CHAPTER 5

STUDY OF THE INHIBITING AND SUCCESS FACTORS IN SOA
DESIGN AND IMPLEMENTATION

5.1 Introduction

Service Oriented Architecture (SOA) is a way of reorganizing software applications and infrastructure into a set of interacting services. The basic SOA does not address over-arching concerns such as management, service orchestration, service transaction management and coordination, security, and other concerns that apply to all components in services architecture. In this chapter the concepts behind service oriented computing and how the basic service oriented architecture helps deliver service-based application is discussed. It covers two aspects of SOA that need to be better understood in terms of their relevance to each stage of SOA evolution i.e. ‘governance’ and ‘service granularity’.

Most organizations (whether educational, commercial, or governmental) provide services to customers, clients, citizens, employees, or partners. Developing a service is different from developing objects because a service is defined by the messages it exchanges with other services, rather than a method signature. A service must be defined at a higher level of abstraction. Service needs to be developed within a larger context rather than an object or procedure because it is more likely to be reused. In fact, defining service for reuse is probably the most important part of service orientation.
The major difference between service oriented development and previous approaches is that service orientation lets you focus on the description of business problem. The previous approaches required you to focus more on the use of specific execution environment technology. Separating the service description from its technology implementation means that the businesses can think about and plan IT investment around the realization of operational business considerations, as represented by the descriptions, more so than the capabilities of any individual product or software technology chosen to execute the description. Following are the factors that form the basis of motivation to adopt SOA:

- The need to respond quickly to on demand change of business needs.
- The need to motivate reuse of technical assets across a larger enterprise.

These requirements form the basis to motivate migration to SOA, and require steps to optimize development and support costs, and call for the creation of standardized assets, that once created, can be run anywhere. For example, consider a situation where business requests rapid and seemingly endless minor changes in business processes that inherently require significant application level code changes within timelines that are very difficult to achieve. Benefits of SOA only can be achieved fully if one is able to answer the following questions:

- How to get started?
- Where to get started?
- When to get started?
- What is the return on investment (ROI)?
Services have to be developed, not simply for immediate benefits, but also for long term benefits. The existence of an individual service is not of much value unless it fits into larger collection of services that can be consumed by multiple applications, and out of which multiple new applications can be developed. In addition, the definition of reusable service is very difficult to get right the first time.

5.2 Approaches to SOA Implementation

Broadly it is found that there are two approaches of SOA implementation i.e. theoretical approach and empirical approach. It is further observed that most of the approaches are empirical based. These two approaches be further categorized into different level (Figure 5.1)

![Figure 5.1 SOA Implementation Categorized View](image-url)
5.2.1 Experiments and Results to Identify of Implementation Factors and Approaches

The study has been focused on reputed journals and websites of computer science, information technology, and information systems covering research articles on service oriented computing, service oriented architecture and issues related to SOA. The survey is limited to time frame from year 2000 to year 2011. This time frame is further divided into three blocks to better analyze their growth and compare certain factors. The articles were searched with search term SOA implementation issues/ SOA Research etc. Out of total 200 papers, 95 articles and paper that are relevant were filtered out for this study. The Figure 6.1 shows the number of article published in different span of time.

The bar chart drawn for the number of research articles published during different interval clearly shows that interest for SOA is increasing drastically. It was identified through literature survey that SOA is evolving as organization are moving from their legacy systems to SOA environment, it is further identified that this growth is further expected to grow for the benefits that SOA provides and its ad-hoc nature that handles the changing needs of business.

![Figure 5.2 Number of articles/papers Identified on SOA Implementation](image-url)
5.2.2 Identification of Implementation Approaches

To analyze the data collected for the purpose, it has been classified into theoretical studies and empirical studies. Theoretical studies were further split into illustrative, conceptual and applied concepts. Conceptual studies describe structure, models or theories and provide explanation or reasons. Illustrative studies, basically try to guide the practice, offer recommendations for actions and explain action to be fulfilled whereas applied concept studies are a mixture of both conceptual and illustrative studies. They are mainly based on ideas, structures and speculations rather than on the systematic and direct observation of reality. Empirical studies have been divided into case studies and field studies. Table 6.1 shows the number of papers reviewed under different categories, out of total 95 papers, the majority of articles/papers found was empirical (52), compared to theoretical (43).

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<tr>
<td><strong>Theoretical Approach</strong> (43)</td>
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<td>Illustrative</td>
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<td>Applied Concept</td>
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<td>Conceptual</td>
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<td><strong>Empirical Approach</strong> (52)</td>
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<td>Case Studies</td>
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<td>Field Studies</td>
<td>7</td>
<td>11</td>
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<td><strong>Total (95)</strong></td>
<td><strong>22</strong></td>
<td><strong>37</strong></td>
<td><strong>36</strong></td>
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Figure 5.3 shows that most of the articles published are covering field studies followed by case studies. It is also analyzed that most of work categorized as theoretical got published during year 2004-2007.

Similarly in Empirical category maximum work were found in year 2007-2011. It further indicate that among the theoretical studies, illustrative concept studies were most common followed by applied concept ones and the conceptual ones. The field study stands out as the most often used among the empirical methods.

5.2.3 Identification of Implementation Factors

Most of the articles/paper published on the area of SOA discussed the following factors (Table 6.2) that need to be taken care while implementing SOA. This research identified various factors in different papers and find out the percentage of each factor out of total articles published. The resulting factors were neither mutually exclusive nor collectively exhaustive; so an article could be classified into one or more categories and
occurrence of given factor could increase with the increase in numbers of reviewed articles. The purpose here was not to rank various factors in terms of their importance but to identify and analyze critical factors of SOA implementation. Table below shows the number of articles dealing with each factor and the percentage of the total that they represent. Here total of each factor comes out to be 167, not 95, since articles reviewed may dealt with more than one factors. In Table 5.2, respective columns represent number of articles; their percentages out of total.

Table 5.2 Distribution of Factors year wise

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<tr>
<td>Governance Issues</td>
<td>6;3.5</td>
<td>10;5.9</td>
<td>8;4.7</td>
<td>24;14.3</td>
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<td>Migration factors</td>
<td>5;2.9</td>
<td>8;4.7</td>
<td>9;5.3</td>
<td>22;13.1</td>
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<td>Legacy Systems Integration</td>
<td>6;3.5</td>
<td>11;6.5</td>
<td>5;2.9</td>
<td>22;13.1</td>
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<tr>
<td>Change Management</td>
<td>3;1.7</td>
<td>4;2.3</td>
<td>4;2.3</td>
<td>11;6.1</td>
</tr>
<tr>
<td>Adhoc requirements</td>
<td>8;4.7</td>
<td>9;5.3</td>
<td>10;5.9</td>
<td>27;16.1</td>
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<tr>
<td>Resource Competences</td>
<td>1;0.5</td>
<td>2;1.1</td>
<td>3;1.7</td>
<td>6;3.5</td>
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<tr>
<td>Security Risk</td>
<td>2;1.1</td>
<td>3;1.7</td>
<td>3;1.7</td>
<td>8;4.1</td>
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<tr>
<td>Risk Management</td>
<td>1;0.5</td>
<td>3;1.7</td>
<td>2;1.1</td>
<td>6;3.5</td>
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<tr>
<td>Challenges in scope understanding</td>
<td>0;0.0</td>
<td>3;1.7</td>
<td>1;0.5</td>
<td>4;2.3</td>
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<tr>
<td>Integration Business and IT</td>
<td>3;1.7</td>
<td>3;1.7</td>
<td>5;2.9</td>
<td>11;6.5</td>
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<td>Return on Investment</td>
<td>3;1.7</td>
<td>2;1.1</td>
<td>3;1.7</td>
<td>8;4.7</td>
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<td>BPM and business agility</td>
<td>3;1.7</td>
<td>1;0.5</td>
<td>2;1.1</td>
<td>6;3.5</td>
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<tr>
<td>User involvement and Organizational Commitment</td>
<td>3;1.7</td>
<td>0;0.0</td>
<td>2;1.1</td>
<td>5;2.9</td>
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<tr>
<td>Training and Teaching Methodology</td>
<td>2;1.1</td>
<td>2;1.1</td>
<td>3;1.7</td>
<td>7;4.1</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>46;27.5</strong></td>
<td><strong>61;36.5</strong></td>
<td><strong>60;35.9</strong></td>
<td><strong>167;100</strong></td>
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Figure 5.4 show the pie chart of factors that are important for SOA adaptation. It clearly reflects the importance of SOA governance followed by issues of migration and legacy systems.

![Pie chart showing factors important for SOA adaptation](image.png)

Figure 5.4 Proportion of factors that are mostly covered in the SOA article published during 2000-2011

5.3 **SOA Aspects**

The two aspects of SOA that need to be better understood in terms of their relevance to each stage of SOA evolution are *Governance* and *Service Granularity*.

5.3.1 **Governance**

Governance, in general, relates to consistent management and cohesive policies, processes, and decision rights for a given area of responsibility. It has different significance in respect to different domains. In respect to the area of IT, governance can be defined as “the leadership and organizational structures and processes that ensure that
the organization's IT sustains and extends the organization's strategies and objectives” (Kerrigan et al., 2009, p. 2).

Software companies propose different perspectives on SOA Governance (e.g., SOA maturity models or service lifecycle management). The following definition can be put forward for enterprise SOA: “Framework in program management methodology ensuring alignment of processes and services with business strategy and resulting in evolution to a service-oriented enterprise” (Lawler et al., 2008, p. 31).

Governance deals with policies and rules that the enterprise must adhere to while implementing SOA systems. The purpose of governance is to avoid lack of conformity between applications. It is difficult to identify and establish all the ground rules during the start. Since SOA is an evolving process, its progression will be in an iterative mode in terms of standards, products, and use within the enterprise.

While there is no common one-for-all solution, the implementation of SOA is much like any large-scale migration, with a few notable differences, particularly regarding governance. Understanding the business needs and capability of technology helps to drive the decisions within each enterprise towards creating a road map for implementation. Addressing the following set of issues may be helpful in achieving this goal.

- Identify the need to implement SOA
- Identify short-term goals and basic steps needed to achieve this goal
- Determine long term objective
- Try to elaborate return on investment
- Impact on business with a wider scope
Complexities and problems in approach to change management

5.3.2 Service Granularity

“Service Granularity” refers to the scope of functionality that a service exposes. One would need to determine and plan the grain of the service based on the current application infrastructure environment. Waiting to identify the perfect or right level of granularity can lead to a never-ending process. Hence, it is important to go through the overall business process and understand the business environment. Only then can you plan and implement the granularity of the necessary services in a simple and generic way, based on your understanding of your current and foreseeable needs. As said earlier, SOA is an evolution; coarse grains may have to be decomposed into finer grains at a later time depending on the business process that is required at the time. Furthermore, it has seen that in order to identify the level of granularity, one has to realize the overall business processes in terms of short term and long term objectives. The following set of questions can identify the short term objectives that can help to determine the granularity of services.

- Which of the business process are most frequently changed?
- What is the scope and how do you sketch a wider view to establish target architecture?
- What is the estimate of the work and timelines involved?
- What are the hidden issues of deployment of SOA?
- How best to determine the basic entities and functionalities?
5.4 Critical Success Factors

The software evolution has had distinct phases or layers of growth, these layers are built up one by one over the last ten decades, with each layer come up with the improvement over the previous one and fulfilling the need of the time. In a SOA, resources are made available to other participants within the network as independent services that are accessible across the network in a standardized way. In this study, factors were identified which are critical for the success of any service oriented model. It is important to have smart goals attached to the critical success factors (CSF) measures, so that there is a strategy and timeline for achieving targets. As a general rule of thumb, CSF should target those things that affect quality, cost, customer satisfaction, market share, increased revenues etc. Targeting these indicators and monitoring them regularly provides a quick visual for how successful the organization is and keeping goals at the fore front is the best way to ensure they are achieved.

Critical success factors have been used significantly to present or identify a few key factors that organizations should focus on to be successful. As a definition, CSFs refer to “the limited number of areas in which satisfactory results will ensure successful competitive performance for the individual, department, or organization” (Rockart et al., 1981). Success factors were already being used as a term in management when Rockart and Bullen reintroduced the concept to provide greater understanding of the concept and, at the same time, give greater clarity of how CSFs can be identified.
5.4.1 Aspects of CSFs

Rockart et al. (1985) have presented five key sources of CSFs: the industry, competitive strategy and industry position, environmental factors, temporal factors, and managerial position (if considered from an individual’s point of view).

An industry’s set of characteristics defines its own CSFs. Different industries will thus have different CSFs. An example of industry and company CSFs was presented by Rockart et al. (1981) and is included here to illustrate their ideas (Figure 5.5).

The example presented is meant to illustrate that companies would have different CSFs and would not be completely similar. It can be seen though that many aspects of the CSFs could end up being similar for organizations in an industry.

5.4.2 CSF in SOA Context

The studies merely focusing on SOA success do not provide adequate results that would explain how business-IT alignment is realized in SOA development. From a
technological perspective, a successful SOA project may not fulfill the business objectives while still being successful in technical excellence. In such a situation, proper alignment is not achieved. Bridging the business-IT gap requires the following:

- A structured view of a business that facilitates its strategic and operational analysis and is a familiar representation to IT professionals,
- A rigorous method to translate this structured business view to the appropriate (service-oriented) IT layer, and
- A new build and runtime technologies suited to the new IT layer (Cherbakov et al. 2005).

However, Luftman et al. (2007) argue, achieving appropriate alignment is not straightforward but involves consideration of interrelated components such as communication, value, governance, partnership, scope and architecture and skills. Henderson et al. (1993) argued that an organization’s external fit is influenced by IT scope and system characteristics (reliability, flexibility and IT governance), and internal fit by the IS architecture, IS processes and skills required to manage and operate information systems.

This research identifies key factors to successful SOA implementation which include organization culture, SOA competency, team cooperation, governance, enterprise architecture, migration, change management, security, scope understanding, return on investment and business agility (Figure 5.6)
Description of each of the success factors is as follows:

**Organization Culture**

- Organization culture has various impacts on the business alignment of SOA development. For example, when business and IT has to traditionally operate in a close cooperation.
- SOA development seemed to be better aligned with IT objectives (as expected) than in organizations where such cooperation was not a part of organizational culture.

**Competences**

- The skills needed in the design phase, such as business process modeling and service design, were considered particularly important for SOA application development. This was underlined, especially in the business process oriented projects.
• Service design was recognized by many organizations to be one of the most challenging parts in SOA development process.

Teams Co-operation

• Multidisciplinary teams, with members from both IT and business domains, were seen as crucial for SOA development.

Governance Issues

• SOA development was directed by defined policies and practices. This improved the quality of the SOA implementation by enabling a better fit with business needs.

• A generic SOA Governance model comprises a policy framework, organizational entities, a metrics system, and a catalog of best practices.

• Several software companies propose different perspectives on SOA Governance, including, e.g., SOA maturity models or service lifecycle management. For IT Governance, many accepted approaches exist. In many aspects they provide guidance for SOA Governance frameworks

Enterprise Architecture Framework

• The utilization of enterprise architecture framework was considered to improve business-IT alignment. With the framework, IT’s capability to involve business people in systems development was increased.
Study of the Inhibiting and Success Factors in SOA Design and Implementation...

Migration Issues

- The problem that accompanies with major shift is that it threatens to make what already exists obsolete, even when existing systems represent massive investment.

Change Management

- The change management primarily deals with the strategies for the realization of new structures, systems, processes or behavior patterns.
- Key strategy to handle this is to first understand clearly the process of changes and then trace the changes.

Security

- Information Security is to ensure that information security weaknesses and events are highlighted in a timely manner.
- Information security is achieved be implementing, amongst others, controls. For governance, control means to ensure that adequate measures are in place to provide assurance that objectives will be achieved and undesirable events will be prevented or detected and corrected (Veiga et al., 2008).

Challenges in Scope Understanding

- It is always very important to understand the architecture and the technology that is to be used in the right way and must understand and identify the capabilities it provides and what you can and can’t do.
Understanding SOA, requires a fresh approach, clear vision and a multi dimensional view to understand the SOA scope. In order to undertake a project to develop a service or an application from services there is a need to know the scope and size of the work involved. This will help in determining the cost and effort for such a project.

Return on Investment

- Setting up the people, training, processes, tools, and components that fit into that architecture requires an initial investment and commitment from the development organization. Jeffrey et al. named this investment as the “relative cost of writing for reuse” (RCWR).
- Based on data collected over the past 10 years, this investment is approximately 1.5 times (meaning 50% more) cost over building software for one-time use.

BPM and Business Agility

- Business Process Management (BPM) empowers a business analyst to align IT systems with strategic goals by creating well defined enterprise business processes, monitoring their performance, and optimizing for greater operational efficiencies.
- The BPM system provides a toolset that allows the business analyst to create process models, and then performs the business process automation, or execution of the model, by invoking the services.
5.5 Chapter Summary

Critical success factors are used by organizations to give focus on a number of factors that help to define its success. They help the organization and its personnel to understand the key areas in which to invest their resources and time. Ideally, these CSFs are observable in terms of the impact on the organization to allow it to have guidance and indications on its achievement of them. After reviewing large number of papers, it is concluded that CSFs can be utilized in both the organization and the individual levels.

In this work, thorough study of working SOA systems around different companies have been done. Study reveals that some factors are crucial for SOA based systems. Factors were identified and percentage of criticality of each factor for the success of SOA systems are calculated based on the feedback and questionnaires submitted by different experts and researchers who are working in the same area. Key factors to successful SOA implementation include organization culture, SOA competency, team cooperation, governance, enterprise architecture, migration, change management, security, scope understanding, return on investment and business agility.
Chapter 5 References