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Impacts of Service-oriented Architecture Transformation on Organizational Structures

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Abstract: Service-Oriented Architecture (SOA) is being used by organizations for becoming more agile and flexible in order to adapt dynamically changing business environments. The main objective of this study was to determine impacts of SOA on enterprise systems. The research model is designed to find out the necessary changes in organization structure for a successful SOA transformation. Information system (IS) professionals from 34 organizations in Europe answered the questionnaire. The research indicates that enterprise level SOA transformations consider service reuse as the main reason to start this transformation. The findings show that while enterprise level transformations value collaboration as important, departmental level transformations do not attach importance to collaboration as a success factor. According to results, 85% of the organizations in the sample made changes in their Information Systems (IS) funding model for SOA transformation.

Key words: Service-oriented architecture (SOA), software reuse, collaboration, agility, organizational structure, organizational change

INTRODUCTION

Many modern enterprises heavily rely on their Information Technology (IT) systems. Because of this dependence, IT is driven by the dynamics of the enterprise itself. Enterprises have high expectations from enterprise IT such as having high level of flexibility and agility (Janssen and Joha, 2008).

When it was first introduced in the enterprises, IT was mostly responsible for storage and processing capacity without having business logic. By time, more and more business logic have been added to IT applications in the previous 20 years that made it a part of the business itself. As IT is a part of business today, changes in the requirements of business and the need to develop new functionalities also requires changes in the IT applications which forces enterprises to reuse existing components efficiently to be able to reduce the costs (Krafzig et al., 2004).

Now imagine a car manufacturer designing all the parts of the car in a way not to let it be possible to replace a single part without replacing the car wholly. After trying to adapt IT to business processes during previous 20 years in many different ways, the state of the business processes of many organizations are like the cars of this fictional manufacturer. These organizations have applications to support the operations of these monolithic systems that are very difficult to replace piece by piece. Fortunately, it is becoming possible to design many business activities as Lego-like software components that can be easily put together and taken apart. This is achieved by using SOA, a new way of designing and implementing the software components (Merrifield et al., 2008).

SOA is a remarkable evolutionary step for technology world especially to help it to complete one of its greatest unfulfilled goals. This goal is to have the ability to connect a wide variety of systems without proprietary software (Pulier and Taylor, 2006).

SOA intends to create a services platform consisting of many services that are elements of business processes that can be combined and recombined into different solutions and scenarios, as determined by business needs. This capability of SOA to integrate and recombine services helps the organizations to have a closer relationship between business and IT. Moreover, it provides to organizations the flexibility to address new situations (Bieberstein et al., 2006).

It is clear that aligning IT systems by the help of service-oriented architecture is a very critical step to enable end to-end enterprise integration and virtualized IT services. On the other hand, to be really effective, SOA should be overarching technology and needs to be extended to transform organizational structure and the behavioral practices of the organization (Bieberstein et al., 2005).

However, most companies that have started SOA adoption have applied it without considering the option of re-designing of their businesses as a first step. Having omitted this option, they have disregarded SOA's

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greatest value which is the opportunity to re-design the organizational structure to make it much more focused, efficient and flexible.

SERVICE-ORIENTED ARCHITECTURE

The term SOA is an acronym for Service-oriented Architecture (Moore, 2007). It is the newest approach for designing, implementing and integrating reusable software components which is offered to organizations as a new technological framework (Saran, 2006).

A SOA has many different elements which are needed to be considered in order to build it. The essential ingredients of a successful SOA involves a conceptual SOA vision, various services, SOA governance and policies, SOA metrics and enabling behavior (Marks and Bell, 2006).

For the sake of the organization's processes, it is required to have enterprise architecture and a SOA vision. The organizations should set their goals in terms of the way they want their processes to function and where they want to see their organizations at a certain point in time (Moore, 2005). SOA's offer is a new way to system design that makes it possible to expose resources on a network as standalone components called services (Joseph, 2006). Services are considered as the central artifact of SOA. Services can be accessed regardless of the programming language used for development or the platform on which the service runs. SOA governance is important and needed to be able to make sure that different development teams will focus on fulfilling the single SOA vision (Marks, 2005). SOA metrics are necessary to let the organization know the current position and the direction of SOA initiatives. Organizations have to spend some time for planning a behavioral model to make sure that SOA initiative will be successful. The planning process should start with the behavior of SOA which will enable the organizations to reach SOA business goals. These behaviors are the ones to lead the organization to service reuse, SOA conformance, governance and metrics.

Apart from the elements mentioned, there are other concepts that business executives should take into account while assessing the potential value of SOA. These concepts include ease of integration (Keller, 2006), software (service) reuse and business agility (Holtschke, 2006).

With SOA, it is possible to create solutions that are portable and interoperable using the existing systems which are actually isolated systems by the help of open standards. Starting point of open standards supporting interoperability is web services. SOA enables the creation of applications built as a combination of loosely coupled and interoperable services (Carter, 2007).

Reusability of the services can be best explained by using mass customization concept from manufacturing which is using combinations of standard modules to form an individualized product. SOA is used to apply this approach to the business processes of the organization. Basically following this concept, the services introduced by SOA can easily be reused to create new business processes. As services created using existing back-end infrastructure, this approach will provide the ability customize products in a mass scale.

The fact that nowadays the market and customers are becoming increasingly demanding requires more flexible IT capabilities to respond in time to changing business processes and business rules. IT systems serving for customer relations focus on the benefit of enterprises while customers receive insufficient information from enterprises. Achieving information symmetry in customer relationships, providing bi-directional information flow between customers and enterprises is one of the various ways of keeping competitive advantage. Customer knowledge management and customer support systems can run with a technology infrastructure based on SOA (Lin, 2010). Opportunity to increase growth and revenue, reduction in time-to-market values and cost reductions are some of the motivations of business agility. SOA fosters the ease of integration in the applications of the enterprise through interoperability and enables the usage of existing applications of the enterprise by wrapping them as services. For this reason SOA is expected to increase the agility of the enterprise in the long-term (Tews, 2007).

BUSINESS VALUE OF SOA

In order to stay up-to-date and survive in this highly competitive business world, businesses can not ignore leveraging diverse technologies in their day-to-day operations and long-term strategy. Organizations are seeking for the opportunities to broaden their connectivity and increase their revenues; however they do not forget the need for innovation which is possible by restructuring the applications for more flexibility and lower costs (Mahdavi and Shirazi, 2010).

It is clear that SOA has a significant potential business impact to an enterprise; however this is possible only if the proper business modeling and context are considered during the planning and implementation of SOA. If a company is not responsive enough to changing business and market conditions, SOA may provide the baseline for the needs of this agile and rolling enterprise vision. This is achieved by delivering a strong business value proposition.

It is also important to decide whether a specific activity is valuable from business perspective. If an

activity or the capability delivered by the activity differentiates the company from the competitors, or has a great influence to keep the customer loyal or drives a key performance measure (like manufacturing cost, quality or time to market), then this activity is considered as an activity providing business value. Moreover, anticipating the changes in the market and developing new customer, partner and supplier relationships can be considered as additional business drivers for SOA.

Business benefits of SOA include not only tangible benefits but also less tangible but more compelling benefits. It is also important to understand how soft issues are relevant to achieve service-oriented architectures (Marks and Corp, 2004). These soft issues are the most difficult aspects of achieving SOA and they are also the key to ultimate success of SOA.

ORGANIZATIONAL CHANGES FOR SOA ADOPTION

Currently, in most organizations corporate governance and IT governance continues separately only with an intersection for SOA governance. The organization does not have a complete alignment of governance practices, so the CEO is not able to find out the responsible person when a customer service request arises. On the other hand, the recommended future structure allows corporate governance to overarch the IT and SOA governance which ensures that everything is driven by business so that IT and SOA goals and directions line up under the business goals.

To be able to achieve a successful SOA adoption with corporate governance overarching SOA governance for business and IT alignment, several changes are recommended by different SOA experts and practitioners: As SOA is a concept for distributed systems and distributed processes have become reality recently, many of the existing organizational structures do not either support or provide sufficient functionality (Josuttis, 2007). In functional structures, as a result of centralized control, multilayered bureaucracies occur resulting in less responsiveness to changing business conditions. In geographic divisions, there are problems like duplication, extra costs and inconsistent messages to different markets. Other divisional structures might cause silo effect. Finally in matrix structures it is difficult to balance the activities within different subsets as the organization is very complex. Even though many people agree that SOA requires change in the organizational structure, most companies that have started SOA adoption have applied it without considering the option of re-designing of their businesses as a first step. Having omitted this option,

they have disregarded SOA's greatest value which is the opportunity to redesign the organizational structure to make it much more focused, efficient and flexible.

As opposed to requirements of SOA which requires sharing capabilities as services and reusing existing assets, in traditional architectures budgets were allocated in silos at the project, group, or department level. For this reason, SOA also requires new procedures for funding new services and architecture. The real benefit of SOA will be realized when organizations stop investing locally to departments and start investing on enterprise-wide assets. If the organization can not address the financial issues, especially the central funding of reusable services, it might result in duplicated services and infrastructure where each of them will address the needs of individual projects and will not be used across departments (Afshar, 2007).

Not only the organizational structure and the funding model but also the people and the roles are expected to be influenced by SOA transformation. Some of the changes required include creating a group of employees called process officers for improving business processes, developing SOA specific skills, encouraging sharable and reusable services and creating a group responsible from SOA governance. As a best practice, foundation of an Integration Competence Center (ICC) to be able to facilitate trainings for managers, stakeholders, project managers, business analysts and quality assurance team is recommended since usually SOA adoption starts with a group of architects and developers and explaining SOA philosophy to employees enterprise-wide is essential.

By the help of service management capabilities of SOA, it is much easier to maintain a SOA enabled system than a system with monolithic applications. As the cost of maintenance is between 60 and 80% of total cost of an application, even 10% reduction will return a lot to the enterprise. SOA adoption requires departments to share operations and application code, companies to outsource more than before and business units to move part of operations to customers and suppliers. SOA transformation definitely requires collaboration from the initial ideas at the start, to operations and maintenance at the end. Collaboration may not be so easy in organizations in which there are isolated departments acting on their own. Changing the culture of the organization will be the only way in such cases to ensure successful SOA adoption and any model within the enterprise which undermines the value of collaboration can jeopardize success.

One of the key success factors of SOA transformation is the management support. SOA is a new strategy which will require transformation not only in

technology but also in culture and the structure of the organization and therefore top managers have to understand these impacts SOA will have in the enterprise. Moreover, they have to provide enough time to SOA team to be able to put in place the new processes and should not expect to get the benefits of SOA in one year. SOA is a strategy which requires long term commitment and will take several years to be established properly.

MATERIALS AND METHODS

The research model of this study was developed to determine the required organizational changes for a successful SOA transformation. As Fig. 1 illustrates one major dimension of the research model defines the required organizational changes based on new roles, new corporate governance and new IT investment and funding models. Other dimensions find out the reasons of SOA transformation and the extent of SOA. The last dimension examines the success of SOA transformation.

The field research instrument involving 11 questions was designed based on literature survey and the research model in Fig. 1. The questions are close ended questions of multiple choice, multiple answers or 5 point Likert scale type except one open ended question.

The sample is small since there are not many SOA transformations going on even though many CIO's all over the world are considering this new information architecture in their organization. The survey has been offered to 50 professionals who have hands on experience and 34 of them responded to the survey which means 68% return rate. Table 1 provides information about the respondent's experience level. The respondents are from Turkey and several European countries
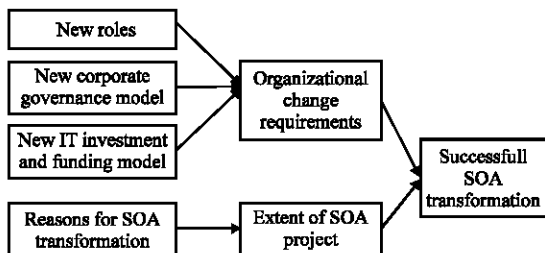
including Denmark, Greece, Italy, Poland, Romania and Slovak Republic.

As SOA is a new design approach, it was almost impossible to find people who have more than 5 years of hands-on experience during the implementation process of the survey which lasted from May 2008 to July 2008. Table 2 provides information about the sector of employment of interviewees and Table 3 clarifies the extent of SOA in their organizations. Table 4 shows stages of SOA in these organizations.

Service quality determines the degree of customer satisfaction which influences decision to repurchase and reuse the service (Sudhahar *et al.*, 2006). User satisfaction is vital for the continuance of an organization's IS functions. Although IS research gives little evidence about the factors predicting whether an IS user will or will not reuse an IS service Kettinger *et al.* (2009) shows that IS service quality plays an important role in predicting behavioral intention to reuse the service. On the other hand reuse of existing software can promote software quality (Fichman and Kemerer, 2001). In this study if it is assumed that SOA increases service quality since it is implemented for improving services then the following hypothesis can be tested:

- **H₁:** Extent of SOA transformation in an organization is correlated with the need for Fostering service (software) reuse

Agility of a company is an ability for adjusting to any unexpected changes in the business environment. The responses of an agile company to environmental changes are rapid and efficient which contributes to sustain its competitiveness. Although there are various methods to measure agility of a company (Ganguly *et al.*, 2009), the need of a company for higher agility can easily

Fig. 1: Research model

Table 1: Years of experience of respondents (n = 34)

Years of experience	Frequency	%
1	6	18
2	11	32
3	7	21
4	9	26
5	1	3

Table 2: Sector of employment of the respondent (n = 34)

Sector	Frequency	%
Finance	7	21
Insurance	1	3
IT	2	6
Telecom	24	70

Table 3: Extent of SOA in respondents' organizations (n = 34)

Extent of SOA	Frequency	%
Enterprise level	23	68
Department or division level	11	32

Table 4: Stage of SOA in the respondents' organization (n = 34)

Stage	Frequency	%
In development	6	18
Deployed in a single department	6	18
Deployed in multiple departments	17	50
Deployed for external use	5	14

be observed by its manager and employees based on the business objectives they achieve. Raschke (2010) states that IT is a platform for business process agility influencing efficiency and quality of results. Since one of the aims of SOA transformation is to increase competitive advantage which includes higher efficiency and quality and less time the following hypothesis is constructed:

- **H₂:** Extent of SOA transformation in an organization is correlated with the need for Supporting ever changing business environment to become more agile

Weinel *et al.* (2011) show that employee's perception of collaboration is positively influenced by social presence which is defined as the degree to which a person is aware of another person in a technology mediated communication setting. SOA enhances collaborative environment allowing flexible interaction between different components (Fang and Sing, 2009). Collaboration also fosters organizational learning (Curran *et al.*, 2004; Lee and Tsai, 2011) which may contribute to the success of SOA transformation. This idea leads the following hypothesis:

- **H₃:** Organizational perception about the influence of collaboration on the success of SOA transformation varies according the level of SOA transformation in the organization

In order to be successful IS implementations require a fit between the design of the system and the organization structure. For example, the fit between the organization structure and standardized business process designs embedded in an adopted ERP system determines the implementation's success or failure (Morton and Hu, 2008). Similarly, there may be a necessity for a match between SOA and organization structure which arises H_{4a} and H_{4b}:

- **H₄ₐ:** SOA requires changes in the organizational structure
- **H₄ᵦ:** Organizational changes depend on the current structure of the organization

Organizational changes involving IS implementations create costs. Sharma *et al.* (2008) confirmed that interdependencies between changes are key drivers of IS implementation costs. During SOA transformation new implementations will be necessary and there are various methods for financing the planned costs. Organizations may need to use a different funding model for SOA

transformation than the funding model used for previous IT implementation projects. This idea is tested with H_5:

- **H₅:** SOA requires change in the funding model of IT implementation

RESULTS

SPSS 16.0 is the software tool used for statistical analyses of the study. The reliability analysis for five variables of reasons for SOA transformation results a Cronbach's Alpha of 0.708. The Cronbach's Alpha is 0.717 for the analysis of 29 organizational change requirement variables. Four variables of successful SOA transformation have a Cronbach alpha of 0.635.

The first hypothesis H_1 had been tested using cross tabulation. The Chi-square test led to Fisher's test which concluded a statistically significant difference with a sig. = 0.001 (Sig.<0.05). This result shows that there is a strong relationship between the extent of SOA transformation and Fostering service reuse. The enterprise level SOA transformations consider service reuse as the main reason to start this transformation. On the other hand, the most divisional level transformations do not start the transformation to be able to foster software reuse. Reasons for SOA transformation are shown in Table 6.

For H_2 cross tabulation technique led to a Fisher's exact test and resulted a significance of 0,029 (sig.<0.05). This statistically significant difference indicates that Supporting ever changing business environment to become more agile as a reason to start SOA adoption depends on whether the SOA project is at enterprise level or divisional level. When the extend of SOA transformation is at divisional level agility may not be an aim of this transformation.

A non-parametric test, K independent samples test had been used to test the H_3. It is not possible to assume that the extent of SOA transformation fits to a distribution like normal distribution and there are more than two independent groups. Kruskal Wallis test variable is the ordinal variable which shows the organization's perception of the impact of collaboration in SOA success. Grouping variable is the level of SOA transformation in the organization which had 3 possible values, enterprise level, departmental/divisional level and single/isolated projects. Table 7 summarizes success level of SOA project in respondent's organizations. The organization's perception of the impact of collaboration in SOA success do differ significantly by level of SOA transformation with a significance of 0.02 (sig.<0.05). This result is an expected result since the organization considers

Table 5: Organization structure prior to SOA transformation (n = 34)

Organization's structure	Frequency	%
Functional	12	35
Divisional	13	38
Matrix	9	27

Table 6: Reasons for SOA transformation (n = 34)

	Frequency			
Reason	Yes	%	No	%
Supporting ever-changing business environment to become more agile	29	85	5	15
Enhancing internal operational process efficiency and flexibility	27	79	7	21
Improving quality of IT systems	9	26	25	74
Increasing revenue	7	21	27	79
Better integration of processes /information with customers/suppliers	24	71	10	29
Fostering Software(Service) reuse	23	68	11	32
Lowering IT operating costs	16	47	18	53
Other reasons	3	9	31	91

Table 7: Success level of SOA projects (n = 34)

Level of success	Frequency	%
Far more successful than expected	0	0
More successful than expected	5	15
Successful as much as expected	22	65
Less successful than expected	5	15
Far less successful than expected	0	0
Not yet deployed	2	5

Table 8: Changes in Organization's Structure (N = 34)

	Frequency			
Type of change	Yes	%	No	%
Creation of project-oriented organization structure for the development of new distributed processes	13	38	21	62
Introduction of some cross-domain departments to be able to maintain the cross-department functionality	9	26	25	74
Foundation of SOA Center of Excellence, Integration Competence Center or Similar to Centralize SOA Activities	10	29	24	71
Moving From Hierarchical Organizational Structures to More Horizontal Structures	5	15	29	85
Improving the Relationship between Business Units and IT	22	65	12	35
Creation of a New Operating Process in IT Organization for Service Management	13	38	21	62

collaboration as a more important factor in the success of the SOA transformation as the complexity of the transformation and the interaction need between different departments increase. It is obvious that in an enterprise level transformation complexity and the need for interaction are more important than in a departmental level transformation. For this reason most of the enterprise level transformations considered collaboration as an important factor however, departmental level transformations did not. Factors influencing the success of SOA are presented in Table 12.

Table 9: Dependency of structural change need to current organization structure

		Existing organizational structure			
		Functional	Divisional	Matrix	Total
Need for structural	Yes	10	11	9	30
change in the	No	2	2	0	4
organization	Total	12	13	9	34

Table 10: Changes in Funding Model (N = 34)

	Frequencies			
Change in funding model	Yes	%	No	%
Central funding-A pool of resources created within the organization to fund the new services	19	56	15	44
The first consumer or the first application which needs the service pays for the implementation	9	26	25	74
All consumers of the service should pay for the development	2	6	32	94
Provider handles the development costs and charges the consumers of the services based on the consumption rate	4	12	30	88

To be able to find out whether SOA requires changes in the organizational structure or not, the number of responses which indicates any change in the organization and which does not are identified. If at least one of the changes indicated in Table 8 is selected, this means organization did some changes; otherwise it is considered as nothing changed. When chi-square test is applied to this new parameter a significant difference exists (sig. = 0.000 (Sig.<0.01)). This supports H_{4a} which states that SOA requires changes in the organizational structure. New roles which may be indicators of structural changes aligned with SOA transformation are shown in Table 11 Organization structures prior to SOA transformation are summarized in Table 5.

As Table 9 indicates cross tabulation has been applied to analyze if the need for organizational change depends on the structure of the organization. Chi-square test revealed that there is no statistically significant difference among organizations of different structures for the need to make structural changes in order to be successful in SOA transformation. H_{4b} is not verified.

In order to test H_5, two groups of organizations are defined: The organizations having responses which indicate any change in the funding model and the organizations with no indication of change in the funding model. When chi-square test is applied to this new parameter, the significant difference supported H_5 (sig. = 0.001 (Sig.<0.05)). Actually 85% of the organizations made some changes in their funding model for SOA transformation as Table 10 show.

Table 11: New roles with SOA (n=34)

New roles	Frequencies			
	Yes	%	No	%
Business process support assistant	7	21	27	79
Business process assistant	9	26	25	74
Business process manager	23	68	11	32
Service developer	26	76	8	24
SOA strategy manager	24	71	10	29
SOA governance manager	16	47	18	53
SOA process manager	15	44	19	56
SOA measurement manager	2	6	32	94
SOA security manager	7	21	27	79
SOA technology scout	8	24	26	76
Business process architect	28	82	6	18
Business process orchestrator	8	24	26	76
Service designer	23	68	11	32
Business process integrator	22	65	12	35
Business process tester	20	59	14	41
Release manager	11	32	23	68
Service librarian	7	21	27	79
SOA project manager	28	82	6	18
SOA project member	25	74	9	26

Table 12: Factors influencing the success of SOA (n = 34)

Factors	Level of impact									
	Very low		Low		Medium		High		Very high	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Collaboration	0	0	2	6	7	21	13	38	12	35
Management buy-in	0	0	4	12	12	35	12	35	6	18
IT stuffing	1	3	5	15	13	38	13	38	2	6
Organizational structure	0	0	8	24	13	38	11	32	2	6

CONCLUSION AND FUTURE RESEARCH

Nowadays, SOA is one of the most discussed words in technology and business world. SOA promises a new way of designing and implementing software components to make it possible to plug-and-play new components like adding a new Lego to a child's model. Being so appealing, SOA adoption started to become the highest priority in the to-do list of many organizations which are keen on creating systems that can easily and quickly be configured and modified to support dynamically changing business requirements. Although previous research emphasizes that the main motive of organizations to implement SOA is to have higher flexibility and agility this study indicates that better integration of processes and information with customers and suppliers and fostering service reuse are also important reasons for preferring SOA.

However, SOA is more than being just a technology change and has impacts on corporate governance model, organizational structures, IT investment and funding models, people and roles and operational activities and requires collaboration and management support which are the organizational change situations created after implementing any organizational development program

(Taghizadeh and Mahmoudzadeh, 2010). Some previous studies claim that pioneering organizations of SOA adoptions ignored redesign issues. However, in this study 88% of firms in the sample are restructuring their organizations. Although collaboration, management support, IT stuff and organization structure are all the factors influencing success of SOA transformation as mentioned in prior studies, organization structure takes its place as the forth factor when they are ranked. The structural change is generally in the form of arrangements of business processes and relations among business units but not changing hierarchy in the organization. Among the 19 proposed new job positions as part of SOA transformation efforts 18 new roles have been confirmed to be useful and necessary for the organization supporting earlier claims of researchers. From financial point of view, the study determines a strong preference for central funding model in order to finance SOA transformation which agrees with recommendations of former studies.

Managers who would like to start SOA transformation in their companies should keep in mind that SOA is a big step towards highly flexible and agile business environment however, it is not a silver bullet which can change everything in the organization in a

moment and requires collaboration between different units of the organization, commitment from the whole organization including business, IT and senior management. It is an important change which requires long term planning at the very beginning to ensure the success of the transformation otherwise it can become a disaster.

The recommendation would be starting with small pilot project(s) and then expanding the scope of the projects to a division or the whole enterprise based on the needs of the organization. This expansion should be considered as a chance to re-design the organization to take full power of the SOA transformation to make the organization much more focused, efficient and flexible.

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