Chapter 2
Creating Enterprise Flexibility Through Service-Oriented Architecture

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1 Introduction

Today enterprises must be capable to adapt to changing business requirements of fast-paced and competitive business environment. This requires a shift from a disintegrated and closed enterprise structure to a more dynamic and flexible enterprise structure. Integration – within the enterprise and across enterprises – facilitates this dynamic and flexible structure by combining processes, systems, and technologies and enables information and resource sharing. Integration facilitates successful operation of a single integrated enterprise, an extended enterprise, or a virtual enterprise. Alignment of processes, systems, and technologies is a critical step to realize enterprise flexibility (Strnadl 2006). This also requires an enterprise architecture which supports a dynamic and flexible enterprise structure. Enterprise architecture provides common view of the primary resources of any enterprise (people, processes, systems, and technology) and how they integrate to provide the primary drivers of the enterprise.

The concept of service-oriented architecture (SOA) is widely accepted software architecture approach which promises the design and implementation of flexible systems and facilitates the change of business processes quickly. SOA leverages the alignment of business and information technology. Although SOA has its roots in software architecture, from a broader perspective the concept has also been applied at the business level (Cherbakov et al. 2005; Bieberstein et al. 2006). In this chapter, we discuss our perspective on SOA as a style of enterprise architecture design and, ultimately, a way of structuring the enterprise.

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Based on the available literature, we provide the benefits of SOA and its impact on creating enterprise flexibility. First section of this chapter provides an overview of the challenges of enterprises we encounter in today's business environment. In this section, we discuss the relative concepts of enterprise integration and architecture, emerging enterprise structures such as extended enterprises and virtual enterprises and the enterprise integration challenges. This section is followed by our view on enterprise flexibility and what flexibility means for enterprises. Next, we provide a literature review on service-oriented architecture. In this section, we also discuss the concept of service orientation and its application at enterprise level. In the next two sections of this chapter, we present our theoretical model based on the attributes of SOA and their impact on enterprise flexibility. We provide our definition of enterprise flexibility and how it relates to use of service-oriented architecture. This chapter concludes with a brief discussion on the relevance and potential implication of our model to the practice of SOA and enterprise flexibility.

2   Emerging Challenges of Enterprises

Enterprises are complex and highly integrated systems (Nightangale and Rhodes 2004; Boardman and Sauser 2008). Enterprises consist of people, processes, information, and supporting technologies, with interdependencies and interrelationships across their boundaries (Nightangale and Rhodes 2004; Swarz and Derosa 2006). The enterprises need to be managed not only for their internal operations, but more importantly for many relations to the different environments in which they are operating. Today, these environments are changing rapidly, and the need for relevant information becomes very important in the decision-making processes at all levels of enterprise management. Fluctuations in market demands, technology evolution, and changing regulations require flexible enterprise operations, capable of reacting to those changes. Enterprises need to acquire and share relevant and current information within their boundaries and across enterprises. The changing business requirements and the fast-paced and competitive business environment surrounding enterprises requires a shift from a disintegrated and closed enterprise structure to a more dynamic and flexible enterprise structure. Integration within the enterprise and across enterprises facilitates this dynamic and flexible structure by combining processes, systems, and technologies and enables information and resource sharing.

Adaptation to market changes in a timely fashion requires flexible organizations and the ability to establish partnerships. One of the major challenges for enterprises today is to be able to structure their processes to accommodate cooperation between partners providing the right core competencies at the right time in the form of extended or virtual enterprise structures.

Another major challenge for organizations is the need for integration of enterprise information systems. Today enterprises heavily depend on the information systems (IS) that are responsible for running almost all business processes (Cummins 2002). Originally, organizations focused on developing heterogeneous applications – as widely known as stovepipe applications to support their business processes (Cummins

2002; Lee et al. 2003; Gold-Bernstein and Ruh 2004). However, due to changing business environment, the business processes evolved, and new processes required new applications and data. As a result, organizations are reinforced to form a functional orientation within their information systems, resulting disparate "islands of applications" in which individual systems remained disconnected from other systems (Lam 2007). These heterogeneous applications have become obsolete and have not served the needs of modern enterprise business solutions such as e-business, supply chain, and customer relationship management which require integration of information and processes within the different parts of the enterprise and across its business partners. The concept of integration of information systems and processes within the enterprise and across enterprises has become one of the critical challenges for modern enterprises.

Enterprise integration facilitates enterprise-wide connectivity of people, processes, applications, and technologies with the goal of improving efficiency, flexibility, and agility. It ensures that the right people and the right processes have the right information at the right time (Brosey et al. 2001). Enterprise integration enables the successful communication between data, applications, processes, people, and enterprises. It helps an organization to establish a technology infrastructure that seamlessly links its complex business applications into a homogenous system so that the processes and the data can be shared across the company (integrated single enterprise), with business partners and customers (extended enterprise) (Kosanke et al. 1999; Brosey et al. 2001; Smith et al. 2002; Venkatachalam 2006).

An enterprise architecture "is a set of descriptive representations (i.e. models) that are relevant for describing an Enterprise such that it can be produced to management's requirements and maintained over the period of its useful life" (Zachman 1987). An enterprise architecture provides a common view of the primary resources of any enterprise (people, processes, and technology) and how they integrate to provide the primary drivers of the enterprise.

Enterprise architecture is a coherent whole of principles, methods, and models that are used in the design and realization of the enterprise's organizational structure, business processes, information systems, and infrastructure (Ortiz et al. 2004). Enterprise architecture integrates different architectural domains such as product, process, technology architecture, application, and information architectures (Jonkers et al. 2006).

Enterprise architectures can be used as a tool for engineering. The enterprise architecture defines guides of the information required, and it complements enterprise methodologies. A methodology defines the steps that the different persons in a company must follow in order to generate that pieces of knowledge and fill the enterprise architecture (Ortiz et al. 2004). Enterprise architectures can also be used as a management tool. Following the engineering phase, a manager could visualize the relationships between any artifact hold at different levels within the enterprise architecture (relationship between processes, resources, information, strategy, and information systems).

Enterprise architecture provides some advantages (Brown 2007) including readily available documentation of the enterprise, ability to unify and integrate business

processes across the enterprise, ability to unify and integrate data across the enterprise and to link with external partners, increase agility to business change, and maximized reuse of enterprise models.

3 Enterprise Flexibility

Flexibility provides competitive advantage to enterprises. Enterprise flexibility is defined as the ability of enterprise to adapt to changing requirements of its environment and its stakeholders with minimum time and effort (Sushil 2006). In order to achieve flexibility, enterprise-wide processes can easily be changed across the enterprise to satisfy the emerging requirements. The systems and the information technology infrastructure which support these processes should be easily changed.

In most cases, enterprises concentrate on making individual business processes more efficient. While having efficient processes is very important, enterprise flexibility requires a comprehensive view across the enterprise and its environment including its suppliers, partners, and customers. To create systems and support enterprise processes across the enterprise needs the ability to use and integrate existing systems and processes (Weske 2007). This will provide flexibility to allow the enterprise to easily adapt and bring together new systems to support new business requirements. Aside from the enterprise flexibility that comes from the ability to integrate people, processes, and information across the enterprise, the information technology infrastructure must also be made simpler and more manageable. This requires a well-defined enterprise architecture and overall architectural approach which support flexibility throughout the enterprise-wide processes and applications (Anaya 2005).

4 Service-Oriented Architecture

4.1 Concept of Service-Oriented Architecture

Service-oriented architecture (SOA) promises the design and implementation of flexible systems that facilitate the change of business processes quickly. A SOA-based approach also supports alignment of information technology (IT) and business processes.

SOA is a technology initiative which requires a software architecture approach where basic element of design and development is a service (Kumar et al. 2007). SOA simplifies the development of enterprise applications as modular, reusable business services that are easily integrated, changed, and maintained. SOA facilitates aligning existing information technology infrastructure and systems to achieve end-to-end enterprise integration by removing redundancies, generating collaboration tools, and streamlining IT processes. By adopting an SOA approach

and implementing it using supporting technologies, companies can build flexible systems that implement changing business processes quickly and make extensive use of reusable components (IBM 2005). SOA supports an information environment built upon loosely coupled, reusable, standards-based services. It promotes data interoperability rather than application interoperability (Erl 2007).

In service-oriented architecture, main design element is "services." Applications communicate with each other in such architectures through services. Services are self-describing components, which can be recognized by client applications through look up from a registry. The client application and the service provider communicate via standard protocols and exchange information using standard data formats (Brahe 2007).

4.2 Service Orientation at the Enterprise Level

Previous section discussed service-oriented architecture from a technology viewpoint and defined it as application architecture. Even though SOA is a technology initiative for many organizations, from a broader perspective the concept of service orientation can also be applied at business level (Cherbakov et al. 2005; Bieberstein et al. 2006). From a business perspective, SOA can be used as a style of enterprise architecture design and, ultimately, a way of structuring the enterprise. It enables a service-oriented enterprise architecture by allowing the business define enterprise workflows around reusable business services.

Service orientation, in theory, is based on the concept of wrapping applications with well-defined interfaces, so that the applications can be turned to a set of "services." "Services" are network-enabled components with well-defined interfaces that are implementation independent (Yang and Lu 2005). The wrapping process creates an abstraction layer that hides all the complex details of the application, as a result the "services" can be integrated with any other application easily. The integration of the applications will not depend on the language, operating system, or database the application uses. Interfaces which describe the services are the most critical part of the service-orientated approach (Cousins and Casanova 2004). Service orientation promotes the creation of highly accessible, loosely coupled, reusable, business-oriented services which can be fully integrated using standards (Bieberstein et al. 2006). Increased interoperability, increased business and technology domain alignment, increased return on investment, and increased organizational agility are benefits of service orientation.

4.3 Creating Enterprise Flexibility in Enterprises

In the previous sections, we discussed the related concepts which provide a foundation for our model to create enterprise flexibility using service-oriented architectures.

Our model intends to explain the relationship between enterprise flexibility and the attributes of service-oriented architectures.

We define enterprise flexibility as the ability of enterprise to adapt to changing business and stakeholder requirements more efficiently, easily, and quickly. In this definition, we emphasize efficiency, agility, and adaptability. Efficiency is related to optimal use of resources. Agility is related to timely and faster response to rapidly changing business requirements. Adaptability is the ability of an enterprise to respond to the changing business requirements and to change its business processes. Adaptability is related to integration of new and existing systems and processes. Enterprise flexibility requires the integration of business processes and systems within the enterprise and across the partners of the enterprise. Alignment of business processes and information technology is also an enabling factor for enterprise flexibility which requires a simple and manageable enterprise architecture.

5   Theoretical Model

Our model suggests two key enablers for enterprise flexibility. First enabler is the capability of an enterprise to connect people, processes, and information in a way that allows enterprise to become more flexible and responsive to the dynamics of its environment, stakeholders, and competitors. This requires integration within the enterprise and across the partners, suppliers, and customers of the enterprise.

Second enabler is alignment of information technology and business goals. This requires simplification of the underlying technology infrastructure and creation of a consolidated view of, and access to, all available resources in the enterprise. This can be achieved with well-defined enterprise architecture. Enterprise architecture provides a common view of relationship between processes, resources, information, strategy, and information systems. It provides ability to integrate business processes and data across the enterprise and with external partners and ability to respond to changing business requirements rapidly.

Table 2.1 summarizes our model which we explain the relationship between the attributes of service-oriented architecture (SOA) and enterprise flexibility. In this table, we list the attributes of SOA, business outcome of each attributes, and each attribute's impact on agility, efficiency, and adaptability. Our model suggests that enterprise flexibility can be obtained as a result of agility, efficiency, and adaptability as shown in the table.

6   Conclusion

In this chapter, we introduced our theoretical model based on concepts of enterprise flexibility and service-oriented architectures. Service orientation, at application architecture level, has already been discussed in various literatures to be beneficial

Table 2.1 SOA and creating enterprise flexibility

Attributes of service-oriented architecture (SOA)	Business outcome	Enterprise flexibility = f(agility, efficiency, adaptability)		
		Agility	Efficiency	Adaptability
SOA enables the development of applications as reusable and modular business services	Applications which are developed as reusable and modular services make them easy to be integrated, changed, and maintained	Agility is obtained as a result of timely response to the changing business requirements	Reusable services provide cost savings	Applications which are developed reusable and modular services can easily be changed to support emerging business needs and requirements
SOA as an application architecture promotes loose coupling. Loose coupling is an attribute of systems, referring to an approach of designing interfaces to reduce the interdependencies across modules or components	This approach minimizes the interdependencies between applications. Adding new applications or modules or replacing modules and changing operations within individual business processes do not impact the other applications or modules	The risk of unanticipated changes due to a change in another business application will be minimized. This will enable faster business application modifications resulting in agility	Due to minimized risk and time of change, efficiency will be obtained	Enterprise will respond to changing business requirement maximizing its adaptability. Adaptability, efficiency, and agility will result in higher enterprise flexibility
SOA enables reusability of existing applications	Rather than developing applications from scratch, companies can utilize existing functionality and create new solutions by assembling component applications from existing and new technology	This attribute enables rapid deployment of new solutions	Use of existing functionality provides cost savings	Enterprise can respond to changing business needs, resulting in higher enterprise flexibility

Table 2.1 (continued)

Attributes of service-oriented architecture (SOA)	Business outcome	Enterprise flexibility = f(agility, efficiency, adaptability)		
		Agility	Efficiency	Adaptability
SOA promotes development and use of standards-based services. Standard-based services leverage the integration of new and existing applications and enterprise integration	Use of standards provides interoperability between applications and systems, regardless of their technology or location. As a result, lower cost and shorter time to market will be obtained	Shorter development and integration of applications will increase the agility	Lower cost of application development and deployment due to support of universal standards will increase the efficiency	Shorter time to market, shorter integration times will enable the faster response to emerging business requirements. Obtained agility and efficiency will result in higher enterprise flexibility
SOA requires use of self-contained services. Having self-contained services means the state of each service does not depend upon the state of another service	SOA speeds time through parallel development. Since each service is self-contained and does not depend upon the state of another service, subsystems can be developed independently	This provides faster development or modification of subsystems. Agility increases	Through the use of resources optimally, efficiency is increased	Faster and efficient response to new business requirements increases the adaptability of the enterprise, resulting in higher enterprise flexibility
SOA requires the use of wrapping applications with well-defined interfaces. This process turns applications that can be turned into a set of services. The wrapping process creates an abstraction layer that hides all the complex details of the applications	As a result, the services can be integrated with any other application easily. The integration of the applications will not depend on the language, operating system, or database the application uses	Easy integration of applications enables faster response to business changes. New applications can be implemented and integrated rapidly into existing systems without interoperability problems	This will help to economic use of existing and legacy systems. The economic life of legacy systems will be longer which will provide cost savings	Ease of integration with new and existing systems will increase the ability of enterprises to respond to new business requirements efficiently and rapidly. Higher enterprise flexibility will be obtained

in obtaining agility, efficiency, and flexibility. We will further investigate the use of service orientation as a style of enterprise architecture design and, ultimately, a way of structuring the enterprise. Our next step will be to develop an enterprise architecture framework. This framework will apply the concept of service orientation at the enterprise level and can be used to increase an enterprise's ability to respond and adapt to emerging business requirements and challenges.

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