2009

Factors Affecting The Adoption Of Service Oriented Architectures

Evaggelia Aggelopoulou
ELTRUN, Department of Management Science and Technology, Athens University of Economics and Business, aevaggelia@aueb.gr

Katerina Pramatari
Athens University of Economics & Business, k.pramatari@aueb.gr

FACTORS AFFECTING THE ADOPTION OF SERVICE ORIENTED ARCHITECTURES

Aggelopoulou, Evaggelia, ELTRUN, Department of Management Science and Technology, Athens University of Economics and Business, 47A Evelpidon & 33 Lefkados Str., Athens, GR-113-62, Greece, aevaggelia@aueb.gr

Pramatari, Katerina, ELTRUN, Department of Management Science and Technology, Athens University of Economics and Business, 47A Evelpidon & 33 Lefkados Str., Athens, GR-113-62, Greece

Abstract

Service-orientated architecture is a very popular approach for building large scale, modular and distributed systems as well as achieving integration in heterogeneous environments. Its acceptance in the world of business is growing over time, mainly in technologically advanced countries, but there are still research gaps regarding SOA adoption and diffusion process. Interesting research questions include which factors drive SOA adoption, e.g. whether it is related to specific attributes of organizations. In this research-in-progress paper, we present a research model for identifying and validating the factors affecting SOA adoption in business contexts. Our model takes into consideration both theoretical background regarding factors of impact on IT innovations adoption and factors closely related to specific SOA characteristics. Our research is at a preliminary stage and thus we also present, the research methodology we intend to follow, in order to come up with results and confirm hypotheses.

Keywords: *Design Science, System Development, Software Development*

1 INTRODUCTION

In the past, we have witnessed a rapid progress which represents a paradigm shift from monolithic to client-server and then to distributed and nowadays to Service-Oriented Computing paradigm (Classon, 2004). Service-Oriented Computing (SOC) is a new computing paradigm that utilizes services as the basic constructs to support the development of rapid, low-cost and easy composition of distributed applications even in heterogeneous environments (Papazoglou et al., 2006). Regarding SOA, there is no single definition that has been unanimously agreed upon by everyone. Instead, several definitions were published by different groups (OpenGroup, 2009; W3C, 2004; OASIS, 2006; Gartner, 2006), vendors (IBM, 2007; TIBCO, 2005; SUN, 2005), business analysts and academic researchers (Papazoglou et al., 2006; Maurizio et al., 2008), ranging from a high-level business view to definitions focusing on technical aspects of SOA solutions.

Based on the aforementioned definitions, in this research work we define SOA as an architectural style for design and development of information systems and systems integration, based on the interaction model of service provider – broker - consumer. Its set of principles, policies, practices, frameworks, describes the interaction and lifecycle of loosely coupled services in a way mapping their infrastructure to business process flows and business goals. Services are autonomous software entities, interoperable, location transparent, platform/language independent which provide self-contained business logic, published under an abstract, network addressable, public and dynamically discoverable interface and can be composed into other services. Their provision and consumption may be subjected to an SLA contract and be under the control of different ownership domains. Services' functionality can be exposed from existing systems, purchased from third parties or developed from scratch. Assumed by its definition, SOA can be used to meet EAI requirements (Deng et al., 2008) but is not limited to an integration approach. As an architectural style it can drive the design and development of service-oriented systems as well as serve purposes in completely different contexts than business organizations, such as pervasive environments (Kalasapur et al., 2006).

The most prominent technologies that implement the SOA architectural approach today are Web services and ESBs (Enterprise Service Buses). However, Service-oriented architectures are not a completely new thing. The first service-oriented architecture for many people in the past was with the use of DCOM or Object Request Brokers (ORBs) based on the CORBA specification (Weerawarana et al, 2005). As Kontogiannis et al. remark (Kontogiannis et al., 2007), there is also a gradual evolution inside the paradigm of Service Oriented Computing itself, from the moment it first came to the foreground until now.

The specific research aims to examine how business organizations decide to adopt or not service-orientation in their IT infrastructure. Our research problem is targeted towards identifying the critical factors in SOA adoption and diffusion process in the world of business and examining whether these factors are closely related to SOA specific characteristics or have much to do with general factors that always drive adoption of innovations. This research is at a preliminary stage at which we have built the research framework based on relative literature and professional experience of authors and decided the research methodology that should be followed to confirm hypotheses.

Reviewing the structure of this paper, in section 2, we present the theoretical background for this research, which focuses on factors affecting IT innovations adoption. Section 3.1 describes the high level research model and hypotheses developed, while sections 3.2, 3.3, 3.4 and 3.5 further analyze the high level model into more detail, listing technological, environmental, organizational and SOA related factors. Section 4 outlines the research methodology approach we intend to follow in order to come up with results. Finally, the ending section provides a summary of the paper and concluding remarks.

2 THEORETICAL BACKGROUND

According to the literature, innovation and adoption research as well as organizational behavior research have been used to theoretically explain the relationship between organizational factors and IT adoption. The level of IT sophistication and organizational readiness has often been identified as a predictor of successful IT adoption. The size of the organization has also been a proven determinant of organizational attitude towards adopting new technologies. Moreover, it has been widely recognized that the support of top management is crucial as a success factor in IT adoption decisions. Regarding the decision to adopt IT, the organization is also influenced by its environment. The aforementioned are only a sample of factors that may affect the adoption of an IT innovation.

A lot of academic research work in this field provided us with the appropriate background for our study. In a more abstract level, Pan has published a case study research on IT adoption factors (Pan, 2005), while Teo et Al. have presented a general institutional view for adoption of inter-organizational linkages (Teo et al., 2003). IT innovations adoption was also a matter of study for Waartsa et. Al (Waartsa et al., 2002), while Moore et al. have focused on a measurement instrument for perceptions of adopting an IT innovation (Moore et al., 1991). Numerous research efforts in this domain have being influenced by the classic theory of Rogers “Diffusion of Innovations” (Rogers, 1995). Apart from these generic approaches, insight to our framework has been also provided by more specialized publications regarding the factors that had impact on the adoption of B2B e-commerce (Sherry et al., 2002), ERP solutions (Buonanno et al., 2005), internet based inter-organizational systems (Solimana et al., 2004), data warehouse implementations (Ramamurthy et al., 2008), as well as XML and Web Services which is much related to SOA (Chen, 2003). Additionally, an empirical study on web services challenges during adoption in the financial industry (Ciganek et al., 2005) constitutes related work with our SOA adoption factors model.

Based on an extended literature review, sample of which we have mentioned above, we present a cumulative list of factors affecting IT adoption, categorized in five classes: Organizational, Governmental, Cultural, Environmental and Technological factors.

Cultural Factors (National Culture)

Power distance (the extent to which the less powerful members of society accept that power is distributed unequally) Uncertainty avoidance (the extent to which people feel threatened by uncertainty and ambiguity and try to avoid these situations) Individualism vs collectivism (in individualism people look after themselves and their immediate family only vs. collectivism where people belong to in-groups who look after them in exchange for loyalty) Masculinity vs femininity (the dominant values of masculinity are achievement and success vs. those of femininity is caring for others and quality of life)
Governmental Factors
Policies promoting the specific technology Regulation
Organizational Factors
Non-functional requirements of the organization (e.g. very high level of security) Business Size Business Scope Business Activity Readiness for the specific technology (Awareness, Competence, Skills, Absorptive Capacity, Training provided to IT personnel) Existing IT Infrastructure (Complexity of IS, Flexibility, Multi-Channel support, Data Quality and Consistency across data sources, Fit of the new technology to existing IT infrastructure) Strategic Goals - Key business drivers (e.g. Increase national / global market share, Cost reduction / increased efficiency, Improve knowledge sharing, Enhanced customer service) Organizational Culture (mission/vision, procedures, policies, rules) Internal Personnel's attitude regarding resistance to change or innovation adoption IT Sophistication level of the organization (Innovation Characteristics) Top Management Attitude towards Innovation Effective Collaboration between departments Effective Collaboration between IT and business personnel Existence of defined Business rules and Business and IT Processes Attitude of the organization towards compliance with standards or regulation The market area (local, regional, national, international) The membership in an industrial group (either as the holding or as a controlled firm) The level of diversification (in terms of products, markets, technologies). The presence of branch offices (localization and number of branches). Cost that the company can afford to invest in IT (IT Budget)
Environment/Industrial Factors
Importance of responsiveness/ Changing Industry Importance of cost cutting Multinational companies Trendsetting companies Competitive Pressure/ Adoption by Competitors Pressure from trading partners Customer Pressure Promotion from Vendors
Technological Factors
Perceived complexity of the technology Technology maturity Perceived Relative Advantage (Perceived Need for Technology) Ability to observe and test the technology Disadvantages of the technology

Table 1: Factors affecting IT adoption according to literature

As listed in Table 1, the category regarding Technological factors includes drawbacks of the innovation under research. Though, perceived benefits of an IT innovation should also be considered as possible factors of impact on its adoption. Thus, beyond the general background literature, in order to create our SOA adoption research framework, we also studied academic and industrial publications which outline the specific attributes of SOA. The above are analytically described in section 3.

3 RESEARCH HYPOTHESES AND MODEL

3.1 High Level Research Model

According to the previous section, there are five categories of factors that may affect the adoption of an innovation. Since governmental and cultural (related to national culture) factors do not appear relevant in the case of SOA, we excluded them from our specialized high level framework (Figure 1). Instead, in order to fit the generic literature IT adoption frame to our research target, we included the specific beneficial attributes of SOA (we name these "SOA value factors"), which we consider possible factors of impact on whether an organization decides or not to adopt SOA.

In the framework below, rectangles represent categories of factors, while intention to adopt SOA is represented as an ellipsis, and arrows stand for hypotheses of impact (direct or not) between factors (independent variables) and the dependent variable of SOA adoption. Rogers (Rogers, 1995) breaks the adoption process down into five stages. These five stages are:

1. awareness
2. interest
3. evaluation
4. trial
5. adoption

In our research, we will adopt this scale for the dependent variable (SOA adoption), in order to measure the intention of a company to adopt SOA.

SOA value components can directly or indirectly affect intention to adopt SOA. An example of direct impact is that companies consider interoperability as a SOA value factor and this fact attracts companies to adopt SOA than other architectural styles. An example of indirect impact, is that companies with numerous and heterogeneous information systems consider interoperability during integration a critical factor for their successful operation. Since there is no other alternative than SOA at the moment which promises this degree of interoperability, they end up adopting SOA. So the factor that affected the adoption of SOA in this case, was a specific organizational characteristic of an enterprise (the complex and heterogeneous IT infrastructure). As another example, if an enterprise must be viable in highly competitive environment, it needs to be responsive to change and thus have a good level of business-IT alignment. Thus, assuming that SOA provides a better potential for alignment than other architectures, the enterprise intentions could indirectly be affected to adopt SOA.

Arrows in our framework represent both possible direct and indirect impact of factors, in order for them to be confirmed or rejected after data collection and analysis phase.

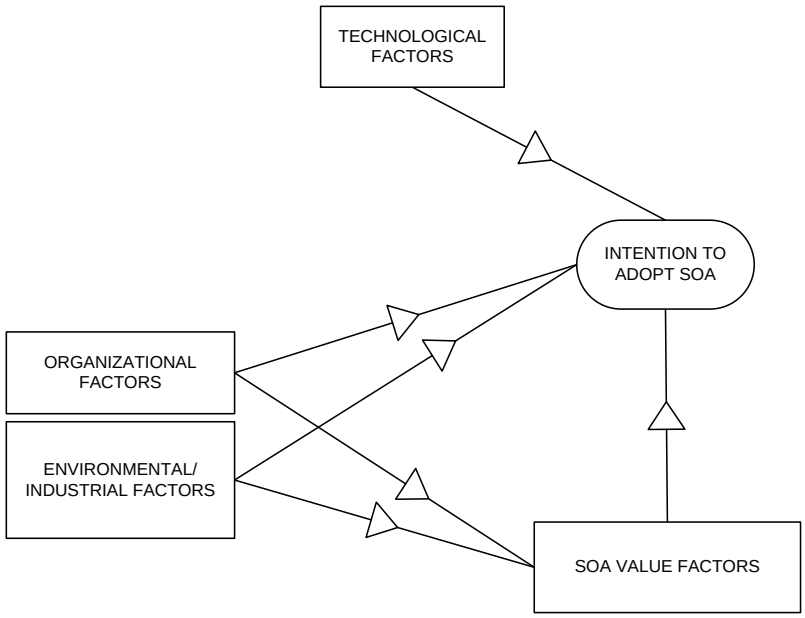

Figure 1: High Level Framework of Factors Affecting SOA adoption

This high level framework is further analyzed in the following sub-sections of the paper, in order to depict specific factors and categories of factors.

3.2 Technological Factors

Technological factors (Figure 2) are related to the technology/innovation under adoption process. Some of them are general as we listed in Table 1 and thus are also included here in our SOA adoption framework. These include perceived complexity of the technology, technology maturity, perceived relative advantage (perceived need for the technology), ability to observe and test the technology and disadvantages of the technology. Disadvantages of the innovation are in this section decomposed into specific disadvantages of SOA, in order to fit to our specialized SOA research model.

Known disadvantages of SOAs have to do with limited performance, testability, security and reliability (transaction management) as well as versioning of services (O'Brien et al., 2007). Security issues of SOAs are related to their modular and distributed nature over the network which might even include the internet. Ownership of services in a SOA might also be decentralised in one or more organizations which does not facilitate security assurance. Testability is also an issue for SOAs because unique features, such as dynamic and late binding, raise the need for new testing methods and tools. Testing a system that uses an SOA is more complex for reasons that include:

- It is more difficult to setup and trace the execution of a test when the system elements reside on different machines across the network.
- The source code of external services may not be available to service users defining and running the tests.
- In some cases, services are discovered at runtime, so it may be impossible to predict which service is actually used by a system until the system executes. The services used may be running on different platforms or operating systems and use different middleware technologies.

Transaction management is also more difficult in a distributed, loosely coupled context for two reasons. Firstly, services are usually implemented in a stand-alone fashion, and transactions begin and end within the service. Therefore, transactions that involve the composition of services require either nested transactions or a redesign of transaction demarcation. Secondly, agents performing data changes (i.e., the service providers) are distributed, and, hence, a distributed transaction model is needed. Because services may be implemented in different languages and platforms, the implementation of distributed

transactions—using two-phase commit, for example—requires compatible transaction agents in all end points that interact using the same protocol.

Versioning is another key issue in a SOA that must be addressed effectively. In an extended implementation, where numerous consumers may request a service operation, a service modification/upgrade could result in malfunction of some systems-consumers. Backward compatibility, and an effective way of achieving it, is necessary in such cases where the whole set of consumers that will be affected by a service amendment may not be able to be modified as well or may not be even known.

Finally, regarding performance issues that may occur in SOAs, key factors include:

- SOA involves distributed computing. The need to communicate over the network increases the response time.
- The interaction protocol sometimes requires a call to a directory of services to locate the desired service. This extra call increases the total time needed to perform the transaction.
- The ability to make services on different platforms interoperate seamlessly has a performance cost. Intermediaries are needed to perform data marshalling and handle all communication between service user and provider.
- The use of a standard messaging format increases the time needed to process a request. For example, XML is text-based and messages can be 10 to 20 times larger than the equivalent binary representation.

According to the above-mentioned general or SOA related factors, we analyse Technological factors of our framework as shown in figure 2.

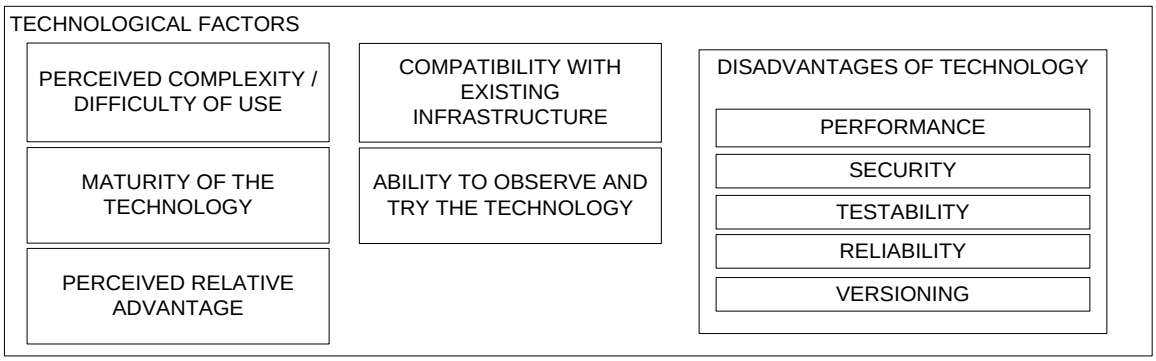

Figure 2: Technological Factors

3.3 Environmental Factors

Environmental/Industrial factors (Figure 3) are related to the specific environment where an organisation performs its business. These factors generally affect each IT innovation adoption process and are not specifically related to SOA, thus they are also presented here in our SOA adoption framework as in Table 1.

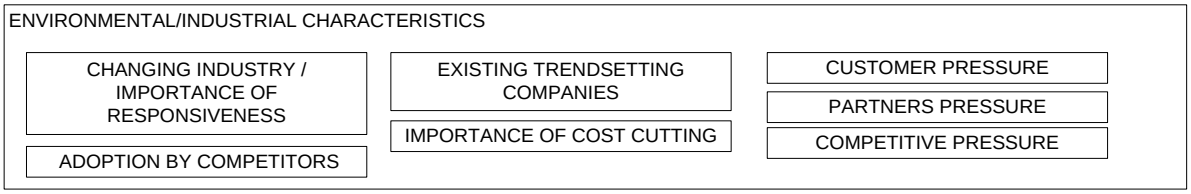

Figure.3: Environmental Factors that may affect intention to adopt SOA

3.4 Organizational Factors

Organizational factors (Figure 4) are related to organizational specific attributes that may generally affect IT adoption or specifically SOA adoption. The framework below, analyzing organizational factors has been created based on a mix of general factors (see Table 1), and SOA related factors based on professional experience of the authors and SOA books (Bieberstein et al., 2005)(Hurwitz et al., 2007) (Erl, 2005)(McGovern et al., 2006)(Krafzig et al., 2004). The framework uses a classification of factors in six sub-categories. Organizational factors may have to do with the nature of existing infrastructure and how this can fit together with the technological innovation under study. Readiness of IT department or infrastructure for accommodating the innovation is also an important sub-category. Moreover, organizational culture is indeed a fact that always affect IT adoption. Management attitude towards IT innovation is recognised by the literature as a significant factor in this sub-category. Importance of compliance with regulation and/or global standards and best practices for the enterprise might also be another driver for adopting or not a technological innovation. Organizational culture, as described in the literature, includes numerous attributes that we considered irrelevant in the case of SOA and thus excluded them from the framework. After this critical review, we included in Organizational Culture sub-category eight factors as presented in Figure 4. Existing and well-defined definitions of business rules, practices and processes is another factor that always makes technology adoption easier for an organisation, and thus may affect its intention to adopt IT innovations. This is specifically applicable in the case of SOA which is characterized as a business process oriented architecture. Non-functional requirements are also a significant sub-category, since for example an organisation that considers real-time systems' response critical for its business goals, may reject the idea of SOA due to its limited performance. Finally, business type, including the size of a company, the market area, the type of activity, the diversification of its products and services are very clearly affecting the IT adoption process and which innovations a company considers suitable for its business.

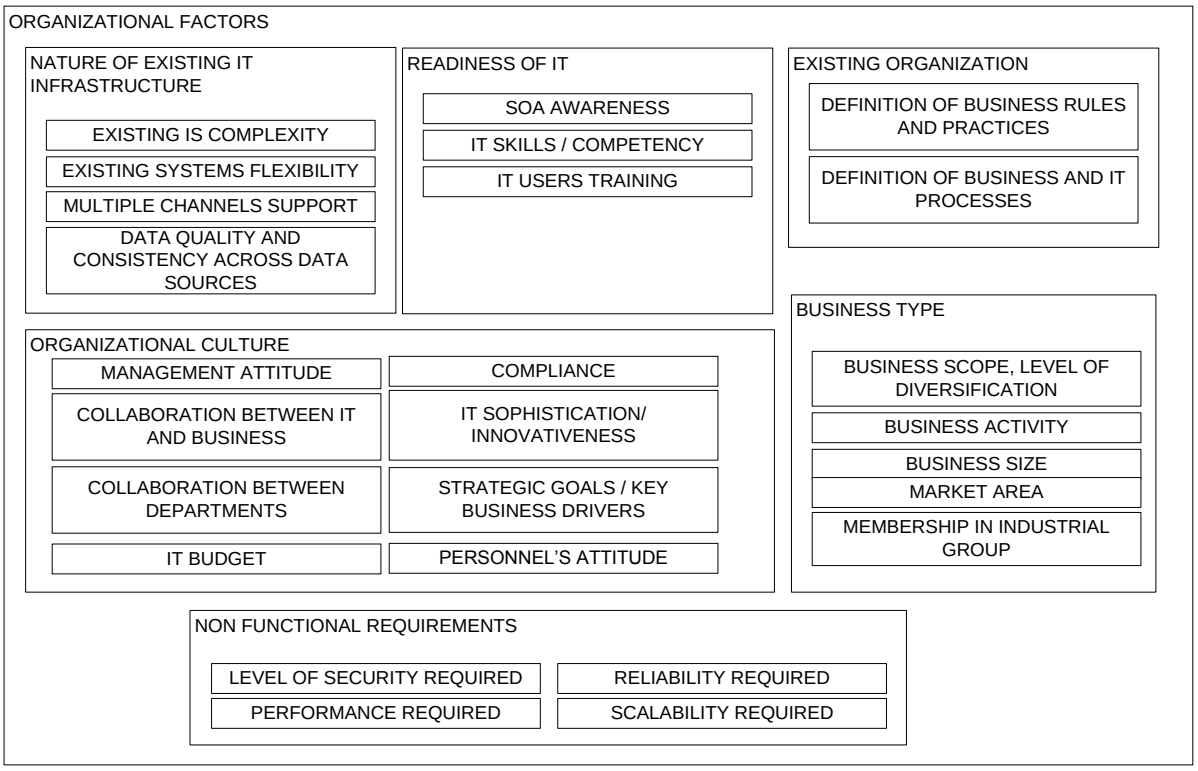

Figure 4: Organizational Factors that may affect intention to adopt SOA

3.5 SOA Value Factors

SOA value factors are related to the specific attributes of SOA that may attract an organisation to adopt this style of architecture. Since organisations evaluate new technologies and innovations based on their business value (benefits – costs = business value), we have included in our framework all claimed business value attributes of SOA (Figure 5), being either classified as factors of cost reduction or increased revenues. We say "claimed" because it is out of scope for this research to prove how real these benefits of SOA are and to which extent. Since academic literature (Papazoglou, 2003; Öhrström,2007), industrial publications (WebMethods,2005; Gartner; Classon, 2004; Schmelzer, 2005; IBM, 2006) and case studies (IBM, 2005; CentraSite; ESRI,2007; Fethi et al. ,2006) by vendors, consulting companies and other SOA practitioners, as well as SOA books (Bieberstein et al.,2005; Hurwitz et al.,2007; Erl,2005; McGovern et al.,2006; Krafzig et al.,2004) promote these benefits as attributes of SOA business value, we consider that these claimed benefits even in the form of unproved promises could affect intention to adopt SOA. Though, many of the below listed business benefits may derive, based on common sense, from the specific attributes of SOA outlined in SOA definition which we included in the introduction section of our paper.

For example easy multichannel support without redundant coding may be provided as a benefit by a service-oriented architecture. Companies may use multiple clients and multiple client types to access a service. A PDA using J2ME may access a service via HTTP, and a SWING client may access the same service via RMI. Since the layers are split into client and service layers, different client types are easier to implement. (IBM,2008; Ganesh et al.,2004).

Additionally, potential outsourcing or use of external services or provision of internal services to third parties others under payment is also a self-explained benefit. Services don't have to be bought as complete components and managed in house, and they don't have to be developed from scratch. Instead, services can be outsourced. They are self-contained , thus providing an autonomous business functionality and on top of this they are interoperable and location transparent (being even invoked through the internet), which means that any organization may expose its services for external use by other systems (partners or not) and get an extra revenue. In the opposite scenario, an organization can also purchase the use of external services if it is too expensive for it to build them or if there is not enough skills and knowledge for this task. Service level agreements establish the foundation for pricing and chargeback models.

Moreover, interoperability offered by SOA helps organizations avoid vendor-lock in. Having adopted an overall enterprise SOA, even though a new system is selected for the needs of a business unit, the organization is able to choose the best-of-breed software for the specific use, based on functionality and price criteria, and still assuring its interoperability with the existing service oriented infrastructure.

Another value factor is claimed optimization of customer service. A service-oriented architecture can link disparate business processes and data sources in ways that were previously impossible due to technological barriers that kept them in silos. The greater sharing of data and improvement of workflows can mean less hassle for a customer and a more streamlined, consistent customer experience. New products and services may also be quickly launched thanks to the agility provided by SOA and the reusability of existing services and legacy applications. On the other hand, multi-channel support for customer service (portals, web, mail, phone, mobile, branch representatives) backed up by SOA solutions (common business logic and infrastructure layer) may also be a significant factor impacting user satisfaction. Finally, creating more automated, efficient business processes may also attract more customers tempted by the non time-consuming processes that require little or no manual intervention.

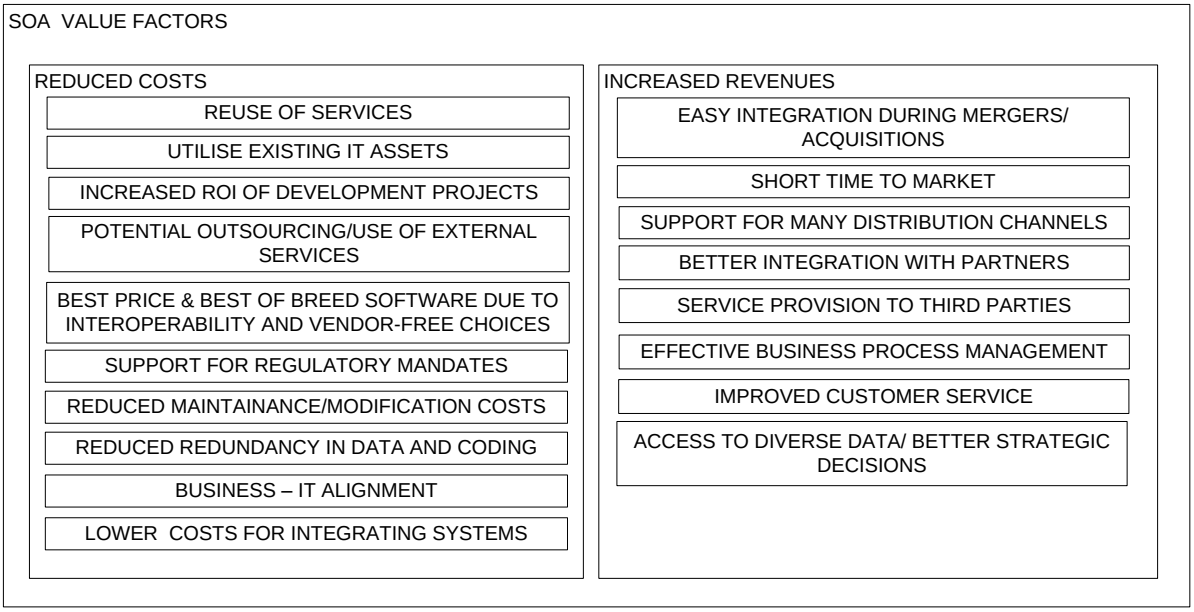

Figure 5: SOA claimed business benefits as factors affecting SOA adoption

4 RESEARCH METHODOLOGY

This research project is designed to empirically test and validate the research model presented in section 3. The study will employ a mixed method approach. Our framework, after analyzing it to a second level (Figures 2, 3, 4, 5), becomes too detailed and complex, including numerous impact hypotheses which will not be easily tested or confirmed. Consequently we shall first perform an exploratory research step, such as focus groups composed by practitioners / professionals and academic participants, which will reveal the most important factors and hypotheses to maintain in our test framework. The feedback will be incorporated into the survey model.

After finally determining which factors (rectangles) and hypotheses (arrows) should participate in the next step, quantitative research will provide as the means to confirm hypotheses. The quantitative data will be gathered through a survey and be used to identify the influence of various organizational, technological, environmental and SOA related variables on the adoption stage.

Questionnaires will be used as a measurement instrument for all factors participating in the model. Open questions will not be used so as the results can be easily quantified. All latent variables / factors shown in the model will be measured through specific item scales, in such a way so as to form nominal, ordinal or interval statistical variables. All the interval-variable items in the survey will be measured using a five-point Likert-type scale.

Each questionnaire shall be replied by IT managers of organizations corresponding to diverse levels of SOA adoption (5 levels according to Rogers), including organizations that have chosen not to adopt SOA. Questionnaires will be web-based in order to maximize access and possible sample. The web or Internet based surveys are seen as a convenient platform in achieving higher response rates due to their ease of use, low cost and greater interactivity. Sample is about to include different size of organizations, in different countries, of different business activity and various organizational characteristics and business environment.

After data collection is completed, exploratory factor analysis could drive us to hypotheses of impact that we might have ignored. Additionally, considering that the conceptual model of this study is grounded in theory, it needs a confirmatory approach to test the various hypotheses of impact of latent variables on the dependent variable. Thus, Structural Equation Modeling (SEM) is considered the most appropriate approach to be used for analyzing data and validating the hypotheses.

5 CONCLUSIONS

While service-orientation is a wide-spread idea in both academia and industry, there are still a lot of research gaps in the service-oriented computing area and especially in the business domain of SOAs. Factors affecting the adoption of SOA by enterprises have not been studied yet, as they have been in the past for many other technological innovations such as ERP, EDI, data warehouses, e-commerce and others. In this research-in-progress paper, we examine the factors influencing the diffusion and adoption of SOA in the world of business. We have developed a research model, which includes factors affecting IT innovations adoption in general, as well as specialized attributes of SOA that may affect business attitude towards it, without focusing on specific SOA implementation technologies such as web services or ESBs. The model includes latent variables (factors) and a dependent variable (adoption stage) as well as hypotheses of impact. Factors derived from literature related to innovations adoption as well as SOA related literature. Our research is at a preliminary stage, where next steps include (1) limiting the number of factors that will be examined, probably through focus groups, (2) finalizing measurement instruments (questionnaires) and (3) performing a survey in a wide sample including IT managers of organizations regardless to whether they have or not adopted SOA. SEM will be used to analyze data and confirm hypotheses. Exploratory Factor Analysis could probably be included in future steps to reveal impacts that we have not taken into consideration. Our work may motivate also other researchers to study SOA adoption factors in other contexts than business organizations, such as WEB 2.0 or pervasive environments.

References

Amelia Maurizio, James Sager, Peter Jones, Gail Corbitt, Louis Girolami (2008). *Service Oriented Architecture: Challenges for Business and Academia.* HICSS , p. 315

Andrew P. Ciganek, Marc N. Haines, William (Dave) Haseman (2005*). Challenges of Adopting Web Services: Experiences from the Financial Industry*. Proceedings of the 38th Hawaii International Conference on System Sciences

CentraSite™ White Paper. *Real-World SOA: Definition, Implementation and Use of SOA*

Dr. Jai Ganesh, Dr. Srinivas Padmabhuni, Deependra Moitra (2004). *Web Services and Multi-Channel Integration: A Proposed Framework*, IEEE, ISBN: 0-7695-2167-3

Dirk Krafzig, Karl Banke, Dirk Slama (2004). *Enterprise SOA: Service-Oriented Architecture Best Practices*, Publisher: Prentice Hall PTR, Pub Date: November 09, 2004, ISBN: 0-13-146575-9

Eric Waartsa, Yvonne M. van Everdingena, Jos van Hillegersbergb (2002). *The dynamics of factors affecting the adoption of innovations*. The Journal of Product Innovation Management 19 412–423

ESRI White Paper (2007). *Developing and Deploying an Integrated Geoenabled SOA Business Solution: A Case Study*

Fethi A. Rabhi Z Hairong Yu Z Feras T. Dabous Z Sunny Y. Wu (2006). *A service-oriented architecture for financial business Processes: A case study in trading strategy simulation*. Springer-Verlag

Gartner SOA Definition (2006): http://cours.logti.etsmtl.ca/mti727/notes/soa-definition-and-principles-en-v10.pdf

G. Buonanno, P. Faverio, F. Pigni, A. Ravarini, D. Sciuto and M. Tagliavini (2005). *Factors affecting ERP system adoption: A comparative analysis between SMEs and large companies.* Journal of Enterprise Information Management, Vol. 18 No. 4, 2005, pp. 384-426

G. C. Moore and I. Benbasat (1991). *Development of an Instrument to Measure the Perceptions of Adopting an Information Technology Innovation*. Information Systems Research, 2, 3, 1991, pp. 192-222.

Haixiao Pan, Management School, Fudan University, Shanghai China (2005). *Factors Affecting IT Adoption: The Case of a Chinese Retail Company*, 0-7803-8971 -9/05/$20.000 2005 IEEE

IBM Case Study (2008). *SOA enables multichannel customer service for Texas health commission*, Published on 24-Dec-2008, Customer: State of Texas Health and Human Services Commission

IBM Case Study (2005). *Standard Life's implementation of an SOA is a sound investment*

IBM Institute for Business Value (2006). *Service-oriented architecture, A practical guide to measuring return on that investment*

IBM SOA Definition (2007): http://www.ibm.com/developerworks/webservices/library/ws-soa-enterprise1/?S_TACT=105AGX22&S_CMP=ISSUE

James McGovern, Oliver Sims, Ashish Jain, Mark Little (2006). *Enterprise Service Oriented Architectures: Concepts, Challenges, Recommendations*, published by Springer, 2006 - ISBN-10 1-4020-3705-8 (e-book)

Jonas Öhrström (2007). *Business Value Using Service Oriented Architecture*. Master Thesis KTH Electrical Engineering, Stockholm 2007

K.Ramamurthy,Arun Sen, Atish P. Sinha (2008). *An empirical investigation of the key determinants of data warehouse adoption.* Decision Support Systems 44 (2008) 817–841

Khalid S. Solimana, Brian D. Janzb (2004). *An exploratory study to identify the critical factors affecting the decision to establish Internet-based interorganizational information systems*. Information & Management 41 (2004) 697–706

Kostas Kontogiannis, Grace A. Lewis, Dennis B. Smith, Marin Litoiu, Hausi Müller, Stefan Schuster, Eleni Stroulia (2007). *The Landscape of Service-Oriented Systems: A Research Perspective.* International Workshop on Systems Development in SOA Environments (SDSOA'07) 2007 IEEE

Liam O'Brien, Paulo Merson, Len Bass (2007). *Quality Attributes for Service-Oriented Architectures*. International Workshop on Systems Development in SOA Environments (SDSOA'07) 2007 IEEE

Michael Barnes, Gartner. *Applied SOA: Measuring Business Value*

Michael P. Papazoglou (2003), Tilburg University. *Service -Oriented Computing: Concepts, Characteristics and Directions*, Proceedings of the Fourth International Conference on Web Information Systems Engineering (IEEE 2003)

Michael P. Papazoglou, Paolo Traverso, Schahram Dustdar, Frank Leymann (2006): *Service-Oriented Computing Research Roadmap*

Minder Chen (2003). *Factors affecting the adoption and diffusion of XML and Web services standards for E-business systems.* International Journal of Human-Computer Studies 58 259–279

OASIS SOA Definition (2006): http://www.oasis-open.org/committees/download.php/19679/soa-rm-cs.pdf

OpenGroup SOA Definition (2009): http://www.opengroup.org/projects/soa/

Peter Classon, Principal Consultant by HORIZONS (2004). *The Business Value of Implementing a Service Oriented Architecture*

Rogers, E.M. (1995). *Diffusion of Innovations*, 4th Edition. Free Press, New York.

Judith Hurwitz, Robin Bloor,Carol Baroudi, and Marcia Kaufman (2007). *Service Oriented Architecture For Dummies*. Published by Wiley Publishing 2007, Inc. ISBN-13: 978-0-470-05435-2

Norbert Bieberstein,, Sanjay Bose,, Marc Fiammante,, Keith Jones,, Rawn Shah (2005). *Service-Oriented Architecture Compass: Business Value, Planning, and Enterprise Roadmap.* Publisher: IBM Press Pub Date: October 19, 2005 ISBN: 0-13-187002-5

Thomas Erl (2005). *Service-Oriented Architecture: Concepts, Technology, and Design.* Publisher: Prentice Hall PTR, Pub Date: August 04, 2005, ISBN: 0-13-185858-0

Sanjiva Weerawarana, Francisco Curbera, Frank Leymann, Tony Storey, Donald F. Ferguson (2005). *Web Services Platform Architecture*, Chapter 3. Publisher: Prentice Hall PTR, Pub Date: April 1, 2005, ISBN: 0131488740

Sherry M.B. Thatcher, Ph.D., William Foster, Ph.D. (2002). *B2B e-commerce adoption decisions in Taiwan: The interaction of organizational, industrial, governmental and cultural factors*. Proceedings of the 36th Hawaii International Conference on System Sciences (HICSS'03), 2002 IEEE

SUN SOA Definition (2005): http://java.sun.com/developer/technicalArticles/WebServices/soa/

Swaroop Kalasapur, Mohan Kumar, Behrooz Shirazi (2006). *Evaluating Service Oriented Architectures (SOA) in Pervasive Computing*, Fourth IEEE International Conference on Pervasive Computing and Communications

Teo, Wei, Benbasat. (2003). *Predicting Intention To Adopt Interorganizational Linkages: An Institutional Perspective*, MIS Quarterly 2003

TIBCO SOA Definition (2005): http://www.tibco.com/multimedia/wp-designing-services-in-an-soa-using-tibco-businessworks_tcm8-2448.pdf
Ronald Schmelzer (2005). *The ROI of SOA.* Document ID: ZAPFLASH-20050127 | Document Type: ZapFlash
WebMethods (2005). The Business Case for SOA
Wu Deng, Xinhua Yang, Huimin Zhao, Dan Lei, Hua Li (2008). *Study on EAI Based on Web Services and SOA*. International Symposium on Electronic Commerce and Security
W3C SOA Definition (2004): http://www.w3.org/TR/ws-arch/#service_oriented_architecture