Service Oriented Architecture as a Strategy for Business Improvement in the Enterprise

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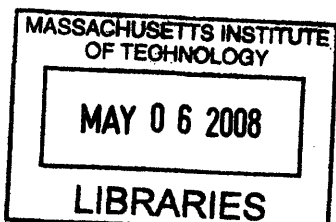Michael Cusumano (Thesis Supervisor)
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Service Oriented Architecture (SOA) as a Strategy for Business Improvement in the Enterprise

Abstract

The service concepts found in Service-Oriented Architecture (SOA) have been used in software design for many years, with ever-improving tools and a growing understanding of where and how SOA should be applied. Applications built utilizing SOA concepts promote principles such as modularity, distribution, encapsulation and clear interfaces, all core concepts of object-oriented and component-based software development. Despite the clear design advantages of the service concept, most SOA implementations have failed to address many of the issues facing corporations today, including the need for corporate agility, the gap between IT and business, IT project failures and shortcomings in the measurement of business performance.

This paper explores the complementary nature of SOA and the core principles of business process management. When combined, these methodologies can help an organization shift to thinking about business processes, map processes to business goals and expose processes as services within the SOA framework. This strategy, when coupled with the abstraction of business flows and rules away from individual applications and infrastructure, has the capability to make the organization more agile, closely aligns IT and the business and enables business performance to be measured and improved. The potential externalization of these business processes can help the organization focus on the needs of customers and partners and promotes the benefits of a virtual organization.

Table of Contents

Table of Figures

Chapter 1 - Introduction

Overview

With increasing globalization and competitive pressures, demanding customers, reliance on virtual organizations and the ever-expanding usage of the Internet as a medium for doing business, companies must be more agile and adaptable in order to remain competitive and profitable. The heavy reliance on Information Technology (IT) in many organizations is both a benefit and hindrance when it comes to implementing business agility, due to the frequent and widening gap between IT and business strategy.

Key research shows that Service-Oriented Architecture (SOA) has the potential to transform how companies develop and deploy mission-critical applications, but approaching SOA as a technology instead of a strategic framework limits its effectiveness and slows its adoption. Companies that implement SOA with principles promoting its strategic benefits are those that are most likely to gain the intended business agility.

Objective

This thesis will identify several of the key issues driving the need for corporate agility, explore the perceived and actual gap between IT and the business and focus in on the difficulties many companies face with monitoring and measuring the performance of their business processes. The main concepts of SOA will be described in a way that helps illustrate their contribution to the agile enterprise and best practices for implementing SOA in a way that supports business strategy will be presented.

Approach

This thesis takes the approach of defining the problem from a number of different angles and builds up an overarching theme that is relevant for most companies and industries.

An in-depth discussion of SOA identifies its positive attributes and potential for solving these problems, but also exposes some issues with the approach companies typically take. Finally, a set of best practices that help companies make the most out of their SOA investment are presented along with an analysis of how they help solve the issues that were identified.

Extensive research of existing literature, including business and technology journals, books, interviews, case studies and other sources was performed. Articles written by industry analysts in the areas of technology, business strategy, supply chain and organizational studies were also consulted. Additional content and insight came from a number of interviews that were performed during the research and synthesis phases.

Chapter 2 - Problem Description

The Need for Corporate Agility

Companies that can sense and respond to changes in business environments and turn these changes into opportunities in an innovative and competitive manner are considered to be agile. When companies have a heavy reliance on Information Technology (IT), their systems and automated business processes must also be agile and adaptable to change. This need for agility is driven by a number of factors, including the following:

Increased Competition

The globalization of goods and services has led to competition from places that most companies would never have anticipated. The power and diversity of globalization powers the bottom-up entrepreneurial spirit of a whole new generation of companies competing in existing and emerging markets. As Thomas Friedman illustrates in *The World Is Flat: A Brief History of the Twenty-First Century*[1], a number of forces have fueled globalization: The rise of India and China in outsourcing and off-shoring, integrated supply chains, the broad availability of information and data, as well as the always-on nature of the Internet.

Outsourcing and the value-added extensions offered to companies provide a tremendous pool of resources that can be leveraged and folded into a company's workforce. In a similar way, the off-shoring of manufacturing provides a company with additional production facilities and often times very quick and efficient turnaround. The challenge faced by companies taking advantage of outsourcing and off-shoring is how to integrate established or emerging business processes with these new resources to extract the most value from them as possible.

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[1] Friedman, Thomas L. "The World Is Flat: A Brief History of the Twenty-First Century" (New York: Farrar, Straus, and Giroux, 2005)

Virtual Organizations

Integrated supply chains used by leading manufacturers, distributors and retailers optimize the flow of raw materials and finished goods between companies of all sizes and help reduce the costs of providing these products to customers. For a company's supply chain to provide as much value as possible, its processes must be automated, reliable and flexible, providing a smooth and timely integration with other company's systems. This inter-reliance of companies in a supply chain is one example of a "virtual organization" that is a challenge for some companies.

The best supply chains are fast and cost-effective, as well agile and adaptable, ensuring that all their companies' interests stay aligned. In the paper "The Triple-A Supply Chain", Hau Lee identifies three attributes of highly-effective supply chains[2]:

- Agility – the ability to respond to short-term changes in demand or supply quickly. This can be achieved by continuous and real-time supply and demand data.

- Adaptability – the ability to adjust the supply chain's design to meet structural shifts in markets by modifying strategies, products and technologies. This can be accomplished through careful monitoring of potential supply markets, flexible product designs and a strong logistics infrastructure.

- Alignment – align the interests of all the firms in the supply chain. Provide all the companies in the supply chain equal access to forecasts, sales data and plans.

The benefits of integrating information between supply chain partners are further illustrated in a study performed by Hau Lee at Stanford University and Anderson Consulting in 1998[3]. This team performed a survey of 100 manufacturers and 100 retailers, finding that companies that engaged in higher levels of information sharing with supply chain partners reported higher than average profits. The degree of information sharing and the impact on manufacturers and retailers in the form of profits are shown in

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[2] Lee, Hau, "The Triple-A Supply Chain", Harvard Business Review (2004)
[3] Lee, Hau and Whang, Jin, "Sharing Information to Boost the Bottom Line"
(http://www.gsb.stanford.edu/research/reports/1999/whang lee.html)

Figures 1 and 2, respectively. Increased profits appear to be well-correlated with the level of information sharing between retailers and manufacturers.
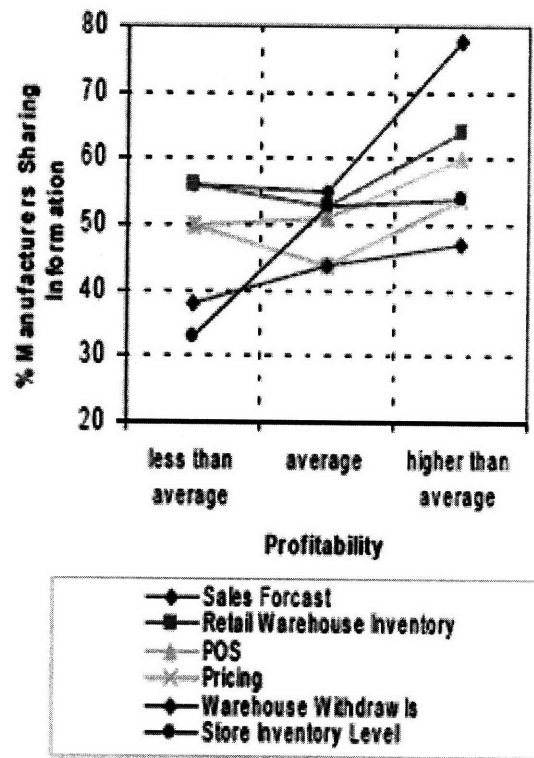
Figure 1 - Profitability and Information Sharing - Impact on Manufacturers[4]

[4] Lee, Hau and Whang, Jin, "Sharing Information to Boost the Bottom Line"
(http://www.gsb.stanford.edu/research/reports/1999/whang lee.html)
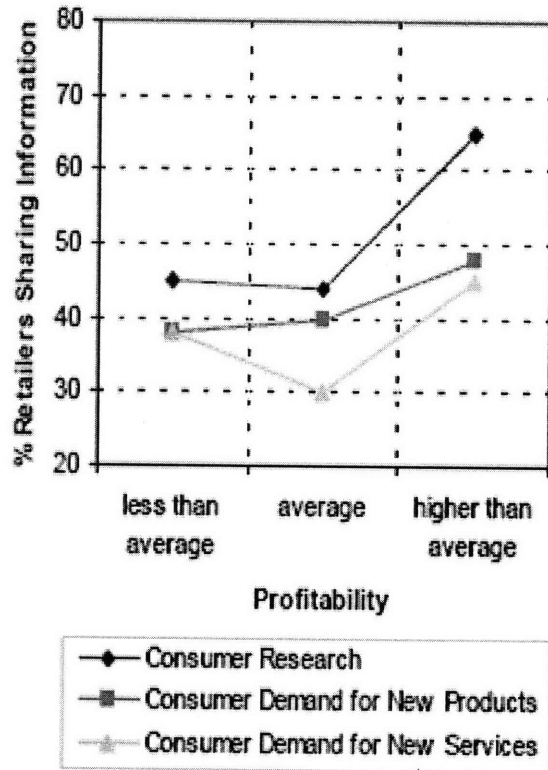
Figure 2 - Profitability and Information Sharing - Impact on Retailers[5]

In addition, Figure 3 illustrates Lee's finding on how higher profits are achieved when supply chain partners performed joint demand and logistics planning.
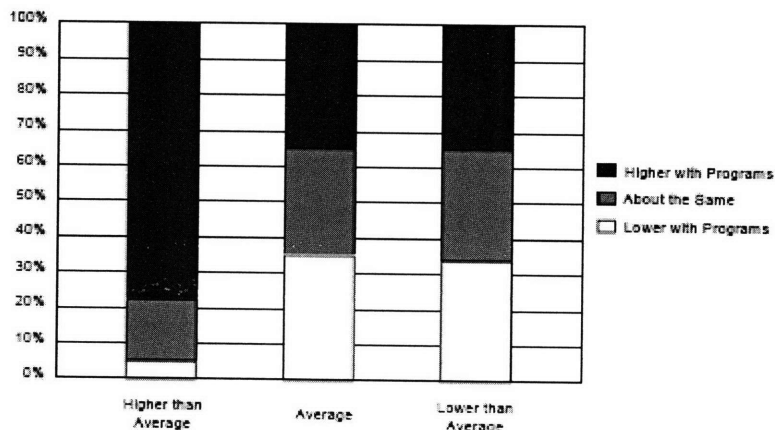
Source: Stanford – Andersen, 1998.

Figure 3 - Profits and Level of Joint Demand and Logistics Planning[5]

Tighter integration between supply chain partners has its obvious benefits, but close integration is typically filled with obstacles, including technical difficulties in sharing data

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[5] Lee, Hau and Whang, Jin, "Sharing Information to Boost the Bottom Line" (http://www.gsb.stanford.edu/research/reports/1999/whang lee.html)

and coordinating workflows across business partners. In a paper on coordinated supply chains[6], Richard Hoppe summarized a survey of 100 supply chain managers conducted by Urban Wallace & Associates that illustrates the four most common obstacles to achieving inventory visibility across the supply chain. As shown in Figure 4 - Obstacles of Inventory Visibility in the Supply Chain, the top five obstacles are all related to information sharing, integration and business process management.
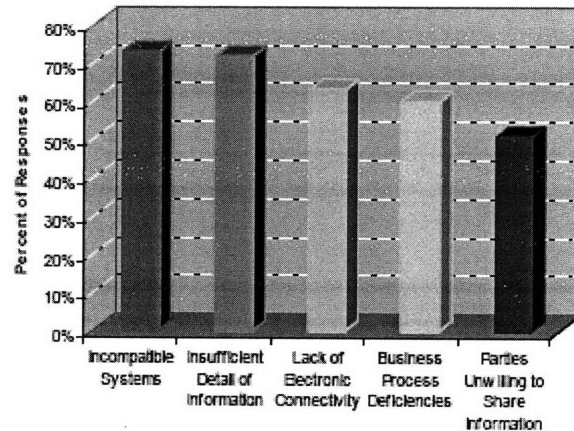
Note: More than one answer allowed.
Source: Research conducted for Transentric by Urban Wallace & Associates, 2001

Figure 4 - Obstacles of Inventory Visibility in the Supply Chain[6]

Partnerships and other forms of collaboration between companies allow greater competitiveness, but the ability for disparate systems to integrate and the flexibility that allows for true collaboration provides a challenge for most companies. Those companies with established integration points and flexible business processes that can integrate virtual partnerships are best able to exploit them.

An additional study[7] by Lorraine Cosgrove Ware reported that IT agility was specifically part of their company's core business strategy for 85 percent of the (Chief Information Officer) CIO 100 winners. The motivations for pursuing agility included:

- Increasing growth and revenue opportunities
- Reducing response times to market forces
- Reducing costs

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[6] Hoppe, Richard, "Outlining a Future of Supply Chain Management - Coordinated Supply Networks" (http://web.mit.edu/supplychain/repository/network_hoppe.pdf)
[7] Lorraine Cosgrove Ware, CIO Magazine, "The Benefits of Agile IT", August 03 2004 (http://www.nitc.state.ne.us/news/0408/EC_agileIT.htm)

The Impact of the Internet

The Internet presents new opportunities as well as a host of additional challenges for well-established brick and mortar companies. Customers and partners up and down the supply chain are expecting real-time access to information and the global, always-on nature of the Internet makes it the essential platform for conducting business. The availability of the Internet makes it possible to extend distributed computing beyond the confines of a single company and allows for the flow of information in ways that were not possible before.

The proliferation of Internet-connected devices used by consumers and businesses creates additional opportunities and challenges in that a company's information is in demand by a wider audience and the types of devices making requests are more diverse and sophisticated. Companies need to look at what information or processes they can expose to customers and partners as new revenue-generating product or service offerings.

New business models have emerged from the integration of Internet-compatible services and business processes with more conventional business systems. Existing companies must have the agility and adaptability to respond to challenges put forth by new firms utilizing the Internet as a platform with a low barrier to entry.

Focus on the Customer

The experience of the customer is becoming more and more important for companies who wish to remain competitive in the global market. Identification of the processes that customers care about the most is the first step to creating an outstanding customer experience. Once the set of processes have been identified, the challenge is how to alter them to improve the customer experience.

Gartner Research has identified three interrelated aspects to measuring the customer experience[8]: customer satisfaction, customer loyalty and brand affinity. Improvements to

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[8] Gartner Research, "How Customer Process Attributes Affect the Customer Experience" (2007)

the business processes valued by customers can improve all three. There is a common set of attributes that have direct bearing on the customer experience and those organizations that understand and improve on these attributes will create positive customer experience:

- Accessibility – many current customer-facing processes are based on measures that stem from operational shortcomings and inflexible systems that are too fragile to improve. Internal resistance to making these processes more accessible to customers is caused by potentially large investments in time and money and the uncertainty that customers will make use of the new process. Some businesses may also see the additional customer usage as a drain on corporate IT resources and fail to appreciate the potential gains in customer experience.

- Reliability – customers want reliable and repeatable processes from the companies they deal with[9]. Unfortunately, many customer-facing processes are fragile, break down frequently and are poorly monitored by IT organizations due to the perceived low value they hold for the company. The customer-facing processes also tend to be rigid, difficult to use and not designed with usability in mind.

- Thoroughness – customer-facing processes that are not automated end-to-end require some form of intervention and handoff between individuals in different departments. Without ensuring that each step of the process is completed in the intended manner, the customer's experience is poor and the customer will likely need to invest time working with employees involved in the process to resolve issues[9]. In some customer-facing applications, such as Internet banking transactions, employees of the company may have limited ability to view and correct issues with the process a customer utilized, leading to unresolved issues and poor customer experience.

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[9] Collier, Joel E. and Bienstock, Carol C., "How Do Customers Judge Quality in an E-tailer?" (MIT Sloan Management Review, Fall 2006)

- Timeliness – lack of timeliness is costly to the customer and to the company providing goods or services. Customer-facing processes designed to meet customer expectations increase customer satisfaction and can be a key competitive differentiator. Process visibility for both the customer and the company allows for expectations to be set and potential early resolution of issues that might detract from the customer experience[10].

- Flexibility and Adaptability – customer-facing processes must be flexible enough to properly respond to situations that deviate from the norm. In addition, adaptable processes respond properly to unplanned situations and events and are as "self healing" as possible. Unfortunately, many customer-facing processes are inflexible and not adaptable, due to their fixed design, requiring expensive and lengthy customization to adapt to new business initiatives or changes based on customer feedback[11].

- Personalization – the ability for companies to tailor processes or applications for a particular customer goes a long way to building loyalty and the perception that personal attention is being paid to the customer makes these processes more effective. Companies with rigid processes are at a distinct disadvantage here, since their applications are less likely to be easily customized for a particular customer. Properly designed customer-facing processes should have the ability to provide personalization features that customers are demanding.

Improving the Customer Experience at Southwest Airlines[12]

In the mid-1980s, Southwest withdrew from the major airline reservation systems of that time and developed its own ticket less reservation system, which eliminated the need to print and process paper tickets. In 2002, the airline introduced kiosks for self-service check-in, in part to address the long lines that resulted from post 9/11 security initiatives. By 2006, more than 50% of customers were relying on Southwest.com or kiosks to check themselves in for

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[10] Collier, Joel E. and Bienstock, Carol C., "How Do Customers Judge Quality in an E-tailer?" (MIT Sloan Management Review, Fall 2006)
[11] Gartner Research, "How Customer Process Attributes Affect the Customer Experience" (2007)
[12] Ross, Jeanne W. and Beath, Cynthia M., "Building Business Agility at Soutwest Airlines" (MIT Sloan School of Management, May 2007)

their flights and more than 70% of passenger revenue was generated by Southwest.com

Southwest management embraced the cost savings resulting from customer self-service, but more importantly, they realized that self-service technology actually improved the customer experience:

"[Without self-service technologies] we would have lines way out the doors at every location. The customer experience would have been real crummy. But, because customers can choose self-service over a face-to-face transaction, or both, we were able to be much more productive and offer a much better customer experience." – Jim Ruppel, VP Customer Relations / Rapid Rewards[13]

The Gap between IT and Business

For a company to extract the maximum value from IT, the IT organization needs to maximize its credibility and make IT an attractive area for investment[14]. The IT organization's ability to meet business needs makes collaboration easier and more effective, increasing the value of IT and aligning it closely with business strategy. However, poor performance in delivering infrastructure services and business change, and the real or perceived lack of payoff from prior projects, can cause organizations to become tentative or risk-averse to IT-related investments. This often leads to underutilization and underinvestment in IT, preventing the organization from realizing the full potential of the IT organization and potentially placing the company at a disadvantage against more-sophisticated competitors.

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[13] Ross, Jeanne W. and Beath, Cynthia M., "Building Business Agility at Soutwest Airlines" (MIT Sloan School of Management, May 2007)
[14] Gartner Research, "Four Giant Steps to Maximize the Business Value of IT" (2004)

The following leading factors have a large influence on the alignment between IT and the business strategy of the company:

IT Project Failures

IT projects can be deemed a failure for a number of reasons, including the inability to satisfy the business requirements of stakeholders, budget and schedule overruns and the failure to deliver promised business value[15]. Why these failures have occurred is often a complex mix of technical, non-technical and project management issues, but the overarching theme is the same – expectations are not aligned with results.

> *A Standish Group study of the US IT industry found that 31% of IT application development projects were cancelled outright and that the performance of 53% of the all projects was so worrying that they were challenged[16].*

In the same study referenced above, The Standish Group asked IT executive managers for their opinions about why application development projects succeed; the three major reasons are user involvement, executive management support, and a clear statement of requirements. What is interesting is that when the same group of managers was asked about the factors that cause projects to be challenged, the same three factors made it to the top of the list (see Table 1). These findings clearly indicate that the level of coordination between IT and the business is inconsistent and that it has a large impact on the success of the project.

Table 1 - Challenged Project Factors (Source: The Standish Group[16])

Project Challenged Factors	% of Responses
1. Lack of User Input	12.8%
2. Incomplete Requirements & Specifications	12.3%
3. Changing Requirements & Specifications	11.8%

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[15] Walters, Kelly, "All About Agile" (http://kw-agiledevelopment.blogspot.com/2007/08/most-it-projects-fail-will-yours_06.html)
[16] The Standish Group, "Chaos Report" (1995)

4. Lack of Executive Support	7.5%
5. Technology Incompetence	7.0%
6. Lack of Resources	6.4%
7. Unrealistic Expectations	5.9%
8. Unclear Objectives	5.3%
9. Unrealistic Time Frames	4.3%
10. New Technology	3.7%
Other	23.0%

For some companies, project failure has come with an attempt to build an IT solution around existing, poorly executed business processes rather than fixing the processes first and then using IT to streamline them. Projects built around existing flawed business processes tend to be overly complex, with stakeholders attempting to reproduce the same functionality found in legacy systems, and their business value is diminished. In other cases, the lack of coherent enterprise architecture and flexible, agile IT processes further compounds the inherit project risks and provides little ability to react to the dynamic nature of most projects.

Companies need to be able to respond quickly to customer demands, increased competition, internal challenges or globalization pressures[17]. IT can help realize and implement this agility, but it is going to take a fundamental change in the way projects are implemented and the supporting processes and architecture must be built from the ground-up to be flexible and adaptable.

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[17] Khoshafian, Setrag, "Service Oriented Enterprises" (Florida: Auerbach Publications, 2007)

IT Stagnation

The situation in some organizations can be best described as "IT Stagnation", where fragmented IT organizations, built around individual systems, struggle to meet existing and new business priorities with antiquated or inflexible systems. The inflexibility is further compounded by the integration points that have been developed between the individual systems for specific company-wide needs. For example, a legacy ERP system that handles order processing (see Figure 5) may have been modified over the years to handle additional needs within the company, but these integration points are now brittle and inflexible, further entrenching the presence of the legacy system and the inability of the IT organization to upgrade or replace it. Through IT efforts that seem heroic at times, these inflexible systems continue to function and support the business, but customization and integration projects have left them unmanageable, inflexible and costly to maintain.
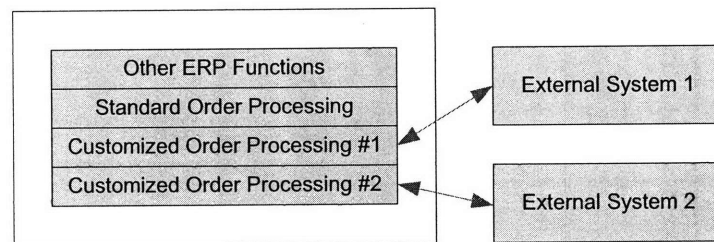
Figure 5 - Legacy ERP System and Integration Points

These stagnant systems continue to be a friction point between IT and the business and the risk and fear of breaking these systems makes IT extremely resistant to change. In this case, it is likely that IT spends the majority of their time and budget on maintenance of existing systems and very little time working on strategic opportunities that support business goals. This cycle of stagnation persists as the business reduces the IT department's budget in response to its inability to get projects completed. In the end, business agility is compromised and IT is not providing a competitive advantage for the company.

IT Stagnation at Southwest Airlines[18]

Between 1996 and 2002, Southwest airlines technology staff grew from around 60 people to almost 1,200 in response to the demand for new IT systems. The dramatic growth increased coordination costs and made it difficult to deliver solutions. By 2001 Southwest's systems were addressing some local needs, but they weren't supporting the company's business objectives:

"Everything was built in silos, on different platforms. There were a whole host of big gaps in functions. So even though we were spending a lot of money on technology, there were many places where we had no technology in the business." - Jan Marshall, CIO

As Southwest was struggling to generate business value from its IT investments, the security requirements of a post-9/11 world further exposed the limitations of the company's systems.

Loss of Human Capital

The developed world has evolved into a service and information economy where people are the critical asset and in a service economy many more outputs are intangible; as much as 80 percent of a company's worth is now tied to its people. Access to financial capital is no longer a source of competitive advantage; competitiveness increasingly derives from know-how, or people's abilities, skills and competence.

In *The Future of Capitalism*, Lester Thurow goes so far as to say that the era of brainpower industries is causing a fundamental shakeup in classical capitalism, because strategic assets are now the brains of employees. Thomas Stewart (editor of Fortune magazine and author of *Intellectual Capital: The New Wealth of Organizations*) says that intellectual capital is simply "packaged useful information." He also quotes the following definition of intellectual capital by Professor David Klein and consultant Laurence

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[18] Ross, Jeanne W. and Beath, Cynthia M., "Building Business Agility at Soutwest Airlines" (MIT Sloan School of Management, May 2007)

Prusak: "Intellectual material that has been formalized, captured, and leveraged to produce a higher-valued asset."[19]

According to the following statistics, the issue of human capital loss is a serious problem facing companies today[20]:

- Fifty percent of all companies recently surveyed say they expect to lose more than half of their senior managers in the next three years (RHR International Study).

- Fifteen percent say they expect to lose 75 percent or more (RHR International Study).

- More than six out of 10 respondents to an Ernst & Young survey say expected retirements during the next five years will cause a major brain drain in at least some business functions.

A study by the Gottlieb Duttweiler Foundation found that only 20 percent of the knowledge available to a company is actually used, yet when companies use their untapped knowledge, the results can be dramatic. Unfortunately, for many companies, the skills and experience of people within the organization stay with the individual and are not promoted as a corporate asset and most IT systems in place today are not designed to address the issue of capturing intellectual capital[21].

If a company understands how its human capital contributes to their business success, it can then be measured and managed more effectively[22]. IT systems that model business processes have the ability to capture the value in human capital and in some cases, replicate the decision-making capabilities and skills of critical people in the organization.

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[19] Stewart, Thomas A., "Intellectual Capital" (New York: Doubleday Currency, 1997), pp. 62-63.
[20] Herzog, Eric, "Preparing Future Leaders" (http://www.preparingfutureleaders.com)
[21] Pegasystems, "Turning Business Rules into Corporate Assets"
(http://www.pega.com/Products/RulesTechnology.asp)
[22] Ceridian UK Ltd. "Human Capital White Paper"
(http://www.ceridian.co.uk/hr/downloads/HumanCapitalWhitePaper_2007_01_26.pdf)

Companies that can successfully match their IT systems to their human capital assets will have a distinct advantage over those who fail to do so.

Shadow Processes

As companies are analyzing business processes and attempting to automate them, they are finding that, in many cases, there is not a single process flow for any given task, but at least two flows. The first is the "official" flow, where all tasks required to complete a process flow are well-documented, whether they are machine- or people-based. In many cases, exception processing is documented and all likely variables are taken into account[23]. The second process flow is undocumented, but in use nonetheless. This is called the shadow process, because it is commonly used across the company, but like a shadow economy, nobody admits it or takes responsibility for it.

In an organization there are shadow processes being created again and again by people that do not follow the official process as prescribed by the organization. Some of them may stay limited to a certain person, while others may spread and become the norm. The reasons for this phenomena are processes that are not well defined, processes that do not provide benefit to the process users, new processes that are longer or more complex than older ones, faulty discovery of the process, bad design of the new process, rigid corporate culture (blocking more effective processes), and employee's unwillingness to change.

An example of such a situation can be described by a case where a company set a hard rule on business versus economy flights. The rule was that flights must be longer than 8 hours to qualify as business flight. Since many people were taking flights around 7-9 hours of length, people started to change their search criteria to prefer flights longer than 8 hours, even if they were more expensive. The resulting situation was bad for moral and expensive for the company.

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[23] Gartner Research, "Shadow Processes Are the Dark Side of BPM", 2006

The absence of IT systems that are closely aligned with actual business operations creates an opportunity for shadow processes to develop and the lack of agility of many of these systems perpetuates their use.

Business Performance Measurement Issues

Lack of Insight into Business Processes

The majority of business decision-makers today don't have ready access to high-quality, reliable, timely, and useful information on operating and financial performance at their companies. Investments in business processes automation have led to the deployment of applications that lack the ability to expose important performance metrics and with the exception of a few cases, most companies fail to gather and analyze these metrics across applications[24]. In effect, business process monitoring is an afterthought and in many cases is reserved for business analysts or a few senior executives who have access to Scorecard-type applications. This highly selective usage of business process monitoring results in a series of critical business challenges faced by organizations today[25]:

- End-to-end business processes are difficult to monitor and optimize because of the lack of process metrics

- Employees are making financial and operational decisions using fragmented and dated information

- Customer interactions are not optimized to improve sales and increase profitability because of inadequate customer information

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[24] Microsoft Corporation, Microsoft SOA and Business Process Conference 2006, "Realizing the BPM Vision", Presentation
[25] Oracle Corporation, "Delivering Greater Business Insight White Paper"
(http://www.oracle.com/applications/fusion/fusion-greater-business-insight-white-paper.pdf)

This lack of insight makes companies less agile and hurts adaptability, since management needs access to information to make business decisions. In order to be competitive, companies must find a way to implement IT systems that are transparent and support decision making at many levels.

Difficulties in Tracking Costs

The majority of companies today have very little knowledge about how much commonly-used business process are costing them and the effect of these business processes on the company's bottom line. Some of this is related to the lack of formalization of business processes in an organization, while others may be caused by shadow processes with out-of-band activities that are non-standard and very difficult to quantify in terms of costs.

Without being able to identify the costs associated with a business process, companies are unable to weigh the benefits of this process with regards to the value it creates for shareholders and customers.

Summary

In this section, we examined a number of problems facing companies today and a common theme has emerged; agility, adaptability and visibility can lead to higher profits, better customer relationships, higher return on IT investments and increased competitiveness. How companies can achieve these goals will be the subject of the remaining sections of this thesis.

Chapter 3 - Service Oriented Architecture (SOA)

Introduction to SOA

The service concept has been used in software design for many years, with ever-improving tools and a growing understanding of where and how SOA should be used. Some of those involved in the development of remote procedure call (RPC) and object request broker (ORB) facilities, in the 1980s and 1990s, respectively, intended them to be used in a manner consistent with SOA, before the term existed. However, relatively few companies implemented them in ways that fulfilled the SOA vision because of minor technical limitations in RPCs and ORBs, and major disagreements among vendors regarding RPC and ORB standards[26]. The introduction of web-oriented standards, including XML and web services has led to a resurgence of the SOA vision and the widespread support for such standards by vendors has brought SOA into the mainstream.

> *SOA is not a product – it's about bridging the gap between business and*
> *IT trough a set of business-aligned IT services using a set of design*
> *principles, patterns and techniques[27]*

Many different definitions of SOA exist, but SOA is not a technology that requires web-oriented standards, nor is it something entirely different from what software developers and IT departments have been delivering for years. SOA has its roots in common object-oriented and component-based concepts such as the notion of loosely coupling a client and service. The key features of SOA in an enterprise deal with the sharing of services, best practices around the sharing of services and quality of service features that enable SOA's support of critical applications.

In order to understand the underlying philosophy and usefulness of SOA, the concept of services must be considered. Services provide a way for work to be structured; process

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[26] Gartner Research, "Five Principles of SOA in Business and IT" (2006)
[27] Arsanjani, Ali, IBM, "Service-oriented modeling and architecture" (http://www-128.ibm.com/developerworks/webservices/library/ws-soa-design1/)

owners with the knowledge and resources to provide capabilities do so in the form of services, which are published for consumers to utilize. More complicated processes can be accomplished by combining multiple services, thus creating compound services that can also be published for use by other consumers. Services are exposed to potential consumers through the use of a contract, which stipulates what capabilities the service has and how to utilize them, but does not provide details on how the service will internally complete the work. The scope of service consumption can range from services utilizing other services to services being exposed to potentially millions of consumers on the Internet.

SOA applications implement the following principles:

- Modularity – The work of one service is distinct from the work of another service or that of the consumer of the service. Each service provider specializes in one kind of capability, making them more effective, easier to understand manage and change.

- Distribution – Services can be consumed from wherever the work needs to be done. In the case of services that are consumed by partners or customers, the service usage may be over the Internet.

- Explicit Interface – Services must be implemented with clear and explicit interfaces that describe the service's functionality, how they can be invoked, what data the consumer must provide and what data the consumer can expect to receive. The service interface should also describe the format of all data exchanges. When a consumer utilizes a service, the interface becomes the contract between the service and the consumer.

- Encapsulation – The interface of the service must be separate from the implementation of the service provider. The consumer of the service is relieved of the burden of understanding the details of the service provider's operation and the service provider has the ability to change its internal processes without affecting the consumer, provides the terms of the contract are not violated.

The Service-Oriented Architecture Stack

For SOA to be useful in the development of a cohesive strategy for enterprise architecture, the following functional layers are built on top of one another[28]:

- Service Orientation Core – this foundation layer consists of service definition, service discovery and service deployment. It defines what functions and interfaces a service provides how to connect to the service and how service requestors can interact with the service.

- Service Oriented Quality of Service – this layer deals with performance, reliability and security of deployed services

- Service Oriented Process and Rules – provides the mechanism for composing services in orchestrations and association of business service rules with processes as well as service level interactions between service requestors and providers

- Service Oriented Management – addresses the overall maintenance, performance monitoring, measuring and control of services.

- Service Oriented Content – deals with the aggregation of information and the human interface side of SOA

Service Architecture

In order for the service stack to provide real benefit to an organization, the services that are provided in each of the layers can be grouped into four major classes: application front-ends, basic services, intermediary services, process-centric service and public-facing services[29].

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[28] Khoshafian, Setrag, "Service Oriented Enterprises" (Florida: Auerbach Publications, 2007)
[29] Krafzig, Banke, Slama, "Enterprise SOA: Service Oriented-Architecture Best Practices" (Prentice Hall PTR, 2005)

Application Front-Ends

These are the applications and tools that initiate business processes and utilize the services provided in the other layers of the stack. They are not services themselves, but are active participants in the SOA. These applications may have a human interface or may be, in the case of many Internet-based services, autonomous applications that are participating in a system-to-system utilization of services.

Basic Services

Basic services are the fundamental building blocks of the SOA and represent the majority of service offerings. Basic services maintain no session state and can be roughly divided into two sub-classifications based on their data-centric or logic-centric orientation. Often times, however, it is difficult to classify a service as either data or logic-centric and many services have characteristics of both.

Data-Centric Services

The purpose of data-centric services is to handle the retrieval and storage of persistent data, using locking mechanisms and transaction management to protect its integrity. The data-centric service communicates with a data storage facility, such as a relational database, file system or object store. The means by which the service communicates with the data storage facility does not differ much from the data access layer (DAL) of a more traditional application.
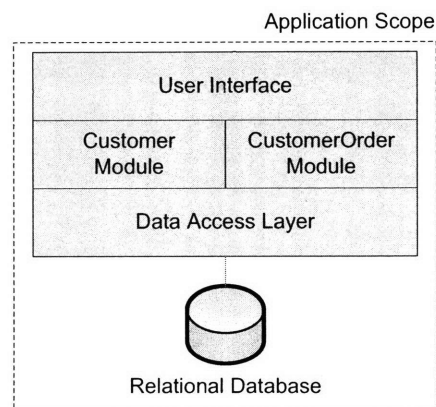
Figure 6 - Data Access in Traditional Application

The major difference is the vertical layering of data-centric services as compared to the more horizontal layering of the DAL in a traditional application (see Figure 6).   A horizontal DAL manages data for the entire application, while a data-centric service deals with one major business entity at a time.   Data-centric services fully encapsulate data entities, forcing any services or applications that require data access to use the service interface.

However, it would not be uncommon for the data-centric service to use a generic, horizontally-layered data access service provider (DASP) in its implementation with vertically-layered service interfaces (see Figure 7).   The common DASP layer provides a way for service implementers to access the data store in a common way, but the varied service interfaces and their individual DALs provide the features of a vertically-layered data-centric service.
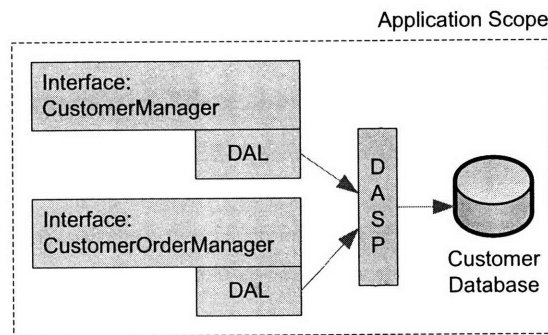
Figure 7 - Data-Centric Services with common DASP

With the vertically-layered service interfaces, the SOA architect must be able to clearly identify a logical partitioning of data based on ownership and the service design will have a major impact on the resulting applications that utilize these services.   One of the most important tasks is to identify the relevant business entities represented by the data-centric services and how the data in the underlying store will map to those business entities.   In comparison with the monolithic approach of horizontally-layered services, the architect of vertically-layered services must be concerned with how to guarantee transaction control, which is usually dealt with by the application or process calling the services.

Logic-Centric Services

Logic-centric services encapsulate the business rules or algorithms behind business decisions or complex calculations. In traditional application development, this logic can be found in common class libraries and specialty business frameworks. The difference between this logic-centric functionality in service oriented architectures and traditional applications is in the reuse and encapsulation provided by the SOA approach. In a traditional application there is likely tight coupling to the class library or business framework, while in the SOA approach, the logic-centric functionality is encapsulated in a service and loosely coupled to the application. Traditional approaches to the inclusion of business logic in applications has sometimes led to a proliferation of duplicate business rules across applications (see Figure 8), as well as the inherit inflexibility of incorporating them directly into the application.
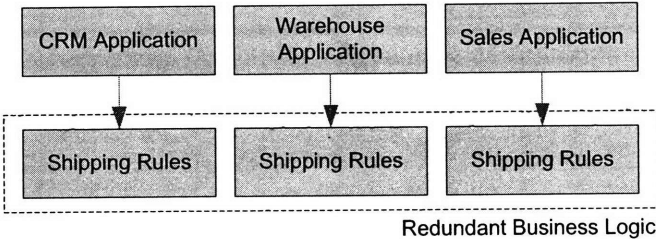
Figure 8 - Traditional Approach to Business Logic

The logic-centric service will publish a service interface that describes to callers how functionality can be utilized, what the expected inputs are and what the caller can expect to receive back from the service. Applications can utilize the business rules by connecting to the service interface of the business rule (see Figure 9).
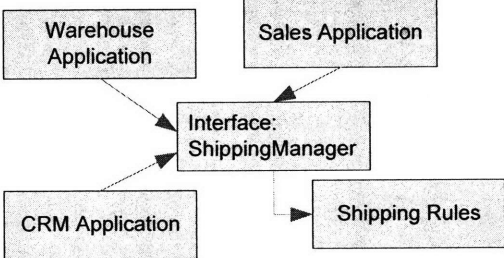
Figure 9 - Logic-Centric Service

Like data-centric services, the logic-centric service owns a business entity and the caller will utilize this entity when interacting with the service. While the core business logic remains the same, different views, in the form of additional service interfaces, can be

provided by the logic-centric service to accommodate the needs of different departments or business partners.

Intermediary Services

Intermediary services are services that bridge technical or design differences between other services and applications in the enterprise. These intermediary services can be further classified into gateways, adapters and aggregation services.

Gateways

In an SOA, gateways often provide a means for legacy applications to participate in the presentation and consumption of services. A gateway acts as a proxy for the business services and business entities and represents the functionality of underlying services in an environment that is likely technologically different.

To the SOA architect, the gateway also becomes a logical point of encapsulation and allows the underlying services to be completely hidden from the exposed interfaces of the gateway. A typical trade-off in any SOA implementation involving legacy applications includes the decision of either encapsulating the legacy system and providing service interfaces with a gateway or re-writing the functionality and moving it out of the legacy system. Gateways can help with this transition and can be instrumental in the staged roll-out of SOA in an enterprise.
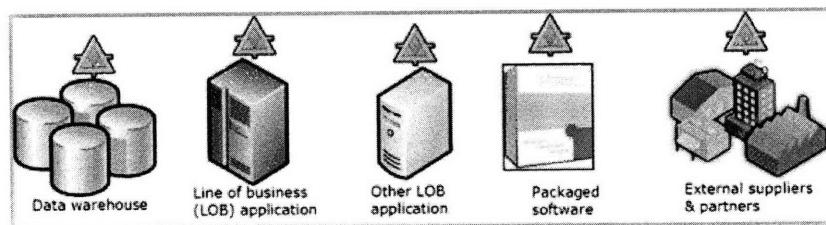
Figure 10 - Wrapping Legacy Applications as Services[30]

Adapters

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[30] Microsoft Corporation, "An Overview of Service-Oriented Architecture in Retail" (http://msdn2.microsoft.com/en-us/library/bb264584.aspx)

An adapter in the context of SOA is a special service that provides both a communications and message format mapping between two systems or technologies. The adapter service differs from the gateway service in that it typically handles many different underlying communication protocols and has less application-layer functionality than the gateway service. A typical adapter will know how to bridge two different technologies using a common protocol and will also provide a means for the SOA architect to map one business entity to another. Adapters are used extensively in the aggregation of web services, since both the communications protocols and the message format will likely differ between services.

Aggregation Services

Aggregation services in the SOA provide a layer of abstraction on top of one or more individual basic services and through this aggregation they are able to provide a single service interface. When the SOA is comprised of a large number of very granular services, the aggregation service provides the flexibility required to combine these granular services into an interface that is more useful and less complex to the caller.
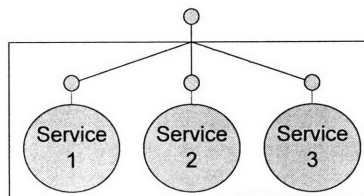
Figure 11 - Example Aggregation Service

This type of service can also be used as façade services to hide the complexity or message format of an individual service and is especially useful in situations where the SOA architect does not have control over a service, as is the case with third-party services or APIs.

Process-Centric Services

Process-centric services model an organization's business processes and are typically sophisticated services that control and maintain their own state. The process-centric service is similar to the aggregation service in that multiple services are encapsulated in

a single service, but they differ in their stateful processing and tendency to aggregate service across different domains in the organization.

Process-centric services introduce some complexity, but they have many benefits:

- Encapsulate Processes – the internal business processes are abstracted away from the caller and a single service interface hides the complexity of the inner workings of the process-centric service. This encapsulation allows the SOA architect to refine and improve the encapsulated processes as needed, without the knowledge of the caller utilizing the exposed service interface.

- Scalability – process-centric services can utilize load balancing and multiple-machine processing to speed process execution. Invocation of individual services from within the process can be done so asynchronously, leading to higher performance and better utilization of available server hardware

- Reliability – process-centric services have the ability to recover gracefully from errors and offer compensating actions. In the case of a process-centric service calling other basic services, this compensation may include wait and retry actions that allow the calling process to recover from short outages of other services.

- Separate Process Logic – process logic guides the execution of the process-centric service and is distinctly separate from other business logic. This logic can be either fixed or dynamic, allowing process-centric services to be flexible and powerful.

In addition to becoming meta-services on top of smaller, less-sophisticated basic services, process-centric services also typically utilize intermediary services, such as gateways and adapters, to make them more useful in the enterprise. Process-centric services are not mandatory for an SOA adoption, but their powerful features make them a compelling addition to moderately-complex SOA scenarios.

Public-Facing Services

Public-facing services are services that an enterprise offers to partners and customers outside of the boundaries of the enterprise. These services may have many of the characteristics of the services described above, but they typically emphasize the following features due to their unique usage:

- Total Decoupling – public-facing services typically have an interface specification that is fairly generic and doesn't expose anything about the enterprise or its operation. The SOA architect should be careful to map internal business entities and operations into these generic formats, both for corporate security reasons and the typical benefits that come from a layer of abstraction.

- Low Granularity – public-facing services should be implemented as process-centric services that execute a number of basic services on the enterprise's private network. The value of not exposing high-granularity services directly is that customers and partners are likely to have a lower number of individual junction points to the enterprise services, lowering support and maintenance costs.

- Security – depending on the type of public-facing services and their intended purpose, different security models will be necessary. In the case of anonymous access to these services through a medium such as the Internet, security of the service invocation is less of an issue, but more restrictive services will require the proper security mechanisms such as authentication, encryption and access control.

- Accounting and Billing – if the public-facing services are designed to generate revenue, it will be necessary to implement a system to capture usage and integrate this usage with the appropriate accounting and billing systems. This functionality is directly related to service granularity and security considerations of the services, which can have a large impact on the ability to accurately account for service usage

- Service Level Agreements (SLA) – public-facing services will likely need to operate under the guidance of an SLA, given the fact that customers and

partners are uses the services and relying on their operations. The SLA becomes increasingly important when customers are partners are utilizing the public-facing services as part of their core operations and their reliance on uptime is very high.

Service Technologies

There a number of different technologies that can be utilized in an SOA, but Web Services have become the most popular and pervasive. This section describes the basic functionality of web services and explains how web services implement SOA.

Web Services

In the preceding sections, there has been an in-depth discussion of services, their classification and their benefits. A number of technologies, both old and new, exist for the implementation of these services, but web services are perhaps the best technology to implement SOA.

The World Wide Web Consortium (W3C) provides the following definition of web services[31]:

> A Web service is a software system designed to support interoperable machine-to-machine interaction over a network. It has an interface described in a machine-processable format (specifically WSDL). Other systems interact with the Web service in a manner prescribed by its description using SOAP messages, typically conveyed using HTTP with an XML serialization in conjunction with other Web-related standards

Services and Interfaces

While a Web service is an abstract concept, it must be implemented in a piece of software or hardware that sends and receives messages. The service is the resource characterized by the functionality it provides and the service is defined by the interface it

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[31] World Wide Web Consortium (W3C), "What is a Web service?"
(http://www.w3.org/TR/2004/NOTE-ws-arch-20040211/#whatis)

defines. How the service can be called is specified by the protocol described in the interface.

Requestors and Providers

The Web service encapsulates some provider functionality and makes it available for requestors to utilize. The requestor typically initiates the conversation with the provider's web service, leading to an agreement on the mechanics of message exchange.

Service Description

The service description represents an agreement governing the interaction with the provider's web service and the mechanics of the message exchange. This agreement is documented in the Web service description (WSD), which is a machine-processable specification of the Web service's interface, written in Web service description language (WSDL).

Semantics

The semantics of the Web service govern the interaction between the requestor agent and the provider agent. This interaction is bound in a "contract" describing the purpose and consequence of the interaction. The contract may be explicit or implicit with the requestor and provider simply needing to implement a non-conflicting view of the semantics and service description of the interaction.

Web services have several advantages over other technologies that implement services, including the level of independence and interoperability with other services and technologies. This "loose coupling" is provided by the focus on the contract that the WSDL provides, rather than the underlying implementation details.

SOAP

SOAP is a protocol for exchanging XML-based messages between systems, normally using the Hypertext Transfer Protocol (HTTP) communications protocol[32]. SOAP forms the foundation layer of the Web services stack, providing a basic messaging framework upon which abstract layers can be built. A common Web service implementation refers

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[32] Wikipedia, "SOAP" (http://en.wikipedia.org/wiki/SOAP)

to the clients and servers that communicate using XML messages that follow the SOAP standard.

Common Myths about SOA

As a way to better understand SOA, the table below describes some of the top myths surrounding service orientation and the facts behind them[33]. I think one of the most compelling implications in this table is that SOA reference architectures are not a "silver bullet" for reducing implementation risk and that there is inherent risk in the fact that no two SOAs are the same.

Myths	Facts
SOA is a technology	SOA is a design philosophy independent of any product, technology or industry trend
SOAs require web services	SOAs may be realized via web services but using web services will not necessarily result in a SOA
SOA is new and revolutionary	EDI, CORBA and DCOM were conceptual examples of SO
SOA ensures the alignment of IT and business	SOA is not a methodology.
A SOA Reference Architecture reduces implementation risk	SOAs are like snowflakes – no two are the same.
SOA requires a complete technology and business processes overhaul	SOA should be incremental and built on your current investments
SOA requires an army of consultants	Tools, not consultants
We need to build a SOA	SOA is a means, not an end

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[33] Microsoft Corporation, "An Overview of Service-Oriented Architecture in Retail" (http://msdn2.microsoft.com/en-us/library/bb264584.aspx)

Chapter 4 - Business Process Management (BPM)

Although organizations with an advanced service-oriented architecture can realize process-centric services in a number of ways, business process management (BPM) represents the most comprehensive approach to process-enabling an SOA. When discussing BPM, it is important to distinguish between business process management as a framework and methodology versus Business Process Management Systems (BPMS), which provide software and a technical platform for realizing BPM management initiatives. For the purpose of this discussion and the applicability to implementing SOA, business process management as a methodology will be the focus.

Introduction to BPM

Defining BPM

Business Process Management (BPM) is a core competency that exists within a process-driven organization. It represents a deeply rooted capability for continuously defining, analyzing, innovating and improving process both inside the organization as well as those that span across business partners[34]. Organizations with a mature BPM capability can accommodate day to day changes in business processes due to competitive, regulatory or market challenges without overly relying on IT departments. This strikes a fine balance between dynamic business areas that want to avoid every risk and grab every opportunity on their way through agile changes in their way to business but are very often restricted by a very stable and hard to change IT infrastructure[35].

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[34] ProcessDriven.org, "Business Process Management"
(http://processdriven.org/business_process_mgmt.html)
[35] Gartner Research, "Getting Started With BPM, Part 1: Assessing Readiness" (2007)
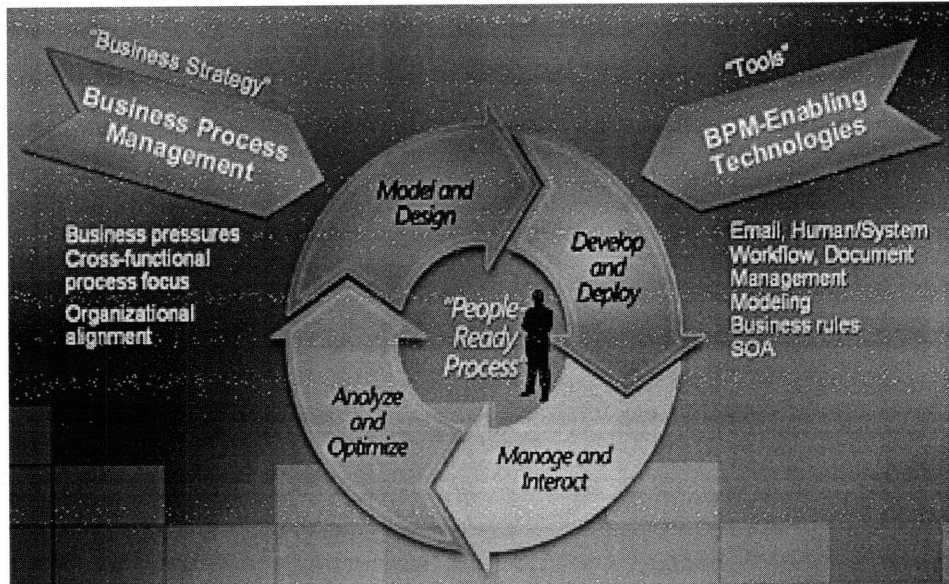
Figure 12 - What is BPM? (Source: Microsoft[36])

Elements of BPM

BPM is comprised of two elements. First, BPM is a management discipline that requires organizations to shift to process-centric thinking, and to reduce their reliance on traditional territorial and functional structures. BPM has evolved from past management theories and practices, such as total quality management (TQM) and business process re-engineering (BPR). Increasingly companies with a strong BPM management discipline are even creating positions like "Chief Process Officer" and assigning executive sponsorship for cross-functional processes[37].

Next, BPM also requires tools that business managers can use to control and modify their processes[38]. Specifically, it requires technologies that make process explicit — that is, clearly expressed and readily changed. These BPM-enabling technologies provide graphical models that enable managers to control various aspects of business operations and invoke the relevant resources. BPM-enabling technologies have existed for many years as point products supporting explicit control of particular aspects of a

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[36] Microsoft Corporation, Microsoft SOA and Business Process Conference 2006, "Realizing the BPM Vision", Presentation
[37] Microsoft Corporation, Microsoft SOA and Business Process Conference 2006, "Realizing the BPM Vision", Presenter's Notes
[38] Gartner Research, "Gartner's Position on Business Process Management" (2006)

process, such as human workflow, document and image routing, and system-to-system interaction patterns.

BPM versus Business Process Re-Engineering

Business Process Management has a number of predecessors that emerged from the Total Quality Management (TQM) efforts of the late 1980s[39]. One of these, Business Process Re-Engineering, focused on the promise of delivering dramatic business performance improvements by completely reinventing existing business processes and starting from scratch with new, optimized ways of doing business[40].

Both of these initiatives focus on business process, but the major difference between Business Process Management and Business Process Re-Engineering is that BPM does not assume that existing inefficient processes be completely thrown-out and started from scratch and instead recommends incremental change and evolutionary optimization.

Business Process Management differs from Business Process Re-Engineering in a number of additional ways:

- The ability to be more agile and responsive in developing and enhancing your processes leads to competitive advantage. This is in contrast to the exclusive focus on cost efficiencies and streamlining focus of earlier BPR attempts. Cost reduction is important, but increasingly not the high-order benefit.

- Eliminating people from the process isn't the goal[41] – in fact, the ability to drive more rapid innovation of the process is inherently a people-centric activity. BPM is enabling people to have greater impact upon business results by removing the traditional barriers to process change and enabling them to be more successful in accomplishing their goals.

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[39] Khoshafian, Setrag, "Service Oriented Enterprises" (Florida: Auerbach Publications, 2007)
[40] Hammer, Michael, "Reengineering Work: Don't Automate, Obliterate", Harvard Business Review (August 1990)
[41] Microsoft Corporation, Microsoft SOA and Business Process Conference 2006, "Realizing the BPM Vision", Presenter's Notes

Core concepts of BPM

BPM has a number of core concepts contributing to its focus on the incremental optimization of business processes with IT and the business working hand-in-hand[42]. It is important to note that business process management principles are vendor and technology-neutral.

Process Design

In this stage, business users and IT come together to capture existing business processes and document their design. In some companies, this may be the first time that these business processes have been examined and documented. Process diagrams, typically including swim lanes, tasks, activities, actors, alerts, notifications and other elements emerge as the artifacts of this effort. Additional modeling of business policies and decision rules associated with the processes may also be necessary.

In the context of process-enabling an SOA, business users and IT must agree on the appropriate level of process documentation and the tools and mechanisms necessary for describing the process. Developers, who will eventually be the recipient of this documentation, think of the processes, business policies and decision rules as the building blocks of the process-enabled SOA they are architecting.

Process Modeling

In BPM, process modeling takes the product of the process design step and puts it in terms of classes, process data, process flows and detailed business rule modeling. Services that will be required for the business processes will also be identified, along with the data that will be sent and received from the services.

Figure 13 illustrates the modeling of a sample loan approval process, which has multiple steps and business rules guiding the processing flow. While this is a simple example, most business processes can be described using these basic constructs.

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[42] Khoshafian, Setrag, "Service Oriented Enterprises" (Florida: Auerbach Publications, 2007)

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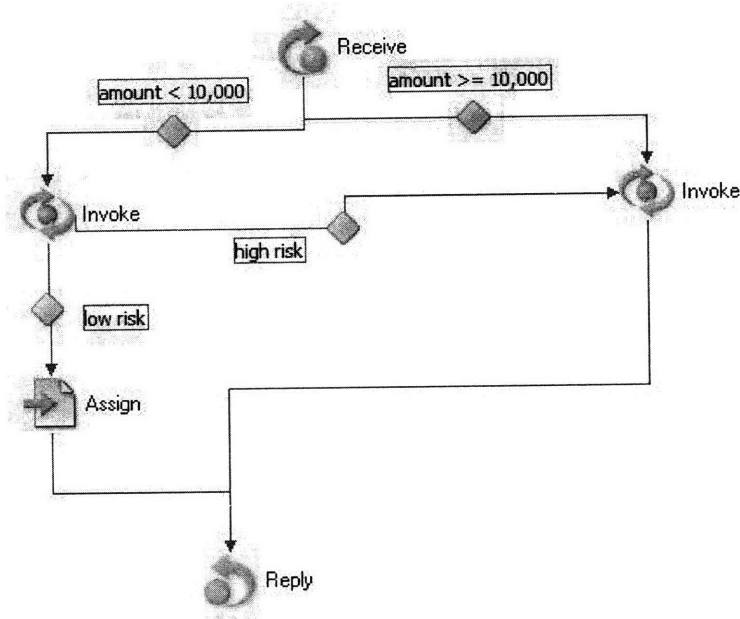
Figure 13 - Sample Loan Approval Process (Source: ActiveEndpoints[43])

The process model is more than just an advanced flowchart[44]. The alignment between business and IT is enhanced during the analysis of the business process and the shared understanding of how the process works. The sequence of activities, who performs them, what the rules are and how much they cost are typical elements of a process model. The model also should support assignment of duration, cost and revenue parameters to process activities and milestones. The purpose of model parameterization is to optimize the design through simulation analysis before calling on scarce IT resources. Simulation transforms the output of a modeling tool from a business requirements document to a cost-justification analysis, with the target ROI connected to specific process-improvement assumptions. This in itself enhances business-IT alignment.

Model-driven implementation will mark a tipping point for BPM, making it a significant force in IT-perhaps the killer app for service-oriented architecture (SOA)[45].

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[43] Active Endpoints, "ActiveBPEL Engine Tutorial" (http://www.active-endpoints.com/open-source-tutorial.htm)
[44] Intelligent Enterprise, "Process Modeling Will Deliver on SOA's 'IT Agility' Promise" (July 2006)
[45] Microsoft Corporation, Microsoft SOA and Business Process Conference 2006, "Realizing the BPM Vision", Presenter's Notes

While business process modeling is an important aspect of BPM, it has proven to be a stumbling block for many companies implementing BPM. According to Forrester Research analyst Connie Moore [46], one of the biggest stumbling blocks when implementing business process management (BPM) is that, "A lot of people get stuck on the modeling and don't move on." One reason for this is that BPM implementers attempt to use complex modeling tools and techniques which sometimes create more problems than they solve.

For those companies beginning to venture into BPM and process modeling, it is important to realize that with BPM, how you turn the business process into a model is not as important as actually going through the steps of analyzing and documenting the process. A simple flowchart identifying all of the items in the process and the relationship between them is a sufficient way to perform basic process modeling.

<u>Process Modeling at Volvo AB[47]</u>

For Volvo AB, for example, to effectively consolidate IT assets and prioritize future IT investment, the company first had to create a common Order-to-Delivery reference model across its Volvo, Mack and Renault truck brands. Using the ProVision modeling tool from Proforma, Volvo began by mapping processes in the current Order-to-Delivery chain to steps defined in the Supply Chain Council's Supply-Chain Operations reference (SCOR) model, specifying attributes such as inputs and outputs, performance metrics and best practices. This mapping simply captured and documented critical differences in as-is processes between brands in terms of use of SCOR best practices, objectives and performance metrics, and opportunities for improvement. By using a common format for describing current practice, the Volvo team was able to model a proposed common reference model for the three brands. Even without improving any of the underlying processes, modeling enabled Volvo to begin managing IT effectively at the enterprise level rather than at the brand or factory level.

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[46] Intelligent Enterprise, "Advice for BPM Neophytes" (2005)
[47] Intelligent Enterprise, "Two Ways To Win At Process Improvement" (2006)

Advanced organizations may also perform an optimization step to potentially simplify and reduce the complexity of the business process. One design goal in particular is to strive for straight-through execution of the business process without human intervention. This goal may take several design and modeling iterations to achieve.

Shared understanding of process models inside of an organization and with its partners is enhanced by standardizing the modeling language[48]. Object Management Group (OMG)'s Business Process Modeling Notation (BPMN) is now widely accepted as the diagramming standard for process models, and an XML storage format for BPMN is very close. Standardizing the XML representation makes process models portable so they can be shared by a wide variety of BPM tools.

The primary goal of the BPMN effort was to provide a notation that is readily understandable by all business users, from the business analysts that create the initial drafts of the processes, to the technical developers responsible for implementing the technology that will perform those processes, and finally, to the business people who will manage and monitor those processes[49]. Thus, BPMN creates a standardized bridge for the gap between the business process design and process implementation.
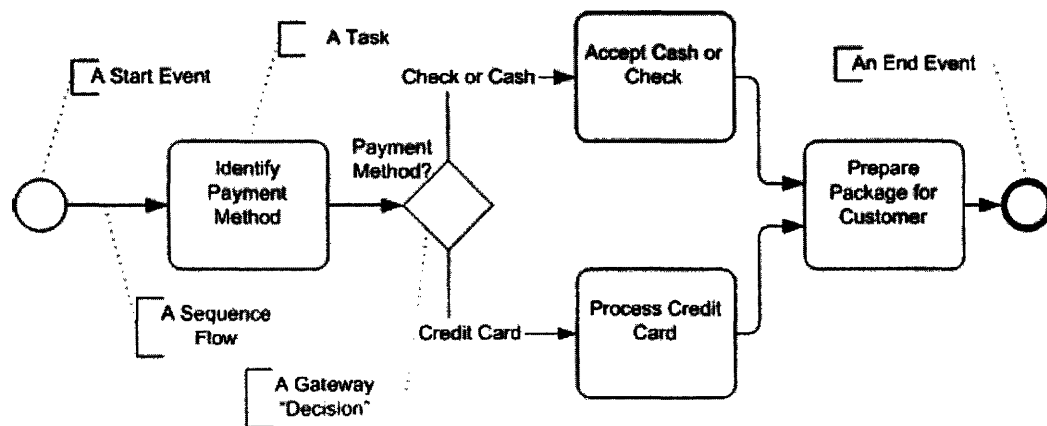
Figure 14 - Simple Business Process in BPMN (Source: OMG[50])

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[48] Intelligent Enterprise, "Process Modeling Will Deliver on SOA's 'IT Agility' Promise" (July 2006)
[49] Object Management Group, "Business Process Modeling Notation Specification"
(http://www.omg.org/bpmn/Documents/OMG%20Final%20Adopted%20BPMN%201-0%20Spec%2006-02-01.pdf)
[50] Object Management Group, "Introduction to
BPMN" (http://www.omg.org/bpmn/Documents/Introduction%20to%20BPMN.pdf)

The standardization on BPMN has its advantages, but transforming models into executable implementation is difficult because not every process you can draw maps easily into a particular process execution language[51]. Researchers have found that 15 percent to 20 percent of BPMN diagrams, for example, must be redrawn to conform to the rules of Business Process Execution Language (BPEL), the standard for service-oriented BPMS. Developing algorithms to redraw those "problem" models automatically will require magic that's still in the labs.

Process Implementation

The core principles of BPM provide the framework for the design and modeling of business processes, but the implementation of these processes is more vendor and technology specific. In later sections of this paper, specific strategies for implementing business processes using SOA will be explored.

Process Instances

The execution of business processes in BPM deals with the shepherding of work items through the process definition. Each executing process is uniquely identified and the processing is predictable and consistent. In terms of SOA, the execution of process instances occur in a process-centric service we defined in an earlier section of the document.

For performance and scalability reasons, most process-centric services will be designed to start executing an instance of a business process and look to complete the process as quickly as possible. The ideal scenario is the "straight-through" process instance where the service receives the request, performs some unit of work and returns the response immediately.

In other cases, particularly in system-to-human workflow, the process instance needs to be suspended for some period of time while a step in the process is completed. This type of long-running process instance requires a special design pattern called "Correlation Identifier", which provides a method for associating a response with a request. It is also being adopted and extended in the Web Services Business Process

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[51] Intelligent Enterprise, "Process Modeling Will Deliver on SOA's 'IT Agility' Promise" (July 2006)

Execution Language [WS-BPEL] where "correlation sets" are defined for similar purposes[52].

Process Monitoring

One goal of BPM is the constant incremental improvement of business processes and the BPM principles dictate that executing processes should be tracked as they move through each step and performance data gathered. An important feature of process monitoring is the ability for faults in processes to be identified and corrected, either automatically or with human intervention.

Process Interrogation

Process interrogation is different from process monitoring in that it satisfies an important goal of BPM – process transparency. Currently executing and completed processes should be able to be observed and the data associated with the processes made available for reporting and analysis. While process monitoring is more of a push-oriented manner of interacting with processes, process interrogation is more likely to be initiated by end-users and managers and the potential use and frequency of this interaction may not be known in advance.

Some business process analysis and modeling tools offer business activity monitoring (BAM) to fulfill two of BPM's key promises: business-IT alignment and performance visibility[53]. Where simulation analysis projects estimated values of Key Performance Indicators (KPIs), BAM actually measures them from running IT systems, aggregating information from a variety of sources, displaying them graphically in management dashboards and triggering alerts to process owners when KPIs deviate from their target values. In some process analysis tools, simulation results are displayed in the same dashboard used for BAM. This facilitates comparison of the modeled and actual performance results, as well as feedback of actual parameter values to refine the simulation model.

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[52] Oasis, "Web Services Business Process Execution Language" (http://docs.oasis-open.org/wsbpel/2.0/OS/wsbpel-v2.0-OS.pdf)
[53] Intelligent Enterprise, "Two Ways To Win At Process Improvement" (August 2006)

Process Lifecycle

The core concepts of BPM, as described above, represent the full lifecycle of a business process.   As shown in Figure 15, this loop enables people to impact business results thorough involvement in the entire process innovation lifecycle, from process design to monitoring and optimization, and enables them to change more frequently to adjust to changing circumstances.
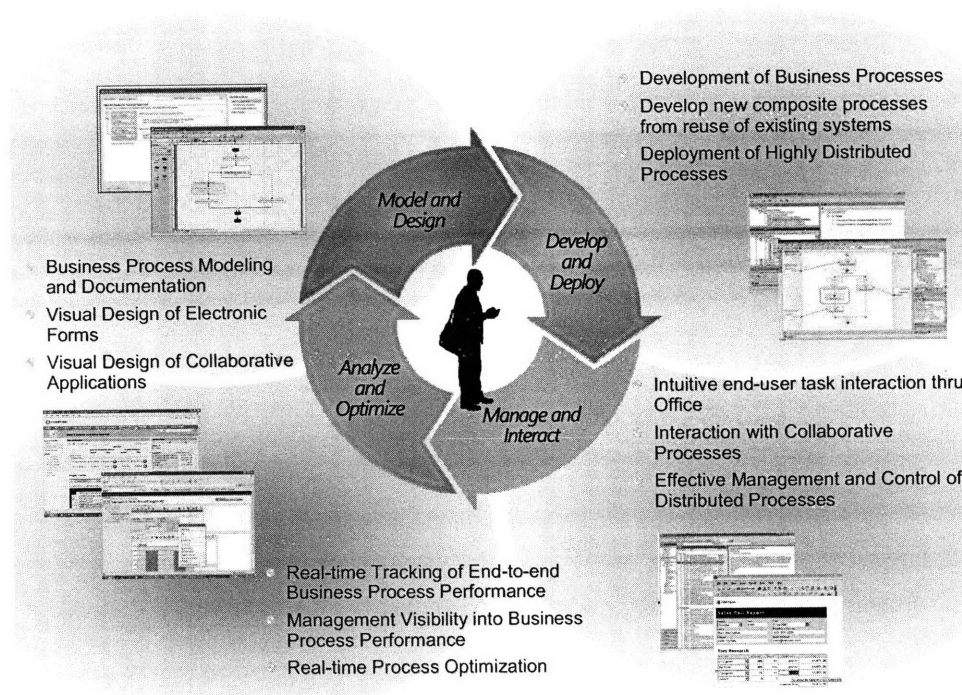
Figure 15 - Process Lifecycle (Source: Microsoft[54])

BPM Value Proposition: Why Does Process Matter?

For a company, the main value proposition of BPM is increased operational performance and process agility.   BPM disciplines also increase process transparency and effectiveness with IT and the business working hand-in-hand.   These innovative

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[54] Microsoft Corporation, Microsoft SOA and Business Process Conference 2006, "Realizing the BPM Vision", Presentation Slide

processes are likely to be perceived as innovative by internal employees, customers and partners[55].

BPM is about efficiency and productivity, streamlining processes, reducing cycle time, getting work done faster, getting work done with fewer resources and freeing up people to do value-added work as opposed to mundane work. Compliance is another driver[56].

As the U.S. economy started moving out of recession last year, there was a marked shift in priorities toward growth initiatives; we started seeing CEOs and CIOs focusing on getting products to market faster and turning new ideas into products and services more quickly. That's a new priority driving BPM adoption[57].

The following business challenges are typical and processes are behind each of them[58]:

- Customer retention - for those companies who are seeking to improve customer satisfaction and have a focus on CRM as a strategy, having consistent customer-facing processes (sales, service, etc) that cross application and functional boundaries (even inter-enterprise boundaries) is critical to the customer experience.

- Shortened process cycle times - this is often a reflection of both ongoing process efficiency initiatives (Six Sigma, Lean manufacturing, etc) as well as the reality of increased competition. Shrinking processes, like order fulfillment, not only improve customer satisfaction, but can tremendously impact a company's financials (reducing carrying costs, improving asset utilization, etc.)

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[55] Microsoft Corporation, Microsoft SOA and Business Process Conference 2006, "Realizing the BPM Vision", Presenter's Notes
[56] Moore, Connie, Forrester Research in Intelligent Enterprise, "Advice for BPM Neophytes" (November 2005)
[57] Moore, Connie, Forrester Research in Intelligent Enterprise, "Advice for BPM Neophytes" (November 2005)
[58] Microsoft Corporation, Microsoft SOA and Business Process Conference 2006, "Realizing the BPM Vision", Presenter's Notes

- Regulatory compliance and management control - regulations like SOX, HIPAA, BaseIIII, etc are requiring a much more detailed ability to control and audit your core business processes. This has driven initiatives to replace manual processes (fraught with errors and security risks) with much more automated processes.

- Increase effectiveness of outsourcing efforts - companies looking to outsource business processes need the ability to distribute parts of their end to end processes across enterprise boundaries, which still retaining complete visibility and control

- Reduce time required for expense reporting - this is merely an example of a common HR process that is painful to nearly all companies. It's something that crosses individual, team, and system boundaries.

- Create new automated processes in spite of systemic limitations in business apps – business development managers are frustrated in IT's ability to respond to change, given the baggage that IT maintains around supporting legacy apps. They are looking for solutions for combining existing assets into new composite processes and applications (see Figure 16).
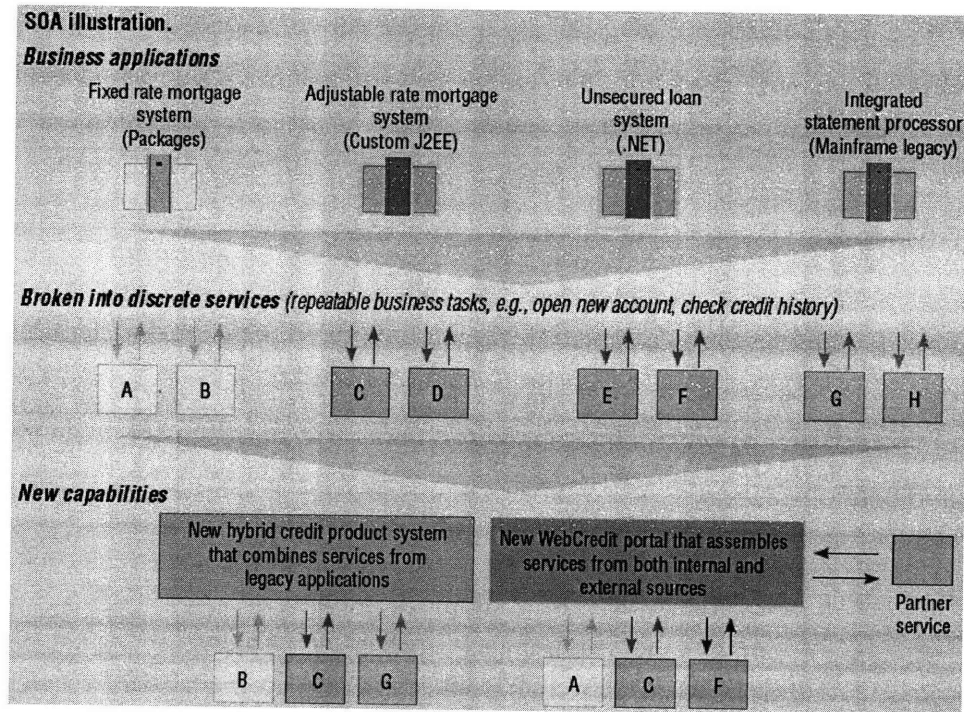
Figure 16 - Composite Applications (Source: IBM[59])

Getting Started with BPM

BPM analyst Connie Moore of Forrester Research has this advice on where to start with Business Process Management[60]:

- Start with the highest-reward, lowest-risk process and then expand as you move up the learning curve

- Look for projects that affect the company's revenue, are high cost or are associated with customer satisfaction

- Avoid processes that transcend company boundaries, involve extensive integration or constantly change, as these are much higher risk

- Don't get stuck on the modeling, keep the initial process analysis simple

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[59] IBM Institute for Business Value, "Service-oriented Architecture: A practical guide to measuring return on that investment" (http://www-935.ibm.com/services/us/gbs/bus/pdf/g510-6320-soa-roi.pdf)
[60] Moore, Connie, Forrester Research in Intelligent Enterprise, "Advice for BPM Neophytes" (November 2005)

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- Work in incremental three-month phases; take your process, improve it, deploy it, use it, make changes to improve it and then deploy it again. Each iteration will improve the process, making it more streamlined and efficient

Derek Miers, independent industry analyst and BPM report author, states "The trick is to find a small project that can be delivered in 90 days or less[61]. That way, you get the business behind you with the 'wow' factor." He suggests that IT directors take an iterative approach focusing on 30% to 40% of functionality that gives the business the biggest bang for its buck.

Defining "BPM Thinking"

The previous section describes Business Process Management (BPM) as a management discipline that looks at the enterprise not as a collection of functional units like sales, manufacturing and customer service, but as a set of business processes that cut across traditional stovepipe boundaries.

What is important to take away from this discussion is the concept of "BPM Thinking", which, other than specifying business requirements, imposes no constraints, methodology or tools on IT's process implementation[62]. By embracing end-to-end process analysis, "BPM Thinking" helps align IT with strategic goals by linking technical innovation with quantitative, business-defined measures of success.

You don't need a full set of tools like those found in a Business Process Management Suite (BPMS) to advance your IT architecture with "BPM Thinking". Although some of BPM's promises, such as faster-cycle times, increased compliance with policies and rules and more agile IT implementations are best realized with a BPMS, other benefits, such as business innovation and performance visibility, have been achieved simply by adopting cross-functional "process thinking" in combination with business process modeling.

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[61] Computer Weekly, "Choosing a Route to Agile Systems" (September 2006)
[62] Intelligent Enterprise, "Two Ways To Win At Process Improvement" (August 2006)

For the remainder of this paper, the terms "BPM", "BPM Thinking" and "BPM Methodologies" will be used interchangeably as a reference to the core tenants of BPM as a management discipline and its focus on business process.

Chapter 5 - Planning for SOA

The Impact of SOA on the Enterprise

As with any new methodology that an enterprise attempts to establish as a standard, the adoption of SOA will meet with a number of challenges, both big and small. Since every enterprise is unique, there is not universal roadmap that will fit all scenarios and guarantee a successful outcome. This section explores the distinct patterns that emerge when it comes to the planning side of SOA and its impact on the enterprise.

Four Pillars for Success

The success or failure of an SOA implementation can depend on a wide number of factors[63]; however four pillars of success have been suggested as the core required elements: securing a budget, choosing a suitable project to start with, setting up a strong team, and finding a backer for the effort. None of these elements seem unusual or special for the adoption of any IT effort, but they represent the basic tenants that in some projects are unfortunately neglected.

Budget

A budget must be established for the introduction of SOA in an enterprise in the form of support for one or two pilot projects. Since these pilot projects will have a significant impact on success of the eventual overall SOA introduction, is important for a sufficient budget to be granted to the implementation team. The budget must account for the initial learning curve of implementing new standards and processes and should consider the impact on the business side of the project, since the pilot project(s) will require significant involvement of people outside of IT.

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[63] Krafzig, Banke, Slama, "Enterprise SOA: Service Oriented-Architecture Best Practices" (Prentice Hall PTR, 2005)

<u>Initial Project</u>

The second pillar is the choice of a suitable project piloting the implementation of the enterprise SOA[64]. The proposed pilot should have the following attributes:

- The project should involve the re-architecture of an existing processes or service that is highly visible and widely used, but not completely critical to business operations. As a general "rule of thumb," good SOA pilot projects tend to have two characteristics[65]: high visibility and as-low-as possible risk. By high visibility, the project in question is important enough to the business to ensure initial funding as well as ongoing attention from the sponsors. However, the project should not entail significant modification, extension or enablement of core, mission-critical business processes, and should minimize the amount of new technology used. Users should employ Figure 17 as a conceptual model when identifying potential SOA projects.

Figure 17 - Evaluating Potential SOA Projects (Source: Gartner Research 2006[65])

- The services created in the pilot should have significant reuse potential, which will contribute to the validation of the benefits of SOA and will help sell it. If the services could be potentially leveraged for new applications or help solve issues

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[64] Krafzig, Banke, Slama, "Enterprise SOA: Service Oriented-Architecture Best Practices" (Prentice Hall PTR, 2005)
[65] Gartner Research, "SOA: Where Do I Start?" (2006)

that have been plaguing the enterprise, this will only strengthen the SOA validation.

- The pilot project must have sufficient interest and backing from the business side of the enterprise and the stakeholders must feel that there is sufficient value in undertaking the pilot. The involvement of the business resources is a critical and necessary component for success.

- The project should have a clear technological scope based on real business requirements with measurable benefits leading to an analysis of ROI. This project should not be a validation of the technical aspects of SOA; it is much more about the business process and execution of the SOA methodology.

- The duration of the pilot project should not exceed two years and the first delivery of production services should occur within the first six months.

- An incremental development methodology, such as Agile or Scrum, is compatible with the incremental delivery aspect of an SOA adoption and is the preferred method for delivering early results which are then refined and iterated upon[66].

The SOA Team

The third pillar is setting up a special SOA team[67]. This team must be focused on how to best support and establish SOA in the enterprise. The team must be capable of establishing the vision of the pilot project and determining the design and specification of the architecture principles, standards, and processes as well as the monitoring of the actual implementation of SOA. The leaders of this team must have the skills necessary to accomplish the technical aspects of the project, but they must also be able to act as "architect evangelists" who explain the benefits of the SOA to different departments of the enterprise.

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[66] Agile Journal, "Agile And SOA: A Natural Synergy" (http://www.agilejournal.com/articles/the-agile-developer/agile-and-soa:-a-natural-synergy.html)
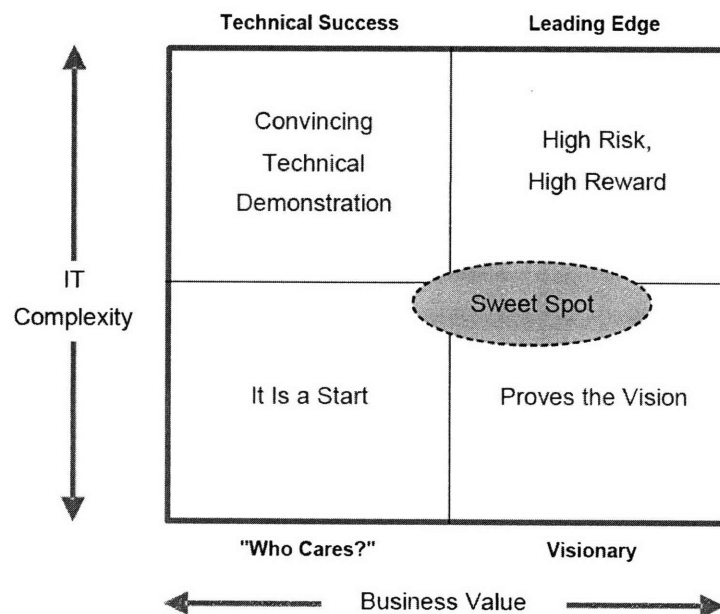[67] Krafzig, Banke, Slama, "Enterprise SOA: Service Oriented-Architecture Best Practices" (Prentice Hall PTR, 2005)

Backers

The forth pillar consists of having backers for the SOA initiative at all levels of the organization, including top management. Ideally, SOA would be included in strategy planning, which is critical for budget approval and can help generate sufficient awareness in the enterprise. As described in the ideal SOA team, evangelists on the business and management side of the enterprise are critical for opening doors to the departments that will be providing or consuming the business functionality provided by the services. These "business evangelists" will help sell the business benefits of SOA and may also begin to generate new ideas or applications that would benefit from the resulting services, strengthening the argument for SOA.

In enterprises that lack a central IT department, it is critical to have the proper backing should the pilot project somehow infringe on an application or system that exists in a decentralized IT function[68]. The SOA team should also consider the opposite of backers, the detractors, who may openly or secretly oppose the introduction of an SOA to the enterprise. The SOA team must actively engage the detractors, attempt to understand their motivation and point of view and find a way to convert them to backers.

Evaluating Architectural Maturity

In its research of more than 200 companies, the MIT Sloan Center for Information Systems Research (CISR) identified four stages of IT architecture maturity[69]. As companies advance from the first stage to the later stages, they realize benefits ranging from reduced IT operating costs to greater strategic agility.

This framework provides an important baseline to determine how lengthy and difficult an SOA implementation may be based on the current architecture state and illustrates how dependent IT architecture and SOA are on each other. An organization with little or no enterprise SOA is likely to be in the lowest level of maturity, while those companies realizing many of the promises of SOA are likely to be at the highest level of maturity.

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[68] Krafzig, Banke, Slama, "Enterprise SOA: Service Oriented-Architecture Best Practices" (Prentice Hall PTR, 2005)
[69] Ross, Weill, Robertson, "Enterprise Architecture as Strategy" (Harvard Business School Press, 2006)
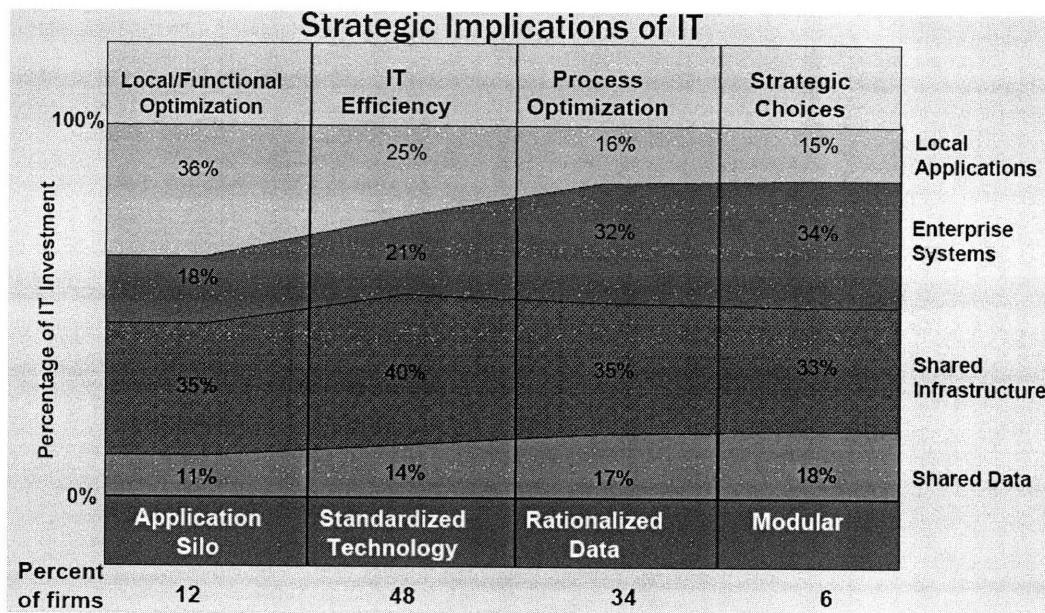
Figure 18 - Architecture Maturity Stages (Source: CISR[70])

Architecture Maturity Stage 1 - Business Silos

In the business silos stage, companies are using IT to maximize the functional needs of individual business units. Shared services, such as data centers, may be established, but they accommodate the unique needs of local business units and no enterprise-wide standardization is established.

At the business unit level, investments are justified on the basis of cost reductions and IT then develops or buys an application to meet the requirements. Since there is typically little in the way of constraints from other parts of the business, the IT systems in this stage tend to deliver close to a 100 percent solution to the specified business need. Solutions developed in the Business Silos architecture can provide a high degree of competitiveness and innovation within the context of the business unit.

These local solutions, although ideal for the business unit, tend to create a legacy of systems within the larger company that are difficult to integrate and link. Over time, companies create ad-hoc links between these systems, making small changes risky and expensive (see Case Study 3: Project Alpha at Acme Company).

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[70] Ross, Jeanne W., "Enterprise Architecture: Driving Business Benefits from IT" (MIT Sloan Center for Information Systems Research, April 2006)

According to the research performed by the CISR, only 12 percent of companies are in the business silo stage, with the majority of them already moving past this first architecture stage. Those companies left behind are faced with expensive and difficult to maintain applications.

Architecture Maturity Stage 2 - Standardized Technology

In the Standardized Technology stage, companies shift some of their IT resources away from local business units and focus more on shared services servicing multiple business units. The incentive for this move is the reduction of platforms and thus a decrease in cost for supporting applications enterprise-wide. Approximately 48% of the companies in the CISR study were in this phase of architectural maturity.

Moving into this stage typically involves the establishment of a position or group with the authority to mandate IT-related expenditures. This position, typically a corporate CIO, or IT steering committee, introduces efficiencies by standardizing and consolidating technology platforms and providing shared infrastructure services.

Companies in the standardized technology stage start to reduce the number of software applications performing similar functions. According to the CISR research, one manufacturing company reduced the number of order management systems from twenty-eight to four.

Unfortunately, technology standardization alone does not overcome the Business Silos problem of data embedded in applications. Companies in the second stage of architectural maturity usually increase access to shared data through data warehouses and other means, but transaction data is typically still embedded in the localized application silos.

In order to advance to this level of architectural maturity, a company may have implemented a limited or "fundamental SOA"[71], which is a good starting point for the

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[71] Krafzig, Banke, Slama, "Enterprise SOA: Service Oriented-Architecture Best Practices" (Prentice Hall PTR, 2005)

introduction of an enterprise-wide SOA because it starts small on the technical side and enables two or more applications to share live data and business logic.

Architecture Maturity Stage 3 - Optimized Core

In the Optimized Core stage, companies move from a local view of data to an enterprise view where transactional data from individual applications is made available to all appropriate processes. Approximately 35% of the companies in the CISR study were in this phase of architectural maturity.

The Optimized Core stage eliminates data redundancy and provides the company with a single point of reference for data. Gartner Research calls this "Master Data Management" (MDM) and defines it as *"a workflow-driven process in which business units collaborate to harmonize, cleanse, publish and protect common information assets that must be shared enterprise-wide. MDM ensures the consistency, accuracy, stewardship and accountability of the enterprise's core information, thus enabling enterprises to eliminate endless debates about 'whose data is right.'"*[72].

The role of IT in the Optimized Core is fulfillment of company objectives by building reusable data and business process platforms. Standardized data and business processes provide predictable business outcomes and the Optimized Core architecture enables process innovation closer to the customer. In many cases, companies operating in this stage have encapsulated the company's core data and process, providing a foundation for existing and future operations and customer interactions. It is likely that an emerging "networked SOA"[73] is bridging the technical gaps with services that shield front-end applications from the complexity of backend systems. According to the CISR research, United Parcel Service (UPS) built its entire business around a single package database supporting its package delivery business.

Achieving this stage of IT architecture maturity is a formidable technical challenge, but the management and planning challenges are even more demanding. Local business

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[72] Gartner Research, "Master Data Management Summit Shows How to Achieve a 'Single Version of the Truth' About Data" (2007)
[73] Krafzig, Banke, Slama, "Enterprise SOA: Service Oriented-Architecture Best Practices" (Prentice Hall PTR, 2005)

unit leaders must be willing to cede control of their data and processes to benefit the entire organization. The optimized core stage is a much harder sell to business managers than the technological standardization stage and often times a top-down effort supported by senior management is required.

Architecture Maturity Stage 4 - Business Modularity

The Business Modularity architecture enables strategic agility through customized or reusable modules that are extensions of the business and are built on top of the infrastructure in the Optimized Core stage. Only 6% of the companies in the CISR study reached this phase of architectural maturity.

In this stage, the processes that were automated in the Optimized Core stage are refined and further modularized, increasing their reusability and value to the company. One way of achieving this is the creation of reusable modules that allow business units to select common customer-oriented processes for inclusion in their applications. Another approach grants business units the ability to connect to more granular modules, allowing for the creation of custom processes based on these smaller, more specialized modules.

The role of IT in this stage is to provide seamless linkages between business process modules; so-called "composite applications" comprised of smaller modules and processes (see Figure 16). The modular stage doesn't replace the architecture of the optimized core stage; it simply extends the standard core modules, linking them to internal and external processes through standardized interfaces. This goal can be achieved through a "process enabled"[74] SOA which encapsulates the complexity of business processes in services which are both client and server in the SOA.

To benefit from modular architectures, companies must learn how to leverage and extend core modules for strategic opportunities and then make these extended modules part of the core itself. Innovation is also enhanced, since solutions to changing market conditions can be prototyped and strategic experiments performed using core modules.

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[74] Krafzig, Banke, Slama, "Enterprise SOA: Service Oriented-Architecture Best Practices" (Prentice Hall PTR, 2005)

Building a Business Case for SOA

SOA is not a magic bullet for all organizations; however, the benefits of implementation can be seen throughout those companies that adopt it. While the primary motivating factor for using SOA is the potential increase in agility it offers, there are other contributing factors related to cost, reuse and the evolutionary approach to its implementation that fits better with the dynamic nature of business. The SOA practitioner should focus in on these benefits when building the business case for SOA.

> *"...the top Global 2000 organizations can save up to $53 billion in IT spending over the next five years through SOA's potential to reduce software implementation costs[75]"*

IBM's Institute for Business Value studied 35 actual SOA implementations in 11 industries worldwide, gaining a very clear picture of the kinds of benefits firms are obtaining from SOA[76]. As shown in Figure 19, one hundred percent cited improved flexibility, the root of all the other benefits. The findings showed that shorter cycle times, increased collaboration, and reuse of IT assets were typical across these projects.

Benefits reported by the SOA projects studied.

Benefit	Percent
Improve flexibility	100
Decrease cost	97
Reduce risk	71
Increase revenue	51
Enable new products	43
Enable compliance	26

Figure 19 - Benefits of SOA (Source: IBM Study of 35 Projects[77])

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[75] Aberdeen Group, "SOA in IT Benchmark Report" (February 2006).
[76] IBM Global Business Services, "Service-oriented Architecture: A practical guide to measuring return on that investment" (2006)
[77] IBM Global Business Services, "Service-oriented Architecture: A practical guide to measuring return on that investment" (2006)

SOA's handling of complexity

In the enterprise, projects can be compromised by complexity that is both technical and non-technical in nature. Complex applications that try to do too much and have become unmanageable are the hallmark of failed or poorly executed projects. Business processes with unclear business rules and ill-defined steps become complex processes to implement. Incomplete business requirements and conflicting business perspectives cause ambiguity and increase complexity. Existing applications and the functionality they provide are a source of integration complexity.

Service Oriented Architecture helps reduce the complexity at all levels of the enterprise through the following means[78]:

- Decomposition – SOA takes large, complex systems and decomposes them into a set of services with a number of potential front-ends. Decomposition also forces SOA planners to think in terms of processes, leading to better discussions and potentially, the simplification or optimization of them.

- Service Granularity – Services can be presented at different levels of granularity, hiding or exposing the proper amount of functionality and detail. This flexibility reduces complexity since it allows services to be utilized at an appropriate level.

- Reuse – SOA helps achieve reusability, one of the hallmarks of object-oriented design and a clear indication of enterprise architecture maturity. With the proper amount of planning and appropriately designed services, complexity can be reduced by centralizing functionality in a set of core services that can be reused in a number of applications across the enterprise.

- Documentation – Service contracts are self-documenting and present a clear definition of the interface and methods of a service. These exposed contracts with their well-defined interfaces reduce complexity by hiding the implementation

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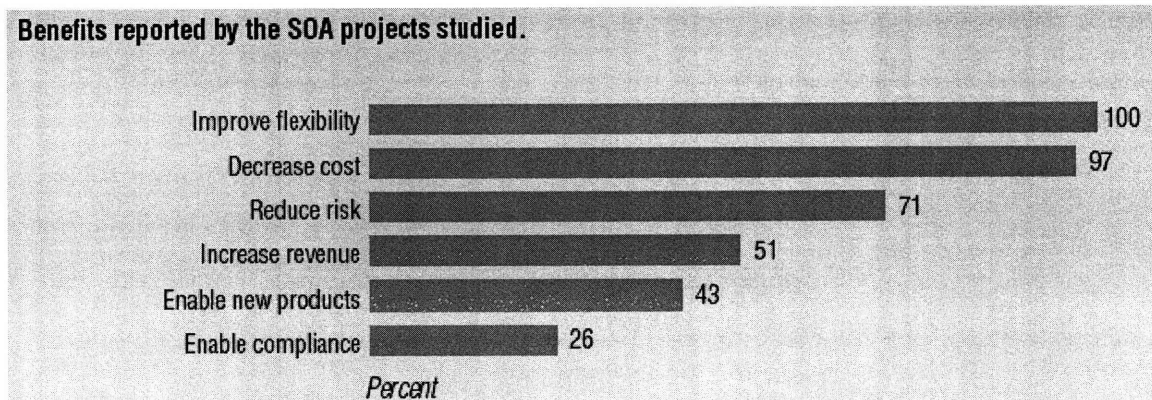[78] Krafzig, Banke, Slama, "Enterprise SOA: Service Oriented-Architecture Best Practices" (Prentice Hall PTR, 2005)

details of the service and allow the service consumer to focus solely on the interaction with the service.

Cost Savings

With a reduction in complexity comes cost savings in the enterprise's core business. At the business level, the majority of the savings comes from increased agility, streamlined business processes and improved visibility into data that was difficult to access prior to the implementation of SOA. From an IT perspective, SOA offers a repeatable implementation and deployment pattern that can be applied to more and more projects over time, lowering costs and reducing implementation times. Additional benefits that reduce costs for IT are lower long-term maintenance, increased understanding of business processes within the organization and the ability to encapsulate existing applications instead of replacing them.

Risk Mitigation

The evolutionary, rather than revolutionary, approach to SOA adoption fits better with most large organizations and helps reduce the risk of failure. Enterprise application or architectures fail for many different reasons, including both technical and non-technical shortcomings. SOA's agile nature and ability to react and handle changes to business and technical requirements is critical to risk mitigation.

Enhanced Development Processes

The emergent approach to implementing SOA in a large organization is very much compatible with modern approaches to software development, such as Agile or Scrum. SOA allows for a high degree of modularity, making it possible to decouple development teams, such that each team is responsible for implementing a set of services. Integration between the teams is reduced and mostly focuses on the agreement of service interfaces. SOA allows for better code integration from these teams since they have already agreed on service interfaces and independently tested the service operations.

Understanding the Risks in SOA Implementations

Measuring SOA success

As described in the "The Impact of SOA on the Enterprise" section, the difficulties and challenges of implementing SOA in an existing organization can be mitigated, however, important risks remain. Gartner Research offers two critical measures of SOA success that focus on two areas – agility and cost as defined below[79]:

- Agility – The degree of enterprise IT agility achieved with SOA, as measured by the time to market for the development of new services, as well as the modification of existing services. In a very agile IT environment these activities are relatively quick and non-disruptive to the business.

- Cost – The cost of SOA can be considered in two dimensions: the cost to deliver a new service and the cost of changing a service in an established SOA environment.

Support for enterprise agility can be promoted by systematic design and management efforts, but with the increase in systematic investment comes increased costs[80]. As organizations begin to better understand and utilize these systematic methods, the cost and time to implement or change services should decrease while agility is on the rise. This perfect balance between cost and agility is illustrated in Figure 20 as the "Best of SOA"

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[79] Gartner Research, "Twelve Common SOA Mistakes and How to Avoid Them" (October 2007)
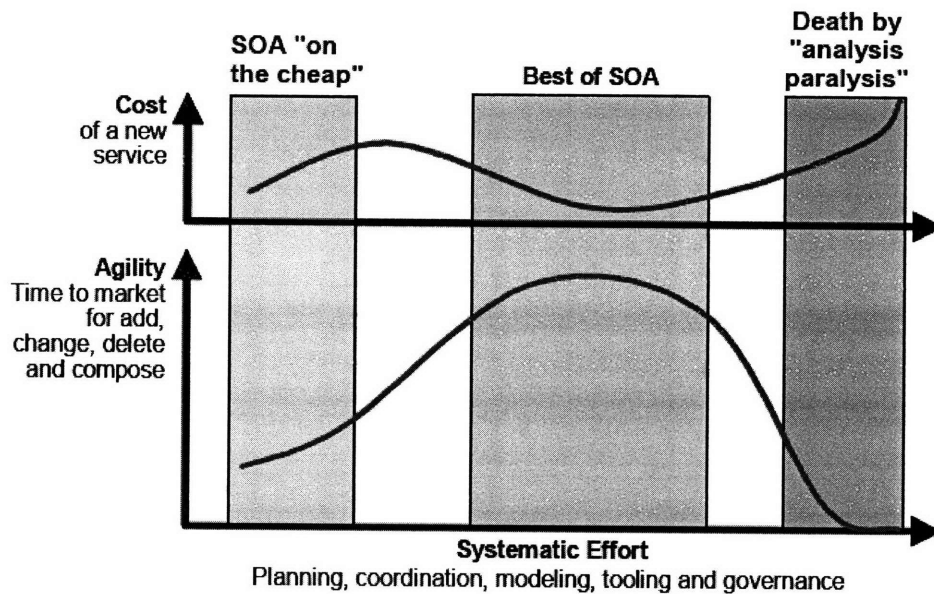
Figure 20 - Balancing Cost and Agility[80]

The undesirable state of low costs and low agility might come from the limited adoption of SOA for a single application's needs in a way that is not systematic or strategic to the enterprise. This isolated "island of SOA" has limited benefit to the enterprise and one of the core goals of SOA, which is a repeatable pattern of service implementation and deployment is likely not to have been achieved.

An even more difficult state of high costs and very low agility is likely the result of poor emergence of SOA as a strategic methodology and the intentional or unintentional overhead created by excessive controls or complex methodologies. Organizations that attempt to tightly control SOA from a central group in a single, unified effort can fall into this extreme. Finding the right amount of control and management of SOA's emergence will help avoid this problem.

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[80] Gartner Research, "Twelve Common SOA Mistakes and How to Avoid Them" (October 2007)

Common risks of SOA implementations

There are a number of common risks or pitfalls that an organization may need to overcome when adopting SOA in the enterprise architecture. In additional to finding the right balance between agility and cost, as described in the previous section, the SOA practitioners should be aware of the following:

Poor service design

While the emergent nature of adoption is touted as an advantage to SOA, there is risk in the fact that poorly-coordinated projects without enterprise guidance may implement services without any regard for their business value[81]. A common issue is that developers wishing to implement SOA may simply externalize all of their application's objects and methods as services, which is a technical solution and doesn't address real business needs of the organization.

Additionally, services and the data they work on must be developed together; forgetting the data in the design process can easily result in services that deliver poor performance and can challenge the integrity of the application[82]. With the proper use of encapsulation and service granularity, the application's objects and methods can be exposed as services that add real business value and have a high degree of reuse in the organization.

Poor IT and business coordination

When the process of implementing SOA is left to IT, even in the smallest of projects, services will likely be optimized for performance and developer ease of use and the business functionality of the application will likely suffer. Collaboration between IT and the business sides of the enterprise is essential for cross-application integration and enterprise-wide usage.

Poor planning

Attempting to begin an SOA implementation in a large organization with too broad of an objective is likely to end in failure. Organizations and their IT infrastructure are

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[81] Feuerlicht, George and Lozina, Josip, "Understanding Service Reusability"
[82] Gartner Research, "Twelve Common SOA Mistakes and How to Avoid Them" (October 2007)

inherently complex; while SOA has the ability to reduce complexity (see "SOA's handling of complexity"), a well-developed discipline of design, technical skills and management is necessary to overcome it. As described in the "Four Pillars for Success" section, SOA is a long-term, complex initiative that must be carefully planned and executed.

Underestimating the technical issues

While web services are a straightforward and well-established means of exposing services in an SOA, they are only an enabler of interoperability and integration. Enterprise service implementations require middleware that provides the necessary quality of service (performance, availability, scalability, manageability and security) as well as a platform for managing the coordination of service calls[83]. SOA practitioners and implementers need to be aware of the complexity in these middleware products and the technical challenges surrounding them.

Advancing Architecture Maturity using SOA and BPM

SOA and BPM share common goals, all of which will help companies move to a more mature enterprise architecture stage. As mentioned previously, business management issues are likely to be harder to overcome than technical issues when implementing SOA. BPM methods help move the architecture to a more modular, service-oriented state by raising awareness of business processes, involving the business in IT decisions and increasing organizational flexibility, which is critical in the second and third stages of the architecture maturity model, where local flexibility is exchanged for global flexibility. SOA enabled by BPM principles delivers strategic alignment of corporate goals with processes, changing enterprise culture and its structure of leadership.

In the following sections, two design patterns will be presented that use SOA and BPM to solve common business issues. The design patterns provide good examples of services that are essential for advancing enterprise architecture maturity.

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[83] Gartner Research, "Twelve Common SOA Mistakes and How to Avoid Them" (October 2007)

Design Pattern – Business Rules Encapsulation

As business processes are analyzed and potentially modeled, a repeating pattern will emerge – that most business processes have a set of rules that govern their operation and that these rules may not be static and are subject to changes in the business environment. Also, in a large organization with many different processes, it's likely that some business rules may be repeated over and over again in different processes and systems. For example, a business process for leasing might require a service that calculates a customer's credit worthiness, which is a calculation based on a number of financial factors. This same credit score may be used in a business process for ordering equipment.

To solve the issues of changing business rules and rule reuse, business rules should be implemented as services in the SOA[84]. Rules can be encapsulated in services in a number of ways, from simply building logic-centric services (see Page 31, "Logic-Centric Services") to the implementation of a dedicated Business Rule Management System (BRMS).

Rules Processing at Acme Company[85]

Acme Company has three e-commerce web sites and two different internal systems for order processing. Each of these systems has its own order pipeline and business rules governing the ordering process.

At some point after these systems were established, a bill was passed in California requiring that any product shipped to CA with a display screen over a certain size would be charged an environmental fee. This fee only applies to non-government customers and the fee amount varies according to the product type and the size of the screen.

Since Acme company operated these disparate systems without an integrated order pipeline, the implementation of this business rule in all order processing

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[84] Intelligent Enterprise, "Business In Balance; Rules management and process management are both aimed at improving business agility and performance" (October 2006)
[85] This mini-case is based on my experience consulting at a major retailer of consumer electronics and is part of a more comprehensive case presented in Chapter 6.

systems involved three different development teams and took more than 6 months to develop, test and release. The amount of actual code to implement this single rule was rather small, but the coordination of these teams and the impact on production applications was fairly large.

Not only did this rule have a large impact on the IT organization and impact production applications, but it was implemented in a way that is inflexible and doesn't lend itself well to variation or extensions to this rule. For example, if another state chooses to follow California, the whole processes of changing business rules in these systems will have to be repeated. Moreover, if another state implements an environmental charge, but the rules and fees are different from California, the impact on production systems would be even greater.

Even if Acme Company didn't implement a full BRMS, the encapsulation of these business rules in a single place and the utilization of them in the order process would provide a huge advantage over the current situation.

Like BPM, business rule management is not simply software technology; it's also a management discipline[86]. And as in the case for business processes, many consultants and practitioners of business rule management believe you can achieve great benefit simply by documenting and centrally managing business rules, even without executing them on a business rule engine. What's required is a methodology for capturing business rules in plain English from subject-matter experts and then structuring that captured knowledge according to a few basic principles.

Design Pattern – Master Data Management (MDM)

Master Data Management (MDM) is a common design pattern found in many enterprise architectures and serves as an ideal example of the intersection between SOA and BPM. In a typical company, data and processes are encoded and identified in different ways

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[86] Intelligent Enterprise, "Business In Balance; Rules management and process management are both aimed at improving business agility and performance" (October 2006)

across different applications[87]. Those applications and business processes are often controlled by different groups, making it difficult to get commitment on a standardized master data set. This lack of consistency in master data has driven interest in master data management (MDM). The goal of MDM is to provide consistent, accurate, complete and timely master information describing key information, such as a company's products, vendors and customers.

MDM is a useful design pattern for advancing architectural maturity because it provides consistent data across systems and services. If data is inconsistent across applications, it is difficult, if not prohibitive, to build composite applications or execute business processes that cut across multiple systems and departments.

SOA practitioners should keep MDM in mind and address data inconsistencies as early as possible in the implementation. Appling BPM thinking and the analysis of business processes and the services they require should help expose areas that could be improved with MDM.

Master Data Management (MDM) at Nationwide Insurance[88]

As Nationwide Insurance grew, its data became siloed and scattered, making it increasingly difficult for the company to get an accurate picture of its finances and it was nearly impossible to get a snapshot of how the company was doing at any given moment. At the time, Nationwide ran its business on fourteen general ledgers, 12 reporting tools, 17 financial data repositories and 300,000 spreadsheets.

In early 2004, Nationwide embarked on a transformational project focusing on master data management that would alter how every Nationwide business reported its financials, how accounting was performed, how data was governed and by whom, and how the company's information systems would pull it all together. They had a simple goal: one platform and one version of the financial truth.

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[87] DM Review, "The Secret to Driving ROI in MDM: Get the Business Involved" (March 2007)
[88] CIO Magazine, "One Company, One Vision, One Truth" (January 2008)

For Nationwide, this was much more of a business and financial project rather than a technology project and it was a hard sell in some of the divisions that had run their finances independently for so long. *"The most difficult part was getting everyone to take their medicine because it was good for the enterprise"* remarked Robert Rosholt, Nationwide CFO. This difficulty in ceding local control (see "Architecture Maturity Stage 3 - Optimized Core") is typical and found in enterprises that are advancing their architectural maturity.

Adhering to a strict time constraint and 80/20 rule got the project delivered on time and it is considered a success, but most people involved in it stress that there is more work to do. The company's evolutionary approach to solving this problem will allow them to complete the remaining 20 percent of functionality in the near future and business units are already capitalizing on the improved business processes and data to experiment with new data analysis methods.

Chapter 6 - Case Studies

In this section, a number of case studies will be presented that illustrate the concepts introduced in this paper. It is the intention that these case studies will provide a foundation from which the reader can apply SOA and BPM to their own projects and initiatives.

Case Study 1: Penn State University Turns to SOA to Automate Workflow

Pennsylvania State University overhauled the 15-year old workflow system it uses to manage its business processes and the new system, which was built using business process management (BPM) tools, will be launched campus-wide using a new service-oriented architecture[89]. This 18-month effort covers more than 75 main business processes used by 16,000 employees and establishes a platform the automation of hundreds of additional processes.

The new workflow system will be the first consumer of services provided by Penn State's SOA, which is still under development. The university's IBM mainframe back-end system was kept in place and its applications and functionality were exposed with services in the SOA. Additional, disparate, back-end systems in various university departments were also integrated into the SOA. The university plans to add new Web-based applications on top of these and new service that arise from the emerging SOA.

The workflow system offers role-based authorization with automated approval paths and the automation of smaller processes at the individual department level will be undertaken with minimal IT involvement. According to Ron Rash, senior director for administrative services at Penn State, individual departments "literally have hundreds of processes they would love to automate". One of the first paper forms to be automated in the new system will be undergraduate travel request forms. Automation could cut the length of that process from three weeks to less than a day.

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[89] Computerworld, "Penn State University Turns to SOA to Automate Workflow" (August 2006)

Penn State was able to realize university-wide process automation with the application of BPM principles and service-based enterprise architecture.

Case Analysis

What I think is important to note about this case is that Penn State appears to be taking an iterative approach to their SOA and are planning for additional services to emerge from it over time. Also, the focus on workflow is a clear indication of the value they placed on understanding their business processes and the services implemented in the SOA are likely a direct result of this analysis. Finally, their approach to handling the functionality provided by their IBM mainframe is a classic example of encapsulating legacy functionality while advancing other portions of your enterprise architecture.

Case Study 2: Austin Energy Improves Business Processes with SOA

Austin Energy isn't using a business process management (BPM) suite per se, but it is realizing business process improvements as part of its enterprise-wide service-oriented architecture (SOA) initiative[90]. Two years in the making, the SOA initiative is helping the $1 billion electric utility integrate and leverage disparate legacy systems.

Planning and design of the new SOA is driven 100 percent by business processes and on its way to building the new architecture, the utility decided to tackle business processes very tactically, with well-defined requirements and desired benefits. Work on the first of those improvements began in November 2006, when the company targeted the customer support process around power outages.

Austin Energy used the WebSphere Business Modeler[91] to spot bottlenecks and potential improvements in the existing process. Scalability was the key problem, as the system could only handle about 4,000 calls per day. As the calls came in, the customer service reps couldn't log on fast enough; they experienced lags referencing customer

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[90] Intelligent Enterprise, "Two Ways To Win At Process Improvement" (August 2006)
[91] http://www-306.ibm.com/software/integration/wbimodeler/index.html

information in the databases and billing systems, and they couldn't create work orders quickly enough. To speed the process, the utility created a composite application comprising five Web services that link existing systems and databases on a robust SOA infrastructure. "The new application went live on May 3, 2007, and the very next day we had a storm and were able to process 20,000 calls," Carvallo says.

Average call times dropped to one-and-a-half minutes from the previous range of three minutes to five minutes. Adding to the savings, work orders were streamlined from a paper-based, batch-oriented system to direct integration with a workforce management and dispatching system.

Austin Energy is currently using the Modeler to find ways to speed and automate as many as 72 processes related to turning off and turning on service for customers and dispatching service crews. "Anything that involves mobile support, because the ROIs are very measurable, the benefits are quickly realized and they have a big impact on customer satisfaction," the CIO says.

SOA and BPM solved these business issues in a very complementary way. From Carvallo's perspective, "if you don't have your infrastructure, data models and integrations in place, you can't do enterprise-wide BPM. Maybe you could do one BPM solution at a time, but to me, SOA was the solution we wanted because we were trying to solve a corporate-wide challenge."

That said, Carvallo says the crucial difference between SOA and previous architectural approaches is that business processes drive it. "You map to the business process and you rationalize the infrastructure that delivers the functionality that makes that business process possible."

Case Analysis

In this case, Austin Energy was able to utilize "BPM thinking" in their modeling of critical business processes. When it came time to implement an automated solution for these processes, SOA's business-process driven approach and the emerging nature of enterprise architecture provided infrastructure to accomplish it.

Case Study 3: Project Alpha at Acme Company

This case study is based on my consulting work at a major consumer electronics reseller in 2004-2006[92]. I was hired by the company to address the shortcomings of their internal systems and IT infrastructure and to architect a set of new applications that would better address their business strategy. An additional issue is that Acme Company's SG&A is too high compared to its competitors; a significant portion of these costs result from inefficient business processes that are tightly coupled with and restricted by Acme Company's software applications (see Page 21, IT Stagnation). The project was launched by senior management as a major business and IT initiative and referred to as "Project Alpha".

For the purpose of this discussion, I will focus in on those applications and systems related to the sales process. I will describe the current state of these applications and systems, the issues surrounding them and how the proposed service-based architecture improves on these systems and advances the maturity of Acme Company's enterprise architecture.

Background

The company had a number of legacy systems either directly taking part in the sales order process or peripheral systems that played a role in sales-related activities like marketing. There was huge duplicity in these systems, which exhibited the classic "stovepipes" found in immature enterprise architectures (see Page 59, Architecture Maturity Stage 1 - Business Silos).

Existing IT Infrastructure

Acme Company's existing IT infrastructure was a product of almost 20 years of expansion and encompassed commercial and custom-built applications running on a number of platforms including IBM iSeries, Unix and Windows. On each of these platforms was a variety of database systems, including Oracle, DB/2, SQL Server and FileMaker. These platforms also supported business applications written in a host of

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[92] Company name withheld and referred to as "Acme Company"

programming languages including RPG, SQL, PowerBuilder, Visual Basic, Java, C++ and C#.

A number of critical applications that are part of the sales process were written by a third-party and little or no original documentation on the inner-workings of these applications was available. No remaining developers at Acme Company had detailed knowledge of how these applications functioned.

Customer Data

As one would imagine, customer data is incredibly important for a company doing direct sales to hundreds of thousands of business and residential customers. Acme Company started off with using and maintaining customer data all in one place - DB/2 on the IBM iSeries. As the company grew and additional business requirements emerged, a number of additional applications were introduced into the environment (see Figure 21), resulting in at least four additional points where customer data was maintained[93].
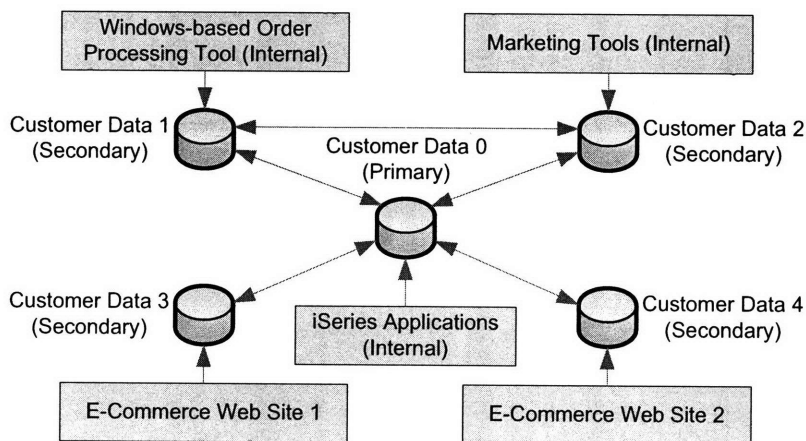
Figure 21 - Project Alpha: Customer Data Proliferation (simplified)

Besides the obvious lack of "Master Data Management" (see Page 61, Architecture Maturity Stage 3 - Optimized Core), this scheme had a number of serious drawbacks:

- More than three dozen scripts, applications and processes were employed to keep the customer data in these systems synchronized. The synchronization was complicated and prone to failure.

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[93] This view of Acme Company's customer data is actually simplified, at least another 3-4 customer databases were in use for other purposes.

- Customer data was not updated at the same rate in each system, resulting in a full 24-hour delay in customer data availability in some cases.

- Each customer database was different and tailored for the local application it supports, resulting in varying detail being stored for customers in each place. This also added to the complexity of synchronizing customer data between the systems.

- As customer data was inserted or updated in a secondary database, there was little or no duplication detection, resulting in the primary database filling up with huge numbers of duplicate records for the same customer[94]

- As a result of this and other unnecessary database complexity, at least three full-time database administrators were employed to maintain the data and synchronization processes.
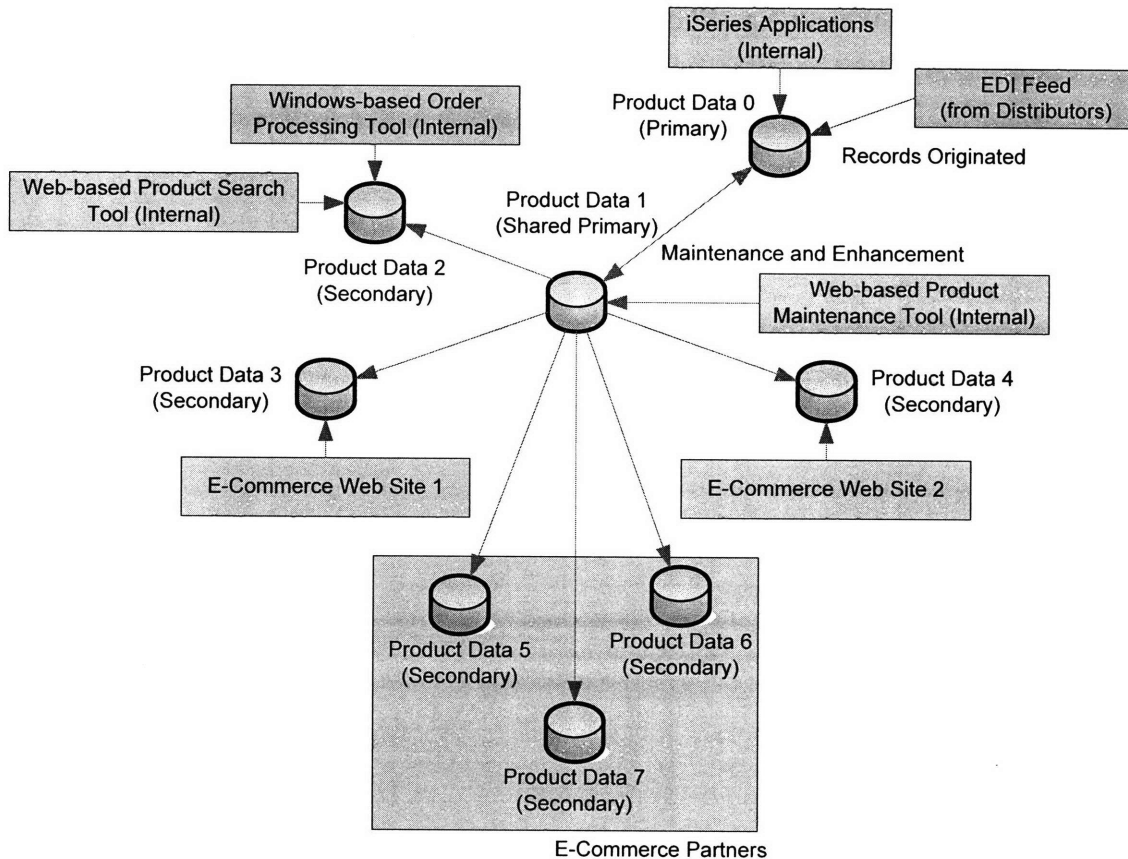

Product Data

Product data is essential for the sales process; customers and Acme Company's account managers must be able to find products and utilize the information to make buying decisions. The majority of product data records at Acme Company originate from EDI data feeds coming from major distributors like Tech Data, Ingram Micro, etc. The EDI feeds are received and processed with a complicated set of automated processes on the iSeries. A team of people in Acme's Product Management and Content Management groups then add additional marketing information to the base records. This process was originally performed on the iSeries, but at some point it switched to a web-based product maintenance tool utilizing a database external to the iSeries platform. Despite this secondary database now controlling a much larger portion of the product data in each record, the EDI feeds continued to be handled by processes on the iSeries, mainly because IT was reluctant to replace them after so many years.

As illustrated in Figure 22, the organic growth of systems over the years has resulted again in a complex web of applications and databases:

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[94] I personally ordered two items from the company in the years prior to working on this project and I somehow had 5 customer records in the primary database.

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Figure 22 - Project Alpha: Product Data Proliferation (simplified)

The problem of data synchronization and timeliness is especially acute, not only from the addition and modification of product records, but from the timeliness of other information that is associated with each product, like inventory availability and pricing. Customers are not going to tolerate inaccurate product availability information and management is certainly not going to be happy with inaccurate pricing. Solving these two problems involves a complex synchronization of product information from the primary databases to the secondary databases in a near real-time mode.

Despite the heroic efforts of the DBAs, the synchronization of product information between so many systems for 100,000 products is not simple or reliable. In addition to this complexity, this infrastructure suffers from the following business shortcomings:

- There is no real workflow between the products arriving in the EDI feeds to the group performing the markup of the base records. This sometimes results in lost customer sales when a product is viewed in Acme's Company's web site and the information is incomplete or inaccurate

- The group performing the markup of base product data records has no way to prioritize their work. With hundreds of new product records being created each day, this limited team does not have a way to organize their efforts to focus on high-margin or other strategic products.

- The delay in data synchronization, both for base product data and the additional information like availability and pricing makes it possible for a customer to see different information than the account manager is viewing using applications inside of the company.

- There was no way for Acme Company's product management teams to highlight certain products or to perform integrated sales campaigns that persuaded account managers or customers to choose one product over another. This affected the company's bottom line since manufacturers provide back-end rebates for certain products and the company would sometimes miss these opportunities.

Order Processing

The processing of orders in Acme Company is an important function at the intersection of both customer and product data. When the Alpha Project was initiated, Acme Company had more than four different systems that were capable of submitting an order, including multiple e-commerce web sites, an internal Windows-based application, JDE on the iSeries and EDI-based transactions (see Figure 23).
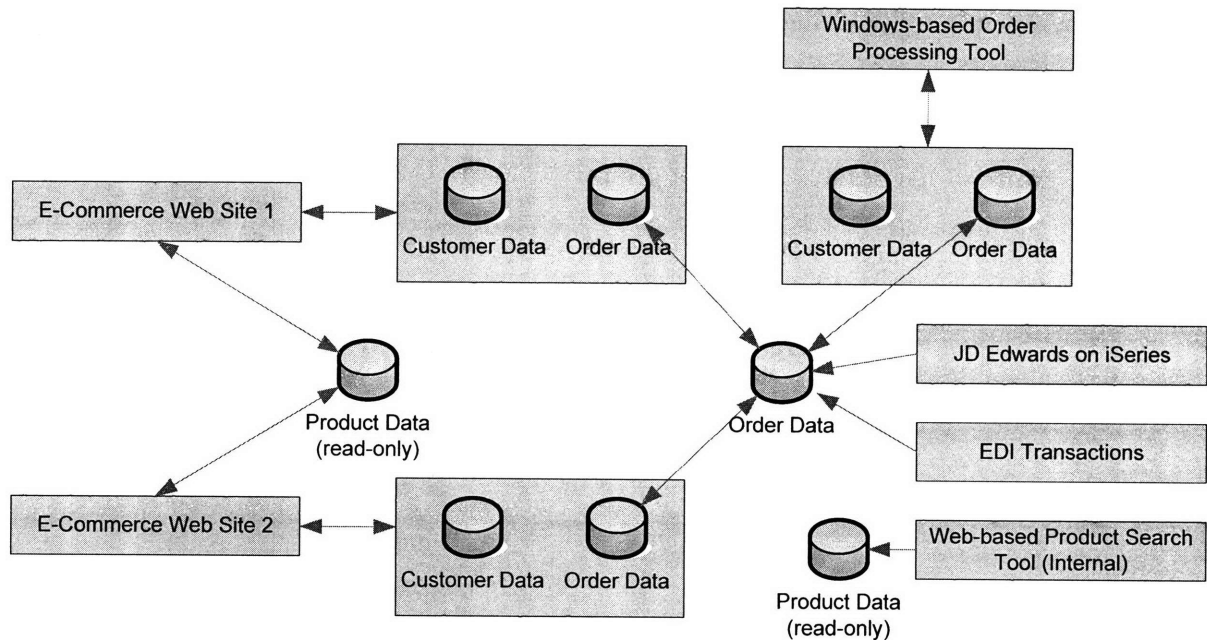
Figure 23 - Project Alpha: Order Processing

As you would expect from the pattern of IT expansion and architectural immaturity, there were many issues with maintaining so many order processing points, in addition to the inherited shortcomings of the customer and product data proliferation. What made the order processing aspect of the IT infrastructure so difficult are the pain points it created for both Acme Company and its customers. Below is a small sampling of these issues:

- Each of the systems capable of submitting an order had their own pipeline with their own business rules, processing and handling of orders. As an IT organization, this was expensive to maintain due to the varied platforms and software.

- An account manager, working with a customer and using the Windows-based order processing tool, would enter an order on behalf of a customer. In the case of some business orders, certain products would require complex configuration that wasn't possible in the Windows-based tool, so the account manager would have to partially submit the order and then complete it in JDE. This frustrated both the account managers and customers.

- Account managers would sometimes respond to RFPs and provide quotes to customers using the Windows-based order processing tool, which was capable

of sending faxes. Unfortunately, there was no automated way for customers to actually respond to the quotes, so the customer would have to call to accept or decline the quote. This was a time-consuming and manually intensive process, especially for complex quotes that were revised many times.

Project Vision

The Alpha project vision was to improve and/or replace business processes and supporting information systems in order to decrease costs and increase revenue by the following means:

- Increasing Employee and Customer Productivity
- Increasing Business and System Control
- Increasing Business and System Flexibility

In order to achieve this vision, the following principles were incorporated in the business requirements of the Alpha project:

Increase Employee and Customer Productivity

- Take a customer-centric approach - always think about the customers' needs
- Enable proactive users, not reactive users - when users must be reactive, enable quick responses
- Recognize that Acme Company employee "touch" is expensive - automate routine tasks and encourage customer and partner self-service. Improve and streamline communication internally among employees and externally with partners & customers.
- Empower the users - provide just-in-time information to the users and enable each user to make appropriate decisions right away
- Make information actionable
- Make information understandable, accessible and updateable in real-time - create central, universally accessible, data repositories

Increase Business and System Control

- Streamlined control - improved attribute level qualification and workflow for review and approvals

Increase Business and System Flexibility

- Modular architecture - databases and code will support flexibility that aids future unforeseen changes in business strategy
- Common concepts across all software modules improving development agility

Project Alpha Phase I - Overview

The most fundamental and critical business process at Acme Company is the process of selling products to the customer. Phase I of the Alpha Project focused on these four capabilities:

- Deal (Order) Management
- Customer Management
- Product Search
- SKU Creation and Maintenance
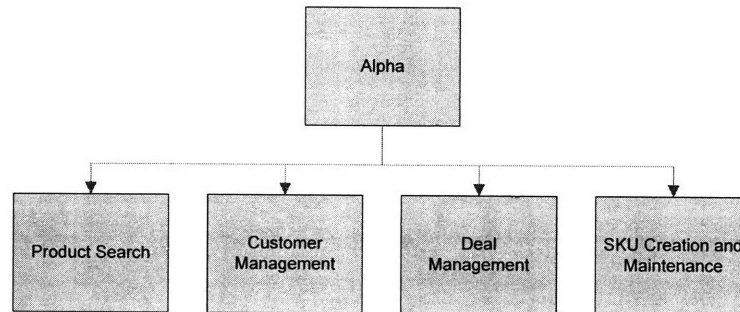
Figure 24 - Project Alpha: Major Project Modules

Each of these capabilities was a separate module within Alpha Phase I. In addition to implementing these four modules, new system and database architectures as well as database consolidations were be designed and implemented as part of Phase I.

The new architecture was designed to support both Phase I and future phases in a manner that standardizes business and system flexibility and control for the entire suite of modules. For example, capabilities that are needed by multiple modules, such as email, fax, printing, notifications, workflow, business rules, security and event logging, are provided in the architecture, enabling consistency across the modules.

Additionally, the new database architecture enables data to be stored once and accessed from any of the modules.

Major Alpha Modules

Deal Management

The process by which deals (orders) are created from a number of sources was studied and the architecture team decided to provide unified quote and order entry, maintenance and searching for the Acme Company sales force and customers via two user interfaces:

- Windows interface for the internal sales force
- Web interface for customers

Functionality for these two user interfaces was provided by a common service stack (see Figure 25) which is formed from the company's new service-oriented architecture (SOA). Interfaces to these services were provided at the appropriate level of granularity, allowing for a high degree of reuse and agility.
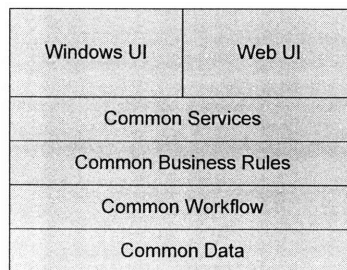
Figure 25 - Project Alpha: Common Service Stack

The Alpha Deal module became the master application managing the deal data for Acme Company. All deals regardless of source (Sales Force, Acme Company web sites, e-procurement and EDI) are entered into the Alpha Deal module and then sent to the JD Edwards system for fulfillment. Systematic and manual deal validation occurs in Alpha before being sent to JDE. Automatic synchronization between JD Edwards and Alpha will occur for an order's fulfillment data changes.
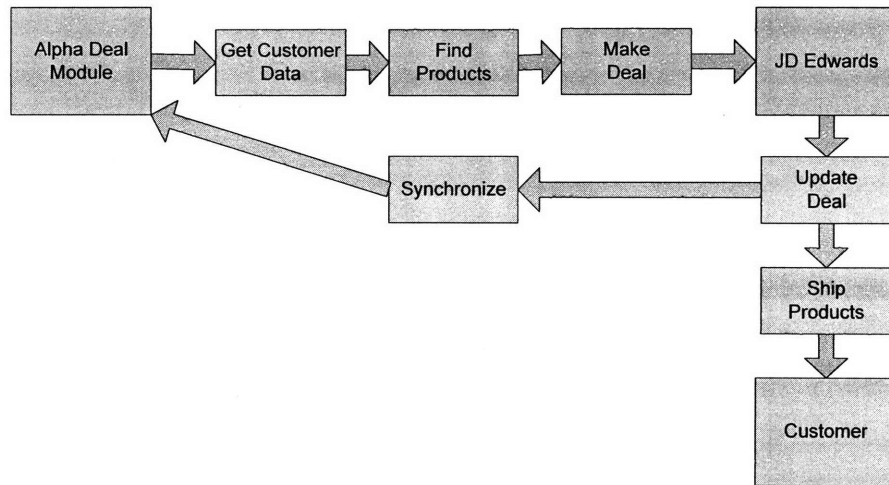
Figure 26 - Project Alpha: Deal Processing

The analysis of Deal Processing as a business process yielded a list of required services (see Figure 26). Some of these services already existed in some form in Acme Company's environment, but the majority of them needed to be built from scratch. Those existing services with interfaces that did not support industry standards, such as XML, were encapsulated by another, more capable service.

Among other benefits, unification of the current sales force application and web sites reduced business operational costs by enabling customer self-service of deals; the creation, editing and ordering of deals originated by both the Account Manager (AM) and the customer. This real-time interaction of customer and AM at the deal level was not possible with the companies legacy systems.

Customer Management

Unified customer data entry, data maintenance and data searching as well as "customer action" (reminders, alerts, etc.) management for the Acme Company sales force and customers is provided via two user interfaces: A Windows interface for the sales force and web interface for customers. The Alpha Customer module is now the master application managing the customer data for Acme Company.
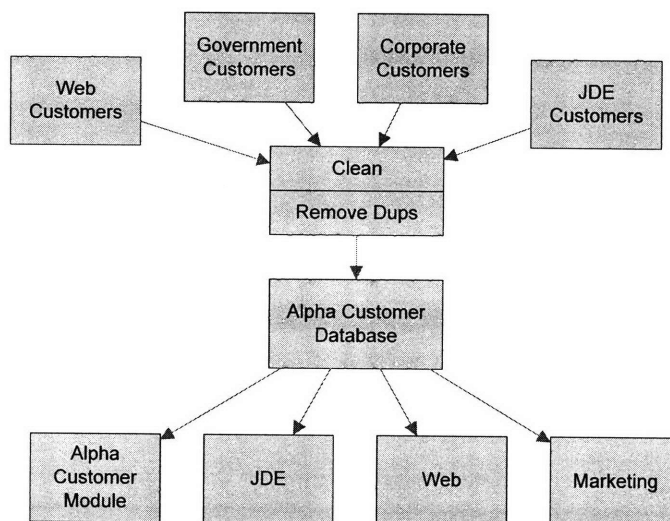
Figure 27 - Project Alpha: Customer Data Clean and Load

Implementation of this module included the consolidation of several currently existing disparate databases (Web customers, Government customers, Corporate customers and JDE customers) into a single Alpha Customer master database with two "downstream" databases (JDE and Customer Marketing Database). Duplicate customer records were radically reduced when the databases were consolidated into the Alpha database and will continue to be minimized by real-time detection.

This module includes the process of creating and disbursing leads to the account management team. Additionally, the Action Management process enables the user to maintain and review the list of open actions or tasks related to the process of selling products to customers.

Product Search

Product Search enables the sales force to find products and services available for sale as well as related products (i.e. companions) and bundles of products. The product search module relies heavily on the SKU Creation & Maintenance module, since it contains the master data record for product information.

In the first phase of the Alpha Project, a single repository of product data is used for all internal and external applications. For performance and scalability reasons, there will be

more than one physical instance of this data, but logically it will be based on a single set of information that is kept up to date real-time.

<u>SKU Creation & Maintenance</u>

The Alpha Project offers unified SKU creation, maintenance and searching for those departments that are responsible for creating and maintaining SKU information. The majority of SKUs are created via an automated SKU creation and modification processing system with a provision for a manual override interface for exception purposes to fix errors from the feeds from distributors. A minority of SKUs are created and maintained manually. The module includes unlimited numbers of attributes, pricing, categorization and grouping of SKUs.

Case Analysis

With the system complexity of Project Alpha and the relative immaturity of the architecture, most of the initial focus was on better understanding the business processes in place. No formal modeling of business process using a Business Process Modeling tool (see Page 43) was performed; for simplicity, we chose instead to document existing and proposed business processes using flowcharts and Microsoft Visio.

In this project, the process analysis could be categorized into three main types:

1. System to System – the process by which systems communicate with each other. This was most pronounced in the deal processing, since many different systems and applications are involved in the process.

2. System to Human – the process by which systems communicate with humans. This type was evident in most of the processes, since human intervention is required for things like supplementing product data records, responding to exceptions in the deal process or resolving potential customer data duplication.

3. Human to Human – this process type is what most people refer to as workflow and we ran into this in many cases where two or more people are needed to

complete a workflow. An example of this is the process by which quotes requested, sent to customers by account managers and then either accepted or declined by the customer.

What was most pronounced about the process focus was that it started people thinking about how to streamline the processes and, in some cases, replace the shadow processes (see Page 24, "Shadow Processes") that had been in place for years due to the shortcomings in the existing systems. Working through the process issues with the business was very time consuming and it was difficult to get people to focus on the intent of the process and the business value they add to the company.

As mentioned in the case, undocumented IT systems written 10-15 years prior in languages and software that is no longer supported added additional complexity. In most cases, if the functionality of these systems could not be completely re-written to hasten the legacy system's removal, the functionality was encapsulated behind a service so that it could operate as part of the SOA.

We approached the project in phases and many of the recommendations in the "Planning for SOA" and "Getting Started with BPM" sections of this paper were followed. While I think we successfully analyzed the processes and identified the services that would be required to automate them in the new architecture, the implementation of the architecture and realization of the Alpha Project took much longer than expected. A number of lessons learned from this experience are detailed below:

1. Don't underestimate the reluctance of IT to change – although this was a joint business and IT project, we found some IT staff to be entrenched in their existing systems and it was not easy to convince them of the benefits of SOA.

2. Embrace "BPM Thinking" – it's all about understanding the business processes, their interactions with other processes, their dependencies on human interaction and the services that are required to automate them. Focusing on the business processes yields business requirements that make sense to business and IT.

3. Staff properly – not all systems analysts and developers are equally skilled in process-thinking and service-orientation.

4. Don't just jump in – resist the urge to start developing immediately. Establish your architecture and provide a framework for the developers to build on.

5. Utilize off-the-shelf applications if possible - provided they can operate in an SOA properly and they have the features you need. Don't try to build everything from scratch.

6. Plan for the continuous emergence of the enterprise architecture – if you want to have agile IT, plan for it and build the services and the applications that utilize them to embrace change.

7. Utilize a development methodology that is also emergent and flexible – don't lock in the features you think you're going to develop, assume that business needs will change and features will need to adapt. Perform iterative analysis of the requirements as well as iterative development.

8. Have major backers – with an enterprise initiative like Project Alpha, you must have financial and management support at the highest levels of the company.

Chapter 7 - Conclusions

Implementing a service-oriented architecture with a set of disparate services is not itself strategic; SOA only becomes beneficial in advancing the business goals of an organization when services are assembled into composite applications that add real business value. The traditional bottom-up approach of building a SOA from services alone without consideration of business strategy is likely to be an expensive and time-consuming effort that increases the complexity of the enterprise architecture but does not advance the maturity.

Conversely, the principles of business process management take a top-down approach of identifying business processes, breaking them into sub processes and determining what services are required for automation. The limitation of this top-down approach is on the implementation side; the BPM thinking helps you with the analysis and creates a set of requirements, essentially "what" is needed, but doesn't provide guidance for implementing the processes in an architecturally mature way. Like some of the pitfalls of SOA, automating business processes without consideration for the entire enterprise architecture is likely to increase complexity and could lead to the undesirable effect of business silos.

To avoid these problems, SOA should be implemented with BPM thinking so that a bottom-up and top-down approach is performed simultaneously in an iterative manner. The key to this methodology is the identification of key service "platforms" from which services of similar type or functionality can be built. These service platforms become major elements of the enterprise architecture and provide a strong framework for the individual services that are required.
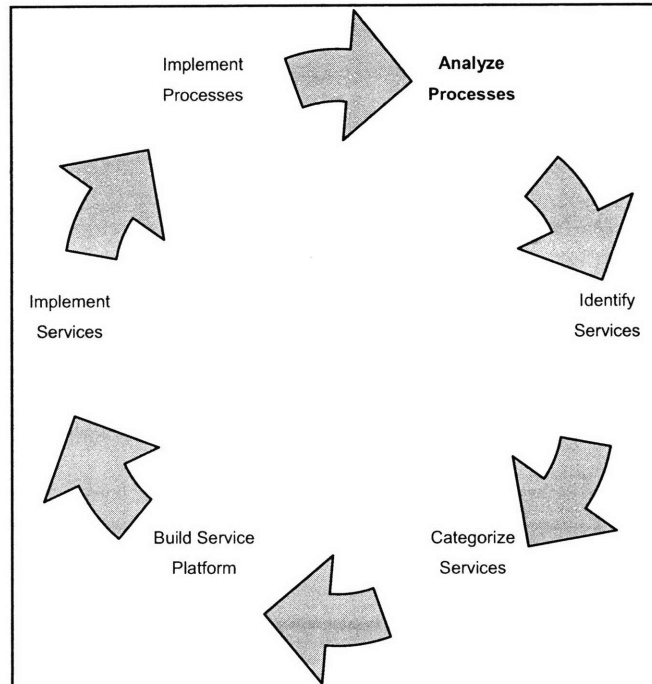
Figure 28 - Implementing SOA with BPM

Figure 28 offers continuous and iterative methodology that is technology and IT platform independent and instead focuses on business processes and service needs. The steps of this methodology are detailed below:

1. Analyze Processes – following the principles of BPM thinking, as illustrated in "Getting Started with BPM" and "Defining "BPM Thinking", processes are analyzed and potentially modeled in a tool that allows for business and IT collaboration. Those processes that advance the business goals of the company should be the highest priority. Typical areas of focus are described in detail in the "Problem Description" section of this paper.

2. Identify Services – a set of required services will come out of the analysis in the first step. These services should be examined in enough detail for discussion, but the mechanics of how the services will be implemented is not necessary at this step.

3. Categorize Services – as processes are analyzed and the set of required services become clear, there will be a natural categorization of services that emerge from the analysis. The Service Architecture (Page 29) section of this

document describes the different types of services that will be encountered. Typical examples of service categorization include rule services, workflow services and data-centric services, which can then be further categorized into specific subject areas (for example "Customer" or "Product").

4. Build Service Platform – based on the needs identified in the service categorization, appropriate service platforms should be established. For example, if workflow is a common service requirement, a service platform that supports a flexible means of providing workflow for all of the services that require it is an architecturally mature way of implementing these services. In an enterprise-wide implementation of SOA, it is likely that a dozen or more of these platforms will be identified for things like security, workflow, business rules, event handling, etc.

5. Implement Services – in this step, the services are actually implemented on the service platform. Coordination and agreement on the service interface must be made in advance of the implementation for the service's useful inclusion in business processes. This is a difficult step to master and several levels of granularity (see Page 33, Intermediary Services) may be required to satisfy different situations.

6. Implement Processes – once the lower-level services have been established, the business processes can be implemented as composite applications on top of these services.

This methodology allows the business-oriented, top-down approach of BPM thinking to meet the bottom-up, IT-oriented approach of SOA to meet somewhere in the middle. While you could implement one without the other, you have a better chance of achieving business improvement by using both approaches in a complimentary manner.