Research Report

State-of-the-Art IT Architecture Paradigms and their Impact on the German Financial Industry

IN THE FINANCIAL INDUSTRY, INFORMATION TECHNOLOGY (IT) IS AN IMPORTANT BUSINESS ENABLER. THIS ARTICLE PRESENTS THE APPROACH AND FIRST RESULTS OF A MULTI-PARTICIPANT CASE STUDY TO DETERMINE THE STATUS QUO OF SELECTED IT ARCHITECTURE PARADIGMS AND THEIR IMPACT ON THE FINANCIAL INDUSTRY.

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Introduction

With the increasing amount and importance of information in business processes, IT is no longer a "supporting actor", but rather a crucial enabler for economic success. This is especially true for the financial industry, where IT has not only created new back office and front office capabilities in recent years, but has also led to significant reductions in operational cost (Berger, 2003; Ho and Mallick, 2010). Due to these facts, we are currently performing a multiparticipant case study that examines contemporary approaches to IT architectures in German financial institutions. Our objective is to evaluate the interaction between business and IT and to assess the impact of state-of-the-art IT architecture paradigms on this relation.

Organization of the Study

To date, we have conducted interviews with four representatives from two organizations. Both organizations are private German banks with more than 10,000 employees globally. The interviewees from the first organization have leading positions in the IT infrastructure group of their company, while the interviewees from the second organization are enterprise architects. This article presents our key findings to date. Further interviews are planned for the next months in order to validate and extend the results. The basic structure of our case study is summarized by the research framework in Figure 1, which also served as guideline for creating the interview questionnaire. The framework is divided into two major categories. The first category deals with IT architecture in general and addresses the two aspects of IT architecture as a task (i.e., the procedures involved in creating an IT architecture) and IT architecture as a result (i.e., the outcomes of aforementioned procedures). Our focus lies on elucidating the mutual influence between business and IT. The second category deals with the status quo and impact of three specific IT architecture paradigms. Specifically, we selected *Service-Oriented Architecture (SOA), Grid Computing, and Cloud Computing*. The objective is to assess the impact of these paradigms on the banks' IT architectures. Figure 2 shows how the interview results were evaluated. Following the transcription of the interviews, all relevant statements were assigned codes representing individual elements of the research framework. For the actual analysis and comparison of the interviews, we applied the "Pattern Matching" method (Yin, 2003). This means that the findings of all research aspects are compared to each other and the final results are recorded in this text. A comprehensive comparison of these results with the theoretical research foundations in the form of current literature will follow once all interviews have been completed.

Case Study Findings

In the following, we will present the key results of our case study, structured along the previously outlined research aspects.

IT Architecture as a Task – While organizations are increasingly pursuing process-orientation in their IT architectures, the traditional silo model is still structurally dominating. That is, the IT architecture is vertically organized along individual business lines or departments, rather than horizontally spanning these units. An important reason can be the lack of a centralized instance that may provide architectural guidance across business domains. In practice, the degree of cooperation between different business lines and the IT departments often depends on experiences and contacts from previously conducted projects. An additional observation is that the business architecture trails the IT architecture in terms of maturity, and processes are often best understood by the *IT side*, rather than the *business side*. The general concept of "business (architecture) driving IT (architecture)" is often inverted in practice not only due to aforementioned reason, but also because the introduction of a new technology triggers novel business opportunities (such as in the case of Grid Computing, which permitted more extensive risk analysis and potentially more complex financial products). In this context, another important perception is that certain business lines, most notably investment banking, drive the IT architecture by serving as early adopters of certain paradigms and technologies. These frontrunners subsequently create synergy effects for other business lines. The question of whether a specific business line serves as early adopter, rather than early or late follower, with respect to a certain IT architecture paradigm is largely determined by economic constraints, such as cost pressure. Because business lines at least partially pursue different agendas in terms of IT architecture, there is little evidence for negative side effects, i.e., the technological choices of one business line restricting other business lines or the whole organization.

IT Architecture as a Result – The current degree of business/IT alignment is perceived as good among our interviewees. Cost pressure and integration issues are main inhibitors to further improvement. Standards and policies comprise a substantial part of the IT architecture process. They are often determined by regulatory requirements rather than just technological considerations. Both standards and policies serve as rather abstract guidelines across *all* business lines. In contrast, the application of architectural patterns largely depends on the respective requirements of *individual* business lines. For instance, the SOA paradigm plays a significant role in the retail and investment banking sector due to its multi-channel orientation and flexibility. However, because of performance reasons, its applicability is limited in domains where real-time capabilities are required. As a consequence, selected architectural *principles* (such as loose coupling and encapsulation), rather than whole architectural *patterns*, are utilized. A big challenge in a steadily grown IT architecture is complexity. Banks are trying to alleviate this problem through increasing standardization, which subsequently leads to a more homo-geneous IT landscape with a smaller portfolio of utilized products and technologies, or structured complexity management. There is agreement that the role of IT is still increasing in financial institutions, which raises the requirements toward IT flexibility and performance.

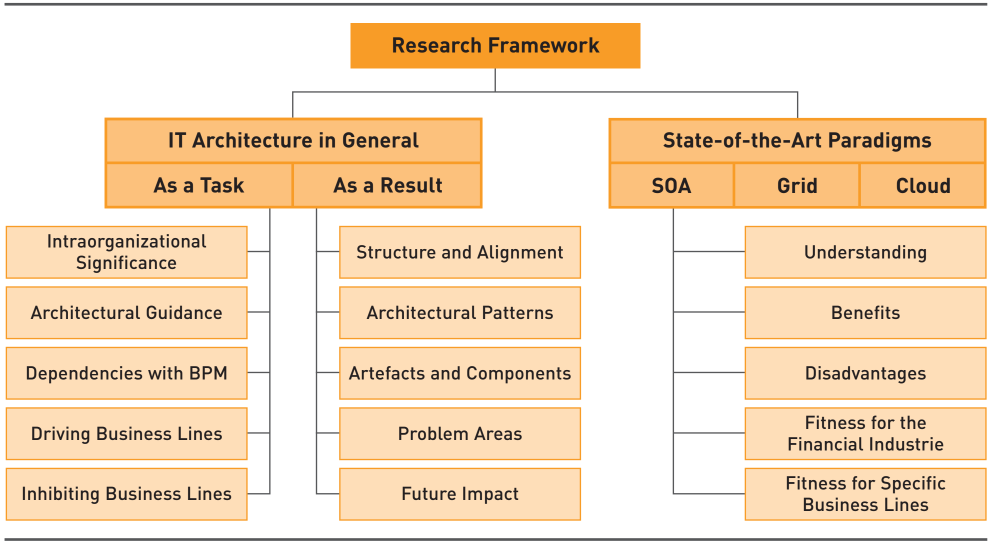

Figure 1: Research Framework of the Case Study

Service-oriented Architecture – The general notion of service-orientation has been around for more than a decade in both interviewed organizations. Encapsulation, loose coupling, the use of service contracts, and business-oriented design are seen as key characteristics. To date, SOA has been implemented in a significant share of the IT systems, mostly applying web-service technologies. SOA is generally seen as "key architecture" and indispensable concept to deal with heterogeneity in the IT landscape. How-ever, the implementation process has not stretched to all core systems and business domains. The general applicability of SOA is limited by performance issues and existing software platforms, such as SAP ERP systems. The key benefits of SOA are seen in data consistency, redundancy reduction, and the ability to formulate service contracts. The reduction of development time and the ability to reuse (IT) artifacts across parts of the organization are also perceived as benefits. However, contrary to our initial expectations, the actual rate of reuse for individual components (i.e., services) has not been significantly improved by the introduction of SOA. One reason may be the persisting tendency among software developers to reimplement rather than reuse existing components. This also seems to be reflected in the observation that SOA requires increased communication between service providers and service consumers. An important inhibitor to the application of SOA is seen in a lack of off-the-shelf products that implement existing SOA standards. Additional challenges concern the integration of legacy systems into an SOA. Lastly, security is an important concern. The general feeling is that the issue has been insufficiently addressed by IT solution providers and research so far. In contrast to the essential idea of process orientation, SOA is often employed in a rather isolated, projectbased manner. Thus, cost savings are hard to quantify, which makes it difficult to argue for the introduction of SOA from a cost perspective. However, it was observed that business lines which aggressively pursued SOA in the past were currently realizing benefits from it.

Accordingly, the general fitness of SOA for the financial industries remains unquestioned. Notable exceptions concern business lines relying on performance-critical applications.

Grid Computing – Grid Computing has been employed by the participants of our case study for more than five years. The introduction was primarily driven by a sharp decline in hardware prices and the increasing popularity of the Linux operating system. The extension of scalability to a logical network of nodes, resulting in the possibility to parallelize and thus speed up tasks, is seen as key characteristic. A major benefit of Grid Computing concerns the possible time reduction in performing certain tasks or, alternatively, the ability to perform more complex tasks within a specific time frame. Furthermore, Grid Computing allows for easy adaptation of the IT environment to fluctuating performance demands at significantly lower costs than traditional monolithic solutions (commonly referred to as *scaling out vs. scaling up*). With respect to the hardware aspect of Grid Computing, managing and cooling many thousands of computers in a data center is seen as a practical challenge. At the same time, the integration of existing heterogeneous resources, such as desktop computers, is found rather impractical due to a high degree of management overhead. The most important disadvantage of Grid Computing, however, concerns the fact that a special type of software application is required that can be split up into small work packages for each node. This problem is further elevated by an insufficient support for parallel programming in current software development tools. As a result, Grid Computing is specifically suited for specific application scenarios, such as extensive risk calculations within the investment banking business lines. In these domains, Grid Computing, for instance, allows for the application of more complex financial models, ultimately resulting in more competitive pricing within the market.

Cloud Computing – While Cloud Computing encompasses concepts from diverse well-developed fields of IT, the paradigm as such has gained momentum only recently. The ability to purchase computing resources, rather than providing them in-house, constitutes an important characteristic. Cloud Computing also resembles many of the features of Grid Computing, but adds a virtualization layer on top of the actual hardware systems. Cloud Computing is currently being employed by only one of the organizations in our study. The dominant aspect is the purchase of external computing resources, primarily software functionality in the form of *Software as a Service* (SaaS). Cost reductions constitute the most important benefit, because Cloud Computing reduces the need to operate and maintain a large data center and introduces the ability to reuse existing software components. In addition, the reduction of latency can be a major benefit. If a Cloud provider has superior connectivity, e.g., with a stock exchange, this may yield significant competitive advantages in certain processes. On the negative side, security is a major concern, triggered by various laws and regulations in the banking industry. This, most notably, concerns the transmission of data across geographical boundaries and the sharing of data with external parties. An additional drawback in Cloud Computing is the inability to determine the future development and life cycle of a (software) product. Cloud Computing seems to offer significant potential to the financial industry across all business lines. However, its actual application is still complicated by security and compliance issues.

Conclusion and Outlook

In recent years, new IT paradigms have recurringly promised to alleviate various short-comings of IT. With respect to the participants in our case study, however, it is safe to conclude that none of the included three paradigms has had *revolutionary* effects on IT architecture. Each paradigm has rather brought *evolutionary* changes. An important finding is that individual business lines, rather than the company as a whole, adopt IT paradigms based on their specific requirements. In this process, certain sections – such as investment banking – regularly serve as *frontrunners*. This has a positive impact for the technological followers within an organization. Another major finding is that business lines or companies as a whole adopt selected architectural principles (such as loose coupling from SOA), rather than the complete paradigms. For that matter, it seems that the most useful parts of both SOA and Grid Computing have now been put to use by financial institutions. Cloud Computing is receiving increasing attention lately and offers significant potential to the financial industry, given that the security and compliance concerns can be efficiently addressed.
The findings presented in this report will be further validated and extended in additional interviews in the next months. Additionally, an extensive comparison with the research foundations will be conducted and best practices will be inferred from our findings.

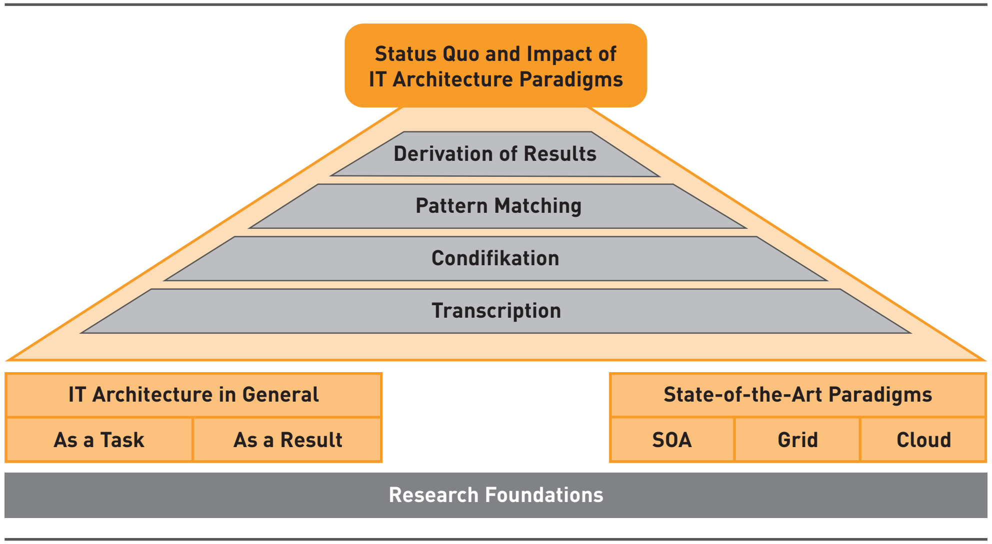

Figure 2: Methodical Evaluation Process

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