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# Impact of Services Grids Assimilation on the Level of Business Agility - a Conceptual Model in the Financial Services Industry

Martin Wolf

*University of Frankfurt*, [mwolf@wiwi.uni-frankfurt.de](mailto:mwolf@wiwi.uni-frankfurt.de)

Jens Vykoukal

*University of Frankfurt*, [jvykoukal@wiwi.uni-frankfurt.de](mailto:jvykoukal@wiwi.uni-frankfurt.de)

Roman Beck

*University of Frankfurt*, [beck@itu.dk](mailto:beck@itu.dk)

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# 13. IMPACT OF SERVICES GRIDS ASSIMILATION ON THE LEVEL OF BUSINESS AGILITY - A CONCEPTUAL MODEL IN THE FINANCIAL SERVICES INDUSTRY

Martin Wolf  
University of Frankfurt  
mwolf@wiwi.uni-frankfurt.de

Jens Vykoukal  
University of Frankfurt  
jvykoukal@wiwi.uni-frankfurt.de

Roman Beck  
University of Frankfurt  
rbeck@wiwi.uni-frankfurt.de

## ***Abstract***

Over the last few years, Grid computing has gained considerable attention in the industry leading to the vision of a new agile business platform which provides the on-demand access to resources and services, thus facilitating new business models. In this article, we depict the current trend of financial institutions to employ Services Grids in order to increase the level of business agility in terms of a faster response to changing business needs. Since little empirical research has been conducted in this field so far, we conducted a case study in a large German bank that has introduced a Services Grid for risk management. Based on the results of the case study we develop a model and propositions depicting the causal relationship between Services Grids competence and business agility as antecedent of an increased financial performance. As part of our conceptual model, we elaborate on a more detailed measure of business agility.

## ***Keywords***

Services Grids, Business Agility, Financial Performance, Financial Services Industry

## **1. Introduction**

Over the last few years, Grid computing (Berman et al. 2003; Foster & Kesselman 1999) has evolved into a well-understood technology that provides users and applications immediate access to a large pool of IT resources, such as supercomputers, storage systems, databases, and services that can be used as a unified resource.

Following the widely accepted definition provided by Foster (2002), a Grid is a system that coordinates IT resources that are not subject to centralized control, uses standards, open protocols and interfaces, and delivers nontrivial qualities of service. Grid computing enables heterogeneous and geographically dispersed IT resources to be virtually shared and accessed

across an enterprise, industry, or department. These capabilities lead to the possibility of a faster IT response to changing business requirements and thereby contribute to an increased level of business agility. In our context and consistent with the extant literature (Dove 2001; McCoy & Plummer 2006; Sambamurthy et al. 2003), business agility encompasses the ability of an enterprise to sense and respond to environmental changes in an efficient, timely and effective manner, which is becoming vitally important due to a fast-changing global business environment (Overby et al. 2006). Thus, our central research question is how Services Grid assimilation contributes to business agility as antecedent of increased financial performance.

The remainder of the paper is organized as follows: since being of central importance to our research model, section 2 introduces the extant literature on business agility whereas section 3 presents Services Grids as highly scalable, powerful, and flexible business architectures leading to an increased level of business agility of enterprises. Since the financial services industry is one of the most promising application domains of Services Grids, section 4 exemplarily depicts the impact of Services Grid assimilation in this industry by presenting the results of a case study. Section 5 introduces our derived research model which elaborates on the causal relationship of Services Grid competence and business agility as antecedent of increased financial performance. Furthermore, a detailed insight in a Services Grid centric measure of business agility is provided. Finally, section 6 concludes the paper with final remarks and depicts further planned research.

## **2. Business Agility**

Many different competing definitions of business agility exist in the extant literature, several of them being originated in the manufacturing domain. Tsourveloudis and Valavanis (2001) elaborate on the term of agility as the ability of an enterprise to operate profitably in a rapidly changing and continuously fragmenting global market environment by producing high-quality, high-performance, customer-configured goods and services.

Besides the manufacturing domain, business agility is often defined as the ability of an organization to sense environmental changes and respond to them in an efficient, effective and timely manner (Dove 2001; McCoy & Plummer 2006; Sambamurthy et al. 2003). Zhang and Sharifi (2000) emphasize the aspect of enterprise agility of being able to cope with unexpected change, arising threats and exploiting emerging market opportunities. In line with this, Haeckel (1999) argues that an enterprise can achieve a competitive advantage if it is able to anticipate and sense customer needs early and accurately and respond to those continually changing needs in real time.

Sambamurthy et al. (2003) distinguish between three different kinds of agility: customer agility, partnering agility, and operational agility. Customer agility encompasses the ability of a firm to co-opt with customers and thus leverages their voices in order to sense market opportunities. Partnering agility is the ability to leverage the knowledge and capabilities of supplier and partner networks for gaining a competitive advantage. Finally, operational agility reflects the competence of a firm to dynamically rearrange and reconfigure its embedded business processes in order to exploit upcoming opportunities for innovation and competitive action.

It is thus the ability of sensing environmental changes and responding to them on the operational level which is being emphasized in our work. Providing on-demand services to companies

facilitates agile and flexible reactions to environmental changes and the provision of digitally enabled services (Rai & Sambamurthy 2006).

As far as the measurement of business agility is concerned, only little research has been conducted so far. Tsourveloudis and Valvanis (2001) focus on the assessment and measurement of manufacturing agility and point out that the current research is missing a holistic measure of agility and its indicators. Sambamurthy et al. (2003) primarily see IT as a digital options generator finally leading to competitive actions as antecedent of financial performance of a firm and further on propose a model depicting this causal relationship. These impacts are mediated by the companies' ability of entrepreneurial alertness which encompasses the capability of a firm to oversee the surrounding market in order to spot and take advantage of evolving opportunities. Finally, Sambamurthy et al. (2003) state that a refinement and empirical evaluation of their model would be eligible.

Since our research focuses on the use of Services Grids, the following section provides an introduction to the field of Grid computing and especially to Services Grids.

### **3. Move towards Services Grids**

After the seminal work of Foster and Kesselman (Foster & Kesselman 1999), the interest in Grid computing was rapidly growing and has gained considerable attention in both academia and industry. This was facilitated by the availability of powerful computers and high-speed networks as low-cost commodity components and by the growth of the Internet that enabled users to discover and manage computing resources distributed across a Grid (Parashar & Lee 2005).

Grid systems can be characterized by a set of latent properties that extend those of traditional computer clusters. These properties bring a variety of benefits (Al-Khannak & Bitzer 2008; Buyya & Sulistio 2008) that include: (1) On-demand provisioning of geographically dispersed, heterogeneous resources; (2) Seamless computing power achieved by exploiting under-utilized or unused resources to solve compute-intensive problems; (3) Increased productivity due to reduced processing time; (4) A more reliable, resilient, and highly available infrastructure with autonomic management capabilities and on-demand aggregation of resources from multiple sites to meet unforeseen demand; (5) Increased business agility, flexibility, and scalability.

Besides these benefits, there are several security issues that need to be addressed when deploying Grid technology. Since a Grid infrastructure embodies a distributed and shared computing environment, it has to be ensured that the communication is secure, in terms of integrity, confidentiality and non-repudiation. Therefore, appropriate means for authentication, authorization, delegation, auditing, and recovery have to be implemented (Smith et al. 2006). Moreover, since Grids encompass the decentralized and concurrent execution of unknown code, measures have to be taken in order to ensure that no malicious code compromises the Grid from the inside. Otherwise it may become feasible for an attacker to utilize Grid resources, e.g., as a mail server for outgoing junk or in order to start denial-of-service attacks (Schmidt et al. 2007). Additional challenges that need to be addressed to further facilitate the adoption of Grid technology in the industry domain include improvements in the stability of Grid systems (Stockinger 2006), reduction of Grid coordination protocol overhead, the development of holistic approaches to virtualization and SLAs (Jiménez-Peris et al. 2007), and trust and reputation

mechanisms (Eymann et al. 2008). Furthermore, the IT staff responsible for the development of a Grid infrastructure and Grid applications has to be skilled and experienced to effectively exploit the benefits of Grid technology.

A promising type of Grid that is supposed to further promote the adoption of Grid technology in the business domain is the Services Grid (Vykoukal et al. 2009). A Services Grid defines a distributed application environment for business applications and is based on SOA principles, technologies, and standards, delivers a mechanism for scaling on multi-core, multi-CPU, and multi-server systems, and enables the integration of disparate technologies, programming languages and systems. Services Grids provide a flexible association of IT resource requirements to physical resources, allowing workloads to change their profile over their usage lifecycle. Provisioning implies that when Grid services are requested, the appropriate resources can be identified and made available automatically. Equally, when the resource is no longer needed, the physical server can be re-provisioned for a different purpose or shut down, allowing for vastly better utilization of IT resources over their lifecycles which leads to significant cost savings. Opitz et al. (2008) attempted to analyze the costs associated with Grid technology by identifying different cost factors (hardware, business premises including electricity, software, personnel, and data communication). They concluded that the costs of Grids are between \$0.20 and \$0.94 per CPU and hour whereas the costs of a traditional computing center range from \$2 to \$12 per CPU and hour, which emphasizes the significant cost savings potential of Grid technology.

Since the financial services industry with its information-driven business processes and its high computational demands is one of the most promising application domains of Services Grids (Schwind et al. 2007), the following section depicts the impact of Services Grid assimilation in the financial services industry by presenting the results of a case study conducted in one of the biggest private-sector banks in Germany measured by the number of consolidated assets.

#### **4. Services Grid Assimilation in the Financial Services Industry**

In general, the banking sector faces increased competition that leads to a high pressure for restructuring and further automation of IT-related business processes. In addition, fast changing customer needs force financial institutions to provide highly customized financial products on demand. Due to this, the reduction of the time-to-market for financial products provides a way to achieve a competitive advantage and a faster reaction time on customer needs (Davamanirajan et al. 2002) which can be achieved by the assimilation of Services Grids.

Since little research has been conducted to analyze the advantages and benefits of Services Grids in the financial services industry (Moreno-Vozmediano et al. 2007), we conducted an exploratory qualitative in-depth case study in a large German bank that has developed and utilized a Services Grid for risk management. The decision to conduct an exploratory research approach allowed us to investigate the unfolding effects and economic impacts of Services Grid assimilation in this particular financial institution.

In order to analyze the Grid solution of the bank from an information systems and economic perspective, we used the embedded, single-case design according to Yin (2003). In October 2007, we were able to apply our exploratory research in a grounded theory-like approach by conducting structured in-depth interviews with the leaders of the IT department responsible for

the Grid application development and implementation. The interviews were recorded, fully transcribed, and finally validated by the interviewees to ensure the accuracy of their responses and to eliminate erroneous inferences. Besides the analysis of the interview transcripts, we analyzed project documentations and Grid usage figures in order to allow for an accurate data analysis.

For our case study, we worked together with the IT business unit that developed a Grid-based platform for two different financial applications of the bank. These Grid-enabled applications are used to (i) value market price risks for controlling purposes and to (ii) value portfolio risks for the stock trading group of the investment banking division, which exemplarily demonstrates the potentials of Grid solutions in the financial services industry. Within the case study, we mainly focused on the motivation, the implementation, and the economic impacts of Grid applications rather than how different algorithms and calculations are processed and used.

In the beginning of 2006, the business department of the bank responsible for the market price risk controlling requested a stable and reliable IT infrastructure that accelerates the very compute-intensive risk calculations in order to reduce time-to-market of new financial products. Since the calculation of market price risks can be computed in parallel, the development team aimed at building a distributed and scalable architecture that enables an easy integration of new functionalities (by means of services) without the need to change the interfaces. Since a Services Grid is highly scalable and facilitates distributed and parallel computing, the development team decided to establish a Services Grid infrastructure by consolidating the already existing hardware resources (storage, databases, servers, etc.). Since January 2007, the Services Grid is being used successfully to calculate market price risks during nighttime. The time-to-market of financial products could thereby be reduced to one fourth of the original time.

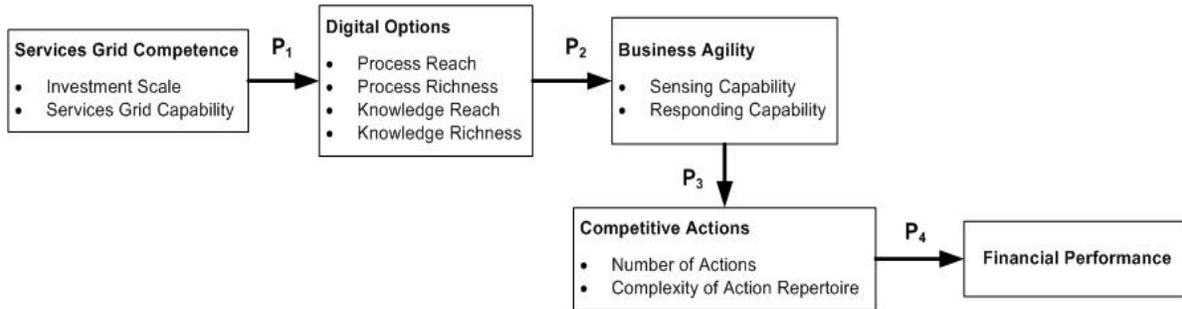
A few months after the successful adoption of the Grid infrastructure, the stock trading department of the bank requested to use the Grid infrastructure during the day to speed up the risk calculations for their stock portfolios. Due to this request, the development team integrated the trading application into the existing Services Grid and thereby obtained a significant reduction in computing time without purchasing additional hardware resources. By using the Grid-based resources, the risk calculations could be accelerated from about 3.5 hours to 7 minutes providing another huge potential for the bank to react faster to the changing and dynamic market environment.

## **5. Impact of Services Grids on Business Agility**

The results of the case study highlight that Services Grids have a high potential to increase the effectiveness and productivity of a financial institution by providing a flexible and powerful business platform. Business applications can be deployed faster on Services Grids in an effective way leading to increased business agility of a firm.

Based on these findings and consistent with the extant literature, we developed a model that analyzes the impact of Services Grid competence on business agility. Furthermore, we introduce a more detailed measure of business agility.

As depicted in our conceptual research model in Figure 1, Services Grids can be seen as an IT-based means of digital options generation leading to an increased level of business agility and thus facilitating the emergence of competitive actions (Sambamurthy et al. 2003; Fichman 2004). Since competitive actions are antecedents of financial performance, the assimilation of Services Grid will impact the overall financial performance of a firm.



**Figure 1:** Impact of Services Grid Assimilation on the Financial Performance

## 5.1 Services Grid Competence

The case study revealed that it is crucial for an enterprise to have a high Services Grid competence in order to adopt and run a Services Grid successfully. In this context, Services Grid competence reflects the level of financial investments for and the quality of the Services Grid infrastructure, as well as the level of technical and business capabilities of the IT staff needed to effectively integrate business applications into the Services Grid. Additionally, Services Grid competence captures the ability of a firm to drive Grid-based innovations of strategic importance in an effective and efficient manner. In our case study, it turned out that the IT staff responsible for the development of the Services Grid solution exhibited deep expertise in the field of Grid technology and collaborated intensively with the two involved business departments to ensure the IT business alignment of the solution and to effectively transform the financial applications into services. The investments for the Grid infrastructure have been relatively low since the hardware resources of the Services Grid already existed.

More than that, the case study revealed that Services Grids allow for the on-demand composition of complex services based on underlying commodity services and thus evolve the ability of an enterprise to react to changing market requirements or customer needs in a flexible manner (Jiménez-Peris et al. 2007; Plaszcak & Wellner 2006). This is due to the characteristics of services which are loosely coupled and their business functionality being fully encapsulated. Thus, we propose:

P1: Services Grids competence positively affects the generation of digital options.

## 5.2 Digital Options

In general, digital options represent a set of IT-enabled capabilities that are reflected in digitized business processes and knowledge systems and can be further subdivided with respect to their level of reach and richness (Sambamurthy et al. 2003).

A high degree of *process reach* is represented by the design and establishment of both inter-departmental and inter-organizational digitized processes, leading to an improved cooperation with customers and/or business partners. In the case of the Services Grid of the analyzed bank, the degree of process reach is moderate since the Grid infrastructure is actually used by only two different business departments within the bank. Therefore, the bank intends to further integrate additional financial applications and standard business applications into the Grid in order to increase the degree of process reach. To share the Services Grid with customers or business partners is not intended.

Digitized *process richness* covers the quality, transparency, and availability of information about transactions running within a process or between two processes and the ability to re-engineer the underlying process upon this. Until now, two financial applications of the bank are running on the Services Grid. Since services need to be well-defined and have to conform to certain interfaces, the services can be monitored and re-engineered very easily. Therefore, the process richness of the Services Grid is very high.

The level of access to codified firm knowledge and its degree of comprehensiveness is encompassed by digitized *knowledge reach*. The knowledge reach of the bank's Services Grid is moderate since the financial applications are very different and serve distinct purposes. Nevertheless, it is possible to decompose financial applications into a large set of simple services in order to provide certain services to different applications. For example, services that provide results of risk simulations or historical data could be encapsulated and used by different financial applications. This modularization is a means to increase the digitized knowledge reach of the Services Grid.

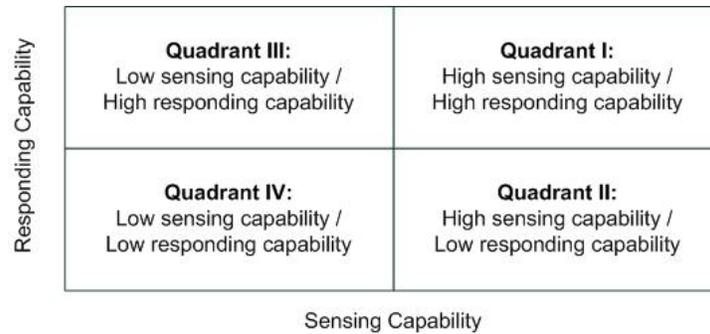
Digitized *knowledge richness* facilitates the exchange and development of knowledge within an enterprise, e.g., through IT-based communication systems. Currently, the Services Grid provides no support for interactions between different business departments.

In order to increase the level of business agility, sensing and responding capabilities have to be developed by the means of a composition of organizational structure, technological options, people and innovation which are the so-called agility providers (Zhang & Sharifi 2000). These agility providers have to be fully integrated with the support of information systems and technology, thus facilitating business agility. Thus, we propose:

P2: Digital options positively influence the level of business agility.

### **5.3 Business Agility**

In order to measure the business agility of the financial institution resulting from the Services Grid assimilation, we referred to the sensing and responding capability of the institution framework proposed by Overby et al. (2006). As shown in Figure 2, the framework consists of a 2x2 matrix with sensing capability on the x-axis and responding capability on the y-axis. Each of the four quadrants represents a distinct profile of an enterprise in terms of its capability to sense environmental changes and to respond to them.



**Figure 2:** Business Agility Measurement Framework

The *sensing capability* refers to the ability of enterprises to sense different types of environmental changes including (based on Zhang and Sharifi (2000)): (1) social, legal, and regulatory changes; (2) changes in customer needs and preferences; (3) changes in technology; (4) changes in the environment, (5) changes in the business network.

The relative importance of each of these change forces (and the institution's capability needed to detect them) vary across industries. For example, the new capital requirements of the Basel II Accord and the customer needs that are changing into the direction of highly customized, on-demand financial products enhance the pressure on the financial institutions in the European Union. Therefore, we claim that financial institutions have to have a high sensing capability in order to meet the legal and regulatory requirements and to fulfill the rapidly changing customer needs to stay competitive in the dynamic financial market.

The *responding capability* of the business agility framework refers to the ability of enterprises to respond fast, accurately, and effectively to environmental changes. The assimilation of a Services Grid in an enterprise is a way to respond to a rapidly changing business environment since Services Grids accelerate the speed of development of business models and thus increase the enterprise's competitiveness in the market.

As far as the IT infrastructure is concerned, both the sensing and the responding capabilities are being facilitated by a high level of interoperability and networking (Tsourveloudis & Valvanis 2001). Interoperability is a measure of the standardization level of the underlying infrastructure thus being an indicator for agility. A high level of interoperability provides an enterprise with the ability to exchange and store information in a possibly distributed and dispersed environment, e.g., as it is found in virtual organizations. The networking capability reflects the level of communication skills of an enterprise and is determined by the degree of connectivity of the enclosed entities and organizational levels. Retrieving and spreading information within and across a (virtual) organization contributes directly to the sensing and responding capabilities leading to an increased level of business agility.

The positive effect of Services Grid assimilation on the business agility of an enterprise has already been illustrated by the depicted case study. Since the Services Grid of the bank is built on a well-defined, service-oriented architecture, it provides a highly scalable, flexible, and powerful business platform that allows for a fast integration and deployment of new business processes.

Further, the capability to flexibly utilize resources allows the bank to shift resources to areas of need which will help them embark on new ventures or adjust existing ventures.

According to the framework depicted in Figure 2, each enterprise can be classified into one of the four quadrants by analyzing its sensing and responding capability resulting from the assimilation of a Services Grid. *Quadrant I* reflects an enterprise with a high sensing and a high responding capability. This is the case if a Services Grid is able to sense environmental changes and can be used to respond to them very fast. *Quadrant II* represents enterprises that are running a Services Grid that is capable of sensing environmental changes without being able to respond to them in a fast and efficient manner. If the Services Grid is not able to sense environmental changes but is capable of responding to external changes very flexible, fast and efficient, the enterprise's profile is reflected in *quadrant III*. *Quadrant IV* represents enterprises that are running a Services Grid that does only provide low sensing capability and high responding capability.

The goal of the bank investigated in the case study is to have a high sensing capability and a high responding capability and thus represent the profile of quadrant I depicted in Figure 2. Currently, the bank can be classified into quadrant III since the Services Grid is not capable of sensing environmental changes. There are no services running on the Services Grid so far that are, e.g., able to sense changes in customer needs and preferences or to sense changes in the competitive environment. Although the Services Grid is currently not capable of sensing environmental changes, these changes have to be sensed by the bank none the less. Currently, this is done by other applications that are running on different servers and computer clusters that are not integrated into the Grid environment so far. Despite the moderate sensing capability, the Services Grid has a high responding capability due to its service-oriented and flexible nature. New services can be integrated into the Grid very fast and efficiently, leading to an increased capability to stay competitive in the fast changing and dynamic market environment.

Ongoing with an increased level of business agility, the number of action alternatives grows since enterprises become more independent from infrastructural restrictions. Since today's environmental conditions become increasingly turbulent for many industries (Overby et al. 2006), e.g., strict regulations as Basel II in the financial services industry, there is an on growing need for agility in order to act successfully on the market. Thus, we propose:

P3: The level of agility positively affects competitive actions.

## **5.4 Competitive Actions**

Competitive actions are market-oriented moves of a firm in order to change the status quo of the addressed market or segment (Sambamurthy et al. 2003). These can be either achieved by the introduction of a new product, a new distribution channel or the establishment of a new market segment (number of competitive actions). Moreover, the variety and richness of the competitive actions may increase, thus leading to a more complex action repertoire. The Services Grid solution of the bank increases the bank's capability to stay competitive in a dynamic market environment leading to an increased financial performance. Further, Young et al. (1996) presented first evidence that the number of competitive actions is positively correlated to the financial performance of an enterprise. Hence, we propose:

P4: Competitive actions positively affect the financial performance.

## 6. Conclusion and Further Research

In this article, we focused on developing a model emphasizing the impact of Services Grid assimilation towards business agility in terms of a faster sensing of and responding to environmental changes. Since little empirical research has been conducted in this field so far, we first conducted a case study in a large German bank that has introduced a Services Grid for risk management leading to a significant reduction in time-to-market of financial products. On the basis of the insights from the case study and consistent with the extant literature, we developed a research model and propositions which emphasize the causal relationship between Services Grid competence and business agility, finally leading to an increased financial performance. More than that, we elaborated on a Services Grid centric measure of business agility.

Both, the utilized research model and the measure of business agility indicate a causal relationship between Services Grids assimilation and business agility of a firm. Further work will be conducted on an operationalization of the underlying theoretical constructs in order to quantify the different drivers of business agility and impact factors. As far as the research model is concerned, other mediating or moderating factors may be identified, leading to a refinement of the current model.

In our future research, we will elaborate on other aspects of Services Grid assimilation in the financial services industry leading to a more holistic theoretical model. Finally, we will conduct an international field study in the financial services industry in order to validate the research model. The results of the planned survey are intended to be of interest to both: researchers who explore the role of Services Grids in the financial services industry as well as financial services providers that are interested in the financial impact of Services Grid assimilation.

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