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Dimensions of Organizational Agility in the Software and IT Service Industry: Insights from an Empirical Investigation

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Abstract:

Agility has increasingly gained attention in the software and IT services industry over the last years and academia put a heavy emphasis on research about agile software development methods. However, an organization does not only comprise development teams, and research often lacks an organizational perspective on agility. Presently, we have no consensus about what constitutes an "agile organization". Hence, in this study, I identify the structure behind the concept of organizational agility using an exploratory research approach. I conducted a survey among organizations in the software and IT service industry and performed an, exploratory factor analysis and a cluster analysis (based on the variables). The results show that one can describe organizational agility using six interrelated factors that one can further aggregate into the three basic dimensions of "agility prerequisites", "agility of people", and "structures enhancing agility". The identified structure is a first step toward a common understanding of organizational agility and helps to guide further research activities while simultaneously supporting practitioners in assessing the agility of their organizations.

Keywords: Organizational Agility, Exploratory, Empirical, Factor Analysis, Cluster Analysis, Software and IT Service Industry.

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1 Introduction

Today, many use the term “agility” excessively, and many organizations even use it as a marketing buzzword without questioning its meaning. However, the idea of agility is not new nor unique to any specific domain such as software development. In fact, the concept of an agile organization dates back to the late 1980s (Iacocca Institute, 1991; Kettunen, 2009), with earlier likeminded ideas expressed in the social sciences as early as the 1950s (Parsons, Bales, & Shils, 1953). Nevertheless, the idea behind agility and, in particular, organizational agility is still essential for organizations in today’s competitive and fast-changing environment (Bessant, Knowles, Briffa, & Francis, 2002; Goodhue, Chen, Claude, Davis, & Cochran, 2009).

Organizations, and especially those active in the software and IT service industry, face such an environment. Rapid technological developments have made IT an essential component of many other products (e.g., in consumer electronics, automotive products, etc.) and increased the importance of IT to support business processes in many companies (Disterer, 2009; Petersen & Wohlin, 2009). As a result, organizations have experienced increased cost- and quality-related pressures, which has forced them to improve their efficiency (Becker, Pöppelbuß, Venker, & Schwarze, 2011; Walter, Böhmann, & Krcmar, 2007).

Researchers and practitioners have discussed organizations’ necessary adaptation to those developments under the slogan “IT industrialization”, which refers to implementing industrial principles to IT (Disterer, 2009; Walter et al., 2007). Similar to the industrialization in the industrial sector, IT industrialization is driven by technological innovations and characterized by product and process standardization (Landes, 2003; Walter et al., 2007) accompanied by new requirements for employees and managers’ skills and capabilities. Furthermore, organizations need to make changes in their (hierarchical) structures and to cope with the effects of decomposed value chains caused by the progressive specialization of work (Walter et al., 2007).

As such, we can see that, to successfully industrialize the software and IT service industry, organizations have to change and adopt their business in many aspects, such as their processes, structures, skills, and capabilities. Hence, being an agile organization is a prerequisite for staying competitive in the software and IT service industry today (Tallon & Pinsonneault, 2011).

Interestingly, in comparing the situation of the software and IT service industry today with the manufacturing industry in the early 1990s, Kettunen (2009) found some interesting parallels. In the manufacturing industry, “the globalization of markets, rapid technological change, shortening of product life cycles, and increasing aggressiveness of competitors” (Volberda, 1996, p. 359) characterized increased competition. At this time, the so-called “Lehigh Report” (Iacocca Institute, 1991) appeared. This influential document postulated some provocative claims concerning the manufacturing industries while recommending the agile manufacturing paradigm and the transition to agile organizations in order to stay competitive (Yusuf, Sarhadi, & Gunasekaran, 1999). The above-mentioned characteristics of change are now also prevalent in the software and IT service industry. In specific, the Internet, Web-based development and services, and the possibility to distribute teams and parts of an organization globally call for enhanced “maneuverability” (Cockburn, 2007) to establish efficient and flexible structures to improve communication, collaboration, and decision processes (Sarker & Sarker, 2009).

Surprisingly, despite the ongoing research in this topic, we lack a clearly defined framework for explaining agility from an organizational perspective (Sherehiy, Karwowski, & Layer, 2007). Although several frameworks are available, they are ambiguous and vary among each other, which suggests that we lack consensus about the determinants and dimensions of organizational agility (Charbonnier-Voirin, 2011; van Oosterhout, Waarts, & van Hillegersberg, 2006; Wendler, 2013b). As Charbonnier-Voirin (2011, p. 122) puts it, “this lack of precision further restricts the potential for operationalization”, which limits the applicability of research results in practice. In addition, the available work heavily focuses on theoretical descriptions and concepts, while empirical investigations are scarce (Bottani, 2010; Sherehiy et al., 2007). Indeed, the overwhelming majority of empirical studies in the software and IT service industry covers only the software-development process often from a specific method-based (XP, Scrum, etc.) perspective (Conboy, 2009). Besides software development, another stream of research deals with service-oriented architectures and their implications for agility (Ren & Lyytinen, 2008; Schelp & Winter, 2007). But again, the available literature mainly focuses on technical solutions, does not adopt an organizational perspective, and only scarcely empirically analyzes data (Schelp & Winter, 2007).

While these approaches are equally important in understanding specific aspects of agility, they are not sufficient when it comes to analyzing agility from an organizational point of view. Hence, a gap in research about the organizational aspects of agility in the software and IT service industry exists. In the manufacturing area, research already moved from technical solutions to organizational approaches by incorporating organizational structures, processes, and so on (Sherehiy et al., 2007). However, in the software and IT service industry, studies have not taken such steps even though one can only achieve agility "if software (and IT) artifacts are regarded in the context of their usage to support business processes and ultimately to support business models" (Schelp & Winter, 2007, p. 2). Indeed, Kettunen (2009), who compared agile software development practices to those of agile manufacturing, concludes that "agility is a capability of the organization (entity)" and insists that one needs to ask "what it means for each area…of a software organization to be agile" (Kettunen, 2009, p. 414).

As such, I focus on identifying the structure that undergirds the concept of organizational agility based on a comprehensive exploratory research approach. Furthermore, I focus on identifying common ground and reducing the confusion in the high amount of ambiguous agility-related concepts in the available literature. Specifically, I address the following research question (RQ):

> **RQ:** What are the underlying (latent) factors of organizational agility in the software and IT service industry?

To answer this research question, I build on the available body of knowledge and complement existing studies by addressing further issues. I consider the available conceptual frameworks and go beyond the previous work by investigating the issue of organizational agility in the software and IT service industry using a comprehensive approach. I empirically determine the relevant factors in assessing an organization's agility. From an academic perspective, this factor structure helps one understand the concept of organizational agility, and other researchers can apply it in further research. From a managerial perspective, the results enable managers to identify potential improvement areas and guide an organization in enhancing its organizational agility.

This paper proceeds as follows: in Section 2, I describe the concept of organizational agility and discuss related work. I present the results of a literature review about agility in general and organizational agility in particular. In Section 3, I discuss the research framework and summarize available agility-related sub-concepts. I describe the research method and study's design in Section 4. In Section 5, I summarize the sample and how I analyzed the data. In Section 5, I provide the results, and in Section 6, I discuss and interpret them in more detail. Finally, in Section 7, I conclude the paper, discuss its main implications and limitations, and discuss further research opportunities.

2 Research Background

2.1 An Organizational Perspective on Agility

Despite the existing research on agility, we still lack a universal definition for organizational agility. The literature contains a huge variety of more or less comprehensive definitions, each heavily influenced by context and application domain. While I cannot discuss these definitions in detail here, several other authors have done so (e.g., Bernardes & Hanna, 2009; Gunasekaran & Yusuf, 2002; Kettunen, 2009; or Sherehiy et al., 2007).

Due to the lack of research from an organizational perspective in the software and IT service industry, I use the following two definitions from the agile manufacturing domain as the basis for this work. Because of their general formulation, they fit well into the software and IT service context and complement each other content wise. In this study, I primarily focus on empirically identifying the factors of organizational agility using an exploratory approach. Hence, I focus on maintaining an objective perspective on the gathered data and not limiting the research's scope with a definition that may be inappropriate or too narrow.

Yusuf et al. (1999, p. 37) define agility as:

> *The successful exploration of competitive bases (speed, flexibility, innovation proactivity, quality and profitability) through the integration of reconfigurable resources and best practices in a knowledge-rich environment to provide customer-driven products and services in a fast changing market environment.*

I selected this definition because it generally describes the kind of market environment prevalent in the software and IT service industry because it does not restrict itself to manufacturing products and because it emphasizes the role of customers and the importance of internal capabilities, structures, and people (i.e., "reconfigurable resources").

An important characteristic of this "fast-changing market environment" is the unpredictability of the upcoming changes. To cope with these changes, organizations need effective knowledge management. Hence, Ganguly, Nilchiani, & Farr (2009, p. 411) define agility as:

> *An effective integration of response ability and knowledge management in order to rapidly, efficiently and accurately adapt to any unexpected (or unpredictable) change in both proactive and reactive business / customer needs and opportunities without compromising with the cost or the quality of the product / process*.

Although those definitions summarize agility well, they do not directly mention the organizational perspective. Looking further into this issue, one can find early works about organizational aspects of agility in the social sciences and date back to the 1950s (Parsons et al., 1953). Despite a growing interest in manufacturing since the 1990s triggered by the so-called "Lehigh report" (Iacocca Institute, 1991), agility became well known in the software industry only after the "Agile Manifesto" in 2001 (Beck et al., 2001).

Set off by this manifesto, a lot of research regarding agility has focused specifically on the domain of agile software development and showed that agile methods may benefit project teams, reduce costs, and enhance quality (see, for instance, Bose, 2008; Dybå & Dingsøyr, 2008; Salo & Abrahamsson, 2008). However, some critical voices have also uncovered some constraints that may hinder the effectiveness of agile methods, including cultural aspects, missing customer commitment, mandatory processes, or the fear of responsibility (Bleek & Wolf, 2008; Chan & Thong, 2009; Wendler & Gräning, 2011). In addition, many agile software development methods lack the support of other business needs (Abrahamsson, Warsta, Siponen, & Ronkainen, 2003). Agile methods need this support, however, because many of the aforementioned changes are outside the scope of individual development teams (Highsmith & Cockburn, 2001), which means we need an organizational view on agility.

Furthermore, the acceptance of agile methods and, hence, the acceptance of agile values and principles is heavily influenced by several individual, team-based, technological, and environmental factors. Incompatibilities between agile methods and organizational culture may occur; therefore, one has to understand and consider the organizational context to avoid resistance (Chan & Thong, 2009; Iivari & Iivari, 2011; Mangalaraj, Mahapatra, & Nerur, 2009; Nerur, Mahapatra, & Mangalaraj, 2005).

Prior research has also shown that there exists the risk that only single development teams may benefit from the implementation of agile methods and that those benefits may not reach out to other parts of the organization (Wendler & Gräning, 2011). Several researchers have found that we lack a holistic and organizational perspective on agility (Abrahamsson, Conboy, & Wang, 2009; Ågerfalk, Fitzgerald, & Slaughter, 2009). If an organization strives to benefit from agility, it needs to do more than have single teams or departments act in an agile manner. As a lesson from manufacturing, organizations have to see agility as a wider, organization-oriented business concept.

Another aspect underscoring the strategic nature of organizational agility is the central role of technology in the software and IT service industry. Researchers generally regard technology as an important enabler or driver of agility (Vázquez-Bustelo, Avella, & Fernández, 2007; Zhang & Sharifi, 2000). That fact might prompt organizations to concentrate on their information systems and technologies to enhance their organizational agility. However, thoughtless or unsuitable investments in information systems can disturb agility through, for instance, unstandardized or inflexible systems, inaccurate information, or increased complexity (Seo & La Paz, 2008). Generally, IT spending does not automatically lead to greater agility. Therefore, we need to examine how other elements such as culture, structure, or people couple with technology in achieving organizational agility (Lu & Ramamurthy, 2011). Although technology is necessary and has a high potential to enhance agility, one must strategically integrate it into the whole business (Bessant et al., 2002).

These considerations make clear that one has to see organizational agility as an interaction of people, structures, processes, and technology (Goldman, Nagel, & Preiss, 1995; Kidd, 1995; Nerur et al., 2005). An organization itself cannot be agile, but its employees can be. However, people do not exist independently from their environment, and they have to share appropriate skills to work under agile

conditions and with suitable technologies (Breu, Hemingway, Strathern, & Bridger, 2001; Seo & La Paz, 2008).

2.2 The Concept of Organizational Agility in the Software and IT Service Industry

In this study, I focus on organizational agility in the software and IT service industry. We have relatively few studies about agility and especially organizational agility in the software and IT service industry. In systematically reviewing agility-related frameworks, Wendler (2013a, 2013b) show that most of the available publications focus on the manufacturing context and that research on organizational agility in general has often used manufacturing frameworks.

We need more research on software and IT service industry because organizational agility does not only apply to the manufacturing domain and because one cannot simply transfer the principles of agile manufacturing to the software and IT service industry (Kettunen, 2009). In addition, we have to distinguish software and IT services from manufacturing products because they are "produced" in different ways, and the classical differentiation between a product and service does not apply to this industry.

Software classically refers to "computer programs, procedures, and possibly associated documentation and data pertaining to the operation of a computer system" (IEEE Standards Board, 1990, p. 66). Services are "intangible activities customized to the individual request of known clients" (Pine & Gilmore, 2011, p. 12), while IT services refers to developing, operating, and customizing application and infrastructure systems (Walter et al., 2007).

Software and IT services are intangible. Often, software and IT services are combined in cloud services and customized to individual requirements, which are typical characteristics of a service. Yet, the ability to standardize, modularize, and scale software and IT services suggest that they also exhibit product-like characteristics. Thus, the classical product-service-distinction cannot adequately frame software and IT services (Araujo & Spring, 2006; Lovelock & Gummesson, 2004).

As such, the software and IT service industry combines characteristics of both product-based and service-based industries and one cannot clearly demarcate products and services in this industry. Hence, one should not simply reuse concepts of organizational agility from the manufacturing domain because such an approach would not be able to cover the outlined specifics above.

For instance, as Kettunen (2009) points out, software development does not need to care about raw materials, physical logistics, or assembly phases. In addition, software has much faster development cycles and reworking or radically designing software has fewer constraints than physically manufactured products do (Kettunen, 2009). As a result, an organization in manufacturing is said to be agile when it already takes changes and adoptions into account at the stage of system and process implementation (Schelp & Aier, 2008). In the software and IT service industry, however, the ability to constantly change processes, structures, etc. themselves is a core aspect of a successful agile organization (Tallon & Pinsonneault, 2011).

The challenge of creating agile IT services lies not in designing a single service but in orchestrating an entire network of services that form a value net (and not a value chain as in the manufacturing environment) (Demirkan et al., 2008; Stabell & Fjeldstad, 1998). To do so, a firm needs an "integrated and holistic approach (including) IT, business processes, enterprise governance, organizational structure and culture" (Demirkan et al., 2008, p. 360). Especially in the software and IT service industry, such an "integrated approach" comprises two components: systems agility (having an IT infrastructure able to meet business changes) and business agility (ability to change the business itself) (Goodhue et al., 2009; van Oosterhout et al., 2006). Hence, to be successful in achieving organizational agility, organizations have to align their business and IT/IS (Strohmaier & Rollett, 2005). IT/IS plays a particularly important role in the software and IT service industry because it can enable business and organizational agility (Strohmaier & Rollett, 2005; van Oosterhout et al., 2006), which again differentiates this industry from manufacturing. Although IT/IS is also important in the manufacturing domain, it does not hold such a central and crucial role.

Finally, a lot of work about agility is situated in the domain of agile software development, which may lead one to assume that software development organizations show a higher affinity and positive attitude to agility in general and organizational agility in particular than organizations in other domains. But, as several studies show, despite benefits in single departments or development teams, organizations have struggled to implement agility at an organizational level (see, for instance, Abrahamsson et al., 2009;

Ågerfalk et al., 2009; Mangalaraj et al., 2009; Wendler & Gräning, 2011). Hence, we need to analyze what constitutes agility from an organizational perspective (especially in the software and IT service industry).

2.3 Related Work

Other theoretically relevant concepts that relate closely to agility include flexibility and adaptability (sometimes called adaptivity). Because research often uses these concepts as synonyms for the ability to cope with change, substantial confusion about their core meanings exists (Conboy, 2009; Iivari & Iivari, 2011; Sherehiy et al., 2007). Hence, to establish a common understanding about the term "agility" in this work, we briefly describe the concepts flexibility and adaptability and differentiate them from agility. The interested reader may refer to Conboy (2009) and Katayama and Bennett (1999) for a detailed discussion.

Various significant features distinguish flexibility from agility. For instance, flexibility focuses on continual changes instead of one-off changes like in agility. Further, flexibility does not emphasize knowledge and continuous learning compared to agility. Also, one can achieve flexibility by applying single practices in specific parts of the company, whereas agility requires an organization-wide view (Conboy, 2009; Katayama & Bennett, 1999). In addition, flexibility—which has its roots in manufacturing as well—mainly refers to the factory floor's capability, while agility adds to the overall business context (Tsourveloudis & Valavanis, 2002). Furthermore, researchers usually describe flexibility in the vein of improving reactivity, whereas agility emphasizes a proactive behavior to anticipate upcoming changes (Bessant et al., 2002; van Oosterhout et al., 2006). Closely related to flexibility, adaptability is a specific attribute of a manufacturing organization's production system that focuses particularly on adjusting the cost function to changes in demand (Katayama & Bennett, 1999).

Table 1 summarizes the differences between flexibility and agility. In general, one can see that agility, rather than replacing flexibility, instead expands on it by maintaining similarities and adding new aspects to address limitations (Gunasekaran, 1999; Vázquez-Bustelo et al., 2007). This consideration also leads to the conclusion that agility is the concept most suitable for application in the software and IT service industry. Flexibility (and adaptability) may be suitable in some instances, especially in the software domain, but their emphasis on production and products and their missing business link limit their usefulness since I focus on an organizational point of view.

Table 1. Differences Between Flexible and Agile Organizations

Flexible Organizations…	Agile Organizations…
…produce flexible and modular products.	…adopt changes promptly to the whole organization.
…are able to fast switch product lines, tasks, etc.	…consider agility as a strategic capability.
…consider configurability already in design.	…establish proactive actions in addition to reactive ones.
…react to changes (environment, customers, competitors, etc.) immediately.	…focus on long-term development of organizations capabilities.
…establish practices to enhance reactivity (mostly on operative level).	…make sustainable, long-lasting efforts (changes in processes, structures, values, etc.).
…focus on **predictable** changes.	…focus on **unpredictable / unplanned** changes that are also seen as chances.

2.4 Extant Studies for Organizational Agility

In a literature review, Wendler (2013a, 2013b) found that, despite the huge number of papers on agility, few dealt with it from an organizational perspective or empirically. I briefly describe those studies that do below.

First, Sherehiy et al. (2007) provide a helpful literature review about organizational agility and create a framework describing the agile organization. However, they focus on only work about the agile manufacturing domain and, due to their study's nature, did not conduct any empirical investigations. Second, Bottani (2009, 2010) investigated different assessment methods of organizational agility and empirically analyzed manufacturing companies in Europe. From the findings, she identified several clusters of organizations that represent different agility levels. In addition, she performed a principal component analysis to describe the clusters with a small number of characteristics. Although one can compare Bottani's empirical approach in principle to the approach I adopt here, she focuses on the

manufacturing domain, and one cannot simply transfer her results to the software and IT service industry. Finally, Charbonnier-Voirin (2011) developed a measurement scale for organizational agility. She used qualitative and quantitative empirical data of French companies that faced continuous change and that came from various domains. Hence, one can apply her results to more general contexts. Based on her findings, she identified four factors describing organizational agility (Charbonnier-Voirin, 2011), which have proven a value resource for the current study. However, they have a strong focus on human resources, customers, and change. Although these are important facets of organizational agility, Charbonnier-Voirin's final scales lack the characteristic aspects of the software and IT service industry, such as technologies and systems, their effects on the organization, and employees' skills. Omitting such aspects may suit Charbonnier-Voirin's general sample but does not suit the software and IT service industry.

To summarize, while the available extant studies deliver important insights and useful results, they do not empirically analyze organizational agility in the software and IT service industry.

3 Research Framework

Despite the above stated shortcomings in the available literature, studying it carefully can reveal insights. To develop a theoretical basis for an empirical study, available literature may deliver useful frameworks and items as a basis even if they do not cover the scope of one's study completely. Hence, I reviewed the literature about agility frameworks to identify a suitable framework that could serve as such a theoretical basis. Specifically, I searched specific databases (i.e., Business Source Complete, ScienceDirect, and Emerald Management) to ensure that I found publications from the most relevant research domains (e.g., information systems, software development, business, and management). To perform the search, I used key words such as "agility", "organizational agility", "agile organization", "agile software development", "agile manufacturing", and so on. I provide the complete list of studies I found in Wendler (2013a, 2013b).

However, due to the problems I mention in Section 2, I realized that selecting one single framework would not suit the study. For instance, some did not adequately describe the organization as a whole, and others specialized in a specific aspect. Generally, I found the available frameworks confusing and inconsistent. Hence, I needed to systematically compare these frameworks to identify some common ground. I explain this comparison in detail in Wendler (2013a, 2013b), but I outline the results below.

In the end, I identified 28 frameworks from the agile manufacturing, agile software development, agile enterprise, and agile workforce domains. To systematically compare these frameworks, I applied the following procedure: first, I listed the core concepts (for instance "customer", "processes", "change", etc.) of the first framework. Then, I assigned the core concepts of the next frameworks to appropriate existing ones or they added to the list if they were new. If the frameworks shared the same content but under a different label (for instance, "people" vs. "workforce" vs. "teams" vs. "employees"), I treated the concepts as one. I repeated this step for every framework. Table 2 shows the result and identifies agility's subconcepts into their respective framework. I mark every concept that one of the frameworks covers with an "X" in the respective column. In addition, the table shows total sum of how often the frameworks as a whole cover a concept.

At the end, this resulted in a list of 33 agility subconcepts (see Table 2). However, these subconcepts are ambiguous in their conceptual meaning and share a lot of interdependencies. For instance, some operate at higher levels of abstraction and, thus, include other subconcepts, or two or more subconcepts overlap in certain areas. This ambiguity underscores the lack of theoretical consensus in this field. In addition, the high number of agility-related subconcepts clearly confirms the other researchers' statements that (organizational) agility is a latent, multidimensional, and vague concept with overlapping dimensions (Bessant et al., 2002; Charbonnier-Voirin, 2011; Gunasekaran, 1999; Ren, Yusuf, & Burns, 2000; Tsourveloudis & Valavanis, 2002; Yusuf et al., 1999). Table A1 describes all identified subconcepts and their related sources. I included all identified subconcepts in the survey instrument to ensure that it viewed organizational agility as comprehensively as possible.

Table 2. Systematic Mapping of Agility-related Subconcepts to Available Frameworks

Concept	Source										
	Agile manufacturing										Agile workforce
	Agarwal, Shankar, & Tiwari (2007)	Gunasekaran (1999)	Gunasekaran & Yusuf (2002)	Kisperska-Moron & Swierczek (2009)	Meredith & Francis (2000)	Sharifi & Zhang (1999)	Sharifi, Colquhoun, Barclay, & Dann (2001)	Vázquez-Bustelo et al. (2007)	Yusuf et al. (1999)	Zhang & Sharifi (2007)	Breu et al. (2001)
Adaptivity											
Authority											
Change									x		
Collaboration											x
Cooperation	x		x	x	x			x	x	x	
Coordination											
Customer				x						x	
Education									x		
Flexibility						x	x			x	
HRM practices								x			
Information							x				
Innovation							x			x	
Intelligence											x
Integration	x								x	x	
Market	x		x						x		
Motivation											
Org. abilities / competences						x	x		x	x	x
Organizational culture							x			x	x
Organizational learning								x			
Proactivity										x	
Processes	x				x			x			
Product			x								
Project											
Quality									x		
Quickness						x	x			x	
Resiliency											
Responsiveness						x	x			x	
Strategy		x			x						
Structure											
Systems		x	x							x	
Technology		x	x	x			x	x	x	x	x
Welfare									x		
Workforce / teams		x	x		x		x		x	x	

Table 2. Systematic Mapping of Agility-related Subconcepts to Available Frameworks

Concept	Source																	Sum
	Agile Software Development						Agile Enterprise / Organization											
	Becker et al. (2001)	Chan & Thong (2009)	Chow & Cao (2008)	Kettunen (2009)	Misra, Kumar, & Kumar (2009)	Sarker & Sarker (2009)	Bottane (2010)	Charbonnier-Voirin (2011)	Eshlagy, Mashayekhi, Rajabzadeh, & Razavian (2010)	Goldman et al. (1995)	Lin, Chiu, & Tseng (2006)	Ren, Yusuf, & Burns (2000)	Sherehiy et al. (2007)	Tallon & Pinsonneault (2011)	Tseng & Lin (2011)	Tsourveloudis & Valavanis (2002)	Zelbst, Sower, Green Jr., & Abshire (2011)	
Adaptivity													x					1
Authority													x					1
Change	x						x	x	x		x	x	x					8
Collaboration																		1
Cooperation	x						x	x	x	x	x	x	x	x	x		x	18
Coordination						x							x					2
Customer	x				x			x	x	x			x	x	x			10
Education							x				x	x						4
Flexibility									x						x			5
HRM practices									x				x					3
Information									x						x	x		4
Innovation															x			3
Intelligence																		1
Integration							x				x	x			x			7
Market							x				x	x		x	x	x	x	10
Motivation		x							x									2
Org. abilities / competences	x	x			x		x		x		x	x			x		x	14
Org. culture	x		x	x	x	x			x	x			x					11
Org. learning		x											x					3
Proactivity													x					2
Processes	x		x	x		x									x		x	9
Product				x										x			x	4
Project			x		x													2
Quality	x			x			x				x	x					x	7
Quickness									x						x			5
Resiliency													x					1
Responsiveness									x						x			5
Strategy																	x	3
Structure									x				x					2
Systems																x		4
Technology						x	x		x		x	x		x	x		x	16
Welfare							x				x	x						4
Workforce / teams	x	x	x	x	x	x	x	x	x	x	x	x				x		19

4 Method and Data Collection

4.1 Research Strategy

To identify the underlying (latent) factors of organizational agility, I used an exploratory approach. One might think a confirmatory approach better since some frameworks are available, but, because no consensus on the structure and dimensions of organizational agility exists, it did not seem appropriate. The conceptual comparison revealed a huge pool of highly interrelated and ambiguous subconcepts, all of which related to organizational agility (see Section 3). Hence, I could not deduce an appropriate hypothesis, and I first needed to explore if these subconcepts had underlying latent factors that might help explain organizational agility.

The methodology used in this study comprises the following phases (following Creswell, 2003; Punch, 2005):

1. Design the survey instrument based on the conceptual framework comparison.
2. Pre-test and refine the survey instrument.
3. Administer and conduct the field survey.
4. Analyze the data (with exploratory factor analysis and cluster analysis) and interpret the results.

4.2 Survey Measures

Due to the study's exploratory nature, I had to develop a new survey instrument. Nevertheless, as a starting point for the first conceptual set of items, I used the extant literature that I identify in Section 3. In a first draft of the questionnaire, I assessed the items that the reviewed studies used for their applicability to the software development and IT service context. Some items from studies of the manufacturing domain appeared to be specifically tailored to the mechanical manufacturing context (Bottani, 2010). If the content of the items was still applicable (for instance, regarding skills and capabilities of employees), I reformulated those items. If the content focused too specifically on manufacturing (for instance, regarding supply chain controlling), I removed the items. I needed to remove these items because their operational versions did not fit this study's conceptual focus (Punch, 2005). Additionally, I formulated the items I used in a homogenous style to guarantee a uniform and easy-to-read questionnaire. Table B1 in the appendix shows the complete questionnaire and the respective sources of the items used.

I also had to consider the scales. Many studies in this field use Likert-type scales, which let the respondents agree or disagree to a set of statements (see, for instance, Misra, Kumar, & Kumar, 2009; Power, Sohal, & Rahman, 2001). However, Likert scales do not reflect how much agility an organization really incorporates. In Section 3, I show that organizational agility comprises many different subconcepts and is represented by a set of different parameters (Tsourveloudis & Valavanis, 2002) that one can only measure by several characteristics of an organization that indicate organizational agility (Charbonnier-Voirin, 2011). These indicators include the actions of employees and management that they perform to establish an agile working environment and the dissemination of employees' and managers' capabilities and abilities that an agile organization needs. Further indicators are prevalent structural conditions such as hierarchies, roles, and responsibilities and the values that employees and management share.

To consider this complexity, I measured the items with so-called item-specific scales. This approach has the advantage of measuring the real issue (for instance, the frequency employees perform activities or the intensity of the dissemination of agile values throughout the organization) that an item covers. The result are response alternatives that are "tailored to each item's particular construct" (Saris, Revilla, Krosnick, & Shaeffer, 2010, p. 61). In addition, research has shown that respondents make less errors and that the quality of the answers is higher for item-specific scales in comparison to agree/disagree scales (Saris et al., 2010). I developed the scales I used in the study following Rohrmann (2007), which resulted in three different scales that apply to several items each: 1) *intensity of dissemination* of various issues in an organization, 2) *proportion of people* sharing specific characteristics in the organization, and 3) *frequency of action* of different activities in the organization (see Table 3).

4.3 Pre-test

The first version of the questionnaire contained 100 items. However, one needs to pre-test such questionnaires for their length and to see how many items the respondents can deal with. Additionally, one can test to see if the respondents understand the items and can respond to them (Punch, 2005).

Hence, I pre-tested the survey with three academics and three practitioners who belonged to the target group. The pre-testers accessed the Web-based questionnaire exactly as it would appear later in the final version. I asked them to assess the questionnaire in terms of clarity, completeness, and suitability of the items while completing it. The pre-test resulted in a huge number of comments that delivered new insights on the items' applicability. I discussed the pre-testers' appraisals with them and revised and improved the questionnaire accordingly.

The pre-test helped significantly in improving the questionnaire. Altogether, I eliminated 32 items and reformulated others to enhance clarity. I eliminated and reformulated items because:

1) They were redundant (i.e., another item already included the content). As a result, I deleted the item and, if necessary, reformulated the other one.
2) They were vague, which means the pre-testers did not understand the item correctly or they showed multiple ways of interpretation. I reformulated such items to be more precise.
3) They did not suit the software and IT service industry. I eliminated all such items.
4) They were too abstract, which prevented the pre-testers from assessing them based on their practical experience. If possible, I reformulated such items; otherwise, I deleted them.
5) Organizations could not influence the items' content, which means those items represented characteristics of the environment instead of the organization. I deleted all such items.

In the end, I reduced the final questionnaire to 68 items after the pre-tests. Table 3 summarizes the structure, while Appendix B contains the complete questionnaire.

Table 3. Structure of Questionnaire

Content	Scale issue	Scale used	No. of items	Item names
Values and principles	Intensity of dissemination	Completely – mainly – partly – little – not at all	10	val1-5, pref1-5
Conditions and IT/IS	Intensity of implementation	Completely – mainly – partly – little – not at all	12	cond1-5; tech1-7
Capabilities of managers and employees	Proportion of people	All – many – some – few – none	18	capman1-7, capemp1-11
Activities of employees	Frequency of action	Always – often – sometimes – seldom – never	6	actemp1-6
Activities of organization in general	Frequency of action	Always – often – sometimes – seldom – never	22	actorgemp1-6, actorggen1-16

4.4 Field Survey

I limited the survey to organizations in the software and IT service industry. Due to the fact that one should assess agility from an organizational point of view, the target group included general and IT-related decision makers such as CEOs, CIOs, (IT) managers, and (IT) architects because their positions make them responsible for processes, structures, people, and so on and because they have the required strategic knowledge that allows them to evaluate their organizations overall (Augier & Teece, 2009; Charbonnier-Voirin, 2011).

As I mention in Sections 4.2 and 4.3, I used a self-administered questionnaire that I administered via the Internet to survey participants (Fink, 2003). I used this strategy because one can assume that the target group generally has access to the Internet. In addition, the target group's profession implies a high affinity for Web-based tasks, which suggests the participants will have more motivation to participate in an online questionnaire than a paper-based one. Furthermore, with this approach, I could disseminate the survey cost-efficiently worldwide (Schmidt, 1997).

Other than the software and IT service industry, I placed no further restrictions on the participating organizations' location, size, or other aspects to obtain a maximally broad sample. In addition, to ensure I disseminated the survey as widely as possible, I spread it via various ways: I asked suitable associations that represented the software and IT service industry to mention the survey in newsletters to their members; I posted links in appropriate communities, forums, and blogs; and I invited a sample of randomly drawn companies from databases such as Amadeus (www.bvdinfo.com), the Yellow Pages, and others to participate via email. Using multiple channels ensured that I could collect a sufficient number of valid and complete responses worldwide.

5 Data Analysis

5.1 Sample Overview

Altogether, 768 persons answered at least one question of the survey, and 490 completed the questionnaire. Unfortunately, I had to exclude 53 invalid responses because they did not belong to the software and IT service industry. Hence, I had 437 responses to further analyze. All following numbers, figures, and tables apply to these 437 responses.

Most of the participating organizations were active in the fields of programming and software development (43.1%) and IT services and consultancy (41.6%). The rest (15.3%) included computer facilities management, telecommunications, and others. Overall, 239 organizations were active in more than one field. The survey asked the respondents to state their managerial role, their organization's size and location, and their customers' location. Table 4 summarizes the sample characteristics.

Table 4. Sample Characteristics

Characteristic		Total (ratio)
Role within the organization	Chief executive officer	127 (29.1 %)
	Chief information / technology manager	36 (8.2 %)
	IT / ICT manager	59 (13.5 %)
	Enterprise / IT architect	155 (35.5 %)
	Other (e.g., managerial board members, other senior managers, …)	60 (13.7 %)
		437 (100 %)
Location of the organization	Europe	259 (59.3 %)
	North America	104 (23.8 %)
	Asia	39 (8.9 %)
	Other (e. g. Columbia, South Africa, Brazil, Australia, …)	35 (8.0 %)
		437 (100 %)
Size (no. of employees) of the organization	less than 10	95 (21.7 %)
	10 to 49	87 (19.9 %)
	50 to 249	87 (19.9 %)
	250 or more	167 (38.2 %)
	n. a.	1 (0.2 %)
		437 (100 %)
Location of customers	Local	32 (7.3 %)
	National	105 (24.0 %)
	Own region (referring to Europe, North America, etc.)	118 (27.0 %)
	Worldwide (referring to at least one additional region than own)	166 (38.0 %)
	"Abroad" (referring to any region except own)	7 (1.6 %)
	N.a.	9 (2.1 %)
		437 (100 %)

In general, all participants held leading or managerial positions in their organizations, which made them qualified to assess their organization from an extensive point of view and answer the survey questions. Altogether, organizations from 45 countries worldwide participated in the study. I assigned the countries to regions according the United Nations Statistics Division (United Nations Statistics Division, 2013). As such, most participants came from Germany (in the European region) (178) and the USA (in the North American region) (92). To classify the participating organizations by size, I followed the European Union's recommendation by splitting them into the following groups: micro (less than 10 employees), small (10 to 49 employees), medium sized (50 to 249 employees), and huge (250 or more employees) (The Commission of the European Communities, 2003). Most of the organizations had more than 250 employees. The rest were nearly equally distributed among micro, small, and medium-sized enterprises.

5.2 Exploratory Factor Analysis

As a first step, I conducted exploratory factor analysis to summarize the data and identify the underlying latent factors able to describe the structure of organizational agility. Based on Sharma's (1996) and Hair, Black, Babin, and Anderson's (2014) advice, I adopted the exploratory approach for this study since the available literature did not deliver a useful a priori factor structure of dimensions and indicators (see Section 3).

Both common factor analysis (FA) and a principal component analysis (PCA) would have been suitable for this research (Hair et al., 2014). However, FA, with its reflective interpretation of items, is in general more appropriate when one seeks to uncover latent dimensions rather than purely reduce data. Furthermore, PCA would require a priori knowledge that the specific and error variances are small (Hair et al., 2014; Sharma, 1996). However, I did not have such knowledge in this case. Finally, Gorsuch (1983) shows that a moderate sample size above 30 and including items with a communality higher than 0.4 leads to practically the same results in exploratory research regardless of the factoring method applied (Gorsuch, 1983). Hence, I chose common factor analysis based on weighted least squares (WLS) as the most appropriate method. I used WLS because they are a common approach especially suited for categorical variables (Bartholomew, Steele, Moustaki, & Galbraith, 2008; Beauducel & Herzberg, 2006) and because research has shown they deliver accurate results in such scenarios (Bartholomew et al., 2008; Mîndrilă, 2010). I analyzed the data using the statistical software R (R Core Team, 2013).

I further based the factor analysis on polychoric correlations. According to the underlying variable approach I assume that the items measured with a five-level item-specific scale (see Section 4) represent underlying continuous variables that one cannot measure directly and that the categorical items can only partially observe these continuous variables (Bartholomew et al., 2008). This fact applies here in particular because respondents cannot assess the exact number of people or the exact frequency of activities in an organization. Hence, categories such as "few", "many", "all," and so on are easily understandable and represent the underlying variables in an appropriate way. Furthermore, these categories allow one to compare companies of varying size.

To validate the results I obtained with my chosen approach, I also used Kendall's tau as a correlation measure because it does not share the abovementioned conceptual assumptions and shows a more general applicability. The correlations I obtained by using Kendall's tau were smaller than their polychoric counterparts, which is consistent with literature stating that polychoric correlations are superior to other approaches in scenarios like this one (Bartholomew et al., 2008). Furthermore, applying Kendall's tau revealed the same factor structure. However, the items had lower communalities, which indicates they did not explain the variance of the variables and the polychoric correlations. For this reason, I ultimately used the polychoric approach to carry out the factor analysis.

Further basic assumptions also supported the factor analysis's applicability as a statistical method. The sample size (n = 437) and number of included items (n = 68) resulted in a 6.4 to 1 ratio. This ratio meets the rule of a sample size's being at least five times the number of the items (Hair et al., 2014). Before I achieved the final factor solution, I deleted 23 items because they did not explain the factor solution sufficiently, which reduced the final set of items to 45 and changed the ratio to 9.7 to 1.

One can consider the sample itself as homogeneous because I included only organizations from one specific industry. This homogeneity is particularly important in that interpreting and realizing organizational agility can vary considerably in different industries, which would negatively influence the quality of the factor analysis results.

Visually observing the correlation matrix showed a substantial amount of correlations (95 % > |0.3|) and low partial correlations (93 % < |0.2|). As such, the items' loading on the factors explained a large amount of the correlation (Hair et al., 2014). Bartlett's test of sphericity proved highly significant, and the measure of sampling adequacy (MSA) was "meritorious" (Backhaus, Erichson, Plinke, & Weiber, 2006, Hair et al., 2014) with an overall MSA of 0.95. Only one item had a lower MSA, but, at 0.64, even that was "mediocre" and, therefore, still usable (Backhaus et al., 2006, Hair et al., 2014). All other items had MSA values between 0.88 and 0.97.

The actual factor analysis followed the process in Figure 1. This process (which Thurstone (1947) proposes) ensures that one purposefully and in a series of distinct stages deletes items that do not fulfill the requirements of a simple factor structure. With a sample size of 437, I kept items that had a significant factor loading above 0.3, had no cross-loadings above 0.3 on more than one factor, and had communalities above 0.5 (Hair et al., 2014).

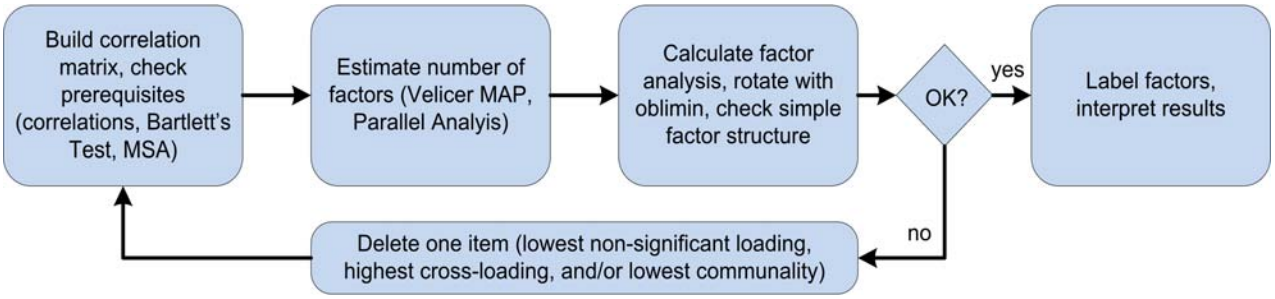

Figure 1. Process of Exploratory Factor Analysis (Adapted from Hair et al., 2014)

To determine the number of factors to extract, I applied parallel analysis and the Velicer MAP criterion. Researchers generally assume both methods to be the most accurate ones available to determine non-trivial factors and to be superior to the Scree test (criticized due to its subjectivity) and the Eigenvalue criterion, which research has found to overestimate the number of factors (Ledesma & Valero-Mora, 2007; Matsunaga, 2010; Zwick & Velicer, 1986). Both methods delivered the same number of factors in most steps. In a few instances, parallel analysis suggested a higher number. When that occurred, I calculated and compared both variations. However, research has established that parallel analysis sometimes tends to overestimate the real number of factors (Zwick & Velicer, 1986), so I based the final decision on the Velicer MAP criterion.

To rotate the factors, I used an oblique method (oblimin). Prior research has shown that the subconcepts of organizational agility are highly related to each other (see Section 3). Hence, to deduce theoretically meaningful factors, one cannot assume that the resulting factors are uncorrelated (as orthogonal rotation would demand). Furthermore, a test with the final set of items showed that orthogonal rotations resulted in a very high number of cross loadings, which supported the assumption of correlated factors.

After 24 steps of the process (see Figure 1), a simple factor structure with 45 items and six factors emerged (Table D1 summarizes the steps and deleted items). The obtained factors are easily interpretable and labeled purposefully (Hair et al. 2014). Table 5 presents a suitable name for each factor based on the included items and a short description of the respective contents. Table D2 provides the complete results of the factor analysis with the oblique (oblimin) rotated loadings, communalities, eigenvalues, variance explained, and factor correlation matrix.

I used several approaches to validate the factor structure I obtained. First, I extracted a simple factor structure as proposed by Thurstone (1947). Furthermore, I calculated the Cronbach's alpha for the six factors. Although normally used in confirmatory applications, Cronbach's alpha is also useful when assessing the internal consistency of the factors in exploratory research. Here, all factors scored relatively high for Cronbach's alpha (see Table D2), which supports a high interrelatedness of the items in every factor.

Table 5. Labeling and Interpretation of Factors

Factor no.	Label / name	Content
F1	Workforce	Employees' capability mainly regarding skills, intelligence, adaptability, responsiveness, etc.
F2	Technology	Technological prerequisites that enable communication, information sharing, and integration of the organization.
F3	Management of change	Managers' capability to cope with changes (customer requirements, new markets, innovations, etc.), to inform the people of the organization accordingly, and to inspire them to welcome these changes.
F4	Collaboration and cooperation	Internal and external collaboration and cooperation between departments and functions of the organizations and with customers and partners.
F5	Agile values	Establishing a culture following agile values such as proactivity, responsiveness, trust, support of employee proposals, etc.
F6	Flexible structures	Ability to quickly adapt organizational structures and processes to implement changes and stay competitive.

In addition, I randomly divided the dataset into two split samples and re-estimated the factor solution. Tables D3 and D4 provide the factor loading matrices for the split samples. Over all, the results support the initial factor solution. In the second split sample, two items switched from factor F4 to factor F6.

Furthermore, some minor cross-loadings appeared in both split samples. However, the main factor structure remained stable.

5.3 Cluster Analysis

To obtain another (independent of the factor analysis) perspective on organizational agility, I chose a second approach to identify a possible structure among the items. One suitable approach for conducting exploratory research is cluster analysis. In most cases, one uses this method to group similar objects into homogeneous clusters. However, with this approach, one can also cluster the items of a transposed data matrix rather than the objects themselves—a process called variable-oriented cluster analysis (Bacher, 1996; Everitt, 1993).

A variable-oriented cluster analysis serves to identify items that participants answer in a similar way based on distance measures instead of correlations. Hence, cluster analysis's underlying assumptions differ from factor analysis's ones. Although a cluster solution always totally depends on the used sample, obtaining a similar result compared to factor analysis is an additional confirmation that the obtained structure does indeed underlie the data.

Two important settings in cluster analysis include the distance measure and the clustering method (Hair et al., 2014). Because the scales I used are ordinal, one possible distance measure would be the respective correlation coefficients used in factor analysis. However, using correlations would lead to an implicit standardization (Bacher, 1996). Furthermore, in cluster analysis, I want a cluster solution as independent as possible from the conducted factor analysis. Hence, the city-block (or "manhattan") distance is an appropriate measure that does not rely on correlations and particularly suits the used item scales due to its ordinal interpretation (Bacher, 1996).

For clustering, I used a hierarchical approach with the so-called "average linkage" method. As a compromise between single linkage and complete linkage procedures, this method adopts the average similarity of all a cluster's members. As opposed to complete-linkage, outliers have a reduced effect on the clusters built by the average linkage approach, and the method tends to produce clusters with small within-cluster variation (Hair et al., 2014). I again performed the computation using the statistical software R (R Core Team, 2013).

After the first run of cluster analysis, I identified one item (actemp5) as an outlier in the dendrogram because it formed a single cluster on its own with relatively high dissimilarity to the other items. This result indicates that the respondents answered this item (closely located teams) in completely different patterns than all the other items. I found a similar result in the factor analysis in which this item showed high cross-loadings (see Table D1). As such, I deleted the item and repeated the cluster analysis with the reduced sample. Based on the resulting dendrogram (see Figure 2), three clusters can be extracted.

Looking at this result, one can see that the general structure I obtained via the cluster analysis is similar to the factor structure shown above. In comparison with the factor analysis results, one can see that each cluster contained the items of two factors (cluster 1 includes the items F2 and F5, cluster 2 includes the items F1 and F3, cluster 3 includes the items F4 and F6). In addition, the items of the single factors were relatively close to each other in separated subbranches of the dendrogram. For both F2 and F5, only one item was outside the respective branch (pref5, tech4). A single branch each represents the items F1 and F3 exactly as in the factor analysis. Cluster 3, however, was slightly more mixed up. Furthermore, each cluster had additional items that I later deleted in factor analysis. To illustrate these deleted items, I highlight them in red.

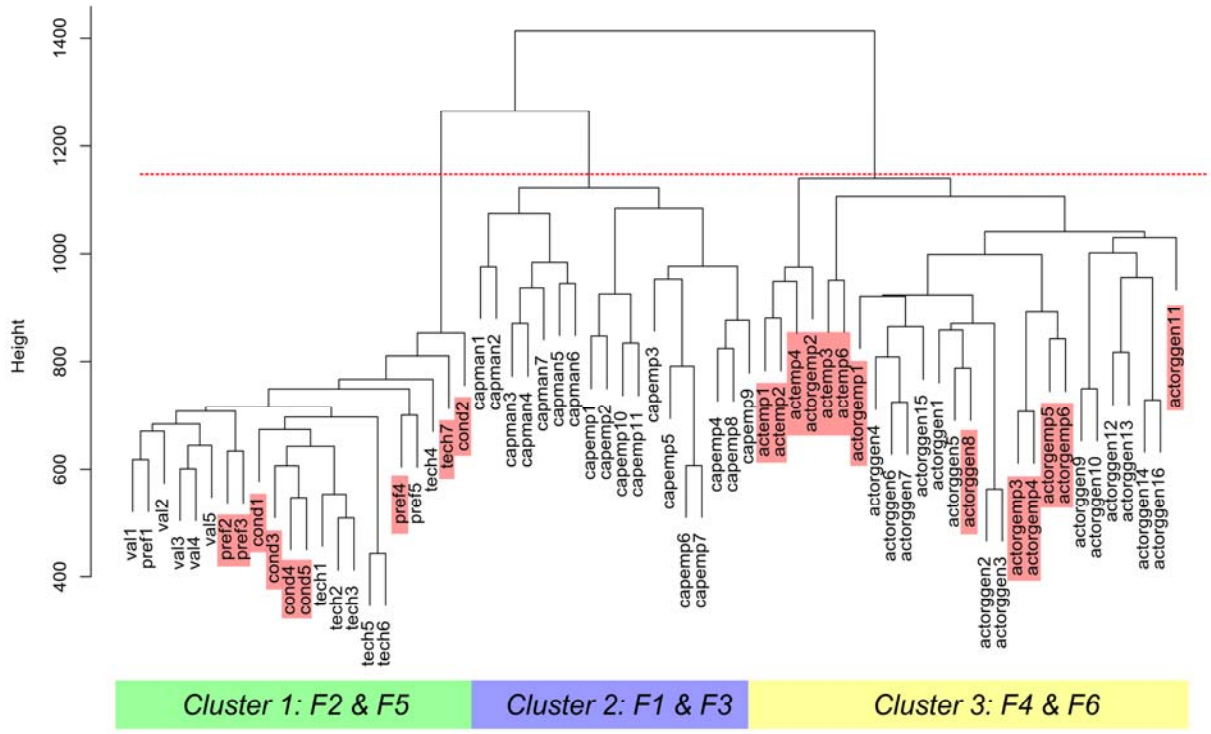

Figure 2. Dendrogram of Cluster Analysis and Related Factors

One disadvantage of cluster analysis is that one cannot assess to what extent the clusters explain the included objects (i.e., the items). Hence, I performed another cluster analysis that included only the items that formed the final solution of the factor analysis (see Figure 3). The result was similar to the previous one. The analysis again suggests three clusters. Additionally, the result confirmed the structure of the factors more obviously. Every cluster summarized the items of two factors (clearly separated by two subbranches). The only exception was the subbranch representing factor F6, which contained two items that were assigned to factor F4 in factor analysis. Table 6 presents names for the found clusters and a short explanation of the contents.

Table 5. Labeling and Interpreting Clusters

Cluster no.	Label (dimension)	Content
Cluster 1 (F2+F5)	Agility prerequisites	Includes the items of factors “technology” and “agile values”: the degree to which the people of an organization share agile values (mental prerequisites) and the ability of the organization to establish the required technological prerequisites.
Cluster 2 (F1+F3)	Agility of people	Includes the items of factors “workforce” and “management of change”: summarizes all necessary capabilities of an organization’s members to translate the agile values into actions.
Cluster 3 (F4+F6)	Structures enhancing agility	Includes the items of factors “collaboration and cooperation” and “flexible structures”: an organization’s ability to flexibly change itself combined with an organizational culture that supports collaboration on every level.

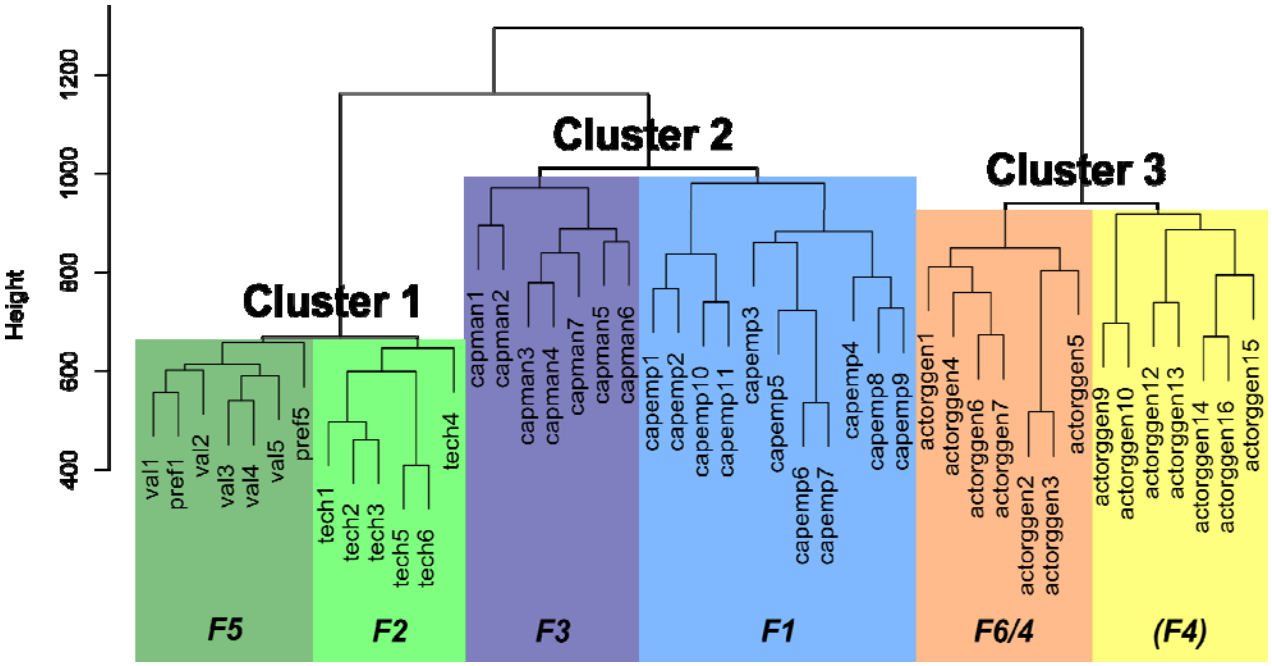

Figure 3. Dendrogram of Cluster Analysis and Related Factors (Using Items of Final Factor Solution)

Moreover, this result also supports applying an oblique rotation method, which correlates the factors to each other. All factor pairs represented in the single clusters highly correlated with each other (see Table D2). As a general result, factor analysis and cluster analysis show the same latent structure regarding organizational agility behind the items.

6 Findings and Discussion

In Section 5, I describe how I analyzed the data, present the results, and label the obtained factors and clusters. In this section, I discuss and interpret the findings in more detail. The structure formed by the extracted factors and clusters describes organizational agility from a comprehensive point of view. As Section 5 shows, each cluster contained the items of two factors. Hence, on a higher level of abstraction, one can treat them as dimensions that each groups two of the factors. For further information, Table C1 summarizes the mapping of the items of every factor and the subconcepts of agility that they represent.

6.1 Dimension 1: Agility Prerequisites

Dimension 1 combines two factors that each represents a particular kind of prerequisite for an organization while becoming agile. For this reason, I name the dimension “agility prerequisites”, The first and probably most important aspect to become agile is establishing an organizational culture that shares

agile values (F5: agile values). The second aspect is the availability of an appropriate technological basis that enables and supports the necessary communication and collaboration processes (F2: technology).

An appropriate IT/IS may enable or hinder overall agility (van Oosterhout et al., 2006). Hence, organizations need agile technologies (IT/IS) to ensure, for instance, close collaboration and cooperation between employees, teams, and divisions, particularly in the software and IT service industry. In addition, successful management decisions regarding change have to rely on agile IT/IS because business in the considered industry is more and more information and knowledge intensive (Strohmaier & Rollett, 2005).

Similar to technology, organizations have to establish agile values in their organizational culture to better develop the other dimensions. Research has shown that employees or decision makers with negative attitudes can greatly hinder an organization from successfully adopting agile practices and related changes regardless if those changes affect individuals, teams, organizational structures, and so on (Wendler & Gräning, 2011).

Hence, I chose the name “agility prerequisites”. Without the factors of this dimension, an organization will not be able to successfully develop the aspects of the other dimensions further, which also explains why it makes sense to bind those two factors into one dimension even though they contain relatively different concepts. However, one has to bear in mind that the term “prerequisite” does not mean one can build the dimension up front. As one dimension out of three, one has to simultaneously develop it with the other dimensions and factors.

6.1.1 Factor 5: Agile Values

This factor comprises the items val1-5, pref1, and pref5, which mainly represent cultural aspects. It incorporates the degree to which an organization’s individuals identify themselves with the principles behind agility and with using agile methodologies and practices. This factor determines how agile an organization’s employees “think” and how much they share a common set of values and goals related to agility (Conboy, 2009; Wendler & Gräning, 2011). For instance, the Manifesto for Agile Software development postulates four key “values” (Beck et al., 2001) that an organization’s employees need to share to use agile software development methods appropriately.

This emphasis on agile values differentiates organizational agility in the software and IT service industry from agile manufacturing. Many available frameworks in agile manufacturing do not cover aspects such as attitudes or organizational culture, or they only indirectly mention them by, for instance, describing the nature of a virtual enterprise (Gunasekaran & Yusuf, 2002) or focusing on relations between the company and its stakeholders (Kisperska-Moron & Swierczek, 2009).

A central aspect covered by this factor’s items is an open and welcoming attitude towards change—whether it is change on the customer’s side or change concerning other circumstances—and seeing change as posing advantages and opportunities rather than threats. Researchers have often named the subconcept of change as a core element of an agile organization (Conboy, 2009; Goldman et al., 1995; Sherehiy et al., 2007). Hence, an organization needs a proactive intention to cope with change rather than a reactive or protective one. In addition, this aspect is closely connected to factor F3 (see Section 6.2.2).

Furthermore, items included in this factor focus on a culture that emphasizes team work, supports experimentation, and accepts decisions at all levels. The latter is especially interesting. Although F6 covers implementing a structure that passes authority to lower levels and allows employees’ decisions and proposals (see Section 6.3.2), an organization first needs the will to establish such a structure. In an agile environment, teams and customers collaboratively make most decisions without delaying the decision process to receive hierarchical approval (Nerur et al., 2005). However, not only the managers need to share the idea of giving decision power to lower levels. Research has argued that employees who demand that superiors take responsibility threaten organizational agility (Wendler & Gräning, 2011).

6.1.2 Factor 2: Technology

This factor comprises the items tech1-6, which all represent issues of information technology and information systems. An appropriate technological infrastructure is among the most commonly named subconcepts that influence organizational agility (see Table 2), and research often refers to it as enabling or driving agility (Vázquez-Bustelo et al., 2007; Zhang & Sharifi, 2000).

Many of the concepts regarding organizational agility are, in principle, technology independent in agile manufacturing (Kettunen, 2009). However, the fact that technology forms its own factor in this study underscores the importance of technologies for the software and IT service industry.

The structure of information technology and systems is an important aspect in this factor. Items that cover integration and standardization among different departments and functions of the organization represent it. As Sarker and Sarker (2009) point out, an agile organization needs to have a set of comparable and compatible technologies to become agile.

Furthermore, information systems supply organizations and their employees with information. To ensure organizations quickly adapt to approaching changes and, therefore, enhance their agility, this information has to be accurate, timely, and easily available (Kassim & Zain, 2004; Power et al., 2001; Sarker & Sarker, 2009; Zelbst, Sower, Green, & Abshire, 2011).

Finally, agile organizations need integrated information systems and easily accessible information to enable employees to rapidly make decisions and, hence, support decentralized decision making.

6.2 Dimension 2: Agility of People

I named the second dimension "agility of people" because it includes two factors that represent an organization's employees' capabilities. This dimension summarizes the capabilities of the employees that are closely connected to agility (F1: workforce), managers' capabilities, and, in particular, their successful management of change (F3: management of change). Both capabilities are essential aspects for achieving organizational agility insofar as change is an important driver to becoming agile (Sharifi & Zhang, 1999; Yusuf et al., 1999), and an organization's workforce is indispensable in implementing the necessary actions (Breu et al., 2001).

To point out people as a central element in an agile organization in the software and IT service industry coincides with a lot of agile manufacturing literature. Many authors identify aspects such as workforce, teamwork, or the management of human resources as essential components of an agile organization (see, for instance, Meredith & Francis, 2000; Vázquez-Bustello et al., 2007; Eshlagy, Mashayekhi, Rajabzadeh, & Razavian, 2010).

6.2.1 Factor 1: Workforce

This factor summarizes the items capemp1-11, which all closely relate to the capabilities of an organization's workforce. The available agility frameworks name the subconcept workforce the most frequently (see Table 2). As a result, this factor represents how many of an organization's employees share the capabilities necessary for an agile organization. While research often interprets change as a driver of agility, research often sees people as the providers or "practical enablers" of organizational agility (Sharifi et al., 2001).

Other important aspects of this factor are the subconcepts intelligence and education. An agile organization's employees should be multi-skilled. Such an attribute enhances their adaptability and allows them to complete different tasks in changing environments when needed (Hoyt, Huq, & Kreiser, 2007; Sherehiy et al., 2007). Furthermore, people should always be willing to continuously learn and update their abilities. To do so in an agile environment, an organization should emphasize learning from experience and informal ways of education like mentoring (Lindvall et al., 2002; Misra et al., 2009; Yusuf et al., 1999).

Furthermore, this factor includes items that aim to achieve market- and quality-oriented employee behavior. In other words, employees should be responsive and proactive by, for instance, anticipating new opportunities in their environment and always paying attention to the quality criteria that customers demand (Breu et al., 2001; Charbonnier-Voirin, 2011).

Finally, as I explain above, managers alone cannot give decision power to lower levels—other staff must, too (see Section 6.1.1). Hence, this factor also includes items that address whether the employees take responsibility for their actions and decisions and can motivate themselves constantly (Goldman et al., 1995; Misra et al., 2009).

6.2.2 Factor 3: Management of Change

This dimension's second factor comprises the items capman1-7 and deals particularly with managers' capability related to managing change. These items relate closely to organizational capabilities and organizational culture. Again, this factor reflects change as a core driver of organizational agility. However, in contrast to F5 (agile values), F3 focuses more on concretely handing change rather than attitudes towards it.

Interestingly, in the frameworks for agile manufacturing I initially identified, only Yusuf et al. (1999) directly names a culture of change as an element of an agile organization. Other frameworks mention change as key driver of agility, but they do not include it as component of the organization. Hence, my results indicate that, especially in the software and IT service industry, organizations need to look more closely at how they handle change.

Likewise, in F3, attributes such as quickness, flexibility, and responsiveness play an important role. Managers should have the abilities and skills to manage change, including the ability to recognize future changes resulting from innovations, quickly implement changes into products and services, and flexibly deploy available resources to seize new opportunities. Furthermore, managers have to share necessary information among employees and maintain a management style focused on coaching and inspiring people (Charbonnier-Voirin, 2011; Zelbst et al., 2011; Zhang & Sharifi, 2007). The latter is especially necessary when it comes to supporting an agile workforce's capabilities as I describe above.

In addition, to manage change, managers should be able to see the organization from a strategic perspective and incorporate a vision for future innovations and the strategic value of IT investments (Lu & Ramamurthy, 2011) because IT investments will directly affect the technological prerequisites for becoming agile (see Section 6.1.2).

6.3 Dimension 3: Structures Enhancing Agility

I named the third dimension "structures enhancing agility". The other two dimensions refer to prerequisites and people. Much like dimension 1, one can also see this third dimension as a kind of "prerequisite". However, its content relates more to the structural conditions and the processes (F6: flexible structures) that influence an organization's way of working, especially concerning collaboration and cooperation among employees and stakeholders (F4: Collaboration and Cooperation). Therefore, these factors are not simply prerequisites; they are circumstances that can enhance current organizational agility and enable an organization to constantly adjust to its current situation.

Furthermore, this dimension differs from the other two in that it suffered from small changes during the split sample validation in factor analysis and also during the cross-validation of the structure with the conducted cluster analysis. In both instances, two items from F6 switched to F4. In addition, the items that switched were not the same in both scenarios. This result underscores the remarkably close relationship between the two factors in this dimension.

For the following interpretation, I used the structure as obtained in factor analysis (see Table D2). I point out aspects that suffered from instability in the factor solution in Section 6.3.1.

6.3.1 Factor 4: Collaboration and Cooperation

This factor comprises the items actorggen6-7, actorggen9-10, and actorggen12-16. These items mainly concern organizational culture, especially aspects of collaboration among different departments and business sections and cooperation with customers and business partners.

Effective and efficient internal collaboration is necessary in many situations, such as in daily tasks involving several departments, in the development of new products and services, and in strategic decision making (Vázquez-Bustelo et al., 2007). Interestingly, the two items that represent this aspect (actorggen6-7) switched to F6 in the cluster analysis. Generally, this issue seems appropriate in F6, too, because efficient internal collaboration also depends on a suitable structure's supporting collaborative processes.

Furthermore, close collaboration is also important in interacting with customers because it helps maintain an efficient feedback process (Misra et al., 2009). Closely connected with customer collaboration is the dissemination of knowledge about customers throughout the organization to align all activities to customers' needs (Charbonnier-Voirin, 2011; Vázquez-Bustelo et al., 2007).

In addition to customers, business partners are another important stakeholder group. Hence, this factor also covers cooperation with partners to support a flexible and trust-based relationship (Hoyt et al., 2007). While research sees establishing an agile supply chain and building virtual organizations as a key aspect in agile manufacturing (Gunasekaran & Yusuf, 2002; Agarwal et al., 2007), this factor's items emphasize selecting and monitoring partners based on quality. This emphasis on quality for partner selection underscores that the "value networks" between companies in the software and IT service industry differ from those in the manufacturing industry and may not play such an important role in agile software and IT service organizations.

Finally, this factor includes two other technology-related items: systematic information about appropriate technologies and strategic investment in appropriate technologies. As for why the factor "collaboration and cooperation" covers these items, one may argue that organizations need to purposefully select technologies to establish successful cooperation and collaboration processes, particularly in the software and IT service industry.

The two items dealing with a strategic and appropriate IT investment and the internal dissemination of customer information (actorggen10 and actorggen15, respectively) switched to F6 in the split sample validation. While one can also interpret strategic IT investments as necessary for establishing flexible organizational structures, the aspect of customer information is much more difficult to understand in this context. In summary, the inconsistency discovered in this dimension's two factors indicates that both factors are conceptually closely related and that one may treat them as one factor.

6.3.2 Factor 6: Flexible Structures

The last factor comprises the five items actorggen1-5 and deals with the organizational ability to react to changes by adjusting and updating structures, processes, strategies, and authorities. Again, attributes such as quickness, flexibility, and responsiveness are important characteristics for flexible and agile structures. In contrast to F3, however, this factor focuses on enabling structures instead of particular managers' capabilities. Organizations need to flexibly and quickly adopt processes to react to changes in customer needs (Hsieh, Chiu, & Hsu, 2008; Zelbst et al., 2011), and an organization that quickly adjusts its strategy supports any opportunities or challenges it may face (Sherehiy et al., 2007).

Flexible structures enable the organization to tie authorities to tasks. Indeed, research has identified that flexible structures are better than rigid hierarchical structures in an environment of continuous change (Weick & Quinn, 1999) and agile manufacturing organizations have already successfully applied flexible structures (Sherehiy et al., 2007). An appropriate structure furthermore enables an organization to make decisions quickly and to anticipate upcoming changes by continuously scanning the environment.

6.4 Summary

The exploratory factor analysis delivered six conceptually relevant factors that describe organizational agility. I further confirmed these factors via conducting cluster analysis on the items as "objects", which showed only minor inconsistencies between the two analyses. In addition, this approach grouped pairs of factors into one of three distinct dimensions: agility prerequisites, agility of people, and structures enhancing agility. This result confirms the assumption that organizational agility comprises dimensions that contain several decision domains (Gunasekaran, 1999; Ren et al., 2000; Yusuf et al., 1999), which, in turn, the identified factors represent.

When interpreting the factors, I found that they all meaningfully explain a specific part of organizational agility on their own but also that they closely relate to each other.

The final structure differs from the available frameworks in the literature that I discuss in Section 3. Although these frameworks include many of the subconcepts of organizational agility I identify in this paper, one cannot directly compare my results with them.

The most common subconcept that the frameworks in the literature mention is "workforce", which the factor "workforce" in dimension "agility of people" represents. Similarly, one factor in the dimension "agility prerequisites" reflects the subconcept "technology" well. Further, the dimension "structures enhancing agility" includes "cooperation", which many of the other frameworks in the literature also include.

Interestingly, the factor solution does not include the subconcepts "customer" and "market" as single factors even though many frameworks in the literature do. Customer-related items occur in many factors,

but mainly in F1 (workforce) and F4 (collaboration and cooperation), which supports the assumption that organizations need a strong customer focus throughout them.

Many of the other subconcepts are scattered among the single factors. The most noticeable is the sub-concept of “change”. As I state in Section 2, previous research indirectly includes this sub-concept in many aspects about agility (Wendler, 2013b), which makes it difficult to clearly assign it to any of the factors I identified. Indeed, my findings show that change affects nearly every factor, which is meaningful because an organization itself cannot influence change. Other subconcepts (that do not clearly belong to one factor or dimension) include attributes such as quickness, flexibility, responsiveness, and proactivity. Every organization should have these capabilities to appropriately cope with change (Sharifi & Zhang, 1999), and, for that reason, they indirectly influence every factor simultaneously.

One can see that, among the frameworks in Table 2, none reflects the factor structure I identified directly. However, one should not find this result surprising. As I note in Section 3, each individual framework differs heavily from each other, and we still lack a consensus on what constitutes an agile organization. In addition, due to the differences in the software and IT service and manufacturing industries, one cannot directly compare the characteristics of an agile organization between these industries. Only Sherehiy et al. (2007) cover all factors I identified (among additional ones). In terms of content, their tables that summarize the characteristics of an agile organization match closely with the factor solution I identify in this study. However, Sherehiy et al.’s structure of characteristics differs from the structure of the factors presented here.

Finally, Table D1 summarizes the items that I deleted during the factor analysis process since they also deliver useful insights into which items are not suitable to explain organizational agility. Specifically, I deleted six items that cover several activities of employees. They reflected the organization of daily work in teams and projects. Likewise, six additional items focused on the concrete activities that affect employees. These items included topics such as offering incentives, developing employees’ skills for the long term, and effectively managing employee proposals.

Indeed, it is surprising that factor analysis suggested to delete these items because they related closely to the workforce, and, as I show above, workforce is an essential element of organizational agility. However, the deleted items referred to concrete actions, whereby the items in F1 (workforce) are more general capabilities. The deletion of these items might indicate that the frequency of actual activities is much more heterogeneously distributed among the organizations and that the presence of capabilities is not necessarily connected with the activities that should result.

Furthermore, I had to delete several items about preferences and basic conditions. They covered issues such as the availability of a strategy that allowed flexibility, an intensive training program, effective communication processes, and the elimination of hierarchical barriers. Again, the deletion shows that the items could not explain the variance in the answers of the participants appropriately, which raises the question of whether some subconcepts in the available literature do not adequately describe organizational agility (e.g., whether it can describe if an intensive training program matters or if informal training and mentoring is sufficient). Unfortunately, at this point, I cannot deduce if the covered subconcepts truly are not meaningful when describing organizational agility, if this effect relates to the specific industry observed, or if it resulted from the respondents themselves.

7 Conclusion and Further Research

Researchers have conducted much research on agility in different domains and from different organizational points of view. However, to my knowledge, this study is the first one to address the topic on an empirical basis and from a comprehensive point of view. Previously, researchers have conducted mostly conceptual research to form an understanding of the relations between agility’s various subconcepts. However, this study contributes to the literature on agility by providing an empirically grounded, simple, and meaningful structure that shows organizational agility’s factors and dimensions and reflects the common ground between agility’s various concepts.

I identified six factors via an exploratory factor analysis: workforce, technology, management of change, collaboration and cooperation, agile values, and flexible structures. Those factors explain 67 percent of the variance of the dataset and deliver first answers to the question of what constitutes an agile organization. None of the prior analyzed frameworks directly reflect this factor structure, and only Sherehiy et al. (2007) includes all the factors I obtained.

Interestingly, one of the most cited publications in this area, Goldman et al. (1995), already states that "the competitive power of the modern industrial corporation did not come from the technologies it exploited. …Its power did not come from its organizational structure, either. …Its power certainly did not come from the exploitation of the talents of its workforce…. [Rather,] the competitive power…came from the way people, organizations, and technology were systematically coordinated with one another" (Goldman et al., 1995, p. 71f.).

Notably, the final three dimensions of organizational agility (agility prerequisites, agility of people, and structures enhancing agility, which each combine two of the six factors I mention above) reflect these aspects well. I empirically identified these dimensions with a variable oriented cluster analysis, which may indicate that simply structured frameworks rather than more complex structures weighted down by a high number of subconcepts (as I show in Section 3) may better reflect organization agility.

7.1 Implications for Research and Practice

This study has implications for both academics and practitioners.

First, for academics, this study delivers a meaningful structure of organizational agility based on an intensive conceptual literature review and a quantitative empirical investigation, it is the (or among the) first to examine organizational agility empirically and from a comprehensive point of view. This structure, which comprises three dimensions that each have two factors (for a total of six) may contribute to establishing a commonly shared consensus about the elements of organizational agility.

Because I offer a much more simplified structure compared to the initial high number of agility-related subconcepts I identified in the literature (see Section 3), it offers the possibility to develop new structural and causal models and new hypotheses about what influences organizational agility and how the identified factors affect each other mutually. Previously, due to the high number of interdependencies, the ambiguity between subconcepts, and the missing consensus in the literature, such research questions were difficult to approach. Until now, researchers either had to focus on a particular section of organizational agility or use one of the available frameworks. In doing so, they had to knowingly omit parts of the organizational agility construct. The structure I identified summarizes and standardizes already existing frameworks and, for that reason, may serve as a basis for further research.

In addition, the results I present here and the questionnaire I used enable researchers to further empirically analyze organizational agility on a comparable basis (e.g., between different industries). These results provide some differences and common ground between agile organizations in the software and IT service industry and the manufacturing industry.

Also, the factor structure I uncovered has the potential to support longitudinal studies in and between organizations to see how the state of organizational agility changes over time. In this study I assume that all identified dimensions and factors should be developed simultaneously. However, future research should try to identify organizations that are transitioning to being agile Based on the factors and dimensions I obtained, one could analyze whether specific factors or dimensions are more important and that may indicate that an organization should develop some factors first or develop factors simultaneously.

Second, for practice, the factors and dimensions highlight different domains that an organization needs to consider to become organizationally agile. The identified structure already supports an understanding of what an agile organization comprises, and one may be able to transform the factors and dimensions I present into a measurement tool such as a maturity model, a self-assessment questionnaire, or similar.

Such a tool also may help consulting companies or research agencies to compare organizational agility among different organizations on a standardized and simply structured basis and to support them in developing and implementing a roadmap to becoming agile by clearly stating the potential improvement areas.

7.2 Limitations

The study suffers from some limitations. First, one has to consider sample-specific issues. The survey focused on only the software and IT service industry. I focused on this industry to ensure the homogeneity of the sample and to keep the survey manageable. Although such a focus does not reduce the study results' applicability, it offers a starting point for further research for transferring the structure I identify to other domains and industries and to compare the results.

The sample includes many respondents from different regions in the world and from differently sized organizations. However, the majority of participants came from Germany (178 out of 437). In addition, the proportion of differently sized companies among the locations was not equally distributed, with an emphasis on large organizations (more than 250 employees) in North America and Asia. As such, further research could try to confirm the results with systematically selected samples.

In addition, I did not distinguish between IT products (software) and services. As I note in Section 2, I assumed that both fields go "hand in hand" in the software and IT service industry. Indeed, 187 of the 437 (43%) participants in this study belonged to organizations active in both fields. However, future research could deal with the differences in agility regarding developing products and providing services.

Finally, participants who occupied different roles in their organizations answered the questionnaire for this study. A first descriptive analysis showed no noticeable differences in the averages of the answers between the organizational roles. I observed differences only in single items (Wendler & Stahlke, 2014). An additional comparison of the factor scores between the organizational roles delivered no significant differences, too.

This result is consistent with prior research, which shows that organizational roles cannot explain differences in perceiving organizational agility (Wendler & Gräning, 2011). As such, the results should be valid. However, one can assume that this aspect is industry specific because research has argued that the software and IT service industry generally has a more positive attitude towards agility (see Section 2). Further research could investigate this issue in more detail and compare the answers of different organizational roles between selected industries.

This study may also have limitations related to how I analyzed the data. I had to exclude a relatively high number of items to obtain a stable and simple factor solution (see Table D1). As I discuss in Section 6, the reasons why I had to delete these items are not clear. From the result I obtained, I could not deduce if the subconcepts covered by those items truly were not meaningful when describing organizational agility, if this effect was related to the specific industry observed, or if it simply resulted from the respondents themselves. Considering that I developed the questionnaire based on already available frameworks and scales, this limitation does not strongly threaten the study results. However, future research could take on this question by replicating the study with other samples and perhaps in other industries to find out if these items do not suitably explain organizational agility or if the exclusion was a sample- or domain-specific issue.

Furthermore, the minor instability in dimension 3 (structures enhancing agility) with items switching from F4 (collaboration and cooperation) to F6 (flexible structures) is a minor limitation. To further analyze this aspect, I applied an additional factor analysis that extracted only five factors instead of six to validate whether both F4 and F6 would form a new one together. However, I was not satisfied with the result and could not easily interpret it because the two factors of dimension 2 (agility of people) joined one factor, while both factors F4 and F6 were still divided in a similar structure as before and were accompanied by a high number of cross-loadings. One has to consider this result when applying the identified structure to other research questions.

Finally, I followed an exploratory research approach for this study, which suited it due to the missing consensus in the field. However, exploratory approaches are always restricted to the sample used for analysis, and one cannot simply transfer the results obtained to the whole population. Although this study delivers new and important insights, it can be only a first step toward developing a comprehensive and empirically based picture of organizational agility. Hence, further research should use the results of this study to develop further confirmatory approaches.

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References

Abrahamsson, P., Conboy, K., Wang, X. (2009). "Lot's done, more to do": The current state of agile systems development research. *European Journal of Information Systems*, *18*(4), 281-284.

Abrahamsson, P., Warsta, J., Siponen, M. T., Ronkainen, J. (2003). New directions on agile methods: A comparative analysis. In *Proceedings of the 25th International Conference on Software Engineering* (Vol. 6, pp. 244-254).

Agarwal, A., Shankar, R., Tiwari, M. K. (2007). Modeling agility of supply chain. *Industrial Marketing Management*, *36*(4), 443-457.

Ågerfalk, P. J., Fitzgerald, B., Slaughter, S. A. (2009). Flexible and distributed information systems development: State of the art and research challenges. *Information Systems Research*, 20(3), 317-328.

Araujo, L., & Spring, M. (2006). Services, products, and the institutional structure of production. *Industrial Marketing Management*, *35*(7), 797-805.

Augier, M., & Teece, D. J. (2009). Dynamic capabilities and the role of managers in business strategy and economic performance. *Organization Science*, *20*(2), 410-421.

Bacher, J. (1996). *Clusteranalyse* (2nd ed.). Munich, Germany: Oldenbourg.

Backhaus, K., Erichson, B., Plinke, W., & Weiber, R. (2006) *Multivariate analysemethoden: Eine anwendungsorientierte* einführung (11th ed.). Berlin, Germany: Springer.

Bartholomew, D. J., Steele, F., Moustaki, I., & Galbraith, J. I. (2008). *Analysis of multivariate social science data* (2nd ed.). Boca Raton, FL: Chapman & Hall.

Beauducel, A., & Herzberg, P. Y. (2006). On the performance of maximum likelihood versus means and variance adjusted weighted least squares estimation in CFA. *Structural Equation Modeling: A Multidisciplinary Journal, 13*(2), 186-203.

Beck, K., Beedle, M., van Bennekum, A., Cockburn, A., Cunningham, W., Fowler, M., Grenning, J., Highsmith, J., Hunt, A., Jeffries, R., Kern, J., Marick, B., Martin, R. C., Mellor, S., Schwaber, K., Sutherland, J., & Thomas, D. (2001). *Manifesto for agile software development*. Retrieved from http://agilemanifesto.org/

Becker, J., Pöppelbuß, J., Venker, D., & Schwarze, L. (2011). Industrialisierung von IT-dienstleistungen: Anwendung industrieller konzepte und deren auswirkungen aus sicht von IT-dienstleistern. In P*roceedings of Wirtschaftsinformatik.*

Bernardes, E. S., & Hanna, M. D. (2009). A theoretical review of flexibility, agility and responsiveness in the operations management literature: Toward a conceptual definition of customer responsiveness. *International Journal of Operations & Production Management*, *29*(1), 30-53.

Bessant, J., Knowles, D., Briffa, G., & Francis, D. (2002). Developing the agile enterprise. *International Journal of Technology Management*, *24*(5), 484-497.

Bleek, W. G., & Wolf, H. (2008) *Agile softwareentwicklung: Werte, konzepte und methoden*. Heidelberg, Germany: Dpunkt.

Bose, I. (2008). Lessons learned from distributed agile software projects: A case-based analysis. *Communications of the Association for Information Systems*, *23*, 619-632.

Bottani, E. (2009). On the assessment of enterprise agility: Issues from two case studies. *International Journal of Logistics*, *12*(3), 213-230.

Bottani, E. (2010). Profile and enablers of agile companies: An empirical investigation. *International Journal of Production Economics*, *125*(2), 251-261.

Breu, K., Hemingway, C. J., Strathern, M., & Bridger, D. (2001). Workforce agility: The new employee strategy for the knowledge economy. *Journal of Information Technology*, *17*(1), 21-31.

Chan, F. K. Y., & Thong, J. Y. L. (2009). Acceptance of agile methodologies: A critical review and conceptual framework. *Decision Support Systems*, *46*(4), 803-814.

Charbonnier-Voirin, A. (2011). The development and partial testing of the psychometric properties of a measurement scale of organizational agility. *M@n@gement*, *14*(2), 120-155.

Chow, T., & Cao, D. B. (2008). A survey study of critical success factors in agile software projects. *Journal of Systems and Software*, *81*(6), 961-971.

Cockburn, A. (2007). *Agile software development: The cooperative* game (2nd ed.). Boston, MA: Pearson Education.

Conboy, K. (2009). Agility from first principles: Reconstructing the concept of agility in information systems development. *Information Systems Research*, *20*(3), 329-354.

Creswell, J. W. (2003). *Research design: Qualitative, quantitative, and mixed methods* approaches (2nd ed.). Thousand Oaks, CA: Sage.

Demirkan, H., Kauffman, R. J., Vayghan, J. A., Fill, H. G., Karagiannis, D., & Maglio, P. P. (2008). Service-oriented technology and management: Perspectives on research and practice for the coming decade. *Electronic Commerce Research and Applications*, *7*(4), 356-376.

Disterer, G. (2009). ISO 20000 for IT. *Business & Information Systems Engineering*, *1*(6), 463-467.

Dybå, T., & Dingsøyr, T. (2008). Empirical studies of agile software development: A systematic review. *Information and Software Technology*, *50*(9-10), 833-859.

Eshlaghy, A. T., Mashayekhi, A. N., Rajabzadeh, A., & Razavian, M. M. (2010). Applying path analysis method in defining effective factors in organisation agility. *International Journal of Production Research*, *48*(6), 1765-1786.

Everitt, B. S. (1993). *Cluster analysis* (3rd ed.). London, UK: Edward Arnold.

Fink, A. (2003). *The survey handbook* (2nd ed.). Thousand Oaks, CA: Sage.

Ganguly, A., Nilchiani, R., & Farr, J. V. (2009). Evaluating agility in corporate enterprises. *International Journal of Production Economics*, *118*(2), 410-423.

Goldman, S. L., Nagel, R. N., & Preiss, K. (1995). *Agile competitors and virtual organizations: Strategies for enriching the customer*. New York: Van Nostrand Reinhold.

Goodhue, D. L., Chen, D. Q., Claude, M., Davis, A., & Cochran, J. D. (2009). Addressing business agility challenges with enterprise systems. *MIS Quarterly Executive*, *8*(2), 73-87.

Gorsuch, R. L. (1983). *Factor analysis.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Gunasekaran, A. (1999). Agile manufacturing: A framework for research and development. *International Journal of Production Economics*, *62*(1-2), 87-105.

Gunasekaran, A., & Yusuf, Y. Y. (2002). Agile manufacturing: A taxonomy of strategic and technological imperatives. *International Journal of Production Research*, *40*(6), 1357-1385.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2014). *Multivariate data* analysis (7th ed.). Harlow: Pearson Education.

Highsmith, J., & Cockburn, A. (2001). Agile software development: The business of innovation. *Computer*, *34*(9), 120-122.

Hoyt, J., Huq, F., & Kreiser, P. (2007). Measuring organizational responsiveness: The development of a validated survey instrument. *Management Decision*, *45*(10), 1573-1594.

Hsieh, Y.-C., Chiu, H.-C., & Hsu, Y.-C. (2008). Supplier market orientation and accommodation of the customer in different relationship phases. *Industrial Marketing Management*, *37*(4), 380-393.

Iacocca Institute. (1991). *21st century manufacturing enterprise strategy: An industry-led view*. Bethlehem, PA.

IEEE Standards Board. (1990). *IEEE standard glossary of software engineering terminology*.

Iivari, J., & Iivari, N. (2011). The relationship between organizational culture and the deployment of agile methods. *Information and Software Technology*, *53*(5), 509-520.

Kassim, N. M., & Zain, M. (2004). Assessing the measurement of organizational agility. *The Journal of American Academy of Business*, *4*(1/2), 174-177.

Katayama, H., & Bennett, D. (1999). Agility, adaptability and leanness: A comparison of concepts and a study of practice. *International Journal of Production Economics*, *60/61*, 43-51.

Kettunen, P. (2009). Adopting key lessons from agile manufacturing to agile software product development—a comparative study. *Technovation*, *29*(6-7), 408-422.

Kidd, P. T. (1995). Agile manufacturing: A strategy for the 21st century. *IEE Colloquium on Agile Manufacturing*, *44*, 1-6.

Kisperska-Moron, D., & Swierczek, A. (2009). The agile capabilities of Polish companies in the supply chain: An empirical study. *International Journal of Production Economics*, *118*(1), 217-224.

Landes, D. S. (2003). *The unbound Prometheus: Technological change and industrial development in Western Europe from 1750 to the present* (2nd ed.). Cambridge: Cambridge University Press.

Ledesma, R. D., & Valero-Mora, P. (2007). Determining the number of factors to retain in EFA: An easy-to-use computer program for carrying out parallel analysis. *Practical Assessment, Research & Evaluation*, *12*(2), 1-11.

Lin, C.-T., Chiu, H., & Tseng, Y.-H. (2006). Agility evaluation using fuzzy logic. *International Journal of Production Economics*, *101*(2), 353-368.

Lindvall, M., Basili, V., Boehm, B., Costa, P., Dangle, K., Shull, F., Tesoriero, R., Williams, L., & Zelkowitz, M. (2002). Empirical findings in agile methods. In D. Wells & L. Williams (Eds.), *Proceedings of Extreme Programming and Agile Methods—XP/Agile Universe* (pp. 197–207). Chicago, IL: Springer.

Lovelock C., & Gummesson, E. (2004). Whither services marketing? In search of a new paradigm and fresh perspectives. *Journal of Service Research*, *7*(1), 20-41.

Lu, Y., & Ramamurthy, K. (2011). Understanding the link between information technology capability and organizational agility: An empirical examination. *MIS Quarterly*, *35*(4), 931-954.

Mangalaraj, G., Mahapatra, R., & Nerur, S. (2009). Acceptance of software process innovations—the case of extreme programming. *European Journal of Information Systems*, *18*(4), 344-354.

Matsunaga, M. (2010). How to factor-analyze your data right: Do's, don'ts, and how-to's. *International Journal of Psychological Research*, *3*(1), 97-110.

Meredith, S., & Francis, D. (2000). Journey towards agility: the agile wheel explored. *The TQM Magazine*, *12*(2), 137-143.

Mîndrilă, D. (2010). Maximum likelihood (ML) and diagonally weighted least squares (DWLS) estimation procedures: A comparison of estimation bias with ordinal and multivariate non-normal data. *International Journal of Digital Society, 1*(1), 60-66.

Misra, S. C., Kumar, V., & Kumar, U. (2009). Identifying some important success factors in adopting agile software development practices. *Journal of Systems and Software*, *82*(11), 1869-1890.

Nerur, S., Mahapatra, R., & Mangalaraj, G. (2005). Challenges of migrating to agile methodologies. *Communications of the ACM*, *48*(5), 73-79.

Parsons, T., Bales, R., & Shils, E. (1953). *Working papers of the theory of action*. Berlin, Germany: Free Press.

Petersen, K., & Wohlin, C. (2009). A comparison of issues and advantages in agile and incremental development between state of the art and an industrial case. *Journal of Systems and Software*, 82(9), 1479-1490.

Pine, B. J., & Gilmore, J. H. (2011). *The experience economy.* Boston, MA: Harvard Business Review Press.

Power, D. J., Sohal, A. S., & Rahman, S.-U. (2001). Critical success factors in agile supply chain management—an empirical study. *International Journal of Physical Distribution & Logistics Management*, *31*(4), 247-265.

Punch, K. F. (2005) *Introduction to social research: Quantitative and qualitative* approaches (2nd ed.). London, UK: Sage.

R Core Team. (2013). *R: A language and environment for statistical computing*. Vienna, Austria: R Foundation for Statistical Computing.

Ren, J., Yusuf, Y. Y., & Burns, N. D. (2000). A prototype of measurement system for agile enterprise. In G. J. McNulty (Ed.), *Proceedings of the 3rd International Conference on Quality, Reliability and Maintenance* (pp. 247-251). Oxford, UK: University of Oxford.

Ren, M., & Lyytinen, K. (2008). Building enterprise architecture agility and sustenance with SOA. *Communications of the Association for Information Systems*, *22*, 75-86.

Rohrmann, B. (2007). *Verbal qualifiers for rating scales: Sociolinguistic considerations and psychometric data*. Melbourne, Australia: University of Melbourne.

Salo, O., & Abrahamsson, P. (2008). Agile methods in European embedded software development organisations: A survey on the actual use and usefulness of extreme programming and scrum. *IET Software*, *2*(1), 58-64.

Saris, W. E., Revilla, M., Krosnick, J. A., & Shaeffer, E. M. (2010). Comparing questions with agree/disagree response options to questions with item-specific response options. *Survey Research Methods*, *4*(1), 61-79.

Sarker, S., & Sarker, S. (2009). Exploring agility in distributed information systems development teams: An interpretive study in an offshoring context. *Information Systems Research*, *20*(3), 440-461.

Schelp, J., & Aier, S. (2008). Serviceorientierte architekturen—potenziale für eine nachhaltige steigerung der unternehmensagilität. In B. Dinter, R. Winter, P. Chamoni, N. Gronau, & K. Turowski (Eds.), *Proceedings der DW2008: Synergien durch Integration und Informationslogistik* (pp. 529-542).

Schelp, J., & Winter, R. (2007). Towards a methodology for service construction. In *Proceedings of the 40th Hawaii International Conference on System Sciences* (pp. 1-7).

Schmidt, W. C. (1997). World-Wide Web survey research: Benefits, potential problems, and solutions. *Behavior Research Methods, Instruments, & Computers, 29*(2), 274-279.

Seo, D., & La Paz, A. I. (2008). Exploring the dark side of IS in achieving organizational agility. *Communications of the ACM*, *51*(11), 136-139.

Sharifi, H., Colquhoun, G., Barclay, I., & Dann, Z. (2001). Agile manufacturing: A management and operational framework. *Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture*, *215*(6), 857-869.

Sharifi, H., & Zhang, Z. (1999). A methodology for achieving agility in manufacturing organisations: An introduction. *International Journal of Production Economics*, *62*(1), 7-22.

Sharma, S. (1996). *Applied multivariate techniques.* New York: John Wiley & Sons.

Sherehiy, B., Karwowski, W., & Layer, J. K. (2007). A review of enterprise agility: Concepts, frameworks, and attributes. *International Journal of Industrial Ergonomics*, *37*(5), 445-460.

Stabell, C. B., & Fjeldstad, Ø. D. (1998). Configuring value for competitive advantage: On chains, shops, and networks. *Strategic Management Journal*, *19*(5), 413-437.

Strohmaier, M., & Rollett, H. (2005). Future research challenges in business agility—time, control and information systems. In *Proceedings of the 7th IEEE International Conference on E-Commerce Technology Workshops* (pp. 109-115).

Tallon, P. P., & Pinsonneault, A. (2011). Competing perspectives on the link between strategic information technology alignment and organizational agility: Insights from a mediation model. *MIS Quarterly*, *35*(2), 463-486.

The Commission of the European Communities. (2003). Commission recommendation of 6 May 2003 concerning the definition of micro, small and medium-sized enterprises. *Official Journal of the European Union*. Retrieved from http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32003H0361

Thurstone, L. L. (1947). *Multiple-factor analysis—a development and expansion of the vectors of mind*. Chicago, IL: University of Chicago Press.

Tseng, Y.-H., & Lin, C.-T. (2011). Enhancing enterprise agility by deploying agile drivers, capabilities and providers. *Information Sciences*, *181*(17), 3693-3708.

Tsourveloudis, N. C., & Valavanis, K. P. (2002). On the measurement of enterprise agility. *Journal of Intelligent and Robotic Systems*, *33*, 329-342.

United Nations Statistics Division. (2013). *Composition of macro geographical (continental) regions, geographical sub-regions, and selected economic and other groupings*. Retrieved from http://unstats.un.org/unsd/methods/m49/m49regin.htm

van Oosterhout, M., Waarts, W., & van Hillegersberg, J. (2006). Change factors requiring agility and implications for IT. *European Journal if Information Systems*, *15*(2), 132-145.

Vázquez-Bustelo, D., Avella, L., & Fernández, E. (2007). Agility drivers, enablers and outcomes: Empirical test of an integrated agile manufacturing model. *International Journal of Operations & Production Management*, *27*(12), 1303-1332.

Volberda, H. W. (1996). Toward the flexible form: How to remain vital in hypercompetitive environments. *Organization Science*, *7*(4), 359-374.

Walter, S. M., Böhmann, T., & Krcmar, H. (2007). Industrialisierung der IT—grundlagen, merkmale und ausprägungen eines trends. *HMD Praxis der Wirtschaftsinformatik*, *44*(4), 6-16.

Weick, K. E., & Quinn, R. E. (1999). Organizational change and development. *Annual Review of Psychology*, *50*, 361-386.

Wendler, R. (2013a). The structure and components of agility—a multiperspective view. *Business Informatics*, *2*(28), 148-169.

Wendler, R. (2013b). The structure of agility from different perspectives. In M. Ganzha, L. Maciaszek, & M. Paprzycki (Eds.), *Proceedings of the 2013 Federated Conference on Computer Science and Information Systems* (pp. 1177-1184).

Wendler, R., & Gräning, A. (2011). How agile are you thinking? An exploratory case study. In A. Bernstein & G. Schwabe (Eds.), *Proceedings of the 10th International Conference on Wirtschaftsinformatik, WI 2.011* (pp. 818-827).

Wendler, R., & Stahlke, T. (2014). What constitutes an agile organization? Descriptive results of an empirical investigation. In *Dresdner Beiträge zur Wirtschaftsinformatik; No. 68/14*. Dresden, Germany: TU Dresden. Retrieved from http://nbn-resolving.de/urn:nbn:de:bsz:14-qucosa-130916

Yusuf, Y. Y., Sarhadi, M., & Gunasekaran, A. (1999). Agile manufacturing: The drivers, concepts and attributes. *International Journal of Production Economics*, *62*, 33-43.

Zelbst, P. J., Sower, V. E., Green, K. W., Jr., & Abshire, R. D. (2011). Radio frequency identification technology utilization and organizational agility. *Journal of Computer Information Systems*, *52*(1), 24-33.

Zhang, Z., & Sharifi, H. (2000). A methodology for achieving agility in manufacturing organizations. *International Journal of Operations & Production Management*, *20*(4), 496-512.

Zhang, Z., & Sharifi, H. (2007). Towards theory building in agile manufacturing strategy—a taxonomical approach. *IEEE Transactions on Engineering Management*, *54*(2), 351-370.

Zwick, W. R., & Velicer, W. F. (1986). Comparison of five rules for determining the number of components to retain. *Psychological Bulletin*, *99*(3), 432-442.

Appendix A: Agility-related Subconcepts

Table A1. Description of Agility-related Subconcepts (Wendler, 2013a)

Concept	Description	Main sources
Adaptivity	As an additional characteristic of an agile workforce, adaptivity enables employees to spontaneously collaborate in changing working environments.	Sherehiy et al. (2007)
Authority	Authority covers the way one controls work results. In an agile organization, authority should be tied to tasks, people should be committed to projects and groups, and control should be decentralized with fewer power differentials.	Sherehiy et al. (2007)
Cooperation	Cooperation focuses how people inside and/or outside the organization work together. The agile manufacturing domain focuses mostly on external cooperation with suppliers and/or customers (in which integrated supply chain planning, joint product development, and virtual enterprises are key aspects). Agile organizations need to pay additional attention to internal cooperation to ensure teams and departments cooperate and to bring people together with different skills and experiences.	Agarwal et al. (2007), Charbonnier-Voirin (2011), Goldman et al. (1995), Kettunen (2009), Meredith & Francis (2000), Sherehiy et al. (2007)
Change	Changes are normally triggered outside the organization and include new technologies, regulations, competitors, etc. Change has the potential to build up a completely new market environment and organizations have to adapt to the new situation. Researchers often see change as a core driver of agility. In addition, a culture of change with a continuous monitoring of the environment, updating of strategies and tasks, and improvement is necessary.	Ren et al. (2000), Sherehiy et al. (2007), Yusuf et al. (1999)
Collaboration	Collaboration refers to how people in organizations work together across departments and functions. Coordination further refines collaboration.	Breu et al. (2001), Sherehiy et al. (2007)
Coordination	See “collaboration”	-
Customer	Customers refers to an organization’s customers, and agility has a central tenet to enrich and satisfy them. To achieve agility, organizations (especially those in the software and IT industry) also need to collaborate with commit to their customers.	Goldman et al. (1995), Misra et al. (2009), Sherehiy et al. (2007)
Education	Education refers to a particular perspective for managing knowledge and deals with, for example, training and improving staff, committing to life-long learning, continuous updating of skills, etc. It also relates closely to organizational learning and intelligence.	Breu et al. (2001), Chan & Thong (2009), Vázquez-Bustelo et al. (2007)
Flexibility	Flexibility (which the authors always name together with responsiveness and quickness) describes an organization’s ability to adapt and change its components and achieve different goals with the same resources (namely: processes, staff, and products).	Sharifi et al. (2001), Tseng & Lin (2011)
HRM practices	Human resource management (HRM) practices cover the issues of education and organizational learning and particularly emphasize employee empowerment and job enrichment.	Chan & Thong (2009), Sherehiy et al. (2007), Vázquez-Bustelo et al. (2007)
Information	Information covers whether the organization supplies its employees with information about customers, suppliers, new products, current events, and so on. Further, it includes who has access to which information and how fast information is disseminated throughout the organization.	Sharifi et al. (2001)
Innovation	Innovation refers to the rate of product and/or service innovations in an organization. As such, it is closely related to the concept “product”.	Sharifi et al. (2001)
Integration	One can understand integration from two perspectives: on one hand, process integration helps ensure organizations concurrently perform activities; on the other hand, information integration allows all employees to access important information.	Tseng & Lin (2011), Yusuf et al. (1999)
Intelligence	See “education”	-
Market	Researchers often use “market” to mean “customer”, but the terms differ. Market-related aspects cover continuously monitoring market activities and responding to changes and to introducing products quickly.	Ren et al. (2000), Yusuf et al. (1999)

Table A1. Description of Agility-related Subconcepts (Wendler, 2013a)

Motivation	See “HRM practices”	-
Organizational abilities / competences	This concept examines if an organization has a strategic vision, can use technologies and people to its advantage, can introduce high quality products and innovations, and knows its core competences.	Kettunen (2009), Sharifi et al. (2001)
Organizational culture	Organizational culture relates closely to the concept of organizational abilities. It includes issues such as openness for change, emphasis on individuals and teams, and open and trustful working environments.	Misra et al. (2009), Sarker & Sarker (2009)
Organizational learning	See “education”	-
Proactivity	Proactivity focuses on anticipating problems and changes instead of simply purely reacting to them.	Sherehiy et al. (2007)
Processes	Processes, which the authors name as prerequisites for agility, have to be flexible, enable an integrated and continuous execution of tasks, and allow fast problem solving and immediate reaction to changes.	Meredith & Francis (2000), Sarker & Sarker (2009)
Product	The concept of product relates closely to quality but more emphasizes satisfying customers through product design and features.	Gunasekaran & Yusuf (2002)
Project	The concept of project focuses how well teams work in projects and, hence, relates to teamwork, collaboration, and coordination.	Chow & Cao (2008)
Quality	The concept of quality relates to processes and customer satisfaction by emphasizing high-quality products and built-in quality control measures.	Kettunen (2009), Yusuf et al. (1999)
Quickness	Quickness (which the authors always name with responsiveness and flexibility) includes developing products and delivering services quickly.	Sharifi et al. (2001) Tseng & Lin (2011)
Resiliency	Resiliency refers to the ability to cope with uncertain and unexpected situations and with stress.	Sherehiy et al. (2007)
Responsiveness	Responsiveness (which the authors always name together with flexibility and quickness) refers to the ability to detect and anticipate changes.	Sharifi et al. (2001), Tseng & Lin (2011)
Strategy	Strategy covers management activities to support and promote agile principles.	Meredith & Francis (2000)
Structure	Structure covers issues of organizational structure, such as hierarchies or teamwork.	Sherehiy et al. (2007)
Systems	Systems refers to how an organization uses and integrates supporting systems to create products or deliver services such as ERP systems, office systems, communication systems, design tools, and so on. Agile manufacturing research mainly uses the systems concept in terms of the use of design, production planning, and control systems. The concept systems is closely related to technology and to differentiate both is difficult.	Gunasekaran (1999)
Technology	In the software and IT service industry, technology mainly refers to how technology supports organizations in achieving agility. In agile manufacturing, technologies mainly refer to advanced design, manufacturing, and administrative technologies, such as systems for enterprise resource planning (ERP), material requirement planning (MRP), computer aided design (CAD), etc. From an organizational perspective, technologies that enhance internal communication and integrate processes are equally important.	Breu et al. (2001), Eshlaghy et al. (2010), Gunasekaran & Yusuf (2002), Vázquez-Bustelo et al. (2007)
Welfare	Welfare covers the issue of employee satisfaction.	Yusuf et al. (1999)
Workforce / teams	This concept refers to employees’ capabilities and how an organization organizes labor. Agile organizations empower employees and teams (about their autonomy in performing tasks and making decisions), support intensive face-to-face communication, and encourage people to collaborate. Furthermore, employees of an agile organization are multi-skilled, continuously participate in training and are open-minded to new ideas and innovations.	Breu et al. (2001), Goldman et al. (1995), Gunasekaran (1999), Kettunen (2009)

Appendix B: Complete Questionnaire

Table B1. Complete Questionnaire with Item Names, Focus, and Related Sources

Item	Abbr.	Item focus	Related sources
Values & principles: our organization values a culture that…			
…harnesses change for competitive advantages.	val1	change as advantage	Charbonnier-Voirin (2011)
…considers team work as integral part.	val2	team work	Vázquez-Bustelo et al. (2007)
…accepts and supports decisions and proposals of employees.	val3	decisions at all levels	Misra et al. (2009)
…is supportive of experimentation and the use of innovative ideas.	val4	experimentation and innovation	Lu & Ramamurthy (2011), Vázquez-Bustelo et al. (2007)
…considers changing customer-related requirements as opportunities.	val5	welcome changing requirements	Lu & Ramamurthy (2011), Misra et al. (2009)
Values & principles: our organization prefers…			
…a proactive continuous improvement rather than reacting to crisis or “fire-fighting”.	pref1	proactivity	Power et al. (2001)
…the elimination of barriers between individuals and/or departments, e. g. by flat hierarchies or simple structures.	pref2	barrier elimination	Power et al. (2001)
…face-to-face communication for conveying information within our organization.	pref3	face-to-face communication	Misra et al. (2009)
…simplicity (i.e., skipping product and/or service features that go beyond the customer requirements).	pref4	simplicity in products	Misra et al. (2009)
...market-related changes (e. g. new competitors, preferences) to generate new opportunities.	pref5	change as opportunity	Lu & Ramamurthy (2011)
Conditions & IT/IS: our organization has…			
…effective “top-down” and “bottom-up” communication processes.	cond1	communication processes	Power et al. (2001)
…an intensive employee training program.	cond2	training programs	Hoyt et al. (2007)
…employees that have a good understanding of how their own job relates to the firm’s overall activity.	cond3	understanding of contribution	Charbonnier-Voirin (2011), Hoyt et al. (2007)
…a strategy that is clearly communicated to all hierarchical levels in terms easily understood by all.	cond4	strategy communication	Charbonnier-Voirin (2011)
…a strategic vision that allows flexibility for market changes from the very start.	cond5	strategic flexibility	Zelbst et al. (2011)
Conditions & IT/IS: our organization has information systems and technologies that…			
…make organizational information easily accessible to all employees.	tech1	information access	Kassim & Zain (2004), Vázquez-Bustelo et al. (2007)
…provide information helping our employees to quickly respond to changes.	tech2	timely information	Kassim & Zain (2004), Zelbst et al. (2011)
…are appropriate to our needs and allow us to be competitive in the marketplace.	tech3	appropriate information	Power et al. (2001)
…enable decentralization in decision making.	tech4	decentralization	Kassim & Zain (2004)
…are integrated amongst different departments and/or business units.	tech5	integration	Vázquez-Bustelo et al. (2007)

Table B1. Complete Questionnaire with Item Names, Focus, and Related Sources

…are standardized or comparable amongst different departments and/or business units.	tech6	standardization	Sarker & Sarker (2009)
…enable us to fully integrate our customers and partners into our processes.	tech7	customer / partner integration	Kassim & Zain (2004), Vázquez-Bustelo et al. (2007)
Capabilities: our managers…			
…maintain an informal management style with focus on coaching and inspiring people.	capman1	informal management style	Zhang & Sharifi (2007)
…understand the value of IT investments from a company-wide perspective.	capman2	IT investments	Lu & Ramamurthy (2011)
…have the knowledge and skills necessary to manage change.	capman3	change management	Zelbst et al. (2011)
…are able to quickly implement changes in products and/or services.	capman4	quick reaction	Hoyt et al. (2007), Sharifi et al. (2001)
…are able to recognize future competitive advantages that may result from innovations in products, services, and/or processes.	capman5	vision / innovation	Zhang & Sharifi (2007)
…are able to flexibly deploy their resources (material, financial, human, ...) to make use of opportunities and minimize threats.	capman6	resource flexibility	Charbonnier-Voirin (2011)
…manage the sharing of information, know-how, and knowledge among employees appropriately.	capman7	information sharing	Charbonnier-Voirin (2011)
Capabilities: our employees…			
…are able to act with a view to continuous improvement of our products, services, processes, and/or working methods.	capemp1	continuous improvement	Charbonnier-Voirin (2011)
…are able to sense, perceive, or anticipate the best opportunities which come up in our environment.	capemp2	market responsiveness	Charbonnier-Voirin (2011)
…are able to meet the levels of product and/or service quality demanded by our customers.	capemp3	quality orientation	Zelbst et al. (2011)
...use a broad range of skills and can be applied to other tasks when needed.	capemp4	multi-skilled	Hoyt et al. (2007), Kassim & Zain (2004)
…communicate with each other with trust, goodwill, and esteem.	capemp5	trustful communication	Misra et al. (2009)
…are ready to learn and are prepared to constantly access, apply and update knowledge.	capemp6	lifelong learning	Misra et al. (2009), Vázquez-Bustelo et al. (2007)
…are in general always willing to continuously learn from one another and to pass their knowledge to others.	capemp7	learning from mentoring	Misra et al. (2009)
…obtain and develop appropriate technological capabilities purposeful.	capemp8	technological capabilities	Sharifi et al. (2001)
…can re-organize continuously in different team configurations to meet changing requirements and the newly arising challenges.	capemp9	ability to re-organize	Misra et al. (2009)
…are self-motivated.	capemp10	motivation	Misra et al. (2009)
…take responsibility and think in a business-like manner.	capemp11	responsibility	Misra et al. (2009)
Activities: our employees…			

Table B1. Complete Questionnaire with Item Names, Focus, and Related Sources

…collaborate closely with different teams, departments, and/or business units.	actemp1	close collaboration	Misra et al. (2009)
…organize themselves in their teams.	actemp2	self-organization	Misra et al. (2009)
…reflect at regular intervals on how to become more effective in their team, then tune and adjust their behavior accordingly.	actemp3	self-improvement	Misra et al. (2009)
…work in small teams in their projects.	actemp4	small teams	Misra et al. (2009)
…form teams that are geographically closely located.	actemp5	closely located teams	Misra et al. (2009)
…rotate amongst different activities, tasks, positions or departments.	actemp6	job rotation	Vázquez-Bustelo et al. (2007)
Activities: regarding our employees, we…			
…manage proposals, new ideas, and solutions from all levels consequently.	actorgemp1	proposal management	Charbonnier-Voirin (2011)
…trust them to get their job done.	actorgemp2	trustful environment	Misra et al. (2009)
…offer incentives not only for individuals, but for the team and their contribution to the overall organization.	actorgemp3	team incentives	Charbonnier-Voirin (2011)
…offer incentives to encourage our employees to upgrade their skills and training.	actorgemp4	skill development incentives	Hoyt et al. (2007)
…encourage also employees at lower levels to make decisions and take responsibility.	actorgemp5	transfer of decision power	Charbonnier-Voirin (2011), Kassim & Zain (2004)
…develop employees skills with a view to the firm's long-term future development.	actorgemp6	long-term skill development	Charbonnier-Voirin (2011)
Activities: in our organization, we…			
…scan and examine our environment systematically to anticipate change.	actorggen1	anticipating change	Charbonnier-Voirin (2011)
…react to approaching changes by immediately updating our business strategy.	actorggen2	flexible strategy	Sherehiy et al. (2007)
…react to approaching changes by immediately updating our processes.	actorggen3	flexible processes	Zelbst et al. (2011)
…are quick to make appropriate decisions in the face of market- and/or customer-related changes.	actorggen4	quick decisions	Lu & Ramamurthy (2011)
…change authorities when tasks change.	actorggen5	flexible authorities	Sherehiy et al. (2007)
…jointly and intensively operate throughout different functions and/or departments for strategic decision making.	actorggen6	intense collaboration	Vázquez-Bustelo et al. (2007)
…encourage early involvement of several departments and/or functions in new product and/or service development.	actorggen7	enterprise-wide innovation	Vázquez-Bustelo et al. (2007)
…design our processes simultaneously to the development of new products and/or services.	actorggen8	simultaneous process development	Vázquez-Bustelo et al. (2007)
…inform ourselves systematically about information technology innovations.	actorggen9	innovation information	Lu & Ramamurthy (2011)
…strategically invest in appropriate technologies and have a clear vision how IT contributes to business value.	actorggen10	strategic IT investments	Lu & Ramamurthy (2011), Sharifi et al. (2001)
…focus on our core competencies and delegate further tasks to our partners and subcontractors.	actorggen11	focus core competencies	Agarwal et al. (2007)

Table B1. Complete Questionnaire with Item Names, Focus, and Related Sources

…monitor the performance of our partners and subcontractors very closely.	actorggen12	partner monitoring	Hoyt et al. (2007)
…select our partners and subcontractors by quality criteria (rather than pure cost-based decisions).	actorggen13	quality-based contracts	experts (pre-test)
…align all our activities to customer requirements and needs.	actorggen14	customer-focused processes	Charbonnier-Voirin (2011)
…encourage compilation and internal dissemination of information on customer's needs.	actorggen15	sharing customer information	Vázquez-Bustelo et al. (2007)
…closely collaborate with and encourage fast feedback from our customers.	actorggen16	close customer collaboration	Misra et al. (2009)
General data			
What are the main fields of activity of your organization? (multiple answers) (Programming and Software Development; IT Services and Consultancy; Computer Facilities Management; Other (TEXT))			
What is your role in your organization? (Chief Executive Officer; Chief Information Officer / Chief Technology Officer; Chief Financial Officer; IT Manager, ICT Manager, or related; Enterprise Architect, IT Architect, or related; Other (TEXT))			
Where is your organization located (if your organization has subsidies in different countries, please refer to your headquarter)? (Germany; USA; Other country (TEXT))			
In which regions are your customers located? (multiple answers) (home country, regional; home country, national; Europe; North America; Latin America / Caribbean; Asia / Pacific; Africa)			
What is the approximate number of employees in your organization? (less than 10; 10 to 49; 50 to 249; 250 to 500; more than 500)			

Appendix C: Mapping Of Items To Agility Concepts

Table C1. Mapping of Items Used to Agility Subconcepts

Item	Subconcept																																
	Organizational culture	Organizational abilities / capabilities	Workforce	Technology	Customer	Structure	Motivation	Welfare	Coordination	Authority	Strategy	Projects	HRM practices	Organizational Llearning	Collaboration	Cooperation	Flexibility	Quickness	Change	Processes	Proactivity	Education	Intelligence	Adaptivity	Resiliency	Systems	Integration	Information	Market	Innovation	Responsiveness	Product	Quality
val1	x				x														x		x										x		
val2	x		x									x																					
val3	x					x				x																							
val4	x						x	x						x																x			
val5	x				x														x												x		
pref1	x	x									x										x												
pref2	x					x				x																							
pref3	x								x																			x					
pref4	x				x																								x		x		
pref5	x																		x										x		x		
cond1	x					x														x													
cond2	x												x	x								x											
cond3	x		x			x																	x										
cond4	x		x								x																						
cond5	x										x						x		x														
tech1	x			x										x												x		x					
tech2		x		x													x	x	x							x		x					
tech3				x																						x		x	x				
tech4	x			x		x				x																x							
tech5				x		x																				x	x						
tech6				x		x																				x							
tech7				x	x															x						x	x						
capman1	x						x			x			x																				
capman2	x			x							x															x							
capman3		x															x		x												x		
capman4		x			x													x	x													x	
capman5		x			x						x								x										x	x			
capman6		x				x											x		x														

Table C1. Mapping of Items Used to Agility Subconcepts

capman7		x						x					x													x	x					
capemp1		x	x															x		x									x		
capemp2			x																									x		x		
capemp3			x		x																										x
capemp4			x																			x	x								
capemp5	x		x						x					x	x																
capemp6	x		x										x								x	x									
capemp7	x		x										x								x	x									
capemp8			x	x																		x									
capemp9			x											x	x	x							x								
capemp10			x				x																								
capemp11			x							x																					
actemp1			x			x						x			x	x															
actemp2	x		x				x		x	x		x																			
actemp3	x		x				x					x											x								
actemp4			x			x						x																			
actemp5			x			x						x																			
actemp6	x		x			x			x				x																		
actorgemp1			x			x						x			x	x															
actorgemp2	x		x				x		x	x		x																			
actorgemp3	x		x				x					x											x								
actorgemp4			x			x						x																			
actorgemp5			x			x						x																			
actorgemp6			x			x			x				x																		
actorggen1		x			x													x		x							x		x		
actorggen2		x									x					x	x	x													
actorggen3		x														x	x	x	x												
actorggen4		x			x	x				x							x											x				
actorggen5	x	x				x				x			x			x															
actorggen6	x								x						x																
actorggen7	x														x					x									x			
actorggen8		x													x					x									x			

Table C1. Mapping of Items Used to Agility Subconcepts

actorggen 9		x		x																						x		x			
actorggen 10	x			x							x														x						
actorggen 11		x														x				x								x			
actorggen 12	x															x															x
actorggen 13	x															x															x
actorggen 14		x			x															x								x			
actorggen 15	x				x																						x				
actorggen 16	x		x		x							x			x					x											

Appendix D: Exploratory Factor Analysis: Additional Information

Table D1. Steps of factor analysis

Step	No. of factors	No. of items	Deleted item	Reason for deletion
1	8	68	actorgemp1	non-significant loading
2	8	67	actorgemp2	non-significant loading
3	8	66	actorgemp5	non-significant loading
4	8	65	actorgemp6	non-significant loading
5	8	64	cond1	non-significant loading
6	8	63	cond2	non-significant loading
7	8	62	pref3	cross loading, low communality
8	8	61	actemp5	cross loading, low communality
9	7	60	actorggen8	cross loading
10	7	59	actemp6	non-significant loading
11	7	58	cond3	non-significant loading
12	7	57	cond4	non-significant loading
13	7	56	cond5	non-significant loading
14	7	55	actemp4	non-significant loading, low comm.
15	7	54	actemp1	non-significant loading
16	7	53	pref2	cross loading
17	7	52	actemp2	cross loading
18	7	51	actemp3	cross loading, low communality
19	6	50	actorgemp4	non-significant loading, low comm.
20	6	49	actorgemp3	non-significant loading, low comm.
21	6	48	pref4	low communality
22	6	47	actorggen11	low communality
23	6	46	tech7	low communality
24	**6**	**45**	**-**	**-**

Table D2. Oblimin Rotated Factor Analysis Results

Item	Item focus	F1	F2	F3	F4	F5	F6	Com.
capemp6	lifelong learning	0.92						0.87
capemp7	learning from mentoring	0.84						0.80
capemp9	ability to re-organize	0.77						0.65
capemp5	trustful communication	0.74						0.68
capemp8	technological capabilities	0.73						0.75
capemp4	multi-skilled	0.73						0.67
capemp10	motivation	0.71						0.65
capemp11	responsibility	0.60						0.62
capemp3	quality orientation	0.59						0.61
capemp2	market responsiveness	0.57						0.66
capemp1	continuous improvement	0.51						0.68
tech5	integration		0.93					0.78
tech6	standardization		0.78					0.63

Table D2. Oblimin Rotated Factor Analysis Results

tech1	information accessibility		0.74					0.67
tech3	appropriate information		0.62					0.75
tech2	timely information		0.57					0.72
tech4	decentralization		0.55					0.58
capman3	change management			0.74				0.85
capman5	vision / innovation			0.72				0.73
capman4	quick reaction			0.67				0.78
capman1	informal management style			0.59				0.73
capman7	information sharing			0.59				0.76
capman2	IT investments			0.57				0.65
capman6	resource flexibility			0.53				0.71
actorggen12	partner monitoring				0.75			0.63
actorggen13	quality-based contracts				0.66			0.66
actorggen16	close customer collaboration				0.58			0.69
actorggen14	customer-focused processes				0.50			0.60
actorggen10	strategic IT investments				0.45			0.67
actorggen9	innovation information				0.44			0.57
actorggen6	intense collaboration				0.37			0.67
actorggen15	sharing customer information				0.36			0.62
actorggen7	enterprise-wide innovation				0.36			0.62
val1	change as advantage					0.69		0.59
val5	welcome changing requirements					0.68		0.61
val4	experimentation and innovation					0.64		0.67
pref5	change as opportunity					0.51		0.52
pref1	proactivity					0.47		0.59
val2	team work					0.46		0.51
val3	decisions at all levels					0.45		0.61
actorggen2	flexible strategy						0.81	0.81
actorggen3	flexible processes						0.78	0.76
actorggen1	anticipating change						0.50	0.59
actorggen5	flexible authorities						0.43	0.51
actorggen4	quick decisions						0.43	0.68
Sum of squares (eigenvalue)		7.77	4.93	5.38	4.43	4.02	3.60	
Cumulative variance explained		0.17	0.28	0.40	0.50	0.59	0.67	
Cronbach's Alpha		0.96	0.92	0.95	0.93	0.90	0.90	
Factor Correlation Matrix		**F1**	**F2**	**F3**	**F4**	**F5**	**F6**	
F1		1.00						
F2		0.55	1.00					
F3		0.69	0.53	1.00				
F4		0.50	0.53	0.52	1.00			
F5		0.46	0.54	0.50	0.48	1.00		

Table D2. Oblimin Rotated Factor Analysis Results

F6	0.49	0.46	0.50	0.46	0.44	1.00	
Note: I do not include loadings < 0.3. I sort items by loadings on each factor.							

Table D3. Validation of Factor Analysis with Split Samples (Oblimin Rotation): Split Sample 1

Item	Item focus	F1	F2	F3	F4	F5	F6	Com.
capemp6	lifelong learning	0.87						0.87
capemp7	learning from mentoring	0.80						0.79
capemp9	ability to re-organize	0.77						0.64
capemp4	multi-skilled	0.71						0.62
capemp8	technological capabilities	0.71						0.76
capemp5	trustful communication	0.67						0.67
capemp10	motivation	0.66						0.62
capemp3	quality orientation	0.58						0.62
capemp2	market responsiveness	0.50			0.31			0.69
capemp11	responsibility	0.46			0.40			0.61
capemp1	continuous improvement	0.45						0.67
tech5	integration		0.89					0.82
tech1	information accessibility		0.72					0.72
tech6	standardization		0.72					0.65
tech4	decentralization		0.58					0.57
tech3	appropriate information		0.57					0.74
tech2	timely information		0.51					0.70
capman3	change management			0.66				0.84
capman5	vision / innovation			0.65				0.72
capman6	resource flexibility			0.59				0.75
capman7	information sharing			0.59				0.82
capman4	quick reaction			0.56				0.74
capman2	IT investments			0.51				0.58
capman1	informal management style			0.47				0.64
actorggen12	partner monitoring				0.75			0.60
actorggen13	quality-based contracts				0.75			0.69
actorggen16	close customer collaboration				0.74			0.73
actorggen14	customer-focused processes				0.59			0.58
actorggen15	sharing customer information				0.55			0.65
actorggen10	strategic IT investments				0.49			0.63
actorggen9	innovation information				0.42			0.55
actorggen7	enterprise-wide innovation				0.38			0.55
actorggen6	intense collaboration				0.35			0.63
val1	change as advantage					0.77		0.58
val4	experimentation and innovation					0.66		0.67
val5	welcome changing requirements					0.65		0.53
val3	decisions at all levels					0.59		0.57
pref1	proactivity					0.50		0.62

Table D3. Validation of Factor Analysis with Split Samples (Oblimin Rotation): Split Sample 1

pref5	change as opportunity					0.50		0.56
val2	team work					0.43		0.43
actorggen3	flexible processes						0.80	0.76
actorggen2	flexible strategy						0.75	0.74
actorggen5	flexible authorities						0.49	0.57
actorggen1	anticipating change						0.47	0.58
actorggen4	quick decisions						0.45	0.68
Sum of squares (eigenvalue)		7.10	4.56	5.00	5.25	4.09	3.75	
Cumulative variance explained		0.16	0.26	0.37	0.49	0.58	0.66	
Note: I do not include loadings < 0.3. I sort items by loadings on each factor.								

Table D4. Validation of Factor Analysis with Split Samples (Oblimin Rotation): Split Sample 2

Item	Item focus	F1	F2	F3	F4	F5	F6	Com.
capemp6	lifelong learning	0.86						0.86
capemp5	trustful communication	0.83						0.76
capemp10	motivation	0.82						0.77
capemp11	responsibility	0.81						0.79
capemp7	learning from mentoring	0.81						0.83
capemp9	ability to re-organize	0.76						0.70
capemp4	multi-skilled	0.72						0.76
capemp8	technological capabilities	0.72						0.76
capemp2	market responsiveness	0.68						0.71
capemp3	quality orientation	0.62						0.64
capemp1	continuous improvement	0.59						0.75
tech1	information accessibility		0.87					0.75
tech5	integration		0.84					0.77
tech6	standardization		0.77					0.66
tech2	timely information		0.70					0.83
tech3	appropriate information		0.68					0.81
tech4	decentralization		0.57					0.72
capman5	vision / innovation			0.61				0.78
capman4	quick reaction			0.57				0.84
capman3	change management	0.32		0.57				0.86
capman1	informal management style	0.42		0.50				0.81
capman7	information sharing			0.48				0.74
capman6	resource flexibility			0.46				0.74
capman2	IT investments	0.36		0.41				0.74
actorggen12	partner monitoring				0.59			0.66
actorggen13	quality-based contracts				0.45			0.69
actorggen16	close customer collaboration				0.44	0.36		0.79
actorggen9	innovation information				0.39			0.64
actorggen14	customer-focused processes				0.38			0.68

Table D4. Validation of Factor Analysis with Split Samples (Oblimin Rotation): Split Sample 2

actorggen6	intense collaboration				0.36			0.74
actorggen7	enterprise-wide innovation	0.31			0.35			0.73
val5	welcome changing requirements					0.79		0.76
val1	change as advantage					0.75		0.75
pref5	change as opportunity					0.72		0.61
val4	experimentation and innovation					0.65		0.72
pref1	proactivity					0.58		0.65
val2	team work					0.56		0.69
val3	decisions at all levels		0.30			0.36		0.70
actorggen2	flexible strategy						0.87	0.88
actorggen3	flexible processes						0.84	0.82
actorggen1	anticipating change						0.59	0.65
actorggen4	quick decisions						0.51	0.71
actorggen5	flexible authorities			-0.40			0.49	0.66
actorggen10	strategic IT investments				0.30		0.38	0.72
actorggen15	sharing customer information						0.32	0.68
Sum of squares (eigenvalue)		9.35	6.19	4.30	2.95	5.49	5.01	
Cumulative variance explained		0.21	0.35	0.45	0.52	0.64	0.75	
Note: I do not include loadings < 0.3. I sort items by loadings on each factor.								

About the Authors

Roy Wendler is researching in the field of information systems at Technische Universität Dresden, Germany, and works as ERP consultant at SolarWorld Industries Sachsen GmbH. His focus of interest lies on organizational agility and the connection of agile software development and organizational culture. As a second research topic, he analyzes maturity models as potential measurement tools for organizational capabilities. The aim of his current work is to develop tools and offer possibilities to practically implement academic findings about agility into an organization.