ECONOMIC JUSTIFICATION OF SERVICE-ORIENTED ARCHITECTURE

RESEARCH STUDY: EXPERIENCES AND GUIDELINES ON BUILDING SOA BUSINESS CASES
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As service-oriented architecture (SOA) undergoes mass adoption and establishes itself as a de facto technology standard for implementing software architectures for increased flexibility, efficiency, and insight, organizations are looking for more economic justification for their SOA projects. This study focuses on the quantifiable SOA business-value proof points that organizations are using to convey the benefits of an SOA strategy to decision makers.

To enable best-practices sharing, SAP cooperated in this research with the University of St. Gallen, Institute of Information Management (IWI-HSG), interacting with SAP and non-SAP customers in industries such as financial services, telecommunications, media, and the public sector. Key findings from the study show that customers approach making the business case for SOA in two different ways.

The first is an IT-centric approach (the SOA infrastructure business case) in which the benefits of the SOA technical infrastructure and IT organization are the driving factors behind implementation. This approach values the IT savings that SOA can bring, such as its reuse of services or the efficiency gains experienced through reduced software-development time and related cost. “Our study shows that service orientation significantly improves the reusability of software functionality,” says Prof. Dr. Robert Winter, Institute of Information Management, University of St. Gallen. “In mature organizations, we found an average reuse rate of four, which leads to considerable IT consolidation and cost-saving potential. However, strict governance is absolutely vital.”

The second approach is business-driven (the business process platform business case), which all SAP customers participating in this study pursue. This uses the IT-centric method as one component in a broader, more comprehensive way of evaluating SOA. Burda Digital Systems GmbH, for example, approaches SOA from an enterprise standpoint, as an open architecture for adaptive business solutions. “SOA is a powerful concept that allows us to increase our productivity dramatically,” says Gerhard Thomas, CEO of Burda Digital Systems. “We achieve 10% to 20% savings in operations cost and 20% to 30% shorter project durations across our IT landscape. Sometimes it’s even more. However, the major benefit of SOA unfolds on the business-process side. We achieve increased process efficiency of between 10% and 30% and also benefit from improved process quality due to consistent data and role-specific process design. This is only possible if you closely align your IT with the business and design services along process needs. SAP’s concept of built-in business semantics in enterprise services is exactly the way to guarantee this.”

**MANAGEMENT SUMMARY**

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A business process platform with service-enabled solutions, prepacked enterprise services, and a business intelligence and unified technology foundation helps companies run core business processes efficiently and allows them to reorganize, extend, or create new business processes flexibly at predictable cost across the IT environment. A business process platform enables standardization and innovation at the same time.

With a business process platform following SAP’s business-driven SOA approach, the City of Hagen was able to meet new challenges faster and more effectively while also responding faster to demands from constituents. In a joint project, the University of Hagen and the City of Hagen designed and built the “Rathaus 21” – an online portal for citizen and constituent services. “Ensuring compliance with legal regulations, such as the new European Union service directive, is critical for public administration,” says Prof. Dr. Gunter Schlageter, Institute for Cooperative Systems, University of Hagen. “At the same time, we also need to provide new or enhanced citizen and constituent services. SAP’s approach to SOA allows us to drive flexibility and efficiency into our processes. We are now able to provide improved public services and achieve higher efficiency at the same time. The resident registration process is a very good example: we increased our internal-process efficiency by 16%, because citizens can now use a new self-service interface and benefit from a reduced process-execution time – from 8 days to 60 seconds. For us, SOA is not only a technological concept – it has strategic relevance for our business.”

SAP embarked on this study with the University of St. Gallen to find out how organizations approach SOA to adapt to rapidly changing market needs and how they calculate their business cases to justify the investments. SAP views this study as an installment in the qualitative research and feedback that it is constantly collecting from its customers. As the study shows, many SOA projects start small and without an explicit business case, but once SOA adoption gains momentum, organizations must prove the value of the initiative.
1 INTRODUCTION

1.1 Motivation and Goal of the Study
As global competition intensifies and the speed of change accelerates, successful businesses have to break down the barriers between strategy and strategy execution, between their own organizations and their ecosystem, and between business and IT. To continuously optimize business performance, organizations must ensure that their strategies are executed properly across their entire value chains. Today, whole business networks need to operate as efficiently and nimbly as a single organization had to just a couple of years ago. As part of those business networks, individual companies continuously increase competitiveness while moving nondifferentiating tasks to business partners. The resulting business network transformations deliver superior (aggregate) customer value. Business is turning to IT to deliver the efficiency, insight, and flexibility it needs. By using IT strategically, organizations can improve operational efficiency and enable business innovation at the same time. Therefore, IT must get ahead of the curve to transform the existing IT infrastructure into a more flexible business process platform and enable better support of the company's business needs. That's why IT organizations increasingly leverage service orientation to improve their ability to serve the needs of the business more quickly and at lower cost. According to research from Accenture\(^1\), high-performing organizations are twice as likely as low performers to use SOA.

SOA is currently undergoing mass adoption and is establishing itself as a de facto standard for software architectures. A recent report from AMR Research Inc. states, “Fifty-three percent of the companies we surveyed in the United States, Germany, and China reported at least one SOA project completed or underway in 2007, with the differences between geographies, industries, and company size smaller than ever before. SOA is becoming a global enterprise IT requirement. Our most recent studies show SOA adoption grew by over 100% in 2007. By our estimates, 77% of all companies with more than 1,000 employees will adopt SOA in some form by 2012.”\(^2\) And a report from Gartner Inc. finds that “SOA was used, to some extent, in more than 50% of large, new applications and business processes designed in 2007. By 2010, we expect that more than 80% of large, new systems will use SOA for at least some aspect of their design.”\(^3\)

\(^2\) Finley, I., Kraus, B.: The SOA Market to Hit $51.9B in 2012 (AMR Report 2008).
Initial SOA projects often start without an explicit business case. In many cases, the spending is funded out of the IT budget. The focus is mostly on “learning” the new technology and addressing specific but isolated pain points.

As the number of SOA projects and spending increases, the need for proving value in business cases becomes key in order to get management commitment and business sponsorship. However, experience has shown that return on investment (ROI) figures for SOA are elusive. Many IT organizations struggle to link technical SOA capabilities and characteristics to IT and business benefits. But this step is essential to convince business management, because managers usually do not want to sponsor “pure” IT infrastructure projects and do not care about the technological concept of SOA. A value-oriented SOA business case can help to bridge that gap by explicitly defining quantifiable business benefits. But what are these business benefits, and what are the differences regarding methodology, structure, and tools for SOA business cases compared to traditional business cases for IT projects? How do you sell SOA to your business leaders? What is a suitable structure, and how do you start building an SOA business case? What are the best practices that mature companies follow?

The goal of this study is to address these key questions by showing how companies experienced with SOA calculate business cases and ROI figures and prove the IT and business value of SOA.

The study targets organizations that intend to implement SOA, companies that want to verify their business case calculations, and consulting companies or system integrators that support organizations in SOA adoption. It offers a pragmatic approach to help companies justify SOA investments by focusing on the business perspective rather than on the technical capabilities of SOA.

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1.2 Study Approach and Participating Companies

This study is a joint research effort of SAP AG and the University of St. Gallen, Institute of Information Management (IWI-HSG).

The research approach follows commonly accepted methodology for case studies. A case study is an empirical inquiry, performed by interviews, surveys, or observations, that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between the phenomenon and the context are not clearly evident. Particularly in this case, where SOA business cases and economic justification are subject to analysis, a variety of context factors have to be taken into account. Therefore, this document presents the results of the validation of a generic cost and benefit framework for SOA business cases. The sample of participating companies was limited to a small number because the focus is on depth rather than breadth. That’s why the study results are not claimed to be representative. The collection of data was conducted in face-to-face interview sessions with SOA experts in the participating companies. The interview guidelines were designed by business consultants of SAP and researchers of IWI-HSG, based on thorough research on contemporary topics of SOA adoption and SOA business cases. Participating companies were selected based on the status of their SOA initiatives and their experience and activity in the field of economic justification and business case calculations for SOA. Importance was also attached to the diversity of industries within the sample. Participating companies represent financial services, telecommunications, media, and the public sector. Customer status of SAP or IWI-HSG was not an issue in the selection process.

Since business case information is subject to confidentiality, SAP AG and the University of St. Gallen agreed on keeping all cost and benefit data of all study participants anonymous except for the information given in officially approved customer quotes in the management summary. Therefore, it is not possible to draw any conclusions about specific cost and benefit information at specific organizations. All participating companies agreed to identify themselves by name. The participating companies are Burda Digital Systems GmbH (media), Institute for Cooperative Systems GmbH, University of Hagen/City of Hagen (public sector), E-Plus Service GmbH & Co. KG (telecommunications), Bauer Systems KG (media), and Credit Suisse Group (financial services).
In a later phase, the researchers plan to design a more strongly structured interview guideline to approach a broad range of companies that express willingness to disclose details of their ROI calculations. Having this type of broad empirical basis would enable companies to reliably calculate and benchmark their SOA business case within their respective industries.

1.3 SOA Definitions and Terminology

As the perception of SOA varies from organization to organization, it was essential to have a common understanding of the architectural concept of SOA and the terminology upon which the discussions with the study participants were based. Therefore, the following definitions of SOA and the approach to SOA supported by SAP are used:

- **Service-oriented architecture (SOA)** is an information systems architectural concept for creating and using independent functions packaged as services. An SOA is essentially a collection of services. These services communicate with each other, and that communication can involve either simple data passing or two or more services coordinating some activity. Some means of connecting services to each other is needed. A service is a function that is well defined, self-contained, and not dependent on the context or state of other services. Web services are a common connection technology of service-oriented architectures.

- **SAP** supports a unique, enterprise-oriented approach to implementing SOA. This approach aims at leveraging the established aspects of SOA, such as its strong link to established standards for the enterprise as a whole. It does not remain in the technology domain but takes SOA to the core of every company’s business. It aims at connecting the business domain with the technology domain in a holistic and consistent manner. At the heart of SAP’s approach to SOA is the concept of enterprise services. Enterprise services allow leveraging SAP® solutions in conjunction with partner solutions and homegrown solution landscapes to build new, flexible, and innovative solutions based on the consistent integration concept of SOA. Enterprise services can be used in application-to-application (A2A), business-to-business (B2B) integration, and application-to-user interface/composite⁵ (A2X) scenarios.

In a nutshell, enterprise services are highly integrated Web services combined with business logic and semantics that can be accessed and used repeatedly to support core business processes.

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⁵ A composite application makes use of data and functions provided as services by underlying applications and combines these into a coherent business scenario, supported by its own business logic and specific user interfaces.
SAP has SOA-enabled its SAP Business Suite applications by exposing their business functionality in the form of enterprise services as ready-to-consume process steps with built-in business semantics. These enterprise services are grouped along business scenarios as so-called enterprise services bundles and are based on an SOA governance model to manage the enterprise services for a consistent business semantic, together with life-cycle management capabilities.

Enterprise services governance provides consistent, business-oriented terminology and integrated modeling for business and IT, ensuring high service reuse and supporting faster process implementation. Consistent behavior, reliable execution, and uniform error and exception handling help to reduce IT operations costs. Service developers can take advantage of modeling and implementation guidelines to increase development efficiency. Enterprise services from SAP follow the enhancement package concept, which allows new functionality to be added in a continuous manner without big upgrade cycles.

Within this study, the term “SOA governance” refers to the processes, policies, and associated control mechanisms a company establishes to steer the adoption, implementation, and evolution of SOA in line with business needs. Governance provides SOA initiatives with structure, discipline, and control. Consistently successful SOA calls for a holistic and evolutionary governance approach that encompasses people, processes, and technologies.

1.4 Customer Situation and General Results
Participants typically started to look into SOA because they had complex IT landscapes coming from many different applications, including self-developed and best-of-breed solutions. Their networks have grown and expanded over time and so has their IT. As a result of this complex landscape with mostly hard-coded processes inside the applications and hard-wired connections between applications, the organizations spent a major part of their IT budgets on maintaining the status quo (by creating and maintaining interfaces or by providing user support). Adapting to changes in business processes was difficult and frequently required substantial effort in terms of time and costs both to change the IT infrastructure and for the users. The combination of these two aspects leads to the vicious circle in which IT departments could only slowly adjust to changes in business needs because most resources were already devoted to keeping the existing systems running.
The SOA concept offers companies a method for breaking up these rigid structures into encapsulated and flexible services while still being able to leverage existing investments in applications and IT systems. Moreover, a gradual move toward the new architecture is possible, and no disruptive big-bang approach is required. Aside from IT cost reduction potential, this also creates a more open, flexible, and manageable platform to support change and growth.

When asked about their most important drivers and the strategic benefits of their SOA initiatives, the study participants gave these answers:

- IT productivity increase
- Improved process/user productivity
- Increased flexibility
- Faster time to market
- Facilitation of postmerger integration
- Higher insight/transparency

Regarding their SOA adoption, the study participants showed different maturity levels, from introduction and proof-of-concept stage, addressing one specific challenge within one application, to a strategically deployed SOA infrastructure for several hundred applications over different organizational entities. The most advanced participating company started conceptualizing work on service-oriented architecture 10 years ago and currently has over 2,000 services implemented with 15 to 20 million calls per day.

By looking at SOA adoption, we identified three architectural use patterns among the study participants. These patterns are the main drivers from an IT architecture point of view:

- Connectivity in business networks
- Open consumption
- Accelerated business process innovation support
These architectural use patterns have also been identified by analyzing over 200 SOA reference customers that follow SAP’s approach to SOA. These architectural use patterns are relevant to players of all sizes in all industries.

1.4.1 Connectivity in Business Networks
Customers are deploying SOA to foster the collaborative aspects of their business networks. SOA enables near-real-time collaboration in networks with a high degree of process automation. Companies are able to connect across diverse and distributed IT landscapes.

A participating company stated that it is able to share its flexible process landscape with third parties, which generates new revenue streams and leads to economies of scale. Another organization built up a shared-services platform and is now able to integrate new partners much faster than before.

1.4.2 Open Consumption
An important driver for the majority of the participating companies was the creation of simplified, role-specific processes for users. SOA enables the creation of role-specific interfaces for interaction with different back-end systems and on various devices or channels for user interaction (such as mobile devices).

For example, a participating organization integrated a worldwide unified Web front end into different back-end systems. All this was realized at reduced cost in comparison with traditional methods. The company realized significant user productivity gains and reduced software development cost by 10%.

Another participant implemented new standardized and automated end-to-end agency processes on a shared-services platform. The reusability of central functions like authentication, payment, and accounting improved efficiency and compliance and was key to fulfilling increased business demands in a very cost-efficient way.
1.4.3 Accelerated Business Process Innovation Support

A business process platform enables integrated processes across applications in heterogeneous IT landscapes spanning various locations and back-end systems and different releases of the same application.

Study participants are deploying SOA as a means of coping with the dilemma of consolidation versus innovation in their IT landscape. Instead of keeping their investments high in legacy applications, they instead choose to provide innovation on top of their existing IT landscape with composites, thus reducing the cost of future innovation. A composite application makes use of data and functions provided as services by underlying applications and combines them into a coherent business scenario, supported by its own business logic and specific user interfaces. One study participant used SOA as a new integration technology (A2A and user interface). Main drivers were the coupling of different mainframe applications and their integration with a worldwide unified (Web) front end.

According to an SAP customer in the sample, the use of industry-specific process blueprints for future processes is key to a shorter development cycle due to faster prototyping, earlier involvement of business departments, and faster implementation. It also leads to an increase in flexibility and efficiency in cooperation with external business partners.

While these use patterns show SOA adoption more from an architectural point of view and explain the diversity of SOA capabilities, the following section presents the resulting IT and business benefits.
2 BLUEPRINT FOR SOA BUSINESS CASES

Key findings from the study show that customers view the business case for SOA in two different ways. There is no “one size fits all” approach because customer situations and business and IT needs are mostly specific due to IT landscape history and business models. Nevertheless, we found two main patterns for how participating companies approach the business case challenge for SOA. The first is an IT-centric approach (SOA infrastructure business case) in which the benefits of the SOA technical infrastructure and IT organization are the driving factors behind implementation. This approach mainly values the IT savings that SOA can bring through its reuse of services or the efficiency gains experienced through reduced software-development time and cost.

The second approach all participating SAP customers pursue uses the IT-centric method as one component in a broader, more comprehensive way of evaluating SOA. For the participants following this approach, SOA is not an IT-led initiative driven by technology. It is a business-driven architectural approach that helps IT organizations work with their business counterparts to realize a flexible business process platform. Therefore, the business case is not an SOA infrastructure but a business process platform business case in which business process benefits, strategic business benefits, and IT benefits are considered.

Figure 1 describes the main differences in the two business case approaches.

<table>
<thead>
<tr>
<th>IT-Centric Approach</th>
<th>Business-Driven Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus</td>
<td>Focus</td>
</tr>
<tr>
<td>Business case mainly covers IT-related measures like IT infrastructure and organization</td>
<td>Enhancing IT-centric approach in showing proven quantifiable benefits on IT and business side</td>
</tr>
<tr>
<td>Key Drivers</td>
<td>Key Drivers</td>
</tr>
<tr>
<td>&quot;Reuse of services&quot; as the most relevant driver for savings</td>
<td>As a result, extends the business case beyond &quot;just&quot; SOA (business process platform business case)</td>
</tr>
<tr>
<td>Focus on IT efficiency gains like reduced software development cost and reduced software development time</td>
<td>Comprises IT, business process, and strategic benefits</td>
</tr>
<tr>
<td>Conclusion</td>
<td>Conclusion</td>
</tr>
<tr>
<td>Missing connection between business and IT – SOA benefit hard to communicate</td>
<td>Strong involvement of lines of business – expected value of SOA clear on business and IT side</td>
</tr>
</tbody>
</table>

Figure 1: Different Business Case Approaches to Service-Oriented Architecture

In the following sections, these two approaches are described in detail. None of the participating companies used all the benefits and cost items, because of their specific situations, needs, and SOA adoption strategy. What follows is more a collection of best practices showing general patterns in structuring SOA business cases.
Starting with the description of the general framework for business case calculation, the following sections describe the benefit and cost categories of both approaches. Examples of quantitative benefits and benefit metrics are given for each category. For the benefit metrics, concrete customer experiences are described. All benefit categories are validated by the participating companies, but not all were used in business cases due to the lack of suitable quantifiable metrics. This is the gap the study wants to close by providing best-practice approaches from the University of St. Gallen and several (extensible) SAP reference projects.

2.1 SOA Infrastructure Business Case

The SOA infrastructure business case includes the calculation of the costs and benefits of the SOA technical infrastructure and IT organization. The benefit categories focus on the factors increasing IT productivity and organizational benefits; the costs include investments for the technological foundation and organizational aspects.

2.1.1 Framework, Cost, and Benefit Categories

The proposed costs and benefits of SOA adoption can be subdivided into quantifiable and qualitative measures, which include one-time and ongoing items. The cost and benefit categories represent the accumulated factors that were evaluated in the study.

2.1.2 Quantitative IT Benefits

This section presents quantitative measures of the IT-centric SOA business case. Benefit and cost categories of IT productivity and organization are listed and explained. Table 1 gives an overview on the benefit categories and quantitative measurements of IT productivity that were identified in the study.

Figure 2: SOA Infrastructure Business Case Framework
<table>
<thead>
<tr>
<th>Benefit Categories</th>
<th>Examples of Quantitative Measurements</th>
<th>Benefit Metrics Examples and Customer Examples</th>
</tr>
</thead>
</table>
| Development efficiency/reusability  | Less interface and functionality development efforts due to reuse, minimized coding, pattern-based development, and so on, leading to shorter project time, lower project costs, and less testing costs due to reduced dependencies | Suitable benefit metrics:  
  ▶ Percentage of overall development costs  
  ▶ Amount of reusable services times reusability factor times interface/functionality development costs  
 Study customer experiences:  
  ▶ 10% overall development cost reduction  
  ▶ Highest reusability factor of 4 led to €35 million savings  
  ▶ 50% to 70% reusable services  
  ▶ 20% to 30% shorter project duration  
 Additional SAP reference customer experiences:  
  ▶ Oil and gas company: development of new applications in 2 weeks instead of up to 6 months  
  ▶ Logistics services provider: reduction of integration effort by 30% |
| Operations/maintenance efficiency   | Operations cost reductions and reduced maintenance costs due to consolidation of redundant functionalities, data, and interfaces; less need for user support due to user interface simplification and empowered users | Suitable benefit metrics:  
  ▶ Difference between operations and maintenance costs of traditional architecture and service-oriented architecture  
  ▶ Productivity increase  
 Study customer experiences:  
  ▶ 10% to 20% savings in operations  
  ▶ Productivity increase through internationally unified screens on different back-end systems  
 Additional SAP reference customer experiences:  
  ▶ Financial service provider: change cost savings of 70% to 80% |
| Application life-cycle extension    | Avoidance of cost of new applications due to extended application life cycle by wrapping of legacy functionality and reuse in new processes | Suitable benefit metrics:  
  ▶ License/development costs of providing functionality by service minus license costs of legacy software  
 Study customer experiences:  
  ▶ Extended application usage confirmed by customers |
| Consolidation                       | Reduced cost for hardware, licenses (operating systems), and database tools or products by leveraging existing assets and avoiding additional maintenance costs for new equipment; midterm skill cost reduction due to consolidated IT platform | Suitable benefit metrics:  
  ▶ Reduced license costs (operating systems)  
  ▶ Reduced hardware costs  
 Study customer experiences:  
  ▶ Cost reduction by access consolidation to third-party services |

Table 1: IT Productivity Benefits
The benefits from service orientation arise from the encapsulation of IT functionalities, which enable distributed sourcing, development, and management activities. Following the principles of autonomy and modularity, a service can be developed and modified without the necessity of changing all the entities connected to this service.6 However, the possibility of modifying and developing services that are independent and distributed requires a strict commitment to governance mechanisms and service design guidelines, as well as compliance with defined standards. All participating companies in the study confirmed that SOA governance is mandatory to realize the benefits described later in this section. Therefore, participating companies prefer a holistic approach to SOA governance with a proven design and modeling methodology to ensure reusability. Harmonized business semantics enable accessibility of required functionality across all back-end applications, and tools enable governance automation and life-cycle support of all SOA-based applications. Once governance mechanisms are implemented, service orientation offers new concepts of distributed system responsibilities, such as service ownership, which enables more efficient ways of stakeholder coordination and communication, especially in terms of development and maintenance. Compared to large-scale software systems, services represent much smaller, and therefore more manageable, units. As a result, it is possible to assign transparent costs to the development process. One participating company of the study stated that six days are needed to develop and test one service. With this ratio and the respective development rationale known, the goal of reducing the time to four and a half days could be expressed.

Development Efficiency/Reusability
Cost reductions in the development process can be found when comparing the effort of creating certain functionalities in a service to the implementation of the same functionality in a monolithic system with complex and inexplicit dependencies. From a technical and economic perspective, the reusability of services is a core argument for service orientation. Cost-saving potential can be found in the development process and deployment, where existing services can be reused instead of redeveloping functionalities. An approach to quantify the savings is the calculation of development costs per service multiplied by the number of reused services.7 The highest average reuse rate identified within the study was four, which, in that particular case, led to cost savings of €35 million.

In one of the cases, development cost could be reduced by 10%. Because interfaces can be reduced through reuse, significant cost savings can be realized as well, assuming an average cost per interface of €5,000 to €10,000. Participating SAP customers confirmed that SAP's concept of productized enterprise services with common underlying semantics (harmonized data model) enables faster development and deployment.

The benefits of more-efficient communication between business and IT should be taken into account as well. Participating companies perceive an important advantage in shortened development cycles because business users are more eager to get involved when the definition is based on business requirements, not IT requirements.

Restructuring software development processes and the concept of reusable services reduce the need for development and testing personnel. Particularly, testing becomes much more efficient because services' dependency on each other is reduced by design. (A prerequisite for this benefit is following sound service-design rules.)

**Operations/Maintenance Efficiency**

Reuse of services implies that redundant functionalities can be built into one service that is then called and executed in all needed contexts. The minimization of redundant functionality results in cost savings due to reduced development and maintenance costs. (For example, most applications will need a service to find a customer, so this service can be written once and reused in many contexts.)

Participating companies reported less user disruption during new release rollouts by just adding new functions and keeping the user experience consistent rather than changing the front end with each release.

Furthermore, instead of big-bang application introductions, SOA offers the possibility of delivering the required functions to the user earlier and in smaller chunks. This reduces the complexity of the application, provides faster feedback cycles and application updates, and shortens delivery time, which leads to less operational effort and cost on the IT and business side.

The service-design guidelines mentioned earlier and concept of distributed responsibilities enable new ways of collaboration. Cost-saving potential arises, for example, in offshoring and outsourcing operations and development. Therefore, SOA's demand for strict IT governance also increases overall IT efficiency.
Application Life-Cycle Extension

Legacy systems can be integrated into an SOA via dedicated services that encapsulate only the needed functionalities. Since the replacement of the entire system would be the alternative, cost savings can be realized in the extended life cycle of legacy systems.

Consolidation

Decoupling the application landscape by implementing SOA enables new virtualization technologies to be leveraged to reduce hardware and operating system license and maintenance costs. Supporting new required business processes through composite applications avoids additional hardware and software (operating system) cost by consuming services provided by existing applications. An example in the financial sector showed that multiple systems used individual interfaces to external market data services. The SOA approach enabled the consolidation of these interfaces and thus decreased licensing costs for the external market data service significantly.

Organizational benefits of SOA that were discovered in the study are listed in Table 2, which outlines benefit categories and quantitative measurements.

<table>
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<th>Examples of Quantitative Measurements</th>
<th>Benefit Metrics Examples</th>
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<tbody>
<tr>
<td>User interface (UI) simplification</td>
<td>Reduced training costs, fewer skilled employees, and a shift from power user to front-office agents because of simpler and unified UI using Web services</td>
<td>Suitable benefit metrics: ■ Reduced user training costs ■ Increased user productivity ■ Decreased cost per transaction Study customer experiences: ■ Benefits are confirmed by customers. However, calculation of user productivity gains are only possible in specific business process context within a business-driven approach.</td>
</tr>
<tr>
<td>Future proof</td>
<td>Access to cheaper open-market skills and reduced need for external consultancy services by using open standards for the enterprise as a whole</td>
<td>Suitable benefit metrics: ■ Reduced recruiting, training, and consulting costs in the long-term perspective Study customer experiences: ■ In first projects, these benefits are assumed but not yet realized.</td>
</tr>
</tbody>
</table>

Table 2: IT Organizational Benefits
Organizational benefits are generally harder to quantify due to the indirect nature of effects that SOA has on the organizational structures and processes of a company. However, organizational benefits could also be observed for the IT-centric business case.

User Interface (Simplification)
The modularity of SOA enables more-efficient system design, which has an impact on operational excellence. With the flexible orchestration of services, media discontinuities can be avoided by the flexible composition of workflows along processes via any device (such as mobile, voice, and so on). An increase of user productivity can, for example, be measured by the number of transactions per time unit.

The design of user interfaces is a central factor that influences system acceptance and user productivity. SOA enables the IT organization to clearly separate the user interface from the underlying application functionality. This offers the possibility to launch projects to redesign and unify screen designs. A consistent and unified screen design that is independent from underlying services enables users to work efficiently with various systems without fundamentally adapting the way they interact with the system.

Intuitively and uniformly designed user interfaces across the entire company reduce the effort for a user to become familiarized with the work in different departments, locations, and even countries. Thus, effort for user training decreases.

Future Proof
Use of standards helps organizations to establish best practices and ensure compatibility with others (such as vendors, suppliers, and customers). Adopting SOA as an architecture paradigm requires commitment to a set of standards. In accordance with the market trends, investing in SOA is often seen as a step toward future-proofing IT.

2.1.3 Qualitative IT Benefits
In addition to the quantifiable measures introduced in the previous section, qualitative measures can also be identified. SOA adoption as the implementation of a new technology has effects on the entire company. Table 3 lists qualitative benefits related to IT productivity and organizational impact.

---

8 The SOA benefits for business processes are thoroughly discussed in section 2.2.
### Benefit Categories and Qualitative Measurement Examples

| Benefit Categories                  | Qualitative Measurement Examples                                                                                                                                                                                                                                                                                                                                                           |
|------------------------------------|                                                                                                                                                                                                                                                                                                                                 |
| Business/IT alignment              | Strategic harmonization of business and IT, design of IT architectures in accordance with business processes, resulting in improved fit; and culture of communication between business and IT                                                                                                                                                                                                 |
| IT as business enabler             | Improved IT positioning and business perception due to new possibilities to implement innovative business solutions with competitive time to market                                                                                                                                                                                                                                  |
| Manageability of IT architecture   | Possibility to analytically plan and execute transformation projects                                                                                                                                                                                                                                                                                                                          |
| Architecture transparency          | Knowledge for general IT change projects                                                                                                                                                                                                                                                                                                                                               |
| Enabling IT cost transparency      | Increased efficiency in IT cost distribution based on number of service calls                                                                                                                                                                                                                                                                                                              |

Table 3: Qualitative IT Benefits of Service-Oriented Architecture

### Business/IT Alignment

Because SOA enables easier operational communication between business and IT, it helps to align the strategies of business and IT. Strategic alignment focuses on management activities performed to achieve coherent goals across IT and business units. Therefore, alignment implies harmonizing IT architecture and business processes to achieve the most efficient interplay. Alignment evolves into a relationship where the IT and business functions adapt their strategies together. As discussed above, SOA allows new forms of organizing responsibilities. Traditional IT management divided the ownership of infrastructure and software assets by physical machines, systems, or software packs. The personnel in charge, therefore, primarily cared for their entities but not necessarily for the business purpose for which the entity is necessary. The implementation of service ownership gives employees of IT departments a very concrete idea of what their work is used for in the business of the company.

### IT as Business Enabler

SOA enables faster and more-efficient implementation of business requirements. This not only has a positive impact on the general interplay between business and IT departments, but it also helps to shift the position of the IT department from an infrastructure provider to a business enabler, allowing the company’s value creation to be flexible and even agile. Agility goes beyond flexibility. While flexibility means that a system is able to adapt to expected changes, agility means that a system is also adaptive to unexpected changes. SOA therefore increases the ability to change.

---


Manageability of IT Architecture
Many companies invest in SOA to reduce complexity and make the number of components in their IT landscape smaller and therefore more manageable. In some cases, SOA adoption is seen as a last way out of a heterogeneous application landscape that has become too complex to be thoroughly managed. In these cases, system knowledge has often been the exclusive province of senior IT staff and may not be documented so that anyone else could understand it. Clear benefits in this case result from regaining control over the IT landscape.

Architecture Transparency
Transparency of structures is a central benefit of the SOA paradigm. Clear and structured documentation – for example, in the form of metamodels, process models, infrastructure assets and their dependencies, application landscapes, service domains, and metadata repositories – creates a basis for more IT flexibility and thorough architecture management. Once all the components and connections are documented, various forms of architecture analysis\(^\text{11}\) (for example, heterogeneity analysis, impact analysis, interface analysis, and compliance analysis) are possible to identify the current status of a certain issue or to create an ideal “to be” status. As a consequence, the documentation is important not only for managing inventories but also to support IT management in planning and analyzing future scenarios.

Enabling IT Cost Transparency
The detailed allocation and distribution of IT costs among business units were identified as current problems for IT departments. This is especially challenging due to infrastructure characteristics and the respective overhead expenses that IT usually entails. Modularizing the provided IT products into services enables a more detailed answer to questions such as: who used which resources how many times and to what extent? The number of service calls was identified as the basis for internal charges. The price per service call can be calculated when a sufficiently large number of calls allows building an average of the consumed resources.

2.1.4 SOA Infrastructure Cost
Having named a variety of quantifiable and qualitative benefits, we now examine the necessary cost categories. An overview of cost categories connected to the technology foundation of SOA is given in Table 4. The cost types were validated by the participating companies. The far right column presents findings from the interviews. Due to the relative novelty of SOA, most concerns about costs arise in the early stages, such as initial investments and first implementations.

<table>
<thead>
<tr>
<th>Cost Categories</th>
<th>Examples of Cost Elements</th>
<th>Quantitative Measurement and Cost Metrics Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware and software</td>
<td>Technical infrastructure</td>
<td>New hardware costs</td>
</tr>
<tr>
<td>investment costs</td>
<td>System software</td>
<td>License/development and customizing costs for a service-oriented architecture (SOA) platform, enterprise service bus SOA repositories, and business rule and workflow engines</td>
</tr>
<tr>
<td></td>
<td>Services</td>
<td>License/development and customizing costs for services</td>
</tr>
<tr>
<td>Implementation expenses</td>
<td>Technological setup</td>
<td>Development costs, costs to choose and adapt technological or industry-specific standards and reference models, design of application landscapes and service maps, and technological migration</td>
</tr>
<tr>
<td></td>
<td>Testing</td>
<td>Costs for service tests</td>
</tr>
<tr>
<td></td>
<td>Project management</td>
<td>Project management cost</td>
</tr>
<tr>
<td>Hardware and software</td>
<td>Technical infrastructure</td>
<td>Continuous platform maintenance</td>
</tr>
<tr>
<td>ongoing costs</td>
<td>Services</td>
<td>Continuous service maintenance, costs for development and maintenance of conventions and service design guidelines, and continuous application</td>
</tr>
<tr>
<td></td>
<td>System software</td>
<td>Continuous system maintenance</td>
</tr>
<tr>
<td></td>
<td>System and application operations</td>
<td>Costs for system monitoring and incident management</td>
</tr>
<tr>
<td>Operations costs</td>
<td>Service operations</td>
<td>Costs for service administration, monitoring, and incident management</td>
</tr>
<tr>
<td></td>
<td>System operations</td>
<td>Costs for system administration, monitoring, incident and problem management, and change management</td>
</tr>
<tr>
<td>Governance</td>
<td>Governance setup</td>
<td>SOA services governance processes development; governance policies and standards development; governance organization development; consulting; governance processes; and policies and standards implementation</td>
</tr>
<tr>
<td></td>
<td>Governance operations</td>
<td>SOA services governance processes; policies and standards monitoring; and maintenance</td>
</tr>
<tr>
<td>IT change management</td>
<td>IT organizational change</td>
<td>Cost to implement and run a dedicated SOA unit</td>
</tr>
<tr>
<td></td>
<td>Training</td>
<td>Costs for education and training of developers and architects</td>
</tr>
</tbody>
</table>

Table 4: Technology Foundations and Organizational Costs
Hardware and Software Investment Costs
Prerequisites for SOA adoption include investments in basic infrastructure. Initial infrastructure investments are usually nonrecurring costs that can be depreciated over a certain period of time. The fundamental asset, an SOA technology platform, has to be purchased or developed and, in most cases, customized. While an SOA technology platform provides the core functionality to run and deliver services, additional tools are available and recommended, and, in most cases, are part of an SOA platform. The most prominent examples include an enterprise service bus (ESB) as a means of integrating functionality and a service repository as a basis for a sustainable service management.

To run an SOA, services are obviously needed – they form the core of the technology. As the market for standardized and industry-specific services evolves, external sourcing of services and purchasing or adapting service-enabled applications will become increasingly attractive options as the maintenance costs and governance risk are covered by clear maintenance fees. For external services, licensing fees for service providers have to be taken into account. Service development for nonstandard functionality is the alternative. However, usage of service-enabled applications and tools on that same technology basis provide cost savings, for example, in terms of operations skills. Additional tools needed are business rule or workflow engines for flexibly orchestrating services in business processes.

Implementation Expenses
The SOA implementation process must first be structured and managed, which requires a dedicated change management procedure. To develop and source services that deliver the desired effects of interoperability and flexibility by loose coupling, a defined set of rules and conventions is needed. The initially developed set of rules will run through several iterations as the experience and maturity in service design increases and the requirements change. As SOA is more widely adopted, common practices turn into standards. The adaptation of standards and reference models preserves flexibility, allowing a company to stay independent from specific vendors or to efficiently participate in value networks.
The documentation of technological assets is necessary to redesign the IT landscape. This documentation includes, for example, architecture and metamodels, application landscapes and service maps, and domain models. To eventually leverage SOA benefits, certain parts of existing IT systems and infrastructure should be migrated to a service-oriented approach. While it may not be reasonable to migrate the entire IT landscape, study participants often chose as their first step to migrate the parts of the architecture with the greatest potential for reuse and the highest positive business impact.

In the case of SOA, as with all IT products, thorough testing is mandatory. Therefore, a test infrastructure is not an additional SOA element. However, the existing test infrastructure may need to be adapted for testing services.

**Hardware and Software Ongoing Costs**
Ongoing hardware and software expenses primarily cover maintenance for the technical infrastructure and system software. SOA-specific maintenance costs were identified in the development and continuous application of service design guidelines and conventions.

**Operations Costs**
The operation phase begins after the implementation phase is completed. All activities for operating the system and services are part of this cost category, including administration, monitoring, incident and problem management, and change management.

**Governance**
Within the SOA infrastructure business case approach, the governance cost refers to the SOA services and not to the business process governance as part of the business-driven approach (section 2.2). Arising costs can be divided into one-time governance setup cost (design time) and recurring governance operations costs (runtime).

SOA adoption involves the creation of new organizational roles, such as service developers, architects, and the organizational manifestation of SOA governance. To create the prerequisites for building and running an SOA, investment in a certain degree of expertise is necessary. Primarily this affects the development of necessary technological change and SOA governance. It is important to note that these costs – although higher during the introduction of SOA – are running costs that also arise in a modern non-SOA IT environment. Furthermore, dedicated SOA governance is needed. SOA governance includes regulations concerning organizational structures, roles, standards, responsibilities, and measurement metrics that control and ensure the transparency and conformity of the SOA.
IT Change Management
With respect to the new organizational roles that SOA adoption requires, some companies take a further step to establish dedicated organizational units to manage SOA. Examples include SOA boards (interdisciplinary), SOA teams (usually IT based), and SOA competence centers (cross-organizational).

Service developers and architects are newly formed roles that require education to face the tasks connected to them. Education is necessary to effectively leverage work with the above-mentioned components of SOA infrastructure and SOA tools (such as repositories and ESB). The process of developing services differs from classical software development in many ways, because services differ from classical software in various dimensions, such as different granularities, ownership concepts, and methods of versioning and releasing. Particularly, the crucial ability to design and implement reusable services requires training and a certain level of experience.

Experienced SOA experts are rare in the labor market since very few companies can look back on a solid SOA experience. Initial SOA projects may require investments in recruiting activities to enrich the stock of SOA skills. Additional costs arise from buying external knowledge from consulting companies or vendors.

2.1.5 Blueprint Execution
The quantitative measures found within the sample add up to a broad spectrum of costs and benefits that can be taken into account when calculating an IT-centric SOA business case. These categories can be individually chosen and assembled to build a calculation basis, because all measures depend on the situation of the company – there is no “one size fits all” solution for the quantification of costs and benefits. To customize and adapt the framework for future use, the relevance of the categories must be evaluated. Additional categories may be added.

Figure 3 depicts the proposal of an IT-centric SOA business case, based on the findings presented above. Within the study for the IT-centric approach, five years was identified as an appropriate time frame for a business case calculation. The impact can be derived from the benefit categories, and the monetary estimation can be budgeted over the periods. The savings are calculated using the comparison of the costs of SOA with the costs of traditional architecture. The costs can be estimated according to the SOA-specific calculation of total cost of ownership. The same applies for the benefit estimation. In both benefit and cost estimation, it is crucial to normalize the different parameters to receive reliable results.
The first SOA projects within a company are always the more expensive ones. In most cases, follow-up projects benefit from experience and initial investments in infrastructure and organization. As a consequence, project-based cost distribution among iterative SOA implementations is nontrivial. The cases within this study show that top management support is necessary to justify and back up these initial investments.

The context factors and project types may vary strongly according to the starting position of the implementing company. The more transparent the structures of the IT landscape and the organization are, the easier it is to calculate reliable numbers. This also means that the calculation of measurable costs and benefits must be set in relation to existing solutions and alternative scenarios.

### Figure 3: Service-Oriented Architecture Infrastructure Business Case

<table>
<thead>
<tr>
<th>Impact Estimation</th>
<th>Y1</th>
<th>Y2</th>
<th>Y3</th>
<th>Y4</th>
<th>Y5</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development (Systems/Interface) Cost Savings</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Operations Cost Savings</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Maintenance Cost Savings</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Reinvest Avoidance</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>External Contractor Savings</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>. . .</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Total Cash Inflow</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cost Estimation</th>
<th>Y1</th>
<th>Y2</th>
<th>Y3</th>
<th>Y4</th>
<th>Y5</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware and Software Investment</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Implementation</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Hardware and Software Ongoing Costs</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Operations</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Governance Costs (Services)</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Change Management Costs (IT Organization)</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>. . .</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Total Cash Outflow</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
</tbody>
</table>

| Net Cash Inflow – Realistic Case | $ | $ | $ | $ | $ | $ |

| Net Present Value – Realistic Case | $ | Discounting: discount rate x% |

### Impact Estimation

| Development (Systems/Interface) Cost Savings | $ | $ | $ | $ | $ | $ |
| Operations Cost Savings | $ | $ | $ | $ | $ | $ |
| Maintenance Cost Savings | $ | $ | $ | $ | $ | $ |
| Reinvest Avoidance | $ | $ | $ | $ | $ | $ |
| External Contractor Savings | $ | $ | $ | $ | $ | $ |
| . . . | $ | $ | $ | $ | $ | $ |
| Total Cash Inflow | $ | $ | $ | $ | $ | $ |

### Cost Estimation

| Hardware and Software Investment | $ | $ | $ | $ | $ | $ |
| Implementation | $ | $ | $ | $ | $ | $ |
| Hardware and Software Ongoing Costs | $ | $ | $ | $ | $ | $ |
| Operations | $ | $ | $ | $ | $ | $ |
| Governance Costs (Services) | $ | $ | $ | $ | $ | $ |
| Change Management Costs (IT Organization) | $ | $ | $ | $ | $ | $ |
| . . . | $ | $ | $ | $ | $ | $ |
| Total Cash Outflow | $ | $ | $ | $ | $ | $ |

| Net Cash Inflow – Realistic Case | $ | $ | $ | $ | $ | $ |

| Net Present Value – Realistic Case | $ | Discounting: discount rate x% |
2.2 **Business Process Platform Business Case**

Organizations using a business-driven SOA business case consider both sides, IT and business, to integrate benefit and cost items into their business case. This means that the business-driven approach includes the IT-centric approach described in section 2.1 as well. However, these organizations enhance the IT view with related strategic and business process benefits. Consequently, it is more a business process platform business case than a pure IT infrastructure business case.

2.2.1 Framework, Cost, and Benefit Categories

The business process platform business case includes the costs and benefits of the SOA technical infrastructure and organization of the IT-centric approach, but now expands this view with SOA business and strategy execution capabilities. An SOA infrastructure business case is already described in detail in section 2.1. The following sections focus on factors such as increasing business process benefits and strategic benefits. The costs include investments and running costs of applications, composite development, and end-to-end process integration.

<table>
<thead>
<tr>
<th>Business Process Platform Business Case Framework</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Benefits</strong></td>
</tr>
<tr>
<td>One-time/ongoing benefits</td>
</tr>
<tr>
<td>- Productivity, revenue increase</td>
</tr>
<tr>
<td>- IT cost savings/efficiencies</td>
</tr>
<tr>
<td><strong>Costs</strong></td>
</tr>
<tr>
<td>One-time/ongoing costs</td>
</tr>
<tr>
<td>- Plan, build, and run business applications, composites, and personnel costs</td>
</tr>
<tr>
<td>- Plan, build, and run platform and personnel costs</td>
</tr>
<tr>
<td><strong>SOA Infrastructure Business Case</strong></td>
</tr>
<tr>
<td>IT Productivity</td>
</tr>
<tr>
<td>Organization</td>
</tr>
<tr>
<td><strong>Composite/End-to-End Process Integration</strong></td>
</tr>
<tr>
<td>Application/Enterprise Services</td>
</tr>
<tr>
<td>Technology Foundation</td>
</tr>
<tr>
<td>Organization</td>
</tr>
</tbody>
</table>

The proposed business-related benefits and costs of SOA adoption can be subdivided into directly quantifiable and qualitative measures. The cost and benefit categories represent the accumulated factors that were identified in the study. In the interviews with the study participants, concrete benefits and savings were observed. To further increase the value of the study to the reader, additional benchmark information from further SOA reference projects undertaken by SAP customers are listed but clearly separated from the study results.
2.2.2 Quantitative Business Benefits

This section presents quantitative measures of the business process platform business case. Table 5 gives an overview of the benefit categories and the quantitative measurements of the business process benefits that were identified in the study.

<table>
<thead>
<tr>
<th>Benefit Categories</th>
<th>Examples of Quantitative Measurements</th>
<th>Benefit Metrics Examples and Customer Examples</th>
</tr>
</thead>
</table>
| Business process productivity       | Process efficiency and user productivity gains through increased process automation, iterative process refinement through decoupling from applications and standardized integration capabilities, and user interface simplification | Suitable benefit metrics:  
  - Personnel cost reduction for specific business processes  
  - Decrease in cost per transaction  
  - Less manual effort and higher automation rate  
  Study customer experiences:  
  - 16% productivity increase due to reduction in required resources for customer service  
  - Increased process efficiency of 10% to 30% due to consistent data and role-specific process design  
  Additional SAP reference customer experiences:  
  - Wholesale distribution company: 50% time savings on service-request data entry due to self-service; capacity to handle 30% higher volume of service requests without additional headcount  
  - Oil and gas company: 3% reduction of overall procurement cost due to consistent data and reduction in complexity of business operations |
| Business process quality            | Well-defined interfaces, standard-based access, and better process visibility leading to increased process quality with reduced error rate and faster process execution time | Suitable benefit metrics:  
  - Reduced costs in troubleshooting and exception handling  
  - Reduced QA efforts  
  - Reduced number of errors/exceptions times costs per error/exception  
  - Higher revenue due to better customer service  
  Study customer experiences:  
  - Process execution time reduced from 8 days to 60 seconds via new self-service with reduced error rate  
  Additional SAP reference customer experiences:  
  - Consumer products company: order fulfillment accuracy improved 95% to 99.8%, which led to a 50% QA labor reduction |
### Benefit Categories

#### Innovation
- Higher product, service, and process innovation rate due to possibility of sequential innovation and access to alternative process steps, different roles, or multiple channels by loose coupling capabilities; modularization/decoupling of front end and back-end (stable core) based on services

**Suitable benefits metrics:**
- Revenue/margin increase
- Cost reduction
- Productivity increase

**Study customer experiences:**
- New revenue with process outsourcing of distribution value chain
- Reduction in customer acquisition cost
- Process efficiency increase

**Additional SAP reference customer experiences:**
- Wholesale distribution company: 50% to 66% time savings on order status information due to business process improvement by integration business partner (logistics service provider, supplier) in the new business process
- Industrial machinery and components company: Doubled revenue growth rate by offering value-added service

#### Insight
- Less data collection and reporting effort due to multisource data and information; improved basis for faster and better decisions by accurate and real-time data/information sharable across value network

**Suitable benefit metrics:**
- FTE efficiency increase in dedicated business process/functional area
- Increased efficiency by eliminating redundant, labor-intensive data collection, consolidation, and reporting tasks
- Higher cross-selling volumes: additional products and services sold to existing customer base times product/service margin
- Increased customer loyalty due to single view of customer
- Reduction of days sales outstanding

**Study customer experiences:**
- 30% personnel efficiency increase in accounting due to streamlined accounting

**Additional SAP reference customer experiences:**
- Professional services provider: Web-based billing and customer information system reduced days sales outstanding, improved customer loyalty and satisfaction, and reduced cost by 12% to 15%
- Wholesale company: with real-time status visibility, able to respond immediately to customer queries; automated processes (for example, problem classification and service slip creation) reduce empty pickups

### Table 5: Business Process Benefits
Business Process Productivity

Business process productivity comprises process efficiency and user productivity, which are tightly connected. Participants in the study confirmed that calculation of user productivity gains is only possible in a specific business process context within a business-driven approach. SOA enables increased process flexibility, automation, iterative process refinement through decoupling of applications, and standardized integration capabilities for different integration scenarios (A2A, B2B, UI). User productivity increases due to consistent data and role-specific process design. Study participants realized significant process efficiency benefits by streamlining specific business processes like customer registration and administration or by exposing specific functionality as self-service. Participating SAP customers reported productivity gains between 10% and 30%. Additional benefits included the ability to consolidate back-end systems without disruption, a sharp contrast with the old way of making a big change after a project has been going on for two years or more. Also of benefit is the ability to change processes easily through recombination of encapsulated process steps within the composite application. For example, participating SAP customers could reduce the process steps their accountants had to go through by up to 50%.

Business Process Quality

A higher automation rate within a business process with less manual interference contributes not only to increased efficiency but also, in most cases, to fewer errors and a shorter process execution time. Well-defined process step interfaces, standards-based access to the encapsulated business functions, and better process visibility within SOA architecture lead to a higher process quality as well. Nevertheless, even dramatic changes such as reducing a process from 8 days to 60 seconds of self-service or improving order fulfillment accuracy from 95% to 99.8% does not lead directly to monetized values, as one study participant reported. That’s why we propose some metrics to convert them into monetized values in Table 5.

Innovation

The ability to innovate is critical to companies’ success. Innovation can occur in many forms, including:
- Process innovations
- Product and service innovations
- Technology innovations

In most of these cases, distributed applications are required, and SOA is clearly the preferred underlying architecture.
Process innovation helps to lower costs or enables new sales channels. Product and service innovations drive top-line growth through increased volume or prices. Technology innovations, however, help IT respond more quickly to changing business requirements.

A study participant who is building an SOA architecture based on SAP’s approach to SOA achieved process innovation in moving from a product vendor to an innovative solution provider. The company achieved doubled its revenue growth rate and achieved a 30% cost reduction.

**Insight**

In today’s business climate, data volumes are multiplying by the minute, data quality is under intense corporate and regulatory scrutiny, and an increasing number of users need access to critical business information. It is essential to give business leaders and information workers accurate, timely, digestible information and a “single version of the truth” on which to base strategic, tactical, and (increasingly) operational decisions. Organizations that enable their information workers to focus on differentiating tasks – such as supporting customers, handling exceptions, or resolving problems not covered by standard business processes – gain efficiency, drive innovation, and ensure competitive advantage.

Successful organizations are empowering their information workers in many ways:
- Automating common processes related to specific business roles
- Providing collaborative work environments for improved communication
- Improving real-time access to business information
- Supporting the mobile workforce

As a result, information workers can complete essential business tasks more quickly and efficiently. Customers confirmed that working with an SOA significantly improves these capabilities.

Within the study sample, a customer realized a 30% personnel efficiency increase in accounting due to streamlined accounting information and processes. Redundant, labor-intensive data collection, consolidation, and reporting tasks are virtually eliminated as employees have access to a single, unified business information framework. SOA enables richer end-user interfaces through mashups that combine dispersed data items.
Table 6 provides an overview of the benefit categories and the quantitative measurements of strategic benefits that were identified in the study.

<table>
<thead>
<tr>
<th>Benefit Categories</th>
<th>Examples of Quantitative Measurements</th>
<th>Benefit Metrics Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business network transformation</td>
<td>New revenue/higher profit via new business model in a transformed business network</td>
<td>Suitable benefit metrics:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ Increased revenue times margin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ Shortened integration time of partner in days times margin of collaborative business engagement</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ Cost reduction (such as production, distribution costs, and so on)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Study customer experiences:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ Integration of a new business process outsourcing partner was reduced from more than 3 months to 6 to 8 weeks</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Additional SAP reference customer experiences:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ High-tech company: process throughput via increased procurement supply chain integration and automation; SOA as part of the harmonization and standardization contributes to US$200 million in savings</td>
</tr>
<tr>
<td>Time to market/time to scale</td>
<td>Shorter period of time from product/service idea to market launch</td>
<td>Suitable benefit metrics:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ Shortened time to market in days times revenue per unit per day times margin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Study customer experiences:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ Project time reduction by 30%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ Significant reduction of time to market</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Additional SAP reference customer experiences:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ Financial services company: shortened time to market due to reusable business processes, transformation of information silos to availability of information enterprise-wide, and introduction of a corporate distribution model to facilitate sales</td>
</tr>
</tbody>
</table>
### Benefit Categories

<table>
<thead>
<tr>
<th>Benefit Categories</th>
<th>Examples of Quantitative Measurements</th>
<th>Benefit Metrics Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mergers and acquisitions (M&amp;A), outsource/offshore</td>
<td>Speed up M&amp;A activities; easier outsourcing/insourcing and thus better negotiating position (cost saving, control); transition cost of offshoring/outsourcing because of loose coupling (easier to move people and applications)</td>
<td>Suitable benefit metrics:&lt;br&gt;■ Savings in percentage of overall M&amp;A budget&lt;br&gt;■ Reduction of outsourcing transition costs&lt;br&gt;■ Additional revenue through value-added services&lt;br&gt;Study customer experiences:&lt;br&gt;■ SOA is key for company's extensive M&amp;A activities&lt;br&gt;Additional SAP reference customer experiences:&lt;br&gt;■ Gas and oil company: IT integrations that take most companies 12 to 24 months completed within 3 months</td>
</tr>
</tbody>
</table>

Table 6: Strategic Benefits

### Business Network Transformation

Business networking is a topic with increasing relevance to all players regardless of size or motivation. Successful organizations work with their strategic business partners to develop innovative products and services. Businesses collaborate when one company lacks critical mass to enter a market alone. By leveraging the business knowledge, core competencies, and best practices of strategic partners, businesses deliver end-to-end solutions more quickly to customers.

There are mainly two types of networks:

- Business process–centric coordinated networks with high-volume operations and a concentrator in the middle. These focus on efficiency, automation (connecting systems), and speed.
- Complex collaborative networks that are more relationship-oriented with situational processes and are facilitated by a trusted orchestrator to enable quick innovation. These focus on insight, collaboration (connecting people), and sharing information expertise.

In today's challenging environment, businesses must go beyond the comfort zone and develop the strategic agility to manage both types of networks in parallel and with varying focus. A key enabler to building and managing such a network is SOA, which provides business connectivity. The ticket to transforming business networks and managing both types in parallel is a cross-industry SOA-enabled application suite.
One SAP customer within the study sample generated new revenue streams and realized economies of scale by changing its business model through integration of third-party companies into its distribution chain. Thanks to SOA, the time required to integrate a new business process outsourcing partner was reduced from more than three months to 6 to 8 weeks.

**Time to Market/Time to Scale**

A shorter time to market leads to earlier revenue streams and paybacks and generates competitive advantage.

IT is often the bottleneck for the market launch of new products and services. Study participants see SOA as a way to alleviate this bottleneck, due to the reusability of existing business services that enables a shorter time to market and time to scale. Especially for the latter, IT plays a key role in ensuring that the product or service is ready to sell in high volume.

One company participating in the study expects to significantly shorten its time to market and its IT project durations by 30%.

**Mergers and Acquisitions, Outsourcing, and Offshoring**

Mergers and acquisitions (M&A) are among the most important strategic business initiatives. The number of transactions is increasing, with merger deals reaching values comparable to the GNP of countries such as Denmark, Mexico, and Hong Kong.

According to Accenture, IT integration is the most critical factor in the overall success of a merger. Speed of integrating business processes and applications is essential. SOA helped an SAP customer to speed up postmerger integration to 2 to 8 months instead of the usual 12 to 24 months. SOA helps with M&A because SOA-based business services can provide access to needed business capabilities and data while hiding the complexity of an acquired or merged firm’s applications and processes landscape. The integration teams from both organizations can focus on the business interface between the two, while technical complexity is contained within each organization. One study participant confirmed that a service-oriented architecture is key for the extensive M&A activities of his company.

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12 Arlebäck, J.; Percival, J.: “Driving the full business value of mergers and acquisitions through better IT due diligence,” Accenture Outlook, Point of View, June 2006.
These SOA capabilities are very beneficial in outsourcing scenarios as well. Through flexible outsourcing, processes can incorporate value-added features provided by outsourced suppliers. Businesses expand their value proposition by removing steps from customers’ side of the process and integrating some of their suppliers into their own side of the process, thus increasing revenue. A study participant confirmed that SOA will change the way the company works with its IT partner to become more efficient and effective, such as by accelerating the analysis and proof-of-concept phase of IT projects.

2.2.3 Qualitative Business Benefits
In addition to the quantifiable measures introduced in the previous section, qualitative business benefits were also identified and confirmed by the study participants. SOA adoption as the implementation of a new business process platform affects the entire company. Table 7 lists qualitative business process benefits and strategic benefits.

<table>
<thead>
<tr>
<th>Benefit Categories</th>
<th>Qualitative Measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compliance</td>
<td>Improved and simplified auditing and monitoring (indirectly measurable via avoided penalty fees)</td>
</tr>
<tr>
<td>Agility</td>
<td>Able to react more flexibly and quickly to future business requirements</td>
</tr>
<tr>
<td>Competitive advantage</td>
<td>Result of all mentioned IT and business benefits</td>
</tr>
</tbody>
</table>

Table 7: Business-Oriented Qualitative Benefits of Service-Oriented Architecture

Compliance
With an integrated global marketplace comes the pressure to manage governance, risk, and compliance as part of the corporate strategy. Addressing the growing compliance demands of regulators, customers, suppliers, and partners is increasingly important. With its integration capabilities, SOA helps simplify auditing and monitoring by enabling a consistent data view over different IT landscapes. It also reduces data errors caused by human interaction. Compliance benefits can be measured indirectly, for example, by penalty fees that are avoided.

Agility
SOA promises organizations the agility required to quickly and intelligently react to changes in the business environment so they can maximize value as defined and prioritized by their mission and strategy. SOA opens up possibilities for further business process innovation and flexibility. As future requirements are not known or not clearly specified yet, it is hard to quantify these benefits. But it is certain that changes and new requirements will hit every business, and it is best to be prepared.
Competitive Advantage
As a result of all the IT and business benefits mentioned, SOA delivers more efficiency, flexibility, and insight to help companies outpace their competitors. Every single benefit item contributes to a better competitive situation.

2.2.4 Business Process Platform Cost
The cost side covers all one-time and recurring costs listed in Table 8. The main difference on the cost side is that it includes not only the SOA infrastructure cost (see Table 4) but all additional costs associated with addressing a business problem. With an application or composite application, these could be investment and implementation costs of the end-to-end process integration, which are IT and business efforts, and governance and organizational change management costs. Participants confirmed that sufficient tools for business process management – to define, change, and manage processes – will reduce the governance cost significantly. Furthermore, if the business application is already service-enabled with productized, ready-to-use (enterprise) services, this will reduce the cost for service design and development on the IT side dramatically.

<table>
<thead>
<tr>
<th>Cost Categories</th>
<th>Examples of Cost Elements</th>
<th>Quantitative Measurement and Cost Metrics Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software investment costs</td>
<td>Application software</td>
<td>License or development</td>
</tr>
<tr>
<td></td>
<td>Composite application</td>
<td>License or development and customizing costs</td>
</tr>
<tr>
<td>Implementation expenses</td>
<td>Process design</td>
<td>Requirements analysis, blueprint conception</td>
</tr>
<tr>
<td></td>
<td>Technological setup</td>
<td>Solution architecture, layout, installation, technical configuration</td>
</tr>
<tr>
<td></td>
<td>Business setup</td>
<td>Business configuration of the application, customization, migration</td>
</tr>
<tr>
<td></td>
<td>Testing</td>
<td>Functional and integration tests</td>
</tr>
<tr>
<td></td>
<td>Project management</td>
<td>Project management cost</td>
</tr>
<tr>
<td>Software ongoing costs</td>
<td>Application software</td>
<td>Continuous application maintenance</td>
</tr>
<tr>
<td>Operations costs</td>
<td>Application operations</td>
<td>Monitoring, administration, service management</td>
</tr>
<tr>
<td>Governance costs</td>
<td>Process governance setup</td>
<td>Governance processes development; governance policies and standards development; governance organization development; consulting; governance processes, policies, and standards implementation</td>
</tr>
<tr>
<td></td>
<td>Process governance operations</td>
<td>Governance processes, policies, and standards monitoring and maintenance</td>
</tr>
<tr>
<td>Change management costs</td>
<td>Organizational change</td>
<td>Costs to change the employees’ mind-set and change management</td>
</tr>
<tr>
<td></td>
<td>Training</td>
<td>Costs for education and training of business employees</td>
</tr>
</tbody>
</table>

Table 8: End-to-End Process Integration, Composite, and Application Costs
2.2.5 Blueprint Execution

The quantitative measures found in the sample add up to a broad spectrum of costs and benefits that can be taken into account when calculating business-driven SOA business cases. None of the participating companies calculated a business case like the one shown in Figure 5. This example is more a sample of best practices in defining suitable benefit and costs categories. These categories can be individually chosen and assembled to build a calculation basis, as all measures depend on the situation of the company – there is no “one size fits all” solution for the quantification of costs and benefits. To customize and adapt the framework for future use, the individual relevance of each category must be evaluated. Additional categories may be added.

![Figure 5: Business Process Platform Business Case for Service-Oriented Architecture](image-url)
Figure 5 depicts a proposed business process platform business case, based on the findings presented earlier.

The business-driven approach enriches the IT-centric approach with a business view. The benefit and cost items explained in section 2.1 are applicable for this business case as well and therefore not mentioned again. In addition to the IT-centric view, additional business process benefit and strategic items explained in the previous section are integrated as part of that business case approach.

Not all of the proposed items are integrated in the participants’ business cases. For example, some participating companies already used existing SOA-enabled applications with built-in enterprise services for their projects. In this case, there was no need to integrate the application cost into the business case.

The business-driven part of the SOA business case might not look like a dedicated SOA business case at all. It has a clear description of one or more specific business challenges along with the proposed solutions and their benefits and costs. The differences are that only an SOA can unlock some of the described business benefits and that these business benefits can be realized faster and at a lower cost in comparison with non-SOA-enabled environments (though not for the first SOA project because of additional learning efforts).

Most common economic key performance indicators used by the participants to evaluate different project and solution alternatives and to compare different sensitive scenarios (best, realistic, and worst case) are net present value, ROI, and payback period.
3 ECONOMIC JUSTIFICATION OF SOA

None of the participating companies calculated a dedicated SOA business case. The identified pattern behind economic justification of SOA was either a pure IT infrastructure business case or a broader business process-oriented business case with SOA-related IT and business benefits and costs.

Enlarging the view with the business side helped most of the participants to get management commitment and sponsorship. IT departments used value-oriented arguments as a means of communication and alignment with the business side. They avoided direct discussions of SOA technology details and characteristics but rather translated the SOA capability into business capabilities and related benefits. This presumes a certain degree of business knowledge on the IT side about, for example, strategic initiatives, business challenges, and business processes.

Business buy-in is necessary, because the majority of the companies have no dedicated SOA budget, so the investment in SOA must be built into ongoing business initiatives. This raises the problem of how to handle the up-front investment for the infrastructure and higher implementation efforts, due to the new technology, that the first SOA project will entail. (Actually, the projects that follow will benefit from the business process platform and SOA-experienced people.) Participants solved this problem by cosponsoring the initial business optimization projects out of the IT budget.

For the majority of the participating companies, investment decisions were based not only on ROI calculations. The strategic dimension and benefits of SOA investments were strong drivers as well. Nevertheless, there is a strong and increasing need on the customer side for suitable and significant IT and business benefit metrics to justify SOA investments. Most of the participating companies opt for an integrated business-driven approach covering IT and business benefits, because they expect or have already experienced an increased ROI.
In companies with a strong process orientation, SOA frequently joins forces with business process management to address relevant issues that can be solved quickly ("quick wins"). One of the participating organizations reported that the IT unit started to push the rather inflexible organization toward a higher process orientation and used the SOA benefit potential to trigger business process optimizations.

From an organizational standpoint, SOA as a concept usually resides in the IT units and – depending on the process orientation in the companies – reaches out to business process management. Once the business side starts to see and enjoy the business benefits of the concept, this can even create a demand for better IT support in areas where it wasn’t an issue before (a pull effect from the organization). Therefore, one of the study participants noted that despite the savings from lower system costs, better use of resources, and process optimizations, the increasing demand for more IT support across the company created IT costs similar to those prior to SOA – but with much higher service levels and process coverage.

All SAP customers in the study pursued the business-driven approach. Many of the IT and business requirements the participating companies faced could have been accomplished with traditional methods following enterprise application integration as an integration technology using, for example, proprietary remote function calls. The essential difference is that they could not have done it as fast and efficiently, with flexibility and agility to meet further requirements. Study participants confirmed that SAP’s concept of building semantics into enterprise services helps organizations to reap the described business and IT benefits.


4  RISK AND MITIGATION OF SOA ADOPTION

To gain the benefits of SOA, companies cannot avoid exposure to risks, but there are ways to manage and mitigate them to lead the adoption projects to success and to achieve more predictable results. Risks usually cannot be analyzed separately but often breed close connections with each other. For example, every abnormality in the project plan increases project costs, and the management commitment has a strong impact on the budget situation.

Table 9 lists the risks identified along with mitigation strategies that were discovered in the study.

<table>
<thead>
<tr>
<th>Risk</th>
<th>Mitigation strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exceeding project costs</td>
<td>■ Professional project management</td>
</tr>
<tr>
<td></td>
<td>■ Clear definition of funding and cost distribution, especially in initial service-oriented architecture (SOA) projects</td>
</tr>
<tr>
<td>Technological maturity of SOA (performance, stability, and security)</td>
<td>■ Iterative implementation of services</td>
</tr>
<tr>
<td></td>
<td>■ Choice of adequate initial SOA project(s)</td>
</tr>
<tr>
<td>Technological complexity</td>
<td>■ Investing in internal and external SOA experts</td>
</tr>
<tr>
<td></td>
<td>■ Leveraging SOA built-in technologies/solutions</td>
</tr>
<tr>
<td></td>
<td>■ Repositories and strong SOA governance</td>
</tr>
<tr>
<td></td>
<td>■ Documentation (service maps)</td>
</tr>
<tr>
<td></td>
<td>■ Service management</td>
</tr>
<tr>
<td>User acceptance</td>
<td>■ User involvement in system design (for example, usability studies)</td>
</tr>
<tr>
<td></td>
<td>■ Careful design of SOA training</td>
</tr>
<tr>
<td>Management commitment to SOA</td>
<td>■ Clear and structured communication</td>
</tr>
<tr>
<td></td>
<td>■ Visible proof of concept</td>
</tr>
<tr>
<td>Organizational impact</td>
<td>■ Professional and holistic change management</td>
</tr>
</tbody>
</table>

Table 9: Risks of Service-Oriented-Architecture Adoption and Mitigation Strategies

**Exceeding Project Costs**

Optimistic estimation of project costs is a major risk in the SOA adoption process. Costs can differ from calculated values in various dimensions. Examples include the extended need for external personnel for consulting, customization, and parameterization of the new systems. Furthermore, the actual infrastructure costs can exceed the expected values, as, for example, when initial projects cause decreases in system performance and additional infrastructure is needed.

A clear and dedicated project management effort helps to structure the complexity of initial SOA projects. This includes the explicit definition of goals as well as a road map, transparent project documentation, and, of course, a clear understanding of project funding and cost distribution.
Technological Maturity

Technological maturity of SOA in this context mainly addresses the requirements concerning system performance, security, and stability. Since SOA is emerging and offers no commonly accepted reference models and best practices, existing SOA solutions are sometimes perceived as not sufficiently mature to build up an adequate level of trust.

In early project phases, testing tools from solution providers with preconfigured standard software components for developing and delivering service-based applications – including all the documentation, interfaces, functionality, data, and guidance necessary to run a complete, end-to-end business scenario – can help to evaluate SOA software solutions in a risk-free environment.

To minimize uncertainties about technological maturity, SOA offers an iterative architecture transition, where first services are implemented in a confined environment (for example, monolithic legacy systems). The first implementations of services can be closely monitored with respect to the desired performance, security, and stability. Solution providers offering built-in SOA in their suite solutions provide an environment to gain first experiences without the risk of building all required technology pieces from scratch based on best-of-breed offerings for different SOA features. It is essential to have an environment that automatically provides design-time and runtime governance for SOA in an evolutionary, stepwise manner. Existing services should be addressed first and brought under full governance control before new services are provisioned.

Simple spreadsheets may suffice during the early stages of SOA adoption, but more powerful tools, enhanced capabilities, and broader skills are required to ensure adherence to service design principles as SOA matures. As operational complexities grow, a trusted advisor or the interaction within SOA communities can provide invaluable guidance, helping to establish and enforce effective design-time and runtime governance policies and to ensure that SOA deployments remain cost-effective, reliable, and manageable throughout their entire life cycle.

The choices of the initial project and of which particular technology solution to use are both important. There are arguments that favor selecting a core business process for the initial SOA project and those that favor selecting a supporting process. On one hand, the demonstration of the most prominent benefits, such as time to market and agility, should take place in an environment where these elements mean the most. On the other hand, it can be risky for the first project to support core business processes, due to uncertainty and lack of experience with SOA. Furthermore, these processes and the underlying systems demand the highest security and stability standards.
Either way, an iterative implementation approach toward becoming operational enables a visible showcase of core benefits while minimizing the technological risk. During these first steps, the implementing company might need to involve external experts from vendors or consultants to bring in necessary experience.

**Technological Complexity**

There is a risk that the technological complexity of SOA may lead to stagnation or abortion of the SOA adoption process during the transformation, resulting in an undesirable mixed architecture of partially monolithic and partially service-oriented fragments. The technological complexity demands that SOA experts possess knowledge and experience from both the IT and business process worlds. Due to the relative novelty of SOA, this skill set is rare in the consulting market as well as in the labor market. As a consequence, early investments in the development of SOA skills are crucial to project success.

The adoption of service orientation increases the number of technical components to be managed during transformation. Reuse of services only creates quantifiable value when services are thoroughly administrated. Service repositories offer indexed directories with detailed metadata. Practical use has shown that repositories alone do not suffice to achieve a high degree of reuse. Repositories as a means of service management only develop full potential in combination with strong SOA governance including responsibilities, rules, and guidelines. The necessary documentation of assets and interdependencies help to further mitigate the complexity.

An integrated solution of business applications and technology platform with a unified repository and a harmonized governance model covering design-time and runtime governance reduces the risk of handling SOA's technological complexity. The foundation for every successful SOA strategy is laid during design time. From the architectural bird’s-eye view, services are identified, designed, modeled, and finally published if they don’t already exist in the design-time services repository. Design-time governance ensures that the right services are correctly designed and are available for runtime use. A key element during design time is the abstraction of semantically well-expressed services. Design time encompasses the life-cycle phases of service identification, design, and implementation. The service provisioning phase transitions services from design time to runtime, exposing services to the entire organization by making them available for productive use through the services repository. Runtime encompasses the life-cycle phases of service deployment, management, and analysis.
User Acceptance
User acceptance of new systems depends on various factors, such as system performance, usability of screens, and the way training courses are held. Most of these factors are very manageable and should receive attention in initial SOA project plans – for example, by involving users in the screen design process and by arranging for usability studies. Furthermore, the ways users are introduced to the changes – that is, the design of the educational means – play an important role.

Management Commitment
As for any project that introduces major changes in the way IT and business are designed in an organization, management commitment was identified as a critical success factor for the adoption of SOA. SOA projects need a strong commitment from the very beginning.

The key to management support is a clear communications strategy pointing out quick wins and, more important, a long-term perspective of the business value. This is especially true because, as the interviewed companies point out, it may be four years before the return on investment becomes visible. A clear communication concept also helps to manage expectations.13

Furthermore, a value-oriented business case and a visible proof of concept to demonstrate core benefits of the new technology help to convince management.

Organizational Impact
Risks were also identified in the organizational impact of SOA. Service orientation will change the way IT departments communicate with business units and external partners. The development process including requirements engineering, testing, and release management can be modularized. Moreover, SOA enables new ways of distributing ownership. As a consequence, SOA has an influence on various job descriptions, and the potential impact of these changes is uncertain.

Depending on the effects and organizational changes SOA adoption brings along, a holistic change management process is needed to introduce and implement new strategies, organizational structures, processes, and technologies. To ensure operational excellence and to improve stakeholder acceptance and commitment, staff training and courses of instruction are essential parts of initial SOA projects.

This study shows that SOA can be understood in two ways. First, some companies understand SOA primarily as an IT-centric topic. Drivers to adopt SOA can be found in benefits that concern technology productivity and organizational improvements. The second group of companies considers SOA as a business-driven paradigm and, therefore, adds strategic measures and business processes to the technical perspective of the first definition.

For the majority of the participating companies, investment decisions were based not only on ROI calculations. Strategic decisions were the main driver for SOA initiatives within the analyzed sample. Various approaches to quantify costs and benefits for the IT organization, business processes, and strategy could be defined. These measures are structured in the presented frameworks, which can serve as blueprints for other companies to enhance the understanding of cost and benefit categories in SOA business case calculations.

Even though sophisticated and detailed business case calculations could rarely be identified, there is a clear need to quantify the costs and benefits of SOA. As the transparency of IT costs and outsourcing (and offshoring) becomes more important, justifications of technology investments will grow in priority. SOA is a fairly new paradigm, and most companies do not yet have reliable experience with it, so the expected costs and benefits must be validated and eventually adjusted.

The participating companies mentioned a broad variety of risks connected with SOA adoption. The management and mitigation of these risks can be seen as critical success factors. A recent empirical study\(^\text{14}\) of the Institute of Information Management at the University of St. Gallen validates the findings on critical success factors. Within the study, 300 SOA professionals in Germany, Switzerland, and Austria were interviewed. The following nine critical success factors of SOA were identified:

- Professional project management
- Adequate communication and culture
- Defined SOA governance
- Consideration of nonfunctional requirements
- Top management support and explicit SOA strategy
- Clear design guidelines for services
- Transparent design process using enterprise architecture models
- Highly qualified project members with business and IT backgrounds
- Choice of a suitable initial project

These findings are also in accord with current literature on problems and critical success factors for SOA adoption.15

Future activities to investigate how to quantify costs and benefits include data collection from more companies to enhance the content of the developed frameworks. Because one observation derived from the current sample was that SOA adoption is often initiated by strategic decisions, further research on how decision makers commit to new technologies and IT trends is necessary.

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