SOA implementations are on the rise. A recent survey by the Yankee Group of 306 U.S. IT executives found that 84 percent have an SOA project underway or expect to start one within the next year. Another survey of more than 120 IT and business professionals by the Aberdeen Group indicates that nine out of every ten companies either are adopting or have adopted service-oriented architectures.

Although many organizations are turning to SOA to capitalize on its benefits, there is little academic research on SOA. Current research focuses on the concept of SOA the benefits of SOA implementation; however these studies do not provide sufficient understanding of the factors that affect the diffusion of SOA within organizations. Since the availability of workable SOA is relatively recent, and SOA adoption by organizations is increasing, it is important to understand factors affecting SOA implementation such that organizational benefits are achieved. The objectives of this research are to provide insights to researchers and practitioners interested in SOA implementation. For researchers, we develop a model to serve as a

basis for further studies on diffusion of SOA in organizations. For practitioners, it provides a guide to implement SOA successfully.

Given the lack of prior research specific to SOA, the following broad research question guided our efforts: What factors affect SOA implementation such that organizational benefits can be achieved? In this study, we qualitatively explore the factors affecting SOA implementation based on the experiences of five firms that already have implemented and received SOA benefits.

The rest of paper is organized as follows. In the next section we review the IT diffusion and SOA literatures. We then present our research methodology and the preliminary findings of our research-in-progress. We conclude with a discussion that includes implications for future research and practice, as well as our expected progress for presentation at AMCIS 2007.

2. Literature Review

2.1 IT Diffusion Literature

IT diffusion is a key investigative area in the IT field (Fichman, 2000) because the task of deciding when and how to innovate is difficult, and IT diffusion is not always successful. According to Fichman, IT diffusion research attempts to address two primary questions: What determines the propensity of an organization to diffuse IT? and What determines the rate, pattern, and extent of IT diffusion? These two questions can be combined into one general question: which factors affect innovation diffusion within an organization?

IT diffusion can be defined as a “collective process involving introduction, assimilation, and permeation of information systems technology throughout organizations” (Umanath and Campbell, 1994). IT implementation is a key part of IT diffusion (Cooper and Zmud 1990; Kwon and Zmud 1987), which can be affected by the following factors: organization-innovation fit; innovation delivery system; and innovation, organization, and environment characteristics (Fichman, 2000).

Organization-innovation fit is an important factor affecting IT diffusion. Although an organization may show a generally high propensity to innovate over time, the organization might be slow in implementing IT that does not fit well with its organizational needs, strategies, resources, or capabilities (Fichman, 2000). For example, wealthy organizations are particularly well positioned to implement high-cost innovations (Down & Mohr, 1976). Cooper and Zmud (1990) find that a high level of fit between organizational tasks and the innovation itself predict the adoption of an innovation. In the SOA context, where business services are instantiated within IT services, organization-IT alignment or fit is likely to be critical.

The delivery system for the innovation is the means by which the implementation process is supported and managed for a particular innovation (Leonard-Barton, 1988). In prior literature, the most influential characteristics of the delivery system affecting IT implementation include degree of top management support, technology championship (Howell & Higgins, 1990), level of training, and other resources invested in organizational learning (Raho, Belahlau, & Fielder, 1987). Understanding the extent to which these factors influence SOA implementation is important because SOA implementation involves highly integrated aspects of both organization and IT innovation.

Innovation characteristics have been studied by many diffusion researchers (e.g., Roger, 1995; Tornatzky & Klein, 1982; Moore & Benbasat, 1991). Roger (1995) highlights five such characteristics, including relative advantage, compatibility, complexity, trialability, and observability. Moore and Benbasat (1991) expand upon Roger’s characteristics, generating eight innovation factors: voluntariness, relative advantage, compatibility, image, ease of use, result demonstrability, visibility, and trialability. In general, innovations with favorable characteristics tend to be more attractive and easier to adopt and, therefore, tend to diffuse more rapidly than those with less favorable characteristics (Roger, 1995). Organization and environment characteristics have been found to explain why some organizations are more innovative than others. Organization characteristics include size (Roger, 1995), organizational structure (Zmud, 1982; Kwon & Zmud, 1987), and personal characteristics of leaders (Damanpour, 1991). Environmental characteristics include concentration, competitive pressure, profitability/wealth, IT intensity, and rate of technical change (Eveland & Tornatzky, 1990; Meyer & Goes, 1988; Robertson & Gatignon, 1986). It is important to begin to understand which, if any, of these factors affect SOA diffusion as well.

2.2 SOA Literature

Although many organizations are now implementing SOA, or plan to in the near future, there is little academic research currently published in the SOA domain. Initial studies have found that SOA can provide many benefits to organizations. One of the main benefits of SOA is improved integration of applications, both those hosted internally and those hosted externally. For example, Baskerville et al. (2005) conducted an in-depth case study of two banks to identify the strategic value of SOA, and found that organizations can achieve application integration and agile information systems development through SOA—and thereby increase their competitiveness. Vasilescu and Mun (2006) suggest that flexible integration of middleware can be achieved by SOA use, regardless of platform and physical location. SOA also enables organizations to reuse existing IT infrastructure while incorporating new capabilities in order to improve business productivity; therefore, firms need not replace existing IT infrastructures (Patrick, 2005). In addition to those benefits, SOA provides better data flow within an organization, or across organizations if data sources are considered services (Patrick, 2005), and thus improves decision-making (Granebring and Revay, 2006). In a related study, Kumar et al. (2007) provide empirical evidence of the positive performance impact of SOA adoption on the electronic supply chain for a wide cross-section of U.S.-based firms. They find that SOA adoption leads to better performance of the electronic supply chain.

Overall, a review of SOA literature suggests that benefits can be gained from SOA implementation, yet no academic research has attempted to identify factors affecting SOA implementation such that organizational benefits are achieved. Also, given the paucity of studies available for review, we believe the actual benefits of SOA implementation require further examination. To fill this gap in SOA literature, and further our understanding of SOA diffusion, we studied multiple cases of SOA implementation.

3. Research Methodology

As SOA implementation is a contemporary event in which the relevant behavior cannot be manipulated, this study employs a multiple case-study approach (Yin, 2002) to explore the implementation of SOA. We expect the findings of our multiple case study will be more robust than the single case study (Herriott and Firestone, 1983). Having multiple cases allowed us to choose organizations from different industries, which increased the likelihood of organizational and environmental context differences. This increased the potential for uncovering a broader range of factors affecting SOA implementation.

3.1 Case Selection / Data Collection

A four-phase process was used to select our cases. First, potential cases were extracted from a preliminary search of the Lexis-Nexis, ABI/Inform, Wilson Omni file, and Business & Company information databases. The search was limited to dates between January 1, 2001, and December 31, 2006. A keyword search was employed using the search terms “SOA” and “Service-Oriented Architecture.” These search terms yield 28 cases. Second, a review of the identified cases revealed eight cases that were deemed to have sufficient information (i.e., organizational background, implementation descriptions, and benefits) to address our research objectives. Third, cases published by vendors were eliminated because they might exaggerate SOA benefits and omit the risks of SOA implementation. Finally, we eliminated multiple cases within a single industry. This left us with five cases of SOA implementation from five organizations in different industries: Hartford – insurance, Verizon – telecommunications, Starwood – hotel, Con-Way – transportation, and Wachovia – banking.

Once we selected our cases, we conducted a more comprehensive search of Lexis-Nexis, ABI/Inform, Wilson Omni file, and Business & Company information databases to collect additional data on each firm (e.g., press releases, annual reports, interviews with top management, and conference presentations). This search yielded an enormous amount of data. We also reviewed documents published on each of the company’s web sites. To be consistent with the case selection process, collected documents were limited to dates between January 1, 2001, and December 31, 2006.

3.2 Data Analysis

Data analysis involved coding the data, which enabled us to organize a large amount of text and to discover patterns in the data. While we did not have a specific coding scheme, we were guided by our broad research question and the results of our literature review. Coding was a multi-step process. First, we scanned through the data and labeled any event, object, or action/interaction that was related to SOA implementation or factors affecting the achievement of SOA benefits. Those labels were then recorded. Second, we reviewed the labels obtained from the first step, grouped together similar labels to identify key themes that connected and separated them, and eliminated the less useful labels that did not fall into one of the groupings. Third, we identified relationships among the themes that were identified in the second step. From the groupings of similar labels created in step two, we formed constructs and linked them with the relationships identified in step three to develop a

temporal model. We also conducted a cross-case analysis to identify similarities and differences among cases, with respect to the labels identified by the second step. Our preliminary findings are presented below.

4. Preliminary Findings

This paper presents the preliminary findings of our research-in-progress. Table 1 below presents the coding labels and key themes that have emerged from data analysis. The five categorical labels that represent the constructs in our temporal model (see Figure 1) include business motivations, IT motivations, SOA implementation processes, and realized benefits. In the subsections below we briefly describe each construct and the relationships among them, as they emerged from our data.

4.1 Business Motivations

Specific business motivations led organizations to implement SOA. As Table 1 shows, these business motivations included improving business agility, lowering costs, improving customer service, receiving timely and accurate information, and increasing business efficiency. The most frequently mentioned business motivations across the cases were the improvement of business agility and lowering costs. For example, Susan Certoma, CIO of Wachovia, explains her firm's SOA implementation, stating, "The corporate and investment banking industry is intensely competitive. So, a company needs to respond quickly to market changes and customer demand." Ben Moreland, the director of foundation services in the office of technology at Hartford said, "We implemented SOA project to lower the total costs of IT ownership, speed up the time it took to get products to market, and improve the ease of doing business." The model (Figure 1) shows that business motivations often lead an organization to implement SOA.

4.2 IT Motivations

In addition to identifying SOA implementation as a means to address business motivations, data analysis also identified IT motivations as being driven by business motivations. For example, during the Enterprise Architecture Practitioners Conference in San Diego, Maja Tibbling, a lead enterprise architect at Con-Way said that the business objectives Con-Way faces lead to its IT objectives. For example, Con-Way's need to know information in real-time significantly influenced its IT objectives to provide employees and customers access to timely, accurate information on freight movement.

IT motivations also directly led organizations to implement SOA. As Table 1 shows, these motivations include improving IT scalability and adaptability, efficient application development, decreasing IT maintenance costs, integrating systems or applications, and providing timely and accurate information.

The most frequently mentioned IT motivations include improving IT scalability and adaptability and efficient application development. Tony Bishop, vice president and director of product management at Wachovia, pointed out that their IT needed to be flexible, adaptable, and scalable. Susan Certoma, CIO of Wachovia, stated, "Each business had been building similar capabilities over and over, which included desktop presentation, data management, workflow management, messaging, and customer information management." The next most frequently mentioned IT challenge was the integration of systems or applications. At Hartford, Ben Moreland stated, "The company's applications were tightly siloed within each of its main lines of business....Each developed its own applications with its own architects."

Organizations addressed these and other identified IT motivations with SOA implementations. "With SOA, the challenges of integration are becoming simpler to deal with now," said Tom Conophy, CTO of Starwood Hotels. According to Maja Tibbling, "SOA enabled Con-Way to reduce development costs and to have an agile architecture." The temporal model (Figure 1) shows that IT motivations led organizations to implement SOA.

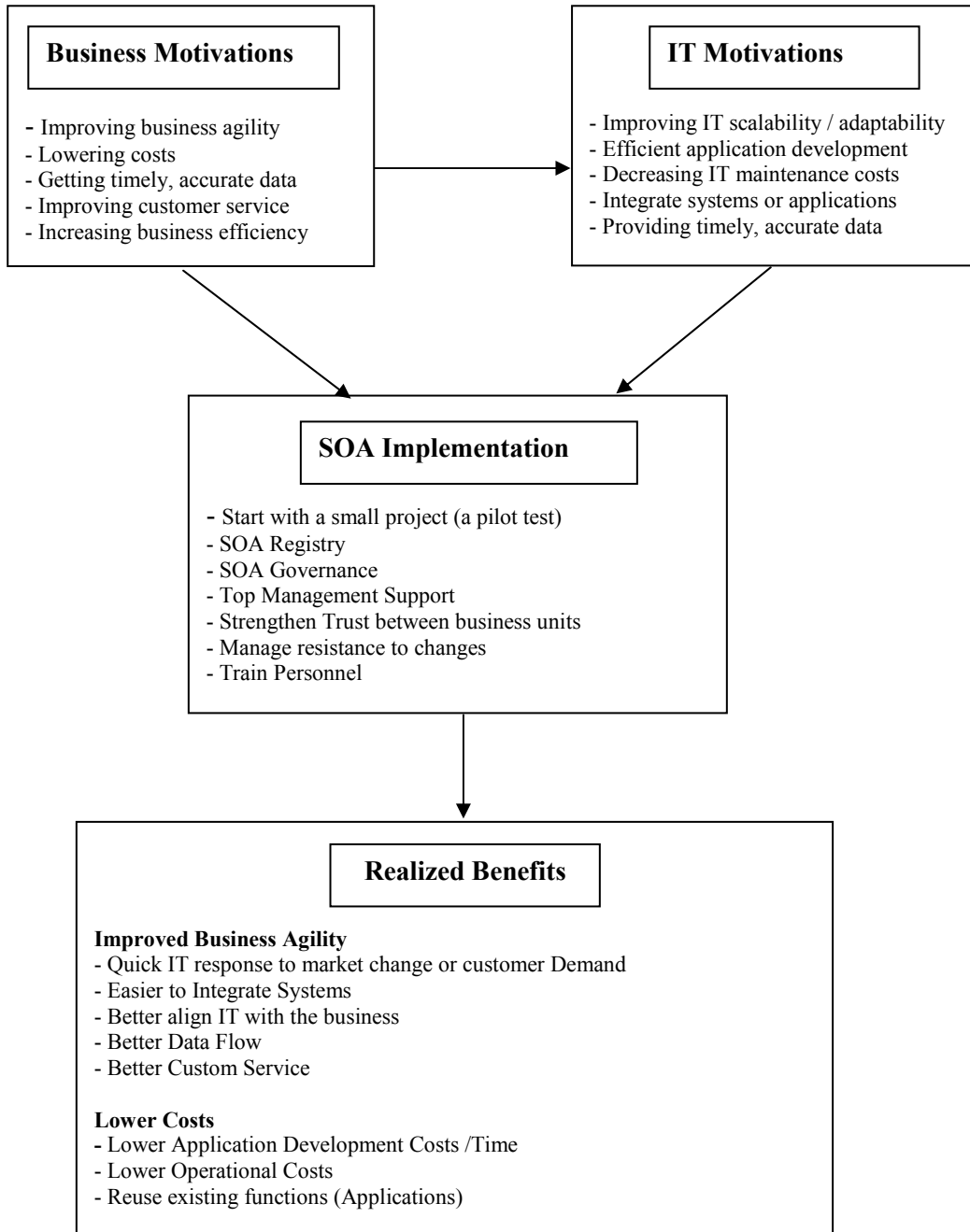
4.3 SOA Implementation

Patterns emerged from the data regarding the processes organizations engaged in to implement SOA. All five of the organizations started with a small SOA project to gain experience and buy-in. The organizations also spent resources establishing SOA governance and registries. SOA registries contain the rules and descriptions associated with every given component. In other words, a SOA registry helps programmers and business analysts select components and connect them together to create new applications. For example, Hartford's Ben Moreland stated, "If you don't have governance, the SOA architecture is going to do what architectures before it have done, become a maintenance burden and eat up the IT budget."

**Table 1
Coding Results Summary**

	Company	Hartford	Verizon	Starwood	Con-Way	Wachovia
Industry		Insurance	Telecommunication	Hotel	Transportation	Bank
Implementation Date		1999	2002	2001	1998	2004
	Total					
Coding Labels						
Business Motivations						
Improving business agility	5	✓	✓	✓	✓	✓
Lowering costs	4	✓	✓	✓	✓	
Improving customer service	2			✓	✓	
Getting timely, accurate information	2				✓	✓
Increasing business efficiency	2	✓			✓	
IT Motivations						
Improving IT scalability /adaptability	4	✓		✓	✓	✓
Efficient application development	4	✓	✓		✓	✓
Decreased IT maintenance costs	2	✓	✓			
Integrating systems or applications	3		✓	✓	✓	
Providing customer better services	1			✓		
SOA Implementation						
Start with a small project	5	✓	✓	✓	✓	✓
SOA Registry	5	✓	✓	✓	✓	✓
SOA Governance	5	✓	✓	✓	✓	✓
Top management support	5	✓	✓	✓	✓	✓
Strengthened trust between business units	3	✓	✓		✓	
Train personnel	3	✓	✓	✓		
Manage resistance to changes	3	✓	✓			✓
Realized Benefits						
Improve business agility	5	✓	✓	✓	✓	✓
Easier to integrate systems	5	✓	✓	✓	✓	✓
Better align IT with the business	5	✓	✓	✓	✓	✓
Quick IT response to market change or customer demand	4	✓	✓	✓	✓	
Better data flow	2			✓		✓
Better customer service	1			✓		
Lower costs	5	✓	✓	✓	✓	✓
Lower application development costs/time	5	✓	✓	✓	✓	✓
Reuse existing functions(applications)	4	✓		✓	✓	✓
Lower maintenance costs	4	✓	✓	✓	✓	
Lower operational costs	2		✓	✓		

Figure 1
Temporal Model



He continued, “Critical to the success of initiatives was the use of a UDDI registry. The registry facilitates service and component reuse by providing the architecture with the ability to look up services that exist and reuse them.”

In addition, the SOA implementations of all examined organizations were supported by top management. The “CEO strongly supported building end-to-end, service-oriented development and delivery platform,” said Wachovia’s Susan Certoma. Con-Way’s Maja Tibbling stated “IT executive management sponsorship is key to success.” Some of the organizations purposely strengthened trust between business units. For example, Con-Way’s Maja Tibbling said that establishing trust between business units is very important.” Tony Bishop, vice president at Wachovia, highlighted that “one of the greatest challenges is overcoming mistrust. Getting the business groups to trust another group to build something for them was not smooth.”

Three of the five organizations trained their personnel regarding how to utilize services. Bishop noted, “We’ve had to educate people about what’s already built, get them thinking about how they build in a componentized environment, how to reuse, how to deploy, and how to make it.” Organizations also needed to manage resistance to the changes resulting from SOA implementation. For example, incentives were used to induce change. One organizational representative stated, “We are providing annual bonuses for developers who participate in web-based seminars, as well as contribute artifacts to a repository of services, and reuse components.”

4.4 Realized Benefits

Benefits that organizations experience from SOA implementation can be divided into two sub-categories: improved business agility and lowered costs. All five of the organizations in our sample experience improved business agility and lower costs as a result of SOA implementation. For example, during the Enterprise Architecture Practitioners Conference in San Diego, Maja Tibbling, a lead enterprise architect at Con-Way said, “With SOA, Con-Way has improved its business agility to respond quickly to market and reduced IT costs.”

The subcategory “improved business agility” consists of quick IT responses to the business environment, market changes or customer demands, easier-to-integrate systems, better alignment of IT with the business, better data flow, and better customer service. The most often reported benefits were easier-to-integrate systems, better alignment of IT with the business, and quicker IT response to business environment, market, and customer demand changes. Song Park, Starwood’s director of pricing and availability technology, stated that SOA afforded the company more real-time and online reservation capabilities and transactions.

The sub-category “lowered costs” consists of lower application development costs/time, reusability of existing functions, lower maintenance costs, and lower operational costs. A decrease in the costs and time of application development was the benefit experienced most often by all five organizations studied. For instance, an executive of one of the organizations noted that the “key benefits of our SOA are reduced development time and maintenance costs because we don’t have multiple versions of the same technology.” An executive at one of the organizations said, “The move to SOA has had a dramatic impact on maintenance. Under the old structure, if a large application experienced problems, a large team of experts would review debugging messages and logs to try to determine the source. However, with SOA, the source of a problem can be pinpointed more quickly. Therefore, fixing problems requires fewer people and less testing. There is a huge savings in terms of time and resources.” “Verizon’s SOA-based system has saved \$20 million in two years,” says Ruchir Rodrigues, director of strategic system and development at Verizon.

5. Discussion

This paper is one of the first to explore SOA diffusion in organizations. We have identified business and IT motivations that led to SOA implementation, key processes for successful implementation, and the benefits organizations achieved through their implementation of SOA. Based on the study findings, a temporal model is provided that demonstrates the relationship between business and IT motivations, SOA implementation, and realized benefits.

This study makes important contributions to the IT diffusion literature. First, we demonstrate the importance of focusing on specific IT characteristics or features when studying their diffusion. With SOA diffusion, alignment between IT and organizational factors are of particular importance. Hence, our model highlights the need to address IT motivations in the context of specific business motivations. Additionally, governance and SOA registries are critical to SOA diffusion. These are architecture-related factors. Based on our review of diffusion literature, no diffusion study has been published that explicitly on IT architecture. This study provides a basis for future study on IT architectures.

In addition to the above contributions, this study provides several contributions to the SOA literature. Several insights are provided with respect to what is needed for organizations to achieve successful SOA implementation. First, the findings suggest that top management support is necessary for successful implementation of SOA in an organization, as the SOA projects of all of the organizations we investigate are supported by top management. Since SOA projects often are expensive, long-term investments, these projects might be difficult to implement successfully without top management support. This finding is consistent with what we found in our review of IT diffusion literature.

Also, to successfully implement SOA, an organization should start with a small project. All five of the organizations studied started with an SOA pilot project. SOA pilot projects allow an organization to take the first step in addressing the challenges SOA implementation might create; they help to lower the risks of moving into a new architecture, while at the same time building acceptance for the new approach and solving business problems in the process. This finding is consistent with Rogers's findings (1995). Rogers found that trialability, one of the innovation characteristics, might affect innovation implementation. Rogers defines "trialability" as whether an organization can use or test an innovation before the organization implement it.

After analysis, this study finds that an organization needs to employee governance and registry in order to implement SOA successfully. All five of the organizations that this study examines had SOA governance to some degree. This suggests that SOA governance is an important component of successful SOA implementation. SOA governance is a process that governs how to design and build quality services and defines rules governing the use of the services. Additionally, it governs behaviors of business and IT units because business and IT units must work together in designing, building, deploying, and operating services, to achieve a high level of alignment between business requirements and IT capabilities, which is required to create quality services. For example, who has the authority to make decisions regarding services? With SOA governance, organizations create quality services, and the services can be used appropriately to conduct business processes. Also, all five of the organizations examined for this paper deploy a SOA registry as a mechanism for service discovery. The registry contains definitions of services and keeps track of any changes to the services so that duplicate services can not be created. Also, it contains other information about the services, such as rules governing the use of the services, and business process definitions. All the information is created during the SOA governance process and stored in the SOA registry. With an SOA registry, service requestors (e.g., human, technology, or service) can quickly identify services they need and get information about the services, which is important to link them to other services to conduct business processes. Therefore, SOA governance and an SOA registry are critical to implementing SOA successfully. In addition, SOA governance and registry make SOA diffusion different from any other type of technological diffusion because they are specific factors affecting SOA diffusion.

Finally, this study empirically identifies and validates actual SOA implementation benefits. The most common SOA benefits realized by the organizations examined for this study were improving business agility and lowering costs. While many IT trade presses mention the benefits of SOA, this is one of a few academic studies that have attempted to systematically identify its benefits.

5.1 Limitations

We used publicly available secondary data to identify patterns regarding SOA diffusion in organizations. Such data has been used in prior academic research (Shang & Seddon, 2002; Raymond et al. 2000), but with limitations. It is possible that published case studies may be biased toward reporting positive views of SOA implementations. Organizations with negative SOA implementation experiences may not be as likely to have their results widely published. Focusing on specific negative SOA implementation experience might provide valuable additional insights into SOA research implications. For example, investigating the risks related to implementing SOA might yield different results.

A second limitation is inherent to all case studies. This study focuses on only five companies. Due to the small size of the data set, it is possible that we did not identify all themes or patterns important to successful SOA implementation in organizations. Because we believe that companies in different industries experience unique business and IT objectives, we selected one company as a representative sample from each industry in order to identify patterns across five different industries. However, more data could be considered from other organizations belonging to the same industries.

5.2 Implications for Future Research

Despite the limitations noted above, we believe that this study provides a strong basis for future research to further explore the diffusion of SOA in an organization. Several potential future studies might further our current understanding of SOA diffusion.

First, our model can be extended to include challenges regarding SOA implementation. Such challenges might include a lack of standards and difficulty managing services. In addition, to extend the model, future researchers might investigate how those challenges can best be addressed by organizations. Second, future research can focus on SOA governance and registry because our study found those are of very important factors affecting successful SOA implementation. Specifically, future researchers can conduct in-depth investigation of their impacts on SOA implementation. Also, future researchers can investigate how to develop appropriate SOA governance and what factors might affect development and implement of SOA governance. Third, future researchers can use objective financial performance measures to support the benefits identified in this study.

Lastly, future researchers should examine how individuals respond to SOA implementation of SOA. An analysis of our data suggests that individuals might resist SOA implementation because it changes employee roles and responsibilities, and employees must learn new skills in order to implement SOA properly.

5.3 Implications for Practice

Our findings provide important implications for managers responsible for SOA implementation. For example, the findings of this study provide evidence of when SOA implementation is likely benefit organizations. Specifically, when organizations have the business and IT motivations identified in our model, SOA implementation has the potential to address those motivations..

In addition, the findings provide insight into some of the requirements for successful SOA implementation. Our model highlights SOA implementation processes that addressed the identified business and IT motivations. Since all organizations in our sample have already realized benefits as a result of SOA implementation, an examination of their methodology in implementing SOA can create a benchmark for organizations that decide to implement SOA.

6 Conclusions

While SOA remains in the headlines of the IT trade presses, and in recent years has become the focus of prominent IT vendors such as IBM and Oracle, little published research exists in the SOA domain. Accordingly, the picture remains unclear for SOA diffusion in organizations.

Conducting a multiple case study of five organizations in different industries, this study explored the antecedents and benefits of SOA implementation. We have examined business and IT challenges that lead to SOA implementation, how SOA was implemented in various organizations, and the benefits of SOA implementation. A model describing the relationships between IT and business motivations, SOA implementation, and realized benefits, provides a starting point for future SOA diffusion study.

We are currently conducting more in-depth analysis of our data and expect to be completed with our study in June 2007. Final results will be presented at the AMCIS conference upon acceptance of our paper.

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