6-18-2022

HOW AGILE IS YOUR IT DEPARTMENT? – DEVELOPMENT AND APPLICATION OF AN FRAMEWORK-INDEPENDENT AGILE SCALING MATURITY MODEL

Lukas Fabri
Augsburg University of Applied Sciences, lukas.fabri@fim-rc.de

Björn Häckel
University of Applied Sciences Augsburg, bjoern.haeckel@fim-rc.de

Bastian Stahl
Augsburg University of Applied Sciences, bastian.stahl@fim-rc.de

Sebastian Beck
Augsburg University of Applied Sciences, sebastian_beck@yahoo.com

Maximilian Gabele
KUKA AG, maximilian.gabele@kuka.com

HOW AGILE IS YOUR IT DEPARTMENT? – DEVELOPMENT AND APPLICATION OF AN FRAMEWORK-INDEPENDENT AGILE SCALING MATURITY MODEL

Research Paper

Lukas Fabri, FIM Research Center, Augsburg University of Applied Sciences, Augsburg, Germany Lukas.fabri@fim-rc.de

Björn Häckel, FIM Research Center, University of Applied Sciences Augsburg, Project Group Business & Information Systems Engineering of the Fraunhofer FIT, Augsburg, Germany Bjoern.haeckel@fim-rc.de

Bastian Stahl, FIM Research Center, University of Applied Sciences Augsburg, Augsburg, Germany bastian.stahl@fim-rc.de

Sebastian Beck, University of Applied Sciences Augsburg, Augsburg, Germany, Sebastian.beck@hs-augsburg.de

Maximilian Gabele, KUKA AG, Augsburg, Germany, Maximilian.Gabele@kuka.com

Abstract

Many IT departments seek to capitalize on the benefits of agile development by scaling agile practices. To manage the complex scaling, established approaches and frameworks promise guidance. However, although existing works envision a clear target state, they lack relevant capabilities along the scaling process, especially for vertical agile scaling. Managers need these capabilities to assess their company's status quo and develop a clear scaling roadmap. Thus, within this work, we use the Design Science Research paradigm to build and evaluate a framework-independent agile scaling maturity model that provides management with a tool for ex-ante identification and evaluation of agile scaling capabilities in five maturity stages. To evaluate our model, we applied it at KUKA IT, the IT department of an international provider of automation solutions. As a result, this work provides insights into the application and outlines how IT departments can operationalize and utilize our model to guide agile scaling.

Keywords: Agile Scaling, Maturity Model, Capability Development, Agile Transformation

1 Introduction

In the light of digitization, IT departments increasingly shift towards a strategic role within an organization (Urbach et al., 2019). Especially for companies with non-digital products at the core, for example, in manufacturing, the IT department is a key facilitator of internal and external digital products, services, and processes (Matook and Maruping, 2014; Piccoli and Lui, 2014; Wessel et al., 2021). To meet this new role and associated requirements, agile approaches have established essential tools for managers to consistently align the IT department with internal and external requirements and increase efficiency (Sambamurthy et al., 2003; Wińska and Dąbrowski, 2020). Not surprisingly, the

implementation of agile practices remains one of the ten most important IT management topics (Aghina et al., 2021; Kappelman et al., 2021). However, the benefits of agile practices require IT departments to develop a range of corresponding capabilities (Jöhnk et al., 2017). The structured identification, prioritization, and development of relevant capabilities are particularly relevant for agile methods since agile scaling needs to be anchored vertically and horizontally (Gustavsson, 2017; Thompson et al., 2017). While horizontal scaling describes adopting agile practices in multiple teams at the same organizational level (e.g., numerous development teams), vertical scaling refers to adopting more sophisticated agile practices along all hierarchies. It thus is a challenge for the entire organization, as leveraging agile practices across management requires a significant shift at all organizational levels and implies creating a learning organization (Kasauli et al., 2021). For example, agile budgeting approaches replace traditional project costing. Quality and requirements management must adapt to short delivery cycles and iterative development. Consequently, vertical agile scaling requires new organizational capabilities that span all hierarchical levels of the organizations (Klimenko et al., 2019; Mahadevan et al., 2015).

Therefore, many agile scaling frameworks and approaches have become established. Especially in practice, there are numerous frameworks for agile scaling, e.g., Scaled Agile Framework (SAFe), Large Scale Scrum (LeSS), Spotify Model, Nexus, and others (Alqudah and Razali, 2016; Uludağ et al., 2021). Academia is also exploring the general purpose of agility (e.g., Tallon et al. (2019)) and the development of frameworks to assess specific aspects of enterprise agility (e.g., Gren et al. (2015), Gunsberg et al. (2018), Wendler (2014)). These works provide target states for agile scaling and use suitable methodologies and specific tools for implementing agile practices. However, they neglect a central challenge of practitioners: Confronted with the broad number and variety of agile scaling approaches, practice calls for a holistic, comprehensive tool that allows an ex-ante assessment of the organization's capabilities to then choose a suited framework for vertical agile scaling (e.g., LeSS, SAFe, etc.) (Uludağ et al., 2021).

Many companies are in the middle of their agile transformation. While only isolated teams are currently working agilely, there is a lack of overarching structures to coordinate agile approaches and guide vertical agile scaling. IT departments are faced with the challenge of understanding the organization's status quo of agile capabilities, defining a target state, and prioritizing fields of action. While there are a variety of existing agile frameworks, there is still a call for a framework-independent understanding of relevant capabilities (Marshburn and Dekkinga, 2020). In doing so, IT departments aim to avoid path dependencies, bias, and openness in the selection process. The call for framework-independent perspectives on agile scaling is also becoming louder in research (Klimenko et al., 2019). Therefore, at the interface between practice and research (Kohli, 2001), we seek to answer the following research question:

How can IT departments identify, prioritize, and develop framework-independent capabilities for vertical agile scaling?

In research, maturity models (MMs) have proven to be a useful management tool to guide the identification, prioritization, and development of relevant capabilities (Röglinger and Pöppelbuß, 2011). MMs have demonstrated their suitability as a guiding structure for agile transformations at the interface between academia and practice (e.g., Gunsberg et al. (2018)) and are of high value due to their use as an analysis and positioning tool (Brookes et al., 2014). To develop their practical value, MMs must be applied by assessing the current state, defining the goals to be achieved, and prioritizing activities (Rigby et al., 2018). However, while some MMs for agile practices already exist (e.g., Gren et al. (2015), Stojanov et al. (2015)), there is still a call for framework-independent yet applicable research (Klimenko et al., 2019; Marshburn and Dekkinga, 2020). We aim to address this problem by creating a framework-independent and thus comprehensive yet guiding Agile Scaling Maturity Model (ASMM). Based on the Design Science Research (DSR) paradigm (Hevner et al., 2004), we draw on the established procedure model of Becker et al. (2009) for rigorous MM development and evaluation. For the latter, we refer to a case study evaluation at KUKA IT, the IT department of a leading manufacturer for intelligent automation solutions, to underpin our model's problem relevance (Yin, 1992). The model's application

as an ex-ante assessment tool for agile scaling provides valuable insights regarding its practical value (Sonnenberg and vom Brocke, 2012). For academia, our model provides a framework-independent conceptualization of agile scaling capabilities and calls upon further investigation on how organizations initialize and structure their agile scaling.

The remainder of this paper is structured as follows: In the next section, we outline and structure related works by comparing existing maturity models in agile scaling as a fundament to develop our ASMM. Within section three, we depict our research approach to develop and evaluate the following the DSR procedure model of Becker et al. (2009). In section four, we present key decisions of the iterative maturity model development on the MMs structure and present the contents of the ASMM. We then provide insights on the ASMM's application at KUKA IT and its use as an ex-ante assessment tool for agile scaling. In chapter six, we evaluate the model's usefulness and discuss it in the context of existing frameworks. Finally, we conclude by outlining limitations and providing an outlook on future research.

2 Related Work

As stated in the Introduction, the research area of agility receives great interest from both researchers and practitioners. On the one hand, existing literature includes considerations of agile development in general (e.g., Conboy (2009), Gerster et al. (2020), Schweigert et al. (2013)). On the other hand, various MMs also exist to assess enterprise agility (e.g., Gren et al. (2015), Gunsberg et al. (2018), Wendler (2014)). However, management needs framework-independent guidance to structure agile scaling ex-ante and develop the necessary capabilities to successfully implement agile scaling (Marshburn and Dekkinga, 2020; Rigby et al., 2018). Therefore, this section discusses existing works (i.e., MMs for agile scaling) as a solid foundation for our ASMM development. We queried established databases in the information systems domain for MMs in our literature search. Furthermore, we included scaling frameworks common among practitioners (e.g., SAFe, Nexus, etc.). These works serve as a foundation of our MM development procedure and provide valuable insights on capabilities for vertical agile scaling. For further methodological insights, we refer to chapter 3 (Research Approach). Overall, we identified three main fields of research regarding agile scaling and MMs (see Table 1):

Field of research	**Representative articles**
Specific use cases	El-Telbany et al. (2020), Fitzgerald et al. (2013), Hohl et al. (2018), Joachim et al. (2011), Patel and Ramachandran (2009), Rashid et al. (2021)
General development and implementation	Benefield (2010), Conboy (2009), Conboy and Carroll (2019), de Koning et al. (2019), Gerster et al. (2020), Gren et al. (2015), Gunsberg et al. (2018), Rigby et al. (2018), Schweigert et al. (2013), Sreenivasan and Kothandaraman (2019), Stojanov et al. (2015), Turetken et al. (2017), Wendler (2014), Yin et al. (2011)
Similarities and differences between the various frameworks and MMs	Alqudah and Razali (2016), Diebold et al. (2018), Ebert and Paasivaara (2017), Kalenda et al. (2018), Wińska and Dąbrowski (2020)

Table 1. Fields of research and representative articles.

The first field focuses on developing MMs for specific use cases. For example, Rashid et al. (2021) developed an MM to assess the agile maturity of software vendors in terms of development from a sustainability perspective. Patel and Ramachandran (2009) adapted the process improvement framework and MM to focus on agile software development practices and identify the key process area for improvement. However, MMs are not limited to software development due to the broad interest mentioned above. For example, for service-oriented architectures such as by Joachim et al. (2011), which developed an analysis model to assess organizations for their service-oriented architecture

maturity. Another example is the work done by El-Telbany et al. (2020), which take an integrative approach to evaluate the success of the digital transformation of organizations in emerging markets.

In the second field, the authors address MMs' overarching development and implementation. In this context, Gren et al. (2015), Gunsberg et al. (2018), and Wendler (2014), among others, deal with measuring the agility of the entire organization. In addition, Yin et al. (2011) look at improving agile software processes by involving users in Scrum processes. Further, Benefield (2010), on the other hand, explores mapping an MM to a superset of XP-style technical and agile program management practices as part of a case study to improve the efficiency and alignment of cross-organizational engineering teams. Sreenivasan and Kothandaraman (2019) create a hybrid model by aligning Capability Maturity Model Integration and SAFe. Regarding SAFe, Stojanov et al. (2015) found that it addresses cross-organizational adoption of agile practices. As a result, they developed an MM for adopting agile and SAFe practices.

In the third field, the authors examine similarities and differences between the various frameworks and MMs. For example, Alqudah and Razali (2016), Diebold et al. (2018), and Wińska and Dąbrowski (2020) compared agile frameworks (e.g., Nexus, LeSS, SAFe, and Scrum@Scale). These works are highly valued when choosing a suitable framework for agile scaling and comparing the options.

We conclude that existing works are not suited for the highly needed ex-ante assessment of agile capabilities in a generalistic and comprehensive character (Marshburn and Dekkinga, 2020). Moreover, they do not provide concrete capabilities at different maturity levels that can be used as managerial guidance independent of frameworks and contextual focus. Therefore, the existing works cannot resolve the upthrown problem definition. In line with Klimenko et al. (2019), we argue that there is still a call for framework-independent yet applicable research. For this purpose, we create a framework-independent and thus comprehensive ASMM by taking the existing frameworks and guidelines in the literature into account.

3 Research Approach

In practice, many IT departments lack a holistic, framework-independent understanding of relevant capabilities when scaling agile (Marshburn and Dekkinga, 2020). To that end, DSR has been established as an adequate problem-solving paradigm in IS research to support organizations in capability development (vom Brocke et al., 2020). DSR aims to enhance organizational capabilities by designing artifacts in various forms (e.g., models, methods, and instantiations) (Hevner et al., 2004). Especially for the structured development of capabilities in targeted domains, MMs have proven to be valuable artifacts developed through DSR (Mettler, 2011). MMs provide a useful managerial tool that delivers descriptive knowledge by status-quo assessments, prescriptive knowledge outlining the desired target state, and comparative knowledge when used as a benchmarking tool (Röglinger and Pöppelbuß, 2011). supplemented it with additional qualitative methods of research (s. Figure 1) (Venkatesh et al., 2013). For instance, we analyzed existing works for relevant capabilities using the literature review procedure of Wolfswinkel et al. (2013).

Moreover, to evaluate our model's design, we conducted a focus group evaluation with domain experts from academia, as Salah et al. (2014) proposed. To evaluate our model's effectiveness in practice, we used a case study setting that reaffirmed the problem's relevance and allowed for an application of the model (Yin, 1992; Sonnenberg and vom Brocke, 2012). We thus applied the ASMM at KUKA IT, the IT department of KUKA, one of the world's leading providers of intelligent automation solutions, with sales of around 2.6 billion euro and roughly14.000 employees worldwide (KUKA AG, 2021). KUKA's case can represent mechanical engineers amidst their digital transformation seeking to leverage agile scaling for their IT department (Seawright and Gerring, 2008). In this respect, the case provides valuable insights for the IT department of any similar company facing the challenge of agile scaling.

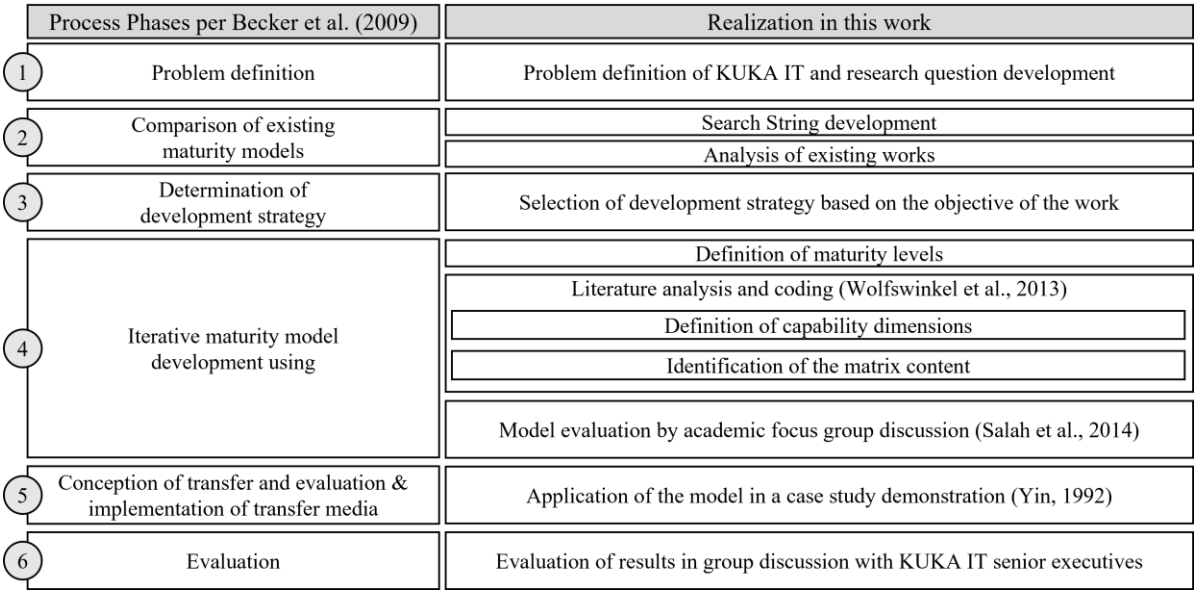

Figure 1. Research approach.

For the **first phase**, the problem definition, our Introduction outlines the motivation for research and practice and derives a suitable research question. Our work aims to develop and evaluate an academic-grounded yet practice-oriented tool to resolve the challenge when approaching agile scaling.

In the **second phase**, the comparison of existing MMs, we searched databases (i.e., ScienceDirect, AIS eLibrary, ProQuest, IEEE Xplore, EBSCO Host) for journal and conference papers using the search term "maturity model" AND "agile" AND ("framework" OR "scale"). We analyzed the existing literature by screening the title, keywords, and abstract to include works providing insights on relevant capabilities and exclude papers that did not target MMs for agile scaling (Webster and Watson, 2002). As a result, we identified 21 relevant articles for further investigation. Furthermore, we performed a forward and backward search for the identified papers, leading to a final set of 25 papers. We identified three fields relevant to our research question (see Related Work). In addition, we included scaling frameworks common among practitioners (e.g., SAFe, Nexus, etc.). We conclude that the existing works do not fit our research question calling for a framework-independent MM. Moreover, there is a demand for overarching works from academia and practice that structure existing knowledge and provide practical insights for scaling agile in organizations (Dikert et al., 2016; Klimenko et al., 2019; Marshburn and Dekkinga, 2020; Wińska and Dąbrowski, 2020).

To determine a development strategy (**phase three**), we argue that the combination of several MMs is particularly suitable to address our research question and answer the call for consolidation and overarching guidance (Becker et al., 2009). Existing MMs' structures and content are combined and transferred to develop a prescriptive ASMM for agile scaling. We chose a top-down approach to precisely map relevant capabilities for the respective maturity level of agile scaling.

In the **fourth phase**, we develop the ASMM in several iterative steps. The development strategy states that structures, contents, and several existing MMs are to be applied. After defining the targeted maturity levels from existing practice in the field, we analyzed existing literature found in phase two using coding to carve out capability dimensions and corresponding capabilities to develop a continuous ASMM (Wolfswinkel et al., 2013). When developing MMs, coding refers to breaking down, conceptualizing, and rearranging data (Klötzer and Pflaum, 2017). Therefore, we refer to open, axial and selective coding (Wolfswinkel et al., 2013). Within the open coding, we extracted excerpts from the identified works (i.e., capabilities). We arranged the excerpts into categories within the axial coding, i.e., capability dimensions (e.g., People-centric & Team Culture). As the last step, selective coding refers to the identification and development of relations between the main categories (i.e., capability dimensions)

(Wolfswinkel et al., 2013). Thus, the aim was to align the identified capabilities regarding their maturity and create consistency along with the maturity levels. For example, within the capability dimension of "customer collaboration," we identified simple customer feedback as the initial maturity level. The iterative development cycles were carried out within the author team involving practitioners. The iterations allowed us to refine the model (e.g., we started with only five capability areas and iteratively expanded the model to cover all developed codes from literature). As iteration three only led to minor changes (e.g., wording), we decided to end the internal development process.

We evaluated our model with an academic focus group to complete the development phase and validate the ASMM's comprehensiveness, accuracy, and mutual exclusion (Salah et al., 2014; Sonnenberg and vom Brocke, 2012). The focus group consisted of 15 domain experts, i.e., research scholars in digital transformation and information systems engineering. This external evaluation thus stated the fourth iteration and only led to minor corrections (e.g., removal of duplicate contents in different capability areas). Therefore, we decided to transfer the model to a real-world context.

In the **fifth phase** of our approach, we applied our ASMM at KUKA IT. Using semi-structured interviews, we perform an ex-ante, framework-independent assessment for agile scaling consisting of status quo analysis at KUKA IT and prioritization of fields of action. By applying our ASMM in this real-world context, we provide a case study demonstration (Yin, 1992) to prove the understandability, ease of use, usefulness, and practicality of our ASMM (Salah et al., 2014).

In the **sixth phase**, we evaluate our ASMM for its practical value by using the evaluation criteria of Sonnenberg and vom Brocke (2012) (i.e., usability, understandability, effectiveness, and impact). For this purpose, the model application results were discussed with senior executives of KUKA IT. Overall, they assessed the ASMM to be a supportive tool for agile scaling and prioritization of fields of action.

4 Development of the ASMM

Our ASMM is developed in several iterative steps. Following the top-down approach, maturity levels and capability dimensions are defined initially. In line with existing MMs (e.g., Gren et al. (2015), we depict the maturation process along five stages (Table 2). However, these existing works mainly provide agnostic maturity levels. To improve the practical applicability of our model, we referred to the practice-oriented maturity levels of de Koning et al. (2019). For example, individual capability dimensions may only be at the beginning of agile scaling and would thus be classified in the lowest maturity level (Initial). In contrast, the highest degree of maturity (Embedded) represents practiced and embedded agility across all vertical organizational levels (de Koning et al., 2019).

Maturity Level	Definition
Initial	There are isolated agile initiatives that are either unstructured or implemented ad hoc in the teams. These initiatives are neither clearly defined across teams nor firmly anchored across management levels. Vertical scaling is, therefore, non-existent.
Emerging	Agile principles and practices are introduced at a team level. As a result, structures and habits are already defined that serve agile scaling.
Growth	Multiple teams become agile and begin to scale, spreading agile practices and principles to adjacent levels of management.
Empowered	Holistic introduction of agility based on clear ambitions and strategy. Teams are empowered and scaled consistently and effectively towards portfolio or enterprise level.
Embedded	The organization scales agile practices at least at the portfolio level. Ongoing improvements of agile practices enable operational excellence. Agile practices and principles are fully integrated into the organization across all management levels.

Table 2. Maturity levels of the ASMM.

We identified eight capability dimensions from existing literature using coding, which serve as our ASMM's second structural layer (Table 3). These capability dimensions align with existing MMs that take a managerial and overarching perspective (e.g., Gunsberg et al. (2018), Stojanov et al. (2015)). Our ASMM spans a matrix between capability areas and maturity levels and provides relevant capabilities that mature along each capability area.

Capability Dimension	Definition
Portfolio management	This dimension addresses selecting investment areas and projects under strategic consideration of future development and balancing opportunities and risks. Portfolio management lays the ground for capacity and resource planning (Puthenpurackal Chakko et al., 2021).
Organization & management	Organization & management encompass the design of organizational structure and process organization. The dimension includes the way decisions are made and how communities are formed in the company (Gunsberg et al., 2018).
Governance & compliance	Corporate governance describes a company-specific legal, regulatory framework in terms of rules, procedures, standards, and laws that a company is managed. Compliance is the observance of regulations to ensure quality standards and reduce risk (Lappi et al., 2018).
People-centric & team culture	This dimension describes how individuals work together to achieve a common goal and mindset (ways of thinking, convictions, behavior patterns, and attitudes). This is reflected in (team) leadership and the organization's ability to cope with changes (Gren et al., 2015).
Customer collaboration	Customer collaboration describes the interaction, involvement, and collaboration with an organization's internal and external customers and how customer feedback is used to tailor the product or solution to the customer's needs (Stojanov et al., 2015).
Requirements & resource planning	Requirements planning describes the capability to gather and implement customer and stakeholder requirements. To deliver the high quality required, resources need to be planned, managed, coordinated, and budgeted (Schön et al., 2017).
Product delivery	Product delivery describes the capability to develop and deliver a functioning (partial) product after defined cycles. It also includes how these (partial) products are released and delivered (Gren et al., 2015).
Technology	This dimension describes the use of technology as the basis for a reliable and efficient working environment to enable collaboration, development, and the goal of continuous delivery. In this respect, testing is also considered (Schmidt et al., 2018; Wendler, 2014).

Table 3. Capability areas of the ASMM.

When maturity is low, portfolios are created at fixed times and in a single step concerning **portfolio management**. Projects are approved on a project-by-project basis, and financial key performance indicators (KPIs) are rarely included (Stettina and Hörz, 2015). With increasing maturity, portfolios gain adaptive nature by integrating feedback gained through KPIs. At high maturity, an adaptive portfolio with agile strategic alignment exists (Puthenpurackal Chakko et al., 2021).

The role of the **organization & management** is equally relevant to agile scaling. Agile scaling is brought to the next level of maturity through new roles and the role model function of management, starting from a hierarchical structure of the organization and the accompanying management practices. Agile practices can be anchored in ever-larger units by increasing decentralization and cross-functional teams, e.g., scaled retrospectives and teams-of-teams-of-teams (Kalenda et al., 2018). The highest maturity manifests itself in an agile strategy (Ahammad et al., 2020).

In **governance & compliance**, there is initially a phase-controlled or time-dependent control (Lappi et al., 2018). This control evolves via build-in quality with increasing maturity to lean audit and compliance (Poth et al., 2020). This capability dimension can be characterized by agile governance and compliance practices at high maturity, such as high decentralized control by the teams and incentivizing constant adherence to quality standards (Lappi et al., 2018).

For agile scaling to be successful **people-centric & team culture** is also an essential capability dimension. In an initial state, teams are motivated, but agile practices cannot yet be leveraged independently for self-organization and collaboration (Gren et al., 2015). Across maturity levels, teams gain autonomy, enhance their collaboration (e.g., by frequent face-to-face communication) and a pull culture emerges (Diebold et al., 2019; Mahadevan et al., 2015; Gren et al., 2015). Moreover, agile principles increase accountability in collaboration and build trust (Gunsberg et al., 2018). At the highest level of maturity, a culture of innovation and relentless improvement is established that can serve as a role model for other organizations.

In addition, **customer collaboration** changes with agile scaling (Matook and Maruping, 2014). While customers can provide feedback on delivered products or projects at initial maturity levels, customers become more involved as maturity increases (Gerster et al., 2020; Shameem et al., 2017). Increments are delivered in ever shorter periods, and customer-driven iterations are enabled. At a high level of maturity, the customer can be integrated directly into the development team (i.e., customer representative) to actively manage quality and requirements there (Matook and Maruping, 2014). Moreover, this can increase the trust between customers and providers.

In agile scaling, the **requirements & resource planning** capability change from project-based, initial requirements gathering with a fixed budget to agile requirements management. Therefore, with increasing maturity, requirements are captured in a standardized, customer-centric form and adapted iteratively (Urbieta et al., 2020) to create a shift from a plan-driven to a value-driven approach of planning (Schön et al., 2017). In this vein, the goal is to optimize the value delivery of requirements by organizing the agile teams at scale (Turetken et al., 2017). With greater agility, the budgeting process changes, as the uncertainty of agile can now be addressed, and budgets are made flexible at the product and feature level (Vierlboeck et al., 2019).

In the initial stage of maturity, **product delivery** is characterized by a focus on high quality, provided by few and inconsistent releases. As maturity increases, a continuous supply chain is established. New approaches such as DevOps and Design Thinking enable shorter release cycles and a focus on customer-centric increments (Karvonen et al., 2017). Thus, mature agile scaling enables a strategic competitive advantage by coordinating value streams (e.g., continuous alignment with business) and systematically reducing time-to-market (Rigby et al., 2018).

For agile scaling, the systematic use of **technology** is a success factor. The working environment and associated systems are provided manually at the initial maturity level, and no automation is used in testing either. With increasing maturity, employee collaboration is supported by digital technologies (Stojanov et al., 2015). This leads to the fully automated provision of a working environment and continuous testing. Continuous automated testing is enabled at the embedded stage, and a flexible, user-centric digital workplace environment can be provided automatically based on individual requirements (Schmidt et al., 2018).

Altogether, our ASMM, therefore, consists of eight capability dimensions and five maturity levels. The content of the matrix describes the respective capabilities at the corresponding maturity level (Table 4).

	Initial	Emerging	Expansion	Empowered	Embedded
Portfolio Management	One-time portfolio planning; project approval on a project-by-project basis; sporadic inclusion of financial KPIs	Continuous monitoring of ongoing projects aligned with strategy; projects are approved within defined portfolios	Value tracking of strategic KPIs; continuous tracking of expected project value and risk	Portfolio vision & lean portfolio management; cannibalization readiness; active monitoring of portfolio deliverables	Adaptive portfolio with agile strategic alignment
Organization & Management	Hierarchical organizational structure organized according to competencies and skills	Leadership by example (lean-agile manager); role clarity by redefinition	Decentralized decision making; servant leadership; long-lived, cross-functional teams organized around value streams	Scaled agile organization units (teams-of-teams-of-teams; scaled retrospective); strong top management involvement	Strategy agility
Governance & Compliance	Governance and compliance requirements are controlled in phases	Establishing the objective of built-in quality	Lean quality management system	Lean governance, including lean audit & compliance	Decentralized, agile project governance and compliance practices
People-centric & Team Culture	Push culture; closed groups and silo barriers	Collaborative, motivated, and empowered teams	Self-organizing teams; Pull culture	Autonomy & alignment	Anchored culture of innovation and relentless improvement
Customer Collaboration	Customer gives feedback on delivered projects or products	Product development focused on added value for customers; open communication	Customers are part of the value chain	Customer-driven iterations	Strong involvement of the customer for direct control of requirements and quality and increase of trust
Requirements & Resource Management	Requirements are gathered in an initial set of project requirements; no common form to gather requirements; fixed budget planning	Release planning and initial establishment of agile planning methods such as personas and user stories	Planning of functions or products, not tasks; regular reflection and adjustment of planning	Agile budgeting model	Active and continuous prioritization across backlogs on all organizational levels
Product Delivery	Focus on high product quality with long and inconsistent release cycles	Continuous supply chain	Release on demand (minimum viable product); design thinking and DevOps	Regular deployment of enterprise solutions	Coordination of value streams and systematic time-to-market reduction
Technology	Manual provisioning of the working environment and manual testing	Introduction of a collaboration system; automated functional tests & test cycles	Continuous provision of an up-to-date working environment; test-driven development;	Fully automated provision of a working environment; continuous testing	Flexible provision of a user-centric digital workplace environment; continuous automated testing

Table 4. The ASMM.

5 Application of the ASMM at KUKA IT

KUKA IT is responsible for implementing and operating IT projects and systems as an internal service provider. Their competence includes, among other things, the development, implementation, and operation of digital solutions (e.g., ERP systems). It also supports KUKA's core business areas in global collaboration. Agile working methods are already partly applied in individual KUKA IT teams. However, KUKA IT strived to approach agile scaling in a structured manner and significantly to drive forward vertical agile scaling. Therefore, KUKA IT considered several established frameworks (e.g., SAFe, LeSS, etc.). However, management was confronted with a difficult decision to choose the most suited framework based on various existing frameworks. Thus, the KUKA IT management demanded a framework-independent ex-ante capability assessment to understand its status quo. Building on that analysis, relevant capability areas should be prioritized to approach shortcomings effectively. To perform an ex-ante assessment based on the ASMM, we conducted an interview study with a cross-section of KUKA IT employees. The interviews were conducted semi-structured using guiding questions, with all interviewees holding relevant roles as long-term decision-makers at KUKA IT (see Table 5).

ID	Function	Years of Experience	ID	Function	Years of Experience
I1	Demand Manager	9+	**I5**	Middle Management	4+
I2	Portfolio Manager	8+	**I6**	Senior Management	9+
I3	Project Manager	8+	**I7**	Senior Management	4+
I4	Middle Management	5+	**I8**	Senior Management	7+

Table 5. Interview Partners for ASMM application.

Three guiding questions structured the interviews. First, the target picture of agile scaling at KUKA IT was inquired. Second, by assessing the status quo of agile transformation, the associated challenges of KUKA IT were to be identified. Third, the interviewees were asked to prioritize the existing challenges according to the dimensions. The ASMM as a guiding structure was presented and explained in its entirety and then guided through the individual dimensions. Respondents could express their feedback (e.g., impressions, experiences, ideas). In the following, we present critical lessons learned from applying our ASMM at KUKA IT. Therefore, we provide insights into KUKA IT's agile vision, outline how our ASMM was utilized to assess KUKA IT's agile status quo, identify challenges, and prioritize fields of action. Lastly, we briefly summarize the implication for KUKA IT's management.

5.1 Agile Vision of KUKA IT

The vision of KUKA IT emerged from the answers to the first guiding question of the interviews. The vision calls for a more agile company with close coordination and communication between KUKA IT and business. This does not necessarily mean that all activities or departments strictly aim to work agilely. Nevertheless, KUKA IT's vision is to strengthen the link between IT and business by employing digital product orientation and close collaboration to increase development speed and enhance service quality. Furthermore, a combination of traditional and agile project approaches should be possible. For the sustainable success of agile scaling, the following should be strengthened: agile mindset, agile standards as well as courage and trust in agile project methods, and a more flexible, autonomous project organization. Overarchingly, KUKA IT thus strives for the long-term goal of achieving agile scaling at a high level of maturity (i.e., at least Empowered).

5.2 Status Quo and Maturation Paths

In the second part of the interview, we asked the interviewees to assess the status quo and define a mid-term target state (two to four years) to approach the long-term vision. As depicted in the status quo assessment (Figure 2), KUKA IT is amid its agile transformation and is currently developing capabilities at the Emerging and Expansion stages. As a mid-term target state, the interviewees considered harmonizing progress relevant. They aimed to achieve the Expansion maturity level in all teams that are to work in an agile manner. In the third part of the interview, we asked the interviewees to describe the maturation path from the status quo towards the target state along the capability dimensions, highlighting challenges encountered and success factors.

Capability Dimension	Initial	Emerging	Expansion	Empowered	Embedded
Portfolio management	●	◔			
Organization & management	●	◑			
Governance & compliance	●	◔	◔		
People centered & team culture	●	◔	◔		
Customer collaboration	●	◑	◔		
Requirements & resource management	●	◔	◔		
Product delivery	●	●	◑	◔	
Technology	●	◑			

◔ Sporadically available in some teams ◑ Available in multiple teams ● Available in all targeted teams ■ Mid-term target state

Figure 2. Status quo and mid-term target of the KUKA IT.

The interviewees emphasized the overarching monitoring of projects and corresponding reviews for **portfolio management** to ensure continuous project overview [I2]. Furthermore, the proper selection and an expansion of the KPIs for tracking strategic performance are important [I8]. In **organization & management**, structures and styles must be created to enable agile scaling and handle projects and changes more efficiently [I1, I2]. Management must promote the topic in the organization and act as a role model. Thus, managers and executives should transform themselves into lean-agile managers. Coaching was considered a key success factor to prepare employees for agile change [I5]. In addition, teams aligned with value streams need to emerge [I8]. Trust and transparency are essential values for teams to work self-organized and autonomous. For this purpose, clear target and result metrics will be introduced [I7, I8]. In addition, transparent task assignment and prioritization will decrease inefficient parallel work [I2, I3]. In **governance & compliance**, agile scaling helps shift towards self-organized and decentralized organizational units. To manage the shift from phase-driven quality gates towards agile governance, it is necessary to strengthen efforts around a lean quality management system and enforce new guidelines and approaches (e.g., the objective of built-in quality) while ensuring their acceptance [I2, I6]. Regarding **people-centric & team culture**, spreading and internalizing the agile mindset in the organization and beyond is a success factor [I1]. To this end, employees need to experience the agile approach (e.g., using initially isolated agile elements such as user stories) [I1].
Moreover, to dismantle rigid silo structures, employees' "openness to change" was considered a straightforward success factor by nearly all interviewees [I1, I3-I5, I7, I8]. To embrace the agile mindset and enable cross-functional, self-organizing teams, employees must develop intrinsic motivation for change. The interviewees regarded training and coaching as effective measures to empower employees to capitalize on agility themselves. For this capability dimension, agile scaling is thus described as a process of empowerment that can only be achieved by investing in the employees. For agile scaling **customer collaboration**, enhancing collaborative exchange with the business was a crucial success factor (e.g., joint prioritization of user stories) [I1]. Effective product owners were found a key resource to enhance prioritization and planning. Scaling **requirements & resource management** in an agile manner includes establishing holistic release planning [I7]. This should enable releases to be implemented quickly and precisely following customer requirements [I8]. The continuous **product delivery** requires continuous alignment with the business [I2-I7].

Since KUKA IT has a high degree of maturity in product delivery, no further measures were defined to achieve the mid-term target state. For **technology**, the switch to automated test cycles, test-driven development must be pursued. The status quo and target state analysis revealed that KUKA IT can

mature in almost all capability dimensions to achieve the target state. Gaps were identified in organizational structures, management, and the development of agile portfolio management.

5.3 Prioritization of the Next Steps

Lastly, the interviewees were asked to prioritize particularly relevant capability dimensions based on their assessment of the status quo and target state. Thus, the dimension with the highest priority received a score of 3, 2nd place received 2 points, and 3rd place received 1 point (see Figure 3).

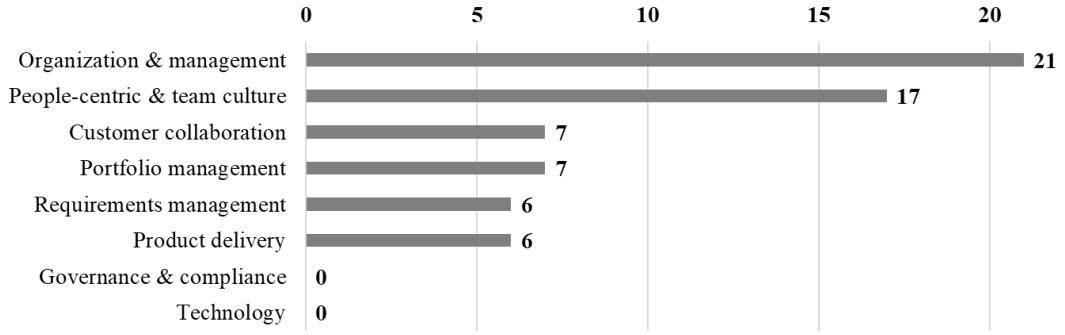

Figure 3. Prioritization of Capability Areas.

The prioritization indicates that both organization & management and people-centric & team culture were considered highly relevant for achieving the target state. The prioritization aligns with KUKA IT's vision of a comprehensive transformation of the organizational environment. Thus, on the one hand, management is called upon to create agile structures and enhance agile leadership. On the other hand, empowering the workforce by creating a people-centric agile work culture was critical to master agile scaling. Slightly less emphasis was placed on operational capabilities such as customer collaboration, portfolio management, requirements & resource management, and product delivery. The prioritization underlines that agile scaling is to be understood primarily as a management and work culture challenge rather than one that can be achieved through the purely operational application of agile practices. This is further underlined by the omission of prioritization of governance & compliance and technology in KUKA IT's prioritization. Thus, the prioritization presented supported KUKA IT in defining initial areas for capability development.

5.4 Managerial Implications

KUKA IT's management faces the challenge of framework-independent status quo assessment, target state definition, and prioritization of field of action. Therefore, we presented the key results of the ASMM's application to KUKA IT's management (VPs and C-Level). They evaluated our approach of a framework-independent ex-ante assessment positively. Building on these results, management could now utilize selected practices and tools from existing frameworks (e.g., for the targeted establishment of agile leadership and management) to work on prioritized fields of action.

6 Evaluation and Discussion of the ASMM

In this chapter, we evaluate and discuss the ASMM against the established criteria of Sonnenberg and vom Brocke (2012) (i.e., completeness, internal consistency, usability, understandability, effectiveness, and impact) and therefore critically reflect our work. While completeness and internal consistency were challenged in our ASMM's design evaluation in a domain expert focus group, our ASMM's application at KUKA IT enabled us to prove its usability, understandability, effectiveness, and impact with a case study demonstration (Salah et al., 2014). We implemented our ASMM as a management tool to assess the status quo and a mid-term target state of agile scaling and enable us to prioritize fields of action.

This allowed KUKA IT to evaluate and structure relevant agile scaling capabilities independently of the choice of a specific agile scaling framework (e.g., SAFe, LeSS). The application results were presented to KUKA IT senior executives (VPs and C-Level) and will contribute to the further structuring of the agile transformation. Thus, the effectiveness and impact of our ASMM were proven, and an added value relevant for KUKA IT could be created. Therefore, our work demonstrates the value of using our ASMM in real applications and enables knowledge transfer between theory and practice.

Our literature review states that the existing works are not comprehensive in scope or do not provide generalistic capabilities at different maturity levels for a framework-independent ex-ante assessment on relevant capabilities. The relevance of this shortcoming in research has already been highlighted in other works (Klimenko et al., 2019; Marshburn and Dekkinga, 2020). Therefore, we followed the DSR procedure model of Becker et al. (2009) to develop and evaluate a comprehensive, framework-independent ASMM for IT departments. The ASMM builds on existing works and maturity models with their dedicated foci (e.g., Sreenivasan and Kothandaraman (2019), Stojanov et al. (2015)) and provides a holistic, framework-independent perspective. It can be used as an ex-ante assessment tool to determine the status quo of agile scaling and prioritize capability areas. Furthermore, the ASMM was not only developed but also evaluated in the real-world context of KUKA IT, which is yet a shortcoming of related works with scientific character (e.g., Wińska and Dąbrowski (2020)). The contribution of our ASMM as a DSR artifact can be outlined by using the knowledge contribution categories of Gregor and Hevner (2013). They distinguish four types of contributions: First, routine design refers to applying known solutions for known problems. Second, exaptation extends known solutions to new problems. Third, improvement implies the development of a new solution for known problems. Fourth, an invention represents a new solution for a new problem. In this way, we classify the ASMM as an improvement: The ASMM represents a new solution to resolve the known problem of lacking comprehensive guidance for agile scaling. Thus, we contribute to the prescriptive knowledge of agile scaling in the academic literature and provide valuable insights and lessons for practitioners in strategic ex-ante planning for vertical scaling.

7 Conclusion

In this work, we have developed a framework-independent yet comprehensive ASMM based on the established approach DSR of Becker et al. (2009) for MM development. The ASMM provides relevant capabilities for vertical agile scaling and was applied in a case study demonstration (Yin, 1992) at KUKA IT, the IT department of a provider for automation solutions. KUKA IT used the model to analyze the status quo, define a target state, and prioritize capabilities. Thus, we provide a valuable tool for guidance in agile scaling for practitioners. For theory, we contribute to the prescriptive knowledge of agile scaling in the academic literature with framework-independent capabilities for vertical agile scaling at different maturity levels.

However, as with any research endeavor, our work is subject to some limitations and may inspire future research. First, like any MM, models only reflect the complex reality to a limited extent. While our ASMM can help structure this process based on relevant capabilities, this is only an abstraction of the complex reality that transformation processes imply. Second, the application context and thus the transferability of our work are limited. On the one hand, by examining only one case company, KUKA IT, which may represent a machine manufacturer's IT department in the digital transformation but is limited in cross-industry generalizability. On the other hand, by the survey method and a limited number of interviews. Therefore, we would like to inspire further research to investigate the complex phenomenon of agile scaling. Thus, for our ASMM, an evaluation in other contexts (e.g., beyond the IT department) would be a relevant issue for further research. Third, the work’s focus on vertical scaling considers the entanglement with horizontal scaling only to a limited extent. The application in practice indicated that vertical and horizontal scaling are closely intertwined. While the central challenge in practice is vertical scaling, it should be combined with measures of horizontal scaling. For research, this observation also gives rise to exciting approaches for investigating how the two scaling types are interconnected.

References

Aghina, W., C. Handscomb, O. Salo and S. Thaker (2021). *The Impact of Agility: How to Shape Your Organization to Compete*. URL: https://www.mckinsey.com/business-functions/organization/our-insights/the-impact-of-agility-how-to-shape-your-organization-to-compete.

Ahammad, M. F., K. W. Glaister and E. Gomes (2020). "Strategic agility and human resource management" *Human Resource Management Review* 30 (1), 100700.

Alqudah, M. and R. Razali (2016). "A Review of Scaling Agile Methods in Large Software Development" *International Journal on Advanced Science, Engineering and Information Technology* 6 (6), 828–837.

Becker, J., R. Knackstedt and J. Pöppelbuß (2009). "Developing Maturity Models for IT Management" *Business & Information Systems Engineering* 1 (3), 213–222.

Benefield, R. (2010). "Seven Dimensions of Agile Maturity in the Global Enterprise: A Case Study" *2010 43rd Hawaii International Conference on System Sciences*, 1–7.

Brookes, N., M. Butler, P. Dey and R. Clark (2014). "The use of maturity models in improving project management performance" *International Journal of Managing Projects in Business* 7 (2), 231–246.

Conboy, K. (2009). "Agility from First Principles: Reconstructing the Concept of Agility in Information Systems Development" *Information Systems Research* 20 (3), 329–354.

Conboy, K. and N. Carroll (2019). "Implementing Large-Scale Agile Frameworks: Challenges and Recommendations" *IEEE Software* 36 (2), 44–50.

de Koning, T. de, W. Weijland and R. Kannekens (2019). *Continuously improve your agility.* KPMG. URL: https://www.compact.nl/en/articles/continuously-improve-your-agility/ (visited on 01/16/2021).

Diebold, P., A. Schmitt and S. Theobald (2018). "Scaling agile: how to select the most appropriate framework" *XP '18: Proceedings of the 19th International Conference on Agile Software Development: Companion*, 1–4.

Diebold, P., S. Theobald, J. Wahl and Y. Rausch (2019). "Stepwise transition to agile: From three agile practices to Kanban adaptation" *Journal of Software: Evolution and Process* 31 (5), 1-15.

Dikert, K., M. Paasivaara and C. Lassenius (2016). "Challenges and success factors for large-scale agile transformations: A systematic literature review" *Journal of Systems and Software* 119, 87–108.

Ebert, C. and M. Paasivaara (2017). "Scaling Agile" *IEEE Software* 34 (6), 98–103.

El-Telbany, O., H. Abdelghaffar and H. and Amin (2020). "Exploring the Digital Transformation Gap: Evidence from Organizations in Emerging Economies" *PACIS 2020 Proceedings*.

Fitzgerald, B., K.-J. Stol, R. O'Sullivan and D. O'Brien (2013). "Scaling agile methods to regulated environments: An industry case study" *2013 35th International Conference on Software Engineering (ICSE)*, 863–872.

Gerster, D., C. Dremel, W. Brenner and P. Kelker (2020). "How Enterprises Adopt Agile Forms of Organizational Design" *ACM SIGMIS Database: the DATABASE for Advances in Information Systems* 51 (1), 84–103.

Gregor, S. and A. R. Hevner (2013). "Positioning and Presenting Design Science Research for Maximum Impact" *MIS Quarterly* 37 (2), 337–355.

Gren, L., R. Torkar and R. Feldt (2015). "The prospects of a quantitative measurement of agility: A validation study on an agile maturity model" *Journal of Systems and Software* 107, 38–49.

Gunsberg, D., B. Callow, B. Ryan, J. Suthers, P. A. Baker and J. Richardson (2018). "Applying an organisational agility maturity model" *Journal of Organizational Change Management* 31 (6), 1315–1343.

Gustavsson, T. (2017). "Assigned roles for inter-team coordination in large-scale agile development". In: *Proceedings of the XP2017 Scientific Workshops*. Ed. by R. Tonelli. New York, NY, USA: ACM, pp. 1–5.

Hevner, A. R., S. T. March, J. Park and S. Ram (2004). "Design science in information systems research" *MIS Quarterly*, 75–105.

Hohl, P., M. Stupperich, J. Munch and K. Schneider (2018). "An Assessment Model to Foster the Adoption of Agile Software Product Lines in the Automotive Domain". In: *2018 IEEE International Conference on Engineering, Technology and Innovation (ICE/ITMC)*: IEEE, pp. 1–9.

Joachim, N., D. Beimborn and T. and Weitzel (2011). "An Instrument for Measuring SOA Maturity" *ICIS 2011 Proceedings*.

Jöhnk, J., M. Röglinger, M. Thimmel and N. Urbach (2017). "HOW TO IMPLEMENT AGILE IT SETUPS: A TAXONOMY OF DESIGN OPTIONS" *Proceedings of the 25th European Conference on Information Systems (ECIS), Guimarães, Portugal, June 5-10, 2017*.

Kalenda, M., P. Hyna and B. Rossi (2018). "Scaling agile in large organizations: Practices, challenges, and success factors" *Journal of Software: Evolution and Process* 30 (10), 1-25.

Kappelman, L., C. Maurer, E. R. McLean, K. Kim, V. L. Johnson, M. Snyder and R. and Torres (2021). "The 2020 SIM IT Issues and Trends Study" *MIS Quarterly Executive* 20 (1).

Karvonen, T., W. Behutiye, M. Oivo and P. Kuvaja (2017). "Systematic literature review on the impacts of agile release engineering practices" *Information and Software Technology* 86, 87–100.

Kasauli, R., E. Knauss, J. Horkoff, G. Liebel and F. G. de Oliveira Neto (2021). "Requirements engineering challenges and practices in large-scale agile system development" *Journal of Systems and Software* 172, 110851.

Klimenko, R., R. Winter and P. Rohner (2019). "Creating Capability Maturity Model for Agile Transformation Excellence" *itAIS/MCIS Conference. - Naples, Italy*.

Klötzer, C. and A. Pflaum (2017). "Toward the Development of a Maturity Model for Digitalization within the Manufacturing Industry• s Supply Chain". In: *Proceedings of the 50th Hawaii International Conference on System Sciences (2017)*.

Kohli, R. (2001). "Industry-Academia Interaction: Key to IT Relevance" *Communications of the Association for Information Systems* 6 (1), 60–61.

KUKA AG (2021). *KUKA - Company*. URL: https://www.kuka.com/en-de/company (visited on 11/13/2021).

Lappi, T., T. Karvonen, L. E. Lwakatare, K. Aaltonen and P. Kuvaja (2018). "Toward an Improved Understanding of Agile Project Governance" *Project Management Journal* 49 (6), 39–63.

Mahadevan, L., W. J. Kettinger and T. O. Meservy (2015). "Running on Hybrid: Control Changes when Introducing an Agile Methodology in a Traditional "Waterfall" System Development Environment" *Communications of the Association for Information Systems* 36.

Marshburn, D. G. and J. V. Dekkinga (2020). "Scaling Agile: Approach for Defining Key Aspects of Multiteam Agile Software Delivery Systems (Research in Progress)". In: *Proceedings of the Southern Association for Information Systems Conference (SAIS) 2020 Proceedings*.

Matook, S. and L. M. Maruping (2014). "A competency model for customer representatives in agile software development projects" *MIS Quarterly Executive* 13 (2).

Mettler, T. (2011). "Maturity assessment models: a design science research approach" *International Journal of Society Systems Science* 3 (1), 81.

Patel, C. and M. Ramachandran (2009). "Agile Maturity Model (AMM): A Software Process Improvement framework for Agile Software Development Practices" *International Journal of Software Engineering* 2 (1), 3–28.

Piccoli, G. and T.-W. Lui (2014). "The competitive impact of information technology: can commodity IT contribute to competitive performance?" *European Journal of Information Systems* 23 (6), 616–628.

Poth, A., M. Kottke and A. Riel (2020). "Evaluation of Agile Team Work Quality". In Paasivaara and Gerstner (eds.) *Agile Processes in Software Engineering and Extreme Programming - Workshops*, pp. 101–110. [S.l.]: Springer International Publishing.

Puthenpurackal Chakko, J., T. Huygh and S. de Haes (2021). "Achieving Agility in IT Project Portfolios – A Systematic Literature Review". In A. Przybyłek, J. Miler, A. Poth and A. Riel (eds.) *Lean and Agile Software Development*, pp. 71–90. Cham: Springer International Publishing.

Rashid, N., S. U. Khan, H. U. Khan and M. Ilyas (2021). "Green-Agile Maturity Model: An Evaluation Framework for Global Software Development Vendors" *IEEE Access* (9), 71868–71886.

Rigby, D. K., J. Sutherland and A. Noble (2018). "Agile at Scale. How to go from a few teams to hundreds" *Harvard Business Review* (3), 88–96.

Röglinger, M. and J. Pöppelbuß (2011). "What makes a useful maturity model? : A framework for general design principles for maturity models and its demonstration in business process management". In *19th European Conference on Information Systems (ECIS)*.

Salah, D., R. Paige and P. Cairns (2014). "An Evaluation Template for Expert Review of Maturity Models". In A. Jedlitschka, P. Kuvaja, M. Kuhrmann, T. Männistö, J. Münch and M. Raatikainen (eds.) *Product-Focused Software Process Improvement*, pp. 318–321. Cham: Springer International Publishing.

Sambamurthy, Bharadwaj and Grover (2003). "Shaping Agility through Digital Options: Reconceptualizing the Role of Information Technology in Contemporary Firms" *MIS Quarterly* 27 (2), 237.

Schmidt, C., C.-P. Praeg and J. Gunther (2018). "Designing Digital Workplace Environments" *2018 IEEE International Conference on Engineering, Technology and Innovation (ICE/ITMC)*, 1–9.

Schön, E.-M., J. Thomaschewski and M. J. Escalona (2017). "Agile Requirements Engineering: A systematic literature review" *Computer Standards & Interfaces* 49, 79–91.

Schweigert, T., D. Vohwinkel, M. Korsaa, R. Nevalainen and M. Biro (2013). "Agile Maturity Model: A Synopsis as a First Step to Synthesis". In F. McCaffery, R. V. O'Connor and R. Messnarz (eds.) *Systems, Software and Services Process Improvement*, pp. 214–227. Berlin, Heidelberg: Springer Berlin Heidelberg.

Seawright, J. and J. Gerring (2008). "Case Selection Techniques in Case Study Research" *Political Research Quarterly* 61 (2), 294–308.

Shameem, M., C. Kumar, B. Chandra and A. A. Khan (2017). "Systematic Review of Success Factors for Scaling Agile Methods in Global Software Development Environment: A Client-Vendor Perspective". In: *2017 24th Asia-Pacific Software Engineering Conference Workshops (APSECW)*: IEEE, pp. 17–24.

Sonnenberg, C. and J. vom Brocke (2012). "Evaluations in the Science of the Artificial – Reconsidering the Build-Evaluate Pattern in Design Science Research" *International Conference on Design Science Research in Information Systems*, 381–397.

Sreenivasan, S. and K. Kothandaraman (2019). "Improving processes by aligning Capability Maturity Model Integration and the Scaled Agile Framework®" *Global Business and Organizational Excellence* 38 (6), 42–51.

Stettina, C. J. and J. Hörz (2015). "Agile portfolio management: An empirical perspective on the practice in use" *International Journal of Project Management* 33 (1), 140–152.

Stojanov, I., O. Turetken and J. J. Trienekens (2015). "A Maturity Model for Scaling Agile Development" *2015 41st Euromicro Conference on Software Engineering and Advanced Applications*, 446–453.

Tallon, P. P., M. Queiroz, T. Coltman and R. Sharma (2019). "Information technology and the search for organizational agility: A systematic review with future research possibilities" *The Journal of Strategic Information Systems* 28 (2), 218–237.

Thompson, J. D., M. N. Zald and W. R. Scott (2017). *Organizations in Action:* Routledge.

Turetken, O., I. Stojanov and J. J. M. Trienekens (2017). "Assessing the adoption level of scaled agile development: a maturity model for Scaled Agile Framework" *Journal of Software: Evolution and Process* 29 (6).

Uludağ, Ö., A. Putta, M. Paasivaara and F. Matthes (2021). "Evolution of the Agile Scaling Frameworks". In P. Gregory, C. Lassenius, X. Wang and P. Kruchten (eds.) *Agile Processes in Software Engineering and Extreme Programming*, pp. 123–139. Cham: Springer International Publishing.

Urbach, N., F. Ahlemann, T. Böhmann, P. Drews, W. Brenner, F. Schaudel and R. Schütte (2019). "The Impact of Digitalization on the IT Department" *Business & Information Systems Engineering* 61 (1), 123–131.

Urbieta, M., L. Antonelli, G. Rossi and J. C. S. do Prado Leite (2020). "The impact of using a domain language for an agile requirements management" *Information and Software Technology* 127, 106375.

Venkatesh, V., S. A. Brown and H. Bala (2013). "Bridging the Qualitative-Quantitative Divide: Guidelines for Conducting Mixed Methods Research in Information Systems" *MIS Quarterly* 37 (1), 21–54.

Vierlboeck, M., K. Gövert, J. Trauer and U. Lindemann (2019). "Budgeting for Agile Product Development" *Proceedings of the Design Society: International Conference on Engineering Design* 1 (1), 2169–2178.

vom Brocke, J., A. Hevner and A. Maedche (2020). *Design Science Research. Cases.* Cham: Springer International Publishing.

Webster, J. and R. T. Watson (2002). "Analyzing the past to prepare for the future: Writing a literature review" *MIS Quarterly* 26 (2), 13–23.

Wendler, R. (2014). "Development of the Organizational Agility Maturity Model" *2014 Federated Conference on Computer Science and Information Systems*, 1197–1206.

Wessel, L., A. Baiyere, R. Ologeanu-Taddei, J. Cha and T. Blegind Jensen (2021). "Unpacking the Difference Between Digital Transformation and IT-Enabled Organizational Transformation" *Journal of the Association for Information Systems* 22 (1), 102–129.

Wińska, E. and W. Dąbrowski (2020). "Software Development Artifacts in Large Agile Organizations: A Comparison of Scaling Agile Methods". In A. Poniszewska-Marańda, N.

Kryvinska, S. Jarząbek and L. Madeyski (eds.) *Data-Centric Business and Applications*, pp. 101–116. Cham: Springer International Publishing.

Wolfswinkel, J. F., E. Furtmueller and C. P. M. Wilderom (2013). "Using grounded theory as a method for rigorously reviewing literature" *European Journal of Information Systems* 22 (1), 45–55.

Yin, A., Soraia Figueiredo and Miguel Silva (2011). "Scrum Maturity Model: Validation for IT organizations' roadmap to develop software centered on the client role" *ICSEA 2011*.

Yin, R. K. (1992). "The Case Study Method as a Tool for Doing Evaluation" *Current Sociology* 40 (1), 121–137.