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Service-oriented Architectures – Status Quo and Prospects for the German Banking Industry

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Abstract: This paper presents the status quo and prospects of the adaptation of Service-oriented architectures in the German banking industry. Based on data collected from a survey conducted among CIOs, CTOs, IT architects, and enterprise architects from Germany's 1001 largest banks (rate of return: 5.19%), we have been able to deduce that Service-oriented architectures are already widespread in this industry and that this IT architecture paradigm is suitable to fulfill the requirements of the German banking industry. Overall, the participants viewed Service-oriented architectures favorably, while the commercial banks showed special preference towards service-oriented technologies. Even though most of the participants were IT experts, there is still a huge information gap about features and qualities of service-oriented concepts. The primary goal when introducing a Service-oriented architecture to an organization is the reduction of costs.

Introduction

Although it is based on well-known concepts such as autonomy and the loose coupling of software components, the adaptation of Service-oriented architectures (SOA) within the research community, as well as, within the software industry has been stimulated by the standardization of Web service technologies in recent years. When considering SOA for the banking industry, most academic discussions focus on how SOA can be applied to predetermined domain-specific problems such as the management of capital market systems [RB02, RYD07] or the core banking system [BCO04, ZMC04].
In comparison, only a few empirical studies have been conducted regarding the impact of SOA on the banking industry in general. Therefore, we decided to extend

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our previous research in the field of SOA by analyzing the German banking industry based on an empirical survey [BGR05, RSE07].
In this paper, the key results from a survey we conducted among CIOs, CTOs, IT architects, and enterprise architects from Germany's 1001 largest banks (with respect to their balance sheet totals) are presented. In this manner, we have extended upon previous publications which contained partial results of this survey and are going to give a review of the complete survey to an international audience [SRB07, SRE07, SRS07, SRE08].
The key focus of this survey was to assess whether SOA is a major trend or mere hype for the German banking industry – thereby determining whether SOA meets the requirements of the German banking industry. Furthermore, the status quo of SOA adaptation in German banks was also investigated. Consequently, the following research question was the key motivation behind the survey:

Is SOA a major trend or hype for the German banking industry?

As we also analyzed the results within each banking group, it is possible to transfer the results to countries which are characterized by similar kinds of banks. Thus, the results are indicative for other industries or countries.
The remaining part of this paper is structured as follows. The next section introduces the basics and common benefits of SOA, the potential impact of SOA on banks, and relevant related work. Based on this theoretical foundation, nine statements were identified which formed the basis of our survey and the respective questionnaire. Subsequently, we introduce the methodology used and characteristics of the data sample. The results of our empirical study are then presented. Finally, the paper concludes with a summary of the findings of the survey.

Theoretical foundation

In order to answer our major research question, it is necessary to define SOA and evaluate its potential role in the banking industry. Hence, we introduce SOA with regards to the banking industry in the following paragraphs. In the following subsection, we briefly describe the SOA paradigm itself. Subsequently, we introduce the potential benefits and effects of SOA within banking industry. Relevant related work is presented in the last part of this section.

The Service-oriented architecture paradigm

Since the term SOA was coined in 1996 by Gartner [SN96], several publications have redefined it. In recent years, SOA has often been used synonymously with Web service technologies, even though there are great differences between the actual implementation of an SOA with a certain technology (i.e. Web services) and the underlying concepts which constitute the SOA paradigm. As the term “paradigm” implies, SOA is not a technology but rather a holistic approach to designing an application and/or enterprise architecture. By using service-oriented concepts, it is possible to model business processes independent of actual technologies or tools

[RYD07]. We define *Service-orientation* from a business-centric view: Service-orientation describes the mapping of a company's business processes on services. Processes can be composed from distinct services. The coupling between these services is loose, i.e., service compositions can be resolved and changed easily.
In order to define the architectural part of SOA, we use the following principles [CHT03]:

- All functions (e.g. business functions) are defined as services.
- All services are independent and can be used without paying any attention to the actual implementation.
- Services can be accessed by an invokable interface without any knowledge of its location.

Therefore, an SOA is "*an application architecture within which all functions are defined as independent services with well-defined invokable interfaces which can be called in defined sequences to form business processes*" [CHT03].
By using this definition, it is possible to apply the SOA paradigm to an application architecture or to accurately map one aspect of a company's business model [KBS04]. Business-oriented services may be mapped to (parts of) business processes, which allows new internal and external users to access processes, replace business functions, reorganize processes, or build new business functionalities from existing services.
In order to design services or processes within an SOA, it is necessary to identify and understand the different business aspects of an organization [CGH05]. Thus, the IT perspective of SOA is strongly related to its business perspective. On the other hand, a strong relationship also exists between the business side and SOA. SOA enhances the agility and flexibility of companies, making it possible to offer new products and services. As a result, business processes may have to be adapted in order to tap into the full potential offered by service-oriented technologies [WM06].
Today, the technologies most commonly associated with the implementation of SOA are Web services. With standardized Web service technologies like SOAP [ML07], WSDL (Web Service Description Language [BL07]) or UDDI (Universal Description Discovery and Integration [CHR04]) it is possible to apply service-oriented concepts on the Web [PG03].

Current state of research on SOA in the banking industry

The banking industry is often recognized as a leader in technology regarding its early utilization of new information technologies (e.g., [HOV05, RYD07]). In the following, we briefly present the effects SOA is supposed to have on banks.
The benefits of implementing an SOA most commonly mentioned include the ability to build agile enterprise systems architectures, which support business flexibility and organizational speed, i.e., how fast a business process can be altered. The adaptation and active application of service-oriented technologies are the basis for transforming a business model (e.g. by realizing new outsourcing strategies) [KBS04]. Furthermore, service-oriented technologies are thought to be able to solve strategic issues like application integration, value reconfiguration processes,

value preservation after mergers and acquisitions, and enable more agile forms of information system development [BCH05].
Rabhi et al. state that banks benefit especially from the implementation of an SOA due to the reusability of services across several business processes and the ability to provide legacy system functionalities without exposing the underlying logics. On the other hand, SOA incurs performance drawbacks and requires extra development time because of the need to develop additional service wrappers [RYD07].
Homann et al. dwell in particular on the evolution from the formerly monolithic value chains towards a more fragmented value net in which each activity (i.e. service) has to be fulfilled by a specialized entity. Accordingly, information systems have to be coupled in order to enable communication within companies, or between an organization and its external partners. SOA provides an approach which reduces both the complexity and costs of these requirements [HRW04].
Apart from these academic considerations, there are several examples in which banks have already implemented an SOA. For example, *Credit Suisse* began deploying service-oriented concepts in 1998, in order to uncouple their platforms and functional groups of applications [HS05, PKH07]. The primary objective was to reduce the complexity of Credit Suisse's IT ecosystem, thereby increasing its comprehensibility. The system landscape was partitioned into 90 components. Hence, instead of administrating a large and complex landscape, it was possible to manage smaller and less complex components on the one hand and clearly defined interfaces on the other hand.
While Credit Suisse is a large organization with its own internal IT management, a large portion of the German banking industry consists of regional savings banks and credit unions which outsource most of their IT infrastructure to data processing service centers established by their umbrella associations. *Sparkassen Informatik* for example, provides such IT services and supports more than 230 German savings banks. As a result of its large number of customers, the application landscape is highly distributed and heterogeneous. In order to tackle the challenges which arise due to the centralized character of the application landscape (e.g. the fast and inexpensive business process integration between Sparkassen Informatik and the savings banks, or a highly heterogeneous front end landscape) a Web services-based SOA was implemented in order to meet the requirements of its IT strategy, e.g. minimizing the interfaces required, decreasing the amount of data transferred, and the reduction of development efforts by minimizing interface complexity [BCO04, ZMC04].

Related work

To the best of our knowledge, this is the first ever survey to analyze the impact of SOA on the German banking industry in detail. However, there have been surveys conducted which are related to our study regarding content. *ibi research* (University of Regensburg, Germany) interviewed 21 IT architecture experts from German credit institutions and other related industries (e.g. Deutsche Bank, Credit Suisse, and SAP) in 2005 [KR05]. While there are certain similarities between this survey and our approach, the focus of this survey differed especially concerning IT architectures, which has been examined in further detail within our study. Furthermore, ibi research primarily interviewed employees of large banks and companies, whereas we invited CIOs, CTOs, IT architects, and enterprise architects

from the largest 1001 (including smaller and medium-sized) German banks to participate in our survey. The main results of ibi research include the following findings [KR05]: 1. Cost reductions are the primary goal of SOA. 2. SOA is the basis for an efficient collaboration between business and IT departments. 3. SOA exceeds the purely technological aspects and comprises of a functional architecture, an organizational structure and a governance model.
While these findings helped in describing the current implementation efforts of German financial institutions, the study did not evaluate whether SOA was the best qualified application architecture paradigm to fulfill the requirements of the financial industry. In addition, arguments against the adaptation of service-oriented technologies, service-oriented collaboration, nor a separate observation of the different banking groups in Germany were not covered by this study.
A very brief analysis of SOA in the German financial industry was carried out by the *Fraunhofer IRB* in 2006 [SEP07]. Here, the authors observed that the primary challenge in IT-management is the reduction of costs due to standardization of processes and interfaces. Further important challenges are the high availability of IT in service and a high degree of IT-security at the workplace. The flexibilization of IT-systems due to the usage of SOA or Web services is only of minor importance.
In addition, several non-academic surveys, e.g. by *InfoWorld* and *Gartner Group,* also investigated the application of SOA in different industries among other topics, in 2005 and 2006 respectively [GG07, IF05].

Methodology and sample characteristics

Within this section, the methodology used for this survey is discussed. In addition, we present the characteristics of the target audience in this survey.

Methodology

Based on the considerations in the last section, we have identified nine statements which address the different potential impacts of SOA on the banking industry. We have identified three major areas in which SOA may have such an impact:

1. Long-term changes in business behavior
2. Short-term impact
3. Cost reductions

The first area concerns the long-term impact of SOA on the business aspect, more precisely on:

- Competitiveness in general and continuous growth
- Innovation
- Flexible and agile business processes
- Departments that will be affected by SOA

The short-term impact of SOA concerns the need for companies and software developers to deal with SOA today:

- Need for action in companies which may adopt a SOA in the future
- System development

Cost reduction has several impacts on companies, which should be observed individually:

- Outsourcing
- Protection of investments
- Cost savings in general

Based on the subjects identified, we have developed the following statements (a detailed discussion is presented in [SRB07]):

- A company has to adopt an SOA if it wants to stay competitive and achieve continuous growth.
- The active adaptation and use of an SOA enforces innovation in a company's processes and products.
- Flexible and agile business processes are only possible if an SOA is adopted.
- The SOA paradigm is a holistic approach not limited to IT or business only.
- Companies have a need for action regarding SOA.
- The SOA paradigm will have an impact on both the development of custom software and standard software.
- Service-orientation is a critical success factor for future outsourcing activities.
- SOA offers protection of investments.
- The adaptation of service-oriented technologies leads to cost reductions.

For this survey, the largest 1001 banks in Germany were chosen based on their balance sheet total as reported officially in 2003. All banks were contacted by phone to identify potential participants. The group contacted comprised of CIOs, CTOs, IT architects, and enterprise architects. We identified one contact per bank. As a large number of banks do not participate in surveys in general and a number of the people contacted were not able to participate due to time constraints or other causes, we were able to invite 288 out of 1001 banks to complete our online questionnaire. In total, 52 analyzable questionnaires were returned. This is equivalent to a response rate of 18.06% among those invited and 5.19% among the 1001 largest banks.
Based on the aforementioned statements, we developed a questionnaire partitioned into the following parts:

- Individual knowledge
- IT architectures in general
- Service-oriented architectures
- Service-orientation and service-oriented collaboration
- Operational figures
- Non-functional questions (e.g., corresponding address)

Most of the 28 functional questions were further divided into sub-questions thereby resulting in more than 120 variables.

Sample characteristics

Size of responding banks

In order to compare the results from the different groups of banks according to size (i.e. in terms of balance sheet total in 2003), we divided the basic population and sample into five groups. As seen in Table 1, an above-average rate of return was recorded for banks with a balance sheet total between 0.5 and 1 bn euros and large banks with a balance sheet total larger than 10 bn euros. The remaining banks showed below average participation, especially the banks with balance sheet totals between 1 and 2.5 bn euros.

Table 1: Participants (Size of responding banks)

	1001 largest banks		Rate of return	
Balance sheet total	Number	Percentage	Number	Percentage
< 0.5 bn euros	293	29.27%	13	25.00%
0.5-1 bn euros	274	28.37%	21	40.38%
1-2.5 bn euros	262	26.17%	8	15.38%
2.5-10 bn euros	118	11.79%	5	9.62%
> 10 bn euros	54	5.39%	5	9.62%
Total	1001	100%	52	100%

A contingency analysis (chi-square test) showed that the distribution of participation in relation to their balance sheet total matched the distribution in the basic population of the largest 1001 German Banks. Therefore, it is possible to draw conclusions from the sample data about the largest 1001 German banks. Hence, the distribution regarding balance sheet total can be regarded as representative.
Furthermore, a Kolmogorov-Smirnov test was performed. Only banks with a balance sheet total between 0.5 and 1 bn euros (z=2.160) did not achieve the required confidence region of 0.05. All test statistics for banks with a balance sheet total smaller than 0.5 bn euros (z=2.160), between 1 and 2.5 bn euros (z=-1.817), between 2.5 and 10 bn euros (z=-0.499), and larger than 10 bn euros (z=1.383) met the acceptance interval of the required confidence region.
Nevertheless, it has to be noted that the utilization of the Kolmogorov-Smirnov test for the banking groups with a balance sheet total between 2.5 and 10 bn euros and those larger than 10 bn euros is problematic, as the number of returns expected is quite low.

Groups of banks

The German banking industry is divided into three types of banks: commercial banks, credit unions, and savings banks. While credit unions and savings banks often supply their products to customers within a certain geographical area, commercial banks are not limited to any particular region.
As shown in Table 2, commercial banks and credit unions showed a higher rate of return than expected while this value was lower than expected for savings banks. A contingency analysis (chi-square test) showed that the distribution of banks which participated did not match the distribution in the basic population of the 1001 largest German Banks. Therefore, the distribution of the banking groups was not representative. This conclusion is supported by the results from a Kolmogorov-Smirnov test.

Table 2: Participants (Banking groups)

	1001 largest banks		Rate of return	
German banks	Number	Percentage	Number	Percentage
Commercial banks	51	5.09%	5	9.62%
Credit unions	495	49.45%	32	61.54%
Savings banks	455	45.45%	15	28.85%
Total	1001	100%	52	100%

Individual knowledge

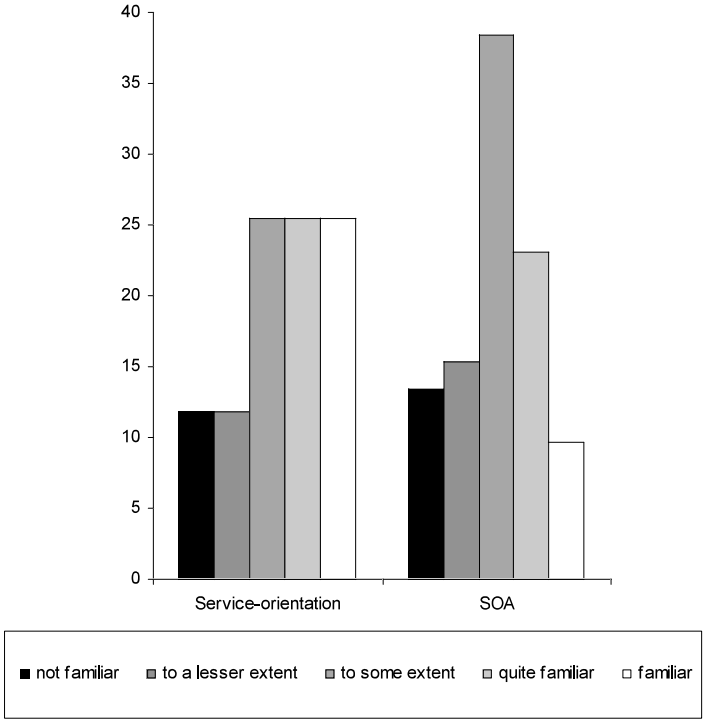

Figure 1: Service-orientation (n_1=51, μ_1=3.41, σ_1=1.31) and SOA (n_2=52, μ_2=3.00, σ_2=1.15),

In order to analyze the data in relation to any prior knowledge the participants had, we asked for a self-assessment about the concepts and terms service-orientation and SOA. The evaluation scale spanned from “not familiar” to

"familiar" on a five-point Likert scale. The participants were provided with the following definitions of the concepts:

- *Service-orientation* describes the mapping of a company's business processes on services. Processes can be composed from distinct services. The coupling between these services is loose, i.e., service compositions can be resolved and changed easily.
- A *Service-oriented architecture (SOA)* is an architecture which utilizes services as building blocks. SOA provides the implementation of service-orientation in a company. A fundamental aspect of a SOA is the selection of a suitable IT architecture to present the service-orientation. Services within such an IT architecture can be implemented with a multitude of technologies, including XML or Web Services.

As shown in Figure 1, 77.47% of the participants were at least "to some extent familiar" with the concept of service-orientation, 50.98% were even "quite familiar" or "familiar" with this concept. The results regarding the SOA concept are similar, with 71.15% of the participants being familiar with this concept at least "to some extent" and 32.69% "quite familiar" or "familiar" with the SOA concept.
These responses indicate that the participants of our survey were rather knowledgeable regarding both concepts of service-orientation and SOA.

Empirical results

IT architectures in general

How functional requirements influence the choice of an IT architecture in general

Requirements made on an IT architecture usually consider aspects like, e.g. *flexibility of business processes*, *scalability*, or *cost savings* which will be further analyzed in the next section. Participants in our study assessed how functional requirements influenced the choice of an IT architecture on a five-point Likert scale, ranging from "minor influence" to "entirely".
As seen in Figure 2, more than half (59.62%) of those surveyed declared the influence of functional requirements on the choice of an IT architecture used in the particular bank to be "big", 11.54% even described functional requirements to influence the choice of an IT architecture "entirely". For 17.31% the influence is "to some extent".
While on the one hand, the data collected demonstrates the strong influence functional requirements have on the choice of an IT architecture, on the other hand, almost a third (28.85%) of all participants surveyed attributed functional requirements with only a "minor" or "small" role. This indicates that many IT

architectures have been instituted without paying much attention to operational or functional issues.

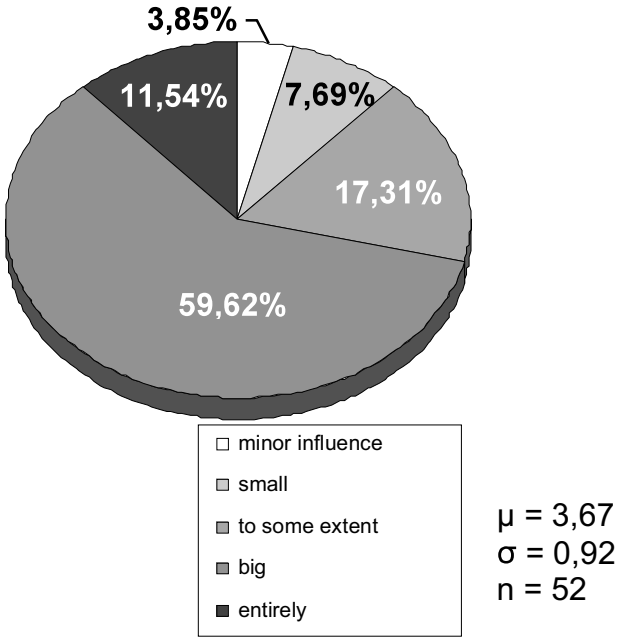

Figure 2: How functional requirements influence the choice of an IT architecture

The mean of 3.67 for all participants is a significant deviation from the expected value "influence to some extent (3)" and indicates that the influence of functional requirements cannot be ignored. The relevance of individual functional requirements will be observed in the next section.

Assessment of current/future relevance of requirements on IT architectures

Table 3: Classification of criteria

	Criterion is met by an SOA	Criterion is partially met by an SOA	Effect of SOA implementation on criterion is difficult to measure
Flexibility of business processes	X		
Turnover increase			X
Cost savings			X
Reduction of time-to-market		X	
Integration potential	X		
Scalability		X	
Reduction of risks			X

Seven core requirements that banks have on IT architectures were identified by a panel of experts (i.e., SOA experts with academic or industrial background) before the actual study. As not all criteria can be met by an SOA to the same degree, the requirements were classified according to their feasibility to be met by an SOA (cp. Table 3).
Participants of our study assessed the current and future relevance of the seven requirements separately. The evaluation scale spanned from "not relevant" to "most relevant" on a five-point Likert scale.
As shown in Table 3, the criterion *cost savings* has the highest mean of all the requirements specified (current relevance: 4.35, future relevance: 4.46). The relatively low standard deviation of 0.65 (current relevance) and 0.61 (future relevance) establishes the relevance of this criterion in particular. There were no significant deviations of means among the different groups of banks aforementioned. The great importance that *cost savings* have regarding the implementation of an IT architecture paradigm shows that while on one hand functional requirements may be the driver behind the implementation of IT architectures, on the other hand, the management however demands short-term gains to improve the shareholder value. As a result, all positive attributes of an IT architecture eventually focus on reducing costs.
While the criteria *flexibility of business processes* (μ_1=3.96, μ_2=4.31) and *reduction of risks* (μ_1=3.92, μ_2=4.33) have significant impact, *turnover increase* (μ_1=3.60, μ_2=4.04) and *reduction of time-to-market* (μ_1=3.58, μ_2=3.87) are of secondary importance. *Turnover increase* shows the highest increase in the mean of all requirements considered from current to future relevance. *Scalability* (μ_1=3.40, μ_2=3.62) and *integration potential* (μ_1=3.33, μ_2=3.25) feature the lowest means amongst the requirements observed.

Table 4: Relevance of requirements on IT architectures (n=52)

	Current relevance		Future relevance		Difference	
	μ_1	σ_1	μ_2	σ_2	Δ_μ	Δ_σ
Cost savings	4.35	0.65	4.46	0.61	+0.11	-0.04
Flexibility of business processes	3.96	0.79	4.31	0.73	+0.35	-0.06
Reduction of risks	3.92	0.95	4.33	0.73	+0.41	-0.22
Turnover increase	3.60	0.98	4.04	0.84	+0.44	-0.14
Reduction of time-to-market	3.58	1.00	3.87	1.03	+0.29	+0.03
Scalability	3.40	0.87	3.62	0.93	+0.22	+0.06
Integration potential	3.33	1.00	3.25	1.23	-0.08	+0.23

Except for *integration potential*, all the means observed have shown significant deviations from the expected value "to some extent relevant (3)" at the 0.01 level. The mean of *integration potential* showed a significant deviation at the 0.05 level for the current relevance, but showed no significant deviation from the value expected for the future relevance of this requirement. A detailed overview of the answers per criterion can is shown in Figures 3 and 4.
When comparing the results from this part of our survey with the classification presented in Table 3, these results have to be analyzed critically. *Integration potential*, which is one of the two criteria presented that is definitely met by an

SOA, is rated as less relevant than any other criterion. The criteria *reduction of time-to-market* and *scalability* which are partially met by an SOA, appear relatively unimportant too.
Besides *integration potential*, *flexibility of business processes* is the second requirement which is definitely met by an SOA within the context of this study. Only the requirement *cost savings* was rated more relevant than *flexibility of business processes*. This reflects the great importance which a large part of the banking industry attaches to flexible business processes. Consequently, this requirement has to be met by an application architecture.

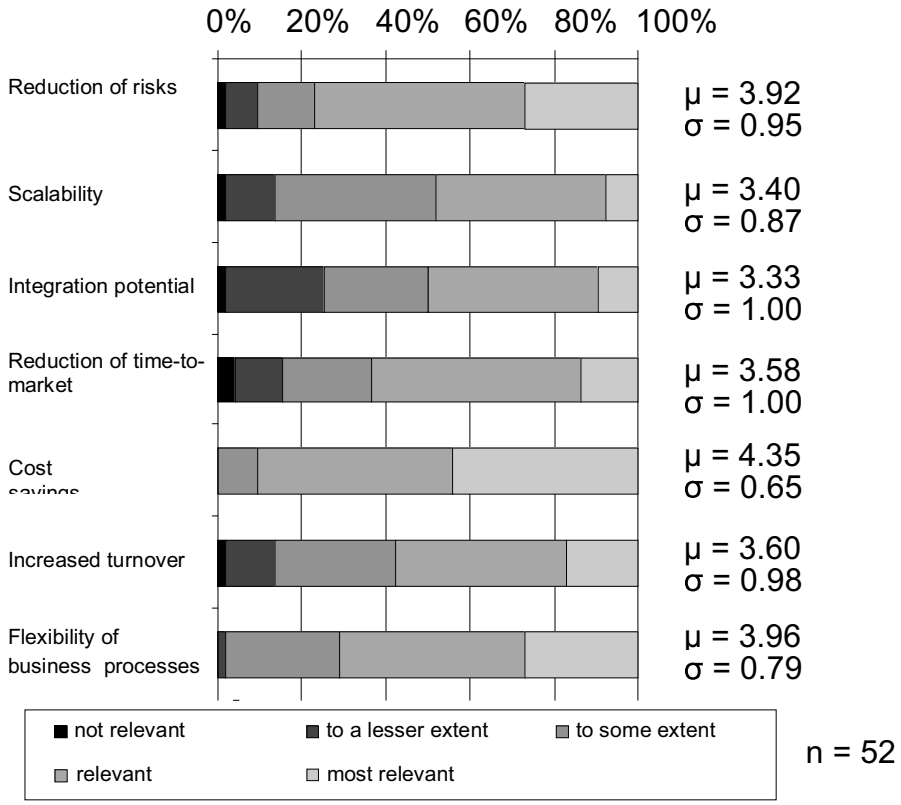

Figure 3: Current relevance of requirements on IT architectures

Other sides, *integration potential* was rated as more relevant by commercial banks compared to savings banks and credit unions, with the means 4.00 (current relevance) and 4.40 (future relevance). The mean (4.00) for current relevance has a significant deviation from the mean for credit unions (3.19) at the 0.10 level, while the mean of future relevance (4.40) has a significant deviation at the 0.05 level from the mean of all savings banks and credit unions (3.13). Commercial banks (mean of 4.20) also assessed the *reduction of time-to-market* significantly more relevant than credit unions (mean of 3.44) at the 0.05 level. Regarding the future relevance, *reduction of time-to-market* was also assessed to be more relevant by commercial banks (mean of 4.60) compared to all other banks (mean of 3.79) with a significant deviation at the 0.10 level.
The higher importance of *integration potential* for commercial banks may be explained by a difference in the IT strategies savings banks and credit unions have. While the latter groups often outsource most of their IT department to data processing service centers established by their umbrella associations, commercial

banks mostly operate their own IT infrastructure and do not outsource to the same extent. Despite this, outsourcing is also part of the IT strategy of commercial banks.

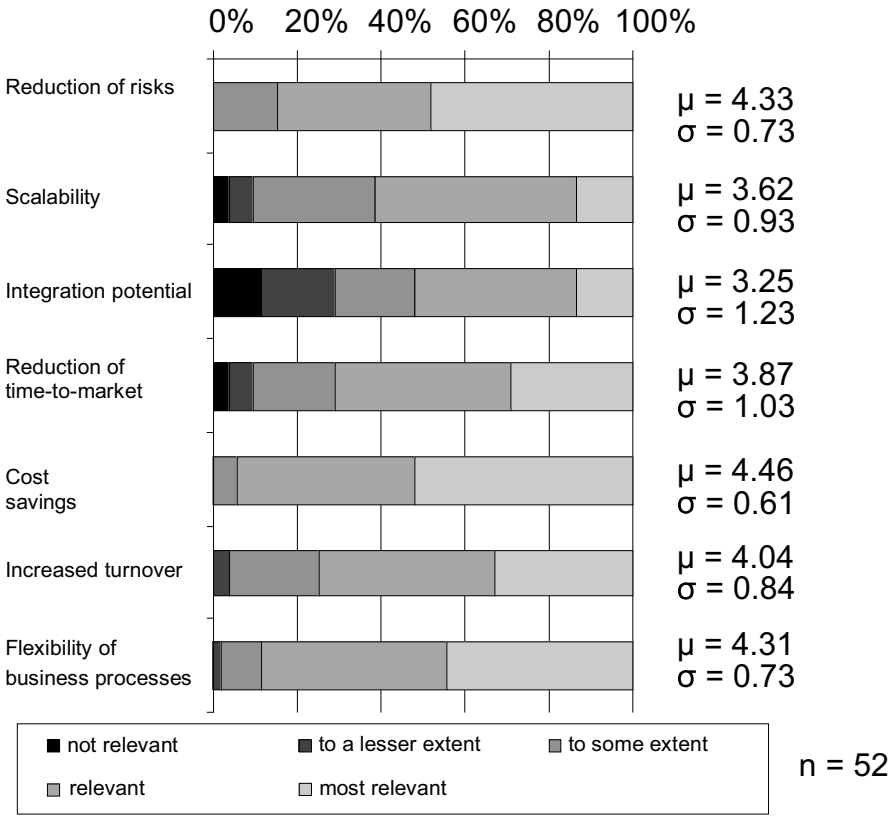

Figure 4: Future relevance of requirements on IT architectures

Therefore, IT architecture experts in commercial banks have an increased awareness for the need to integrate legacy and other systems. Furthermore, *integration potential* is needed especially if a bank has to deal with mergers and acquisitions. This also explains the higher requirement for integration in commercial banks, as mergers and acquisitions are more characteristic for the business model of commercial banks compared to credit unions and savings banks.
There are other deviations between the banking groups which may be observed in the future: concerning current relevance, savings banks (mean of 3.20) assessed *turnover increase* to be significantly less relevant compared to the other banks (mean of 3.76). Commercial banks rated *reduction of risks* (mean of 3.40) significantly lower than savings banks (mean of 4.13) at the 0.10 level. However, this only applies for the current relevance as there is no significant deviation between the banking groups in terms of future relevance.
Similarly, banks from different groups regarding their balance sheet total, assessed some of the criteria variedly. The current and future relevance of *reduction of risks* was rated significantly higher by banks with a balance sheet total between 500 mil. and 1 bn euros (current mean: 4.33, future mean: 4.67) than by all the other banks (current mean: 3.65, future mean: 4.10) at the 0.01 level. On the other hand banks with a balance sheet total smaller than 0.5 bn euros (current

mean: 3.46, future mean: 3.85) rated this requirement significantly lower than all the other banks (current mean: 4.08, future mean: 4.49) at the 0.05 (current relevance) respectively 0.01 level (future relevance).
The abovementioned increase in relevance of *integration potential* for commercial banks applies to large banks with a balance sheet total larger than 10 bn euros as well. For the current relevance, these banks have a significantly higher mean (4.00) than banks with a balance sheet total smaller than 0.5 bn euros (mean of 3.00) at the 0.05 level. Furthermore, banks with a balance sheet total between 2.5 and 10 bn euros showed a significantly higher mean (3.80) than these small banks at the 0.10 level. Regarding the future relevance, banks with a balance sheet total larger than 10 bn euros (mean of 4.20) assessed the relevance of *integration potential* significantly higher than all other banks (mean of 3.15) at the 0.10 level.
Banks with a balance sheet total larger than 10 bn euros (mean of 3.40) rated the future relevance of an IT architecture as a driver for *turnover increase* significantly lower than all the other banks (mean of 4.11) at the 0.10 level.
Banks with a balance sheet total smaller than 0.5 bn euros (mean of 3.15) rated the future relevance of *scalability* significantly lower than all other banks (mean of 3.77) on the 0.05 level. All these deviations shall be further observed in the future.

Quality characteristics of IT architectures

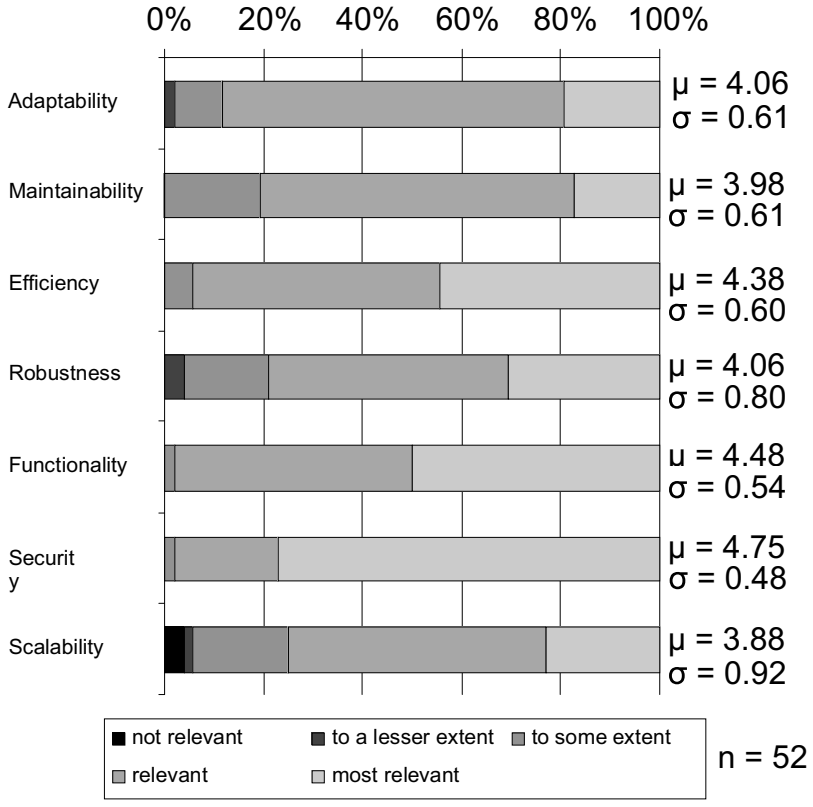

Figure 5: Quality characteristics of IT architectures

Seven quality characteristics of banks on IT architectures were identified by a panel of experts before the actual empirical study (cp. Figure 5). The participants of our study separately assessed the relevance of these characteristics on a five-point Likert scale spanning from “not relevant” to “most relevant”.

The means of all quality characteristics observed are significant positive deviations from the expected value "to some extent relevant (3)" at the 0.01 level. Nevertheless, there are great variations between the relevance of different quality characteristics, which will be further illustrated in the following.

As shown in Figure 5, *security* had the highest mean of all characteristics observed. 98.08% of all participants deemed *security* to be "relevant" or "most relevant". Surprisingly, banks with a balance sheet total larger than 10 bn euros rate the relevance of this characteristic significantly lower than all other banks on the 0.01 level (means of 4.20 and 4.81). The same observation applies for small banks with a balance sheet total of less than 0.5 bn euros on the 0.10 level (means of 4.54 and 4.82). Otherwise, banks with a balance sheet total between 0.5 bn and 1 bn euros deemed the relevance of *security* significantly higher than all other banks on the 0.10 level (means of 4.90 and 4.65).

With a mean of 4.48, *functionality* was also attached with importance by the survey participants. Again, 98.08% of all participants rate this characteristic as "relevant" or "most relevant". Banks with a balance sheet total larger than 10 bn euros rated this attribute significantly less relevant than all other banks on the 0.05 level (means of 4.00 and 4.53). *Efficiency* was also rated relatively important (mean of 4.38); 94.23% of all participants rated this characteristic as "relevant" or "most relevant". Again banks with a balance sheet total larger than 10 bn euros rated this quality significantly less relevant than all other banks on the 0.05 level (means of 3.80 and 4.45). Banks with a balance sheet total between 0.5 bn and 1 bn euros rated the relevance of *efficiency* significantly higher than all other banks on the 0.10 level (means of 4.57 and 4.26).

Adaptability and *robustness* were rated similarly (means of 4.06). However, it has to be noted that *adaptability* was rated as "relevant" or "most relevant" by 88.46% of all participants, while the corresponding percentage for *robustness* is lower at 78.85%. *Adaptability* was rated significantly lower by banks with a balance sheet total between 0.5 bn and 1 bn euros on the 0.10 level (means of 3.77 and 4.15). Another significant deviation at the 0.10 level can be found when comparing savings banks (mean of 3.80) and all the other banks (mean of 4.16).

Maintainability featured a relatively low mean of 3.98. Nevertheless, 80.77% of those observed rate this characteristic as "relevant" or "most relevant". The lowest mean of all attributes considered was given to *scalability* (mean of 3.88); 75% of the participants rate it as "relevant" or "most relevant". On the one hand, credit unions (mean of 3.69) rate this characteristic significantly less relevant on the 0.10 level than all the other banks (mean of 4.20). On the other hand, savings banks (mean of 4.20) rated *scalability* higher than all other banks (mean of 3.76) on the same level. Banks with a balance sheet total lower than 0.5 bn euros (mean of 3.38) rated its relevance lower than all the other banks (mean of 4.05) on the 0.05 level. This observation has already been made when considering *scalability* as a requirement for IT architectures (see above). Hence, we can assume that *scalability* does not play a big role for smaller banks when choosing an IT architecture paradigm.

Taking all things into consideration, it should be noted that the high relevance of *security* for banks is not surprising. Accordingly, this quality characteristic should be achieved within an SOA. The results from this part of our survey have revealed the trends for the future development and research regarding SOA – above all *robustness* and *efficiency* are quality attributes which challenge an SOA more than

for example monolithic IT architectures, especially if regarding the current maturity of SOA solutions.

Service-oriented architectures

Interest in the SOA concept in German banks

Even though it has been shown in the last section that SOA might be qualified to fulfill the (functional) requirements of German banks towards IT architectures, the degree to which these banks are really interested in the SOA concept has not yet been considered. In answer to this question, the participants assessed their interest in the SOA *concept* on a five-point Likert scale spanning from "not interesting" to "interesting".

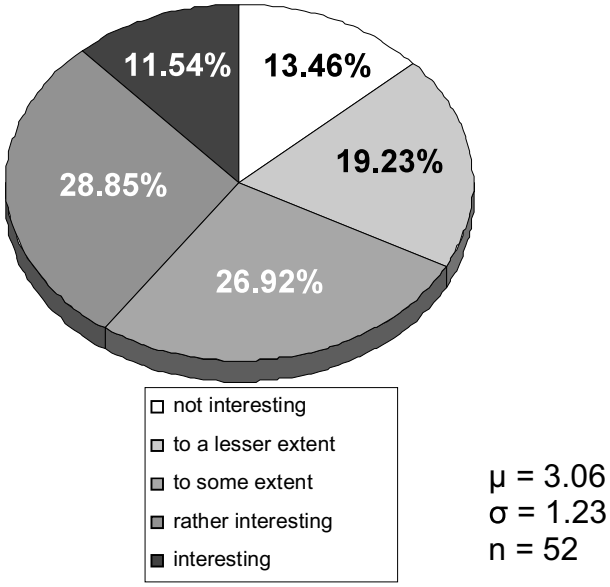

Figure 6: Interest in the SOA concept in German banks

As seen in Figure 6, 40.38% of those surveyed rated the SOA concept as at least "rather interesting", while 32.69% rated it as "not interesting" or "to a lesser extent interesting". The mean is 3.06 and thus shows no significant deviation from the expected value "to some extent interesting (3)". While these results do not show any special interest in the SOA concept, this differs among the different banking groups.

Commercial banks (mean of 4.20) rated their interest in this concept significantly higher than the other banking groups (mean of 2.94) at the 0.05 level. Participants who considered themselves "familiar" with the concept of service-orientation (mean of 3.77) rated their interest significantly higher at the 0.05 level than all other participants (mean of 2.87), too. Otherwise, banks with a balance sheet total between 0.5 bn and 1 bn euros (mean of 2.67) rated their interest significantly lower at the 0.10 level than all other banks (mean of 3.32).

The higher interest in the SOA concept shown by commercial banks confirms the observation aforementioned which highlighted this banking group's increased need

for SOA attributes. We present the status quo of SOA adaptation in the German banking industry in the next section.

Status quo of SOA adaptation in the German banking industry

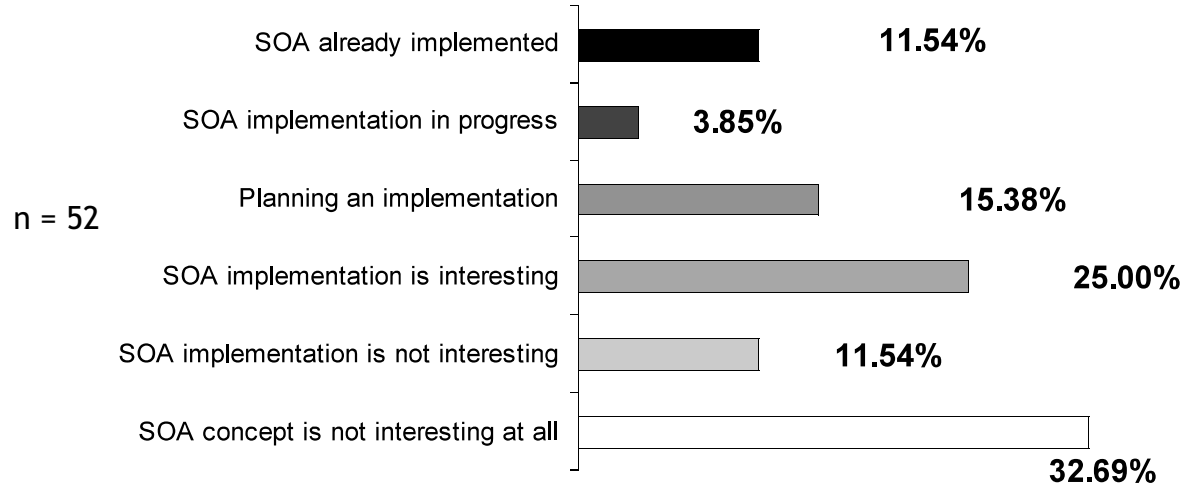

Figure 7: Status quo of SOA adaptation in the German banking industry

Apart from the general requirements on IT architectures and reasons against SOA adaptation (see above), we also examined the current status of SOA implementations in the German banking industry. The participants were asked to estimate the progress of SOA adaptation in their company according to the following categories:

(i) SOA *implementation* is not interesting at all
(ii) SOA implementation is interesting
(iii) Planning an implementation
(iv) SOA implementation in progress
(v) SOA already implemented

Only those participants who rated the SOA *concept* as at least "interesting" in the last section where asked to answer this question (n=35). Hence, all participants who assessed the SOA concept to be "not interesting" or "to a lesser extent interesting" belonged to another category:

(vi) SOA *concept* is not interesting at all

As shown in Figure 7, 30.77% of the participants stated that their organizations *are planning an SOA implementation*, are currently *implementing an SOA* or have already *implemented an SOA*. A further 25% consider an *implementation interesting*.
Although the acceptance of SOA in the banks surveyed appears surprisingly high with nearly one third of the banks *bringing an SOA into operation* or *already*

operating an SOA, it should be noted that the propagation of service-oriented technologies in the German banking industry is promoted either by external parties (e.g. data processing service centers or consulting companies) or by internal IT departments. For example, Sparkassen Informatik (see above) supports one tenth of the German banking industry (or half of all savings banks) with its Web services-based SOA [BCO04, ZMC04]. On the other hand, only 13.33% of the participating savings banks claim to already have an SOA in production.
This data conflicts with the assumptions we made earlier and should be kept in mind for future observations. One possible explanation for this discrepancy between the estimated and actual values could be the low visibility of technologies in use in the data processing service centers. Nevertheless, the results show the extensive distribution of SOA in German banks with 11.54% of all participating banks operating an SOA.
Concerning the different banking groups, our presumptions regarding the higher need for SOA-related requirements in commercial banks (see above) have been confirmed. 60% of the commercial banks *are planning an SOA implementation* or *have already implemented an SOA*. The percentage of credit unions *planning or currently performing an SOA implementation* or *running an SOA* is considerably lower (21.88%). With 40%, the percentage of savings banks ranges between the values for the other banking groups.

Goals when adopting an SOA

As presented in [SRB07], the relevant SOA literature states a number of goals which can be achieved when adopting an SOA. Seven goals were selected by a panel of experts before the actual empirical study and assessed by the survey participants concerning their relevance when adopting an SOA. The evaluation scale spans from “not important” to “very important” on a five-point Likert scale.

- Reduction of interfaces
- Reduction of costs
- Easier outsourcing
- Optimization of Straight Through Processing (STP)
- Flexibilization and agility
- Enhanced transparency in business processes
- Increased innovation speed

Apart from the means for *easier outsourcing* (no significant deviation) and *optimization of STP* (significant deviation on the 0.10 level), all means of the considered goals show significant deviations from the expected value “to some extent important (3)” at the 0.01 level. In the following, we will examine the individual goals more precisely.

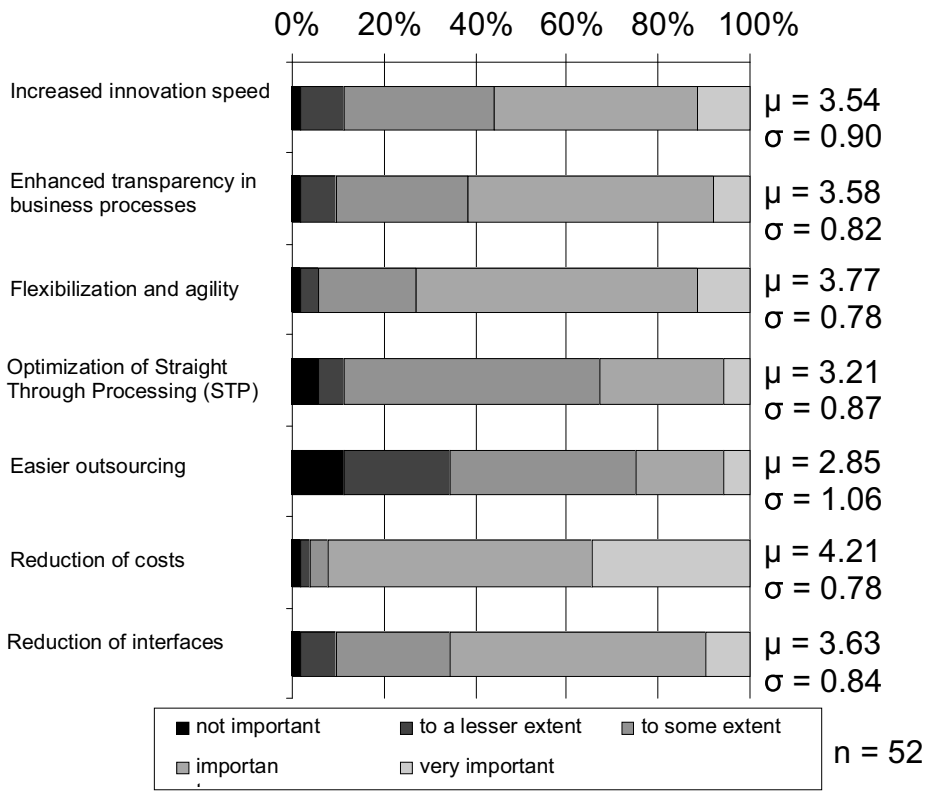

Figure 8: Relevance of goals when adopting an SOA

As shown in Figure 8, *reduction of costs* is the most important goal. More than 92% of those surveyed rated this goal to be "important" or "very important". Credit unions (mean of 4.06) attributed a significantly lower importance to this goal compared to all the other banks (mean of 4.45) at the 0.10 level.
With a mean of 3.77, *flexibilization and agility* has been rated as quite important, too. 73.08% of all participants rate this goal to be "important" or "very important". Noticeable, the participants who assessed themselves as being "familiar" with the service-orientation concept, rated this goal to be more important (mean of 4.31) than all the other participants (mean of 3.61) at the 0.01 level.
Reduction of interfaces has been estimated as "important" or "very important" by 65.38% of all participants, resulting in a relatively mediocre mean of 3.63. Experts regarding SOA (mean of 4.40), i.e. participants who rated themselves as being "familiar" with the SOA concept, rated *reduction of interfaces* significantly more important than the other participants (mean of 3.55) at the 0.05 level. The same observation applies to the experts regarding the concept of service-orientation (mean of 4.08) compared to all other participants (mean of 3.50). Furthermore, participants who considered themselves to be "familiar to a lesser extent" with this concept (mean of 2.83), rated its importance to be lower than all other participants (mean of 3.76) on the same level.
Enhanced transparency in business processes and *increased innovation speed* featured very similar means. While 61.54% of those surveyed rated the former as "important" or "very important", which led to a mean of 3.58, the corresponding

values for the second goal were 55.77% and 3.54. Whereas *enhanced transparency in business processes* features no significant deviations in any particular group of participants, commercial banks (mean of 4.20) rated the importance of *increased innovation speed* higher than all other banks (mean of 3.47) at the 0.10 level. Banks with a balance sheet total between 2.5 and 10 bn euros (mean of 4.20) rated this goal significantly higher than all other banks (mean of 3.47) at the same level.
Optimization of STP possessed the second lowest mean of all the goals considered (3.21). Only 32.69% of those surveyed assessed this goal to be "important" or "very important". For this goal, the answering scheme depended heavily on the participants' familiarity with the concept of service-orientation. Participants who were "familiar" with this concept (mean of 3.69) regarded this goal as being significantly more important than the participants who were "not familiar" (mean of 2.33) or "familiar to some extent" (mean of 2.85) at the 0.01 level. A similar observation could be made about those surveyed who rated themselves "quite familiar" with this concept (mean of 3.54). These participants rate the importance of *optimization of STP* significantly higher at the 0.05 level than participants who were "not familiar" (mean of 2.33) or "familiar to some extent" (mean of 2.85) with the concept of service-orientation. All things considered, this goal was rated higher by the participants who were more familiar with this concept.
Easier outsourcing featured the lowest mean with 2.85 for all the goals observed, only 25% of all the participants rated this goal to be "important" or "very important". Once again, this rating depended on the familiarity with the concept of service-orientation. Participants who were "familiar" with this concept (mean of 3.31) rated the relevance of this goal significantly higher than all the other participants (mean of 2.68) on the 0.10 level, while participants, who were "not familiar" with this concept (mean of 2.17), rated its importance lower than all other participants (mean of 2.93) at the same level. Banks with a balance sheet total larger than 10 bn euros (mean of 2.20) rated the relevance of this goal significantly lower than banks with a balance sheet total lower than 0.5 bn euros (mean of 2.85), between 1 and 2.5 bn euros (mean of 3.25), and between 2.5 and 10 bn euros (mean of 3.40).
All things considered, *flexibilization and agility*, *reduction of interfaces*, *optimization of STP*, and *easier outsourcing* were rated as more important by experts of the service-orientation concept. This shows the diversity of the goals typically set when adopting an SOA based on the state of knowledge of the participants.

Restrictions for the adaptation of SOA

While the results presented in the previous sections have indicated that SOA meets the requirements of German banks and is already well distributed in this sector, a large percentage of banks, in contrast, have no plans to or interest in adapting service-oriented technologies at the time of the survey.
Prior to the actual empirical study, the following list of possible reasons for a lack of interest in SOA were identified by a panel of experts:

- SOA technologies are not standardized
- Lack of experience in the SOA field
- Short-/medium-term benefits are not identifiable/measurable

- Insufficient budget
- Assumptions about the future market environment which do not apply
- Organizational restrictions
- Strategic restrictions
- Technical restrictions

The participants of our study assessed these factors on a five-point Likert scale spanning from “does not apply” to “applies”.

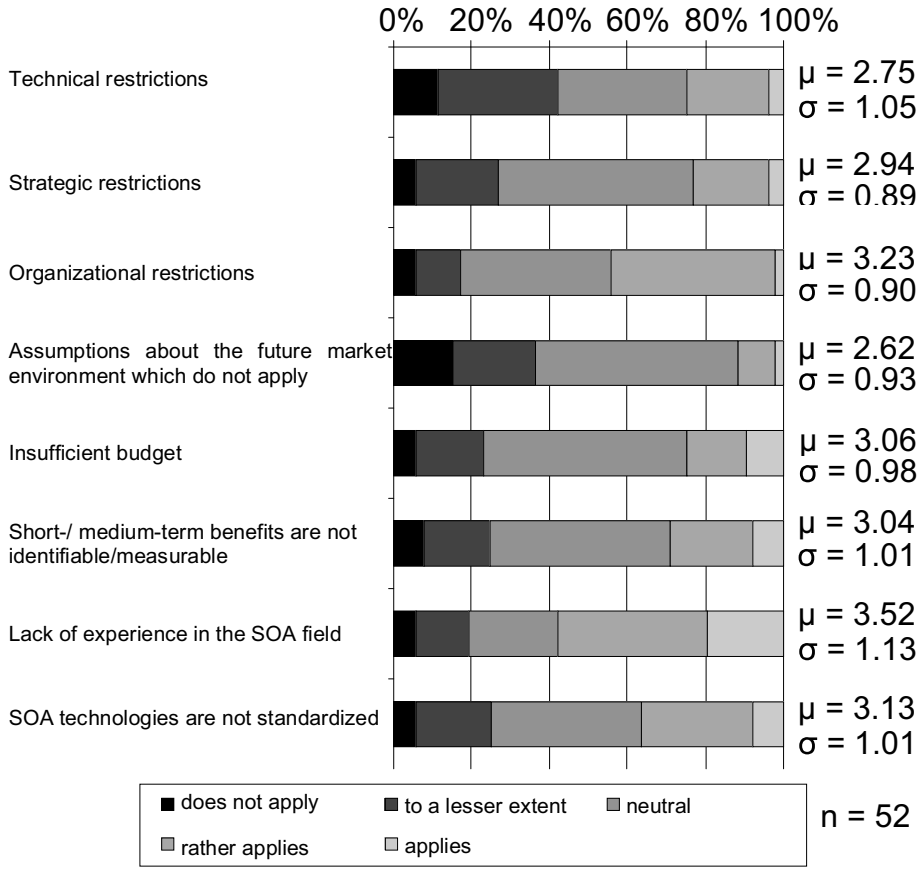

Figure 9: Restrictions for the adaptations of SOA

As shown in Figure 9, *lack of experience in the SOA field* has the highest mean of 3.52 of all the obstacles identified.
Organizational restrictions (mean of 3.23) and the assumption that *SOA-technologies are not standardized* (mean of 3.13) showed relatively high means, while *insufficient budget* (mean of 3.06) and *non-identifiable short-/medium-term benefits* (mean of 3.04) were of secondary importance. *Strategic restrictions* (mean of 2.94), *technical restrictions* (mean of 2.75), and *incorrect assumptions about the future market environment* (mean of 2.62) featured the least means of all the reasons identified.
The observed means for *lack of experience* and *incorrect assumptions about the future market environment* were significant deviations from the expected value “neutral (3)” at the 0.01 level, the means of *technical restrictions* and *organizational restrictions* were significant deviations at the 0.10 level. There was no significant deviation for the means of the remaining criteria.

Experts in the field of SOA (i.e. participants that considered themselves to be "familiar" with SOA) assessed the obstacles *non-standardized technologies* (mean of 2.40) and *non-identifiable short-/medium-term benefits* (mean of 2.00) significantly lower at the 0.05 (*technologies*) respectively 0.10 (*benefits*) level compared to all other participants (means of 3.21 and 3.15). As previously described, prior knowledge regarding SOA and service-orientation affects one's perception of reasons against respectively goals when adopting an SOA.
The different banking groups also assessed these possible reasons against SOA very distinctly. The means from credit unions for the reasons *non-standardized technologies* and *incorrect assumptions about the future market environment* were significantly higher at the 0.05 level compared to other banks. Furthermore, the reasons *lack of experience* and *insufficient budget* were significantly higher at the 0.10 level. Especially the *lack of experience in the SOA field* confirms the abovementioned finding that SOA is less distributed in credit unions compared to other banking groups. Savings banks (mean of 2.67) rated *insufficient budget* significantly less applicable than the other banks (mean of 3.22) at the 0.05 level. With means of 2.33 (savings banks) and 2.73 (other banks) respectively, the same applies to *incorrect assumptions about the future market environment* at the 0.10 level.
Lack of experience in the SOA field (at the 0.01 level), *organizational restrictions* (at the 0.01 level), *non-identifiable short-/medium-term benefits* (at the 0.01 level), *insufficient budget* (at the 0.05 level), *strategical restrictions* (at the 0.01 level), and *technical restrictions* (at the 0.10 level) were rated significantly less applicable by banks with a balance sheet total between 2.5 and 10 bn euros than by all other banks. Furthermore, banks with a balance sheet total larger than 10 bn euros rated *non-identifiable short-/medium-term benefits* significantly less applicable on the 0.10 level than all other banks.

Limitations and transferability of results

There are two limitations in the results of the research presented. First, the survey data was collected at a specific period of time (i.e. at the end of 2006 and the beginning of 2007) and therefore provides a snapshot perspective. Future rollouts of this survey will be able to show the development of SOA in the banking industry and whether the SOA adaptations planned in banks were realized.
Second, generalizations made from the data collected are limited due to the response rate of 5.19% from the 1001 banks in scope. Besides, the distribution of participating banks within the banking groups does not match the distribution of banking groups for the 1001 largest German banks (as mentioned above). Otherwise, the distribution of the banks which participated matches the distribution for the 1001 largest German banks with respect to balance sheet total.
All things considered, we still believe that the results are able to provide insight into IT architectures in general and especially for SOA within the German banking industry. This industry is largely characterized by its partition into three banking groups, but continually undergoes massive changes due to regulations and adjustments in the market. As we also analyzed the results within each banking group, it is possible to transfer the results for commercial banks to countries which

are more characterized by, e.g. more commercial banks. Nevertheless, the results are only indicative for other industries or countries.

Summary

The survey presented in this paper provides an insight into the state of SOA implementation in the German banking industry in the time frame 2006/2007. Based on a sample of CIOS, CTOs, IT architects, and enterprise architects from 52 out of Germany's 1001 largest banks (with respect to their balance sheet totals in 2003), it has been possible to answer questions from this research area for the first time.

All things considered, the results showed that the SOA paradigm is already quite widespread in the German banking industry. A greater part of the banks have started SOA implementations, are currently planning an implementation or have already implemented an SOA. According to our survey results, SOA is a burning issue for the banking industry, which is forcing companies to take action now.

According to the respondents, this applies especially to institutions und service organizations of banks which operate their own IT infrastructure and application environment. Savings banks and credit unions, which often outsource their entire functions to external service providers, have a lower need for such action.

Another interesting outcome of the survey which has to be further investigated in the future is the heterogeneity of the respondents' knowledge regarding the characteristics, advantages and disadvantages, and potential benefits of adopting service-oriented concepts.

A high percentage of those surveyed assessed SOA (compared to other IT architecture paradigms) to be suitable for fulfilling the functional requirements at the IT level. Overall, the respondents are comparably inclined towards SOA, however commercial banks had the highest appreciation for SOA.

Concerning the different expectations of banks when implementing service-oriented concepts, it was not anticipated that potential cost reductions would be the primary advantage for adopting the SOA paradigm. This is even more surprising, considering the investments needed for the introduction and operation of an SOA. Further advantages that are used as sales arguments for SOA, e.g. improved flexibility of business processes or better integration of legacy systems, are only of secondary or subordinate importance when implementing service-oriented concepts.

Differences between the three German banking groups can be observed in terms of their state of knowledge. On the one hand, participants from commercial banks possess a higher knowledge regarding service-oriented concepts in general, as well as the SOA-concept. On the other hand, participants from savings banks and credit unions which rely even more on the outsourcing of IT processes to external service providers, evaluate themselves to be less well-informed.

From this observation, we came to the conclusion that there seems to be a lack of information concerning service-oriented concepts in the German banking industry. This circumstance is especially interesting considering the widespread propagation of service-oriented topics in the technical literature, as well as the extensive advertising efforts of the IT industry and consulting firms. However, it was not

possible to identify the precise causes for this lack of information from the data collected. Nevertheless, a target group-specific addressing of the different banking groups undertaken by the IT industry and consulting firms appears to be a first promising step towards resolving this lack of information.
Another major finding of the survey is the assessment of SOA as a hybrid topic, i.e. SOA should not be restricted to technological or organizational aspects. This observation implies a need to communicate service-oriented concepts and their potential to both the IT and operating departments. SOA offers the potential to enhance communication between these departments and can be regarded as an instrument which supports Business/IT alignment.
However, this duality of the SOA paradigm does not appear to have reached the whole banking industry yet, especially regarding the lower knowledge of service-oriented concepts in savings banks and credit unions (compared to commercial banks) which are less aware of service-oriented concepts due to a high degree of outsourcing. If only SOA would be really considered as both a technological and an organizational topic, there would be more widespread knowledge in savings banks and credit unions as the technological aspect would only play a minor role compared to what it currently does. As mentioned before, a target group-specific information brokering could be the next step towards increased awareness of SOA and hence its organizational aspects.
In conclusion, it has to be stated for the record that SOA will play a significant role both operationally and technologically for German banks. Thus accordingly, further propagation of SOA in the German banking industry will be the subject of our future projects.

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