Defining Situational Characteristics for Situational Agile Method Engineering

Completed Research

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Abstract

Rapidly changing customer demands, increasing competition and faster development cycles requires companies to build capabilities to adapt their product and services as well as their business models quickly. By using agile methods, companies are supported in adapting to these changes and to achieve competitiveness in volatile markets. However, agile "off-the-shelf"-methods bear the risk of not answering the challenges of specific business situations. Thus, the concept of situational method engineering was applied to agile methods, resulting in situational agile method engineering (SAME). For SAME to work, a description of situations is necessary, which allows to decide among different agile methods and method fragments. Thus, situational characteristics have been derived in a literature review and validated in focus group interviews resulting in a list of 5 relevant situational characteristics for SAME.

Keywords

Situational Agile Method Engineering, Organizational Agility, Situational Method Engineering

1. Introduction

The ever advancing digitalization and related changes are affecting the business environments companies operate in (Henriette 2016). Companies are increasingly confronted with a dynamic, more global and customer-oriented market with constantly changing customer demands, increased competition and faster development cycles (Yang and Liu 2012). Therefore, companies' success increasingly relies on their ability to adapt their product and service portfolios as well as their business models regularly to these changes (Roy and Sarkar 2016). In order to meet those requirements, the relevance of agility increases (Denning 2016). Originating from the software development domain, the concept of agility is gaining increasing relevance for strategic issues, too (Denning 2017). Agility allows companies to address the threats of digitization-driven change and to leverage the corresponding opportunities of enhanced collaboration and value co-creation that the advances in information technologies create (Berman and Dalzell-Payne 2018).

Besides the promising opportunities of agile methods, an undifferentiated application of them can lead to disadvantages and risks (e.g., Fagerholm et al. 2014; Korkala and Maurer 2014; Van Waardenburg and Van Vliet 2013) and possibly affect companies' performance negatively, if the company's situational characteristics (SCs) are ignored (Fazal-Baqaie and Güldali 2016). Furthermore, a sudden, complete changeover to agile structures can lead to a loss of productivity and stability, which can threaten the competitiveness of companies (Diebold et al. 2016). Especially in the transformation from a plan-driven to an agile organization, the situational use of agile structures and practices represents an important management task (Teece et al. 2016).

A possibility to utilize the advantages of different agile methods and to mitigate the associated disadvantages and risks lies in the deliberate usage of certain agile method fragments in accordance with a company`s situation (Diebold et al. 2016). The deliberate use of method fragments from multiple methods can have a positive influence on project performance as earlier publications in the field of situational method engineering (SME) have demonstrated (e.g., Pedreira et al. 2007). Information System (IS) scholars have already been working on the topic of process tailoring and SME and have identified a large number of SCs that allow selection among methods and method fragments in accordance with the respective situation (cf., Bucher et al. 2007; Kalus & Kuhrmann 2013; Pedreira et al. 2007; van Slooten &

Hodes 1996; vom Brocke, Zelt, & Schmiedel 2016). However, presumably not all SCs identified in the domain of SME, are applicable for the selection process in the domain of agile methods. Research on SME has already examined the situational use of agile methods in comparison to plan-driven methods and SCs for support of the decision process between plan-driven and agile methods have been discussed (e.g., Boehm 2002 and Rahimian and Ramsin 2008). However, specific SCs relating to a situational selection of agile method fragments are yet unknown. Against this backdrop, we aim to address the following research question: *Which SCs are appropriate for a situation-adjusted decision on agile method fragments selection?*

To approach the research question, the following research procedure was conducted. First, a literature review was conducted to identify characteristics for the description of situations in the SME domain. Second, the derived characteristics were examined regarding their explanatory power for the differentiation of agile method fragments in a pair coding procedure. Finally, the derived SCs were validated using questionnaires and multiple focus group interviews, which finally resulted in a set of five SCs for situational agile method engineering (SAME).

The research at hand contributes to both theory and practice. From an academic perspective, it contributes to the field of method engineering research, more specifically the literature stream of SME, by specifying SCs for the deliberate selection of agile method fragments. By providing those criteria, practitioners are supported in describing prevailing SCs and adapting existing processes or tailoring new processes for IS development respectively considering the actual situation to improve the performance of such processes.

This research paper is structured as follows: section 2 presents the theoretical background and conceptual foundations, before in section 3 the research methodology is outlined. Section 4 exhibits the results, followed by the paper's contributions, limitations and possible avenues for further research, which are discussed in section 5 and section 6.

2. Theoretical Background

Organizational Agility

The term organizational agility is defined diversely in the literature (Altschuller et al. 2010). Ganguly, Nilchiani, and Farr (2009) for instance, present twelve different definitions of agility. Although literature provides several definitions, two overarching classes of definitions can be identified, namely an internal- and an external-oriented perspective (Overby et al. 2006). On the one hand, agility is understood as an internally-oriented capability that enables organizations to respond effectively and efficiently to unexpected changes by adapting internal resources, capabilities and strategies (Yang and Liu 2012). This internal-oriented capability is also related to as "operational agility" (Agarwal and Selen 2009 p. 436), which describes the ability to quickly adapt operational processes and resources to exploit changes in a volatile market environment or to create new ones as required (Sambamurthy et al. 2003). This type of agility can be found in agile methods, which focus on intra-organizational communication and collaboration, i.e., within a single team or within multiple teams. On the other hand, agility is seen as an externally-oriented capability to interact with customers and to internalize and utilize the knowledge and skills of external actors (Sambamurthy et al. 2003). Agarwal and Selen separate those external-oriented capabilities into "customer agility" and "partnering agility" (2009 p. 436). Customer agility describes the responsiveness to actions of other market players that affect the delivery of services to the customer (Ogulin and Selen 2005). Based on the considerations by Dyer and Singh (1998, p. 664), partnering agility can be understood as "interfirm knowledge-sharing routines", by which market opportunities can be explored respectively exploited through the targeted use of third party capabilities, resources and competences as well as their networks by provision or utilization of service delivery processes and interfaces.

In the further course of this research, agility is defined as stated by Overby et al. (2006, p. 121) as "the ability of firms to sense environmental change and respond readily", which includes both the internal- and external-oriented perspective. By using agile methods, companies are supported to quickly adapt existing internal resources and capabilities and to use external information, resources and capabilities to explore and exploit market opportunities.

Situational Method Engineering

SME forms a specific type in the method engineering domain that adapts generic methods of IS development to local conditions by considering specific characteristics (Bucher et al. 2007; Harmsen 1997; Henderson-Sellers et al. 2014). SME arose from the recognition that generic "off-the-shelf"-methods should not be used unadjusted, as SCs differ among different organizations (Henderson-Sellers et al. 2014). Thereby, a method describes an approach to conduct system development project based on a set of rules and activities, which are structured in a logical, systematic way, leading to a desired result (Brinkkemper 1996). Within SME, two generic adjustment mechanisms can be categorized, namely "configuration" and "composition" (Becker et al. 2007). Configuration describes the adaptation of a basic method depending on a specific situation (Karlsson and Ågerfalk 2004), whereas composition refers to the selection and orchestration of method fragments with reference to a specific situation, whereby the composition aggregates method fragments of different methods and transforms them into a new method (Bucher et al. 2007). A method fragment can be understood as piece of a method or part thereof that defines the constituting elements of a method (Karlsson and Ågerfalk 2004). Regardless of the chosen adaptation mechanism, the concept of SME requires a description of the situation for an adequate adaptation of the generic methods (Harmsen 1997). Thereby, the SCs determine the selection of appropriate method fragments for the tailoring of situational adapted methods (Henderson-Sellers et al. 2014).

Contingency Theory

SME can be related to the Contingency Theory (Bucher et al. 2007). The Contingency Theory is a behavioral theory, which postulates that there is no single best way of leading or organizing a company as effectiveness of related means are dependent on certain situational factors (Fiedler 1964). According to the theory, organizations are created out of interdependent parts that again, as a whole, interact interdependently with the environment (Thompson 1967). Research on the Contingency Theory argues that specific situational factors are critical for an adequate choice of decision making, organizational processes and leadership behavior (vom Brocke et al. 2016). A leadership style or organizational structure, that is effective in one specific situation can be inappropriate in another situation (Fiedler 1964; Vroom and Yetton 1973). Thus, there is no best way to lead or manage an organization and respective means should be adapted to the prevailing situation of an organization to improve the fit of the organizational structure into its environment (McLaurin 2006). According to the theory, the most important task of the management consists of adapting the leadership style and the organizational structures to the prevailing situational conditions. It further assumes that the better the fit between an organization and its subunits to its contingency factors, the better the performance of the organization (Weill and Olson 1989). Following the Contingency Theory perspective, both internal factors (e.g., project type) and external factors (e.g., context factors) should be considered for the modelling of business processes (vom Brocke et al. 2016).

3. Methodology

As outlined in the introduction, this research has, besides the academic contribution, a strong relevance for solving practical problems. Due to its novelty, the validation of the list of SCs for (SAME) was conducted interactively with a focus group of experts from practice.

First, the existing literature for SCs in the domain of SME was reviewed. The resulting preliminary list of SCs was analyzed for those characteristics that allow to explain differences in the selection among different agile methods or agile method fragments, which served as the base for the list of SCs for SAME. Lastly, the final list was demonstrated to the focus group and evaluated in surveys and interactive focus group interviews with 32 practitioners.

Research Context

The research at hand was conducted following a consortium research method as proposed by Österle and Otto (2010), where practitioners are involved in the research process in the long-term. Regular exchange between research and practice will ensure that research results are not only related to current academic

discourse, but also to prevailing challenges in practice. Furthermore, through constant involvement of practitioners and knowledge exchange in the course of periodocal presentations and workshops, the proficiency of the interviewees in the examined topic is improved. Ensuring practical applicability and usefulness in theory formation is an important quality criterion for generating new knowledge in scientific work (Corley and Gioia 2011). The research consortium consists of participants from the financial service industry and entails 16 companies from Switzerland, Austria and Germany, who interact with researchers on predefined research topics for a period of two years. The experts from the focus group are working in different IT and business functions in their companies (e.g., IT and business architecture, project- and innovation management, business development) and have a profound knowledge of the application of agile methods in their respective companies.

Research Approach

Identification of SCs for SAME

In order to identify SCs for SAME, first, the academic knowledge base was examined. For this purpose, a structured literature review was carried out to determine existing work on SCs for SME. The search was conducted in the databases ABI/Inform Collection, EBSCO Business Source Ultimate, AISeL and ACM. The results of the literature research were analyzed with regard to the occurrence of SCs in process and method engineering. For the determination of the search string, an initial set of seminal papers in the research area under consideration was examined with regard to similar terms and synonyms, as proposed by Kalus and Kuhrmann (2013). As a result, the search query was formulated as *(process OR method) AND (tailor* OR custom* OR context* OR situati*)*, which was searched for in the documents' title. First, the titles were examined for obviously irrelevant papers. Second, the abstracts were analyzed, and unfitting papers were excluded from further investigation. Last, the full papers were screened and examined for suitable research that shows studies on SCs. The process resulted in 11 studies which aggregated SCs for SME on a meta-level, which in some cases conducted extensive literature reviews on SCs for SME by itself. Subsequently, the result of the literature review on SC for SME can be assessed as a comprehensive overview of existing SCs in academia. The examination of the selected papers resulted in overall 144 SCs for the description of situations.

After the SCs have been identified, a pair coding procedure was executed by two researchers with profound knowledge in the field of agile methods to identify and classify those characteristics, that can explain decision differences in the choice of agile methods fragments into categories and subcategories following the coding procedure as proposed by Vejseli et al. (2018). Thereby, each characteristic has been examined for a set of quality criteria. Those assessment criteria were inspired by the evaluation criteria for classifications by Gregor (2006) and consisted of an assessment for relevance, differentiation, clarity, stability and independency. For instance, the assessment of relevance of a SC were determined, besides other questions, whether it was able to distinguish between the application in the internal- vs external-oriented perspective of agile methods described earlier. The assessment led to a total of 50 characteristics, which were considered for further investigation. As many of the SCs were overlapping or on a subordinate aggregation levels, in the next step, a process of harmonization as proposed by Kalus and Kuhrmann (2013) was conducted. In this process duplicates were removed, and subordinate concepts were grouped to an overarching SCs to guarantee a comparable aggregation level. The procedure of harmonization led to 6 overarching relevant situational characteristics with 25 related sub-concepts (cf., Table 1).

Evaluation and Validation Procedure of SCs for SAME

The derived set of SCs was evaluated in three focus group interviews using an exemplary fictional case and a questionnaire. The use of fictional settings for evaluation purposes is especially useful to assess artifacts before they are implemented and offers the advantage of a higher degree of control in validation (Pries-Heje et al. 2008). The fictional case was used to frame the context and field of application for the list of SCs in SAME. The fictional case studies consisted of two scenarios with different SCs in order to choose from a set of predefined agile method fragments. The first case described a setting in which an IS development process in a backend system should be improved by the use of agile method fragments. The second case was describing a fictional setting were the process for User Interface development should be enhanced. To guarantee that all participants of the focus group have a comparable understanding of SME and the objectives of the SCs, a one-hour input presentation was conducted beforehand, where each SC

and the fictional cases were explained thoroughly. For the evaluation the participants were asked to assess each SC on a 7-point Likert scale for the appropriateness in SAME, using a seven-point scale as proposed by Vagias (2006) ranging from 1 (not appropriate) to 7 (absolutely appropriate). Furthermore, the participants were able to make comments on each SC, to add new SC were required and make indication for unfitting SCs. To support this process, the SCs eliminated in the pair coding procedure were shown to the interviewees as well. After the survey, the participants had a one-hour discussion on the application of the SCs in their own business context, which was recorded and analyzed for further insights.

4. Results

List of SCs for SAME

The literature review and pair coding analysis process of the 144 identified SCs revealed 6 SCs (with 25 subconcepts), which can be used for the description of situation and the choice of agile method fragments: 1) project maturity, 2) application goal, 3) organizational scope, 4) intra-organizational collaboration, 5) customer integration and, 6) business partner integration (cf., Table 1).

SCs	Dimensions		Underlying Sources and Concepts
SC 1: Project Maturity	Ideation	Execution	Exploitation vs Exploration (vom Brocke et al. 2016); Exchange vs Conversion (Murray and Lynn 1997); Re-inventing vs Improving, Synthesis vs Analysis (van Slooten and Hodes 1996); Mark 1 vs Mark n (Lehmann 2016)
SC 2: Appli-cation Goal	Information Acquisition	Rapid Engineering	Information Acquisition vs Rapid Engineering (Xu and Ramesh 2008)
SC 3: Organizational Scope	Operational	Strategic	Operational vs Strategic (Mturi and Johannesson 2013); Big Picture vs Narrow Perspective; Global vs Local (Murray and Lynn 1997); Size (van Slooten and Hodes 1996); Scope (vom Brocke et al. 2016)
SC 4: Intra-Organizational Collaboration	Cooperation	Isolation	Org. Level of Standardization (Bass et al. 2013; Eichentopf et al. 2011); Org. Level of data base-lining (Bass et al. 2013); Neighboring Systems (Kalus and Kuhrmann 2013); Relationships, Dependency (van Slooten and Hodes 1996)
SC 5: Customer Integration	Integration	Exclusion	Customer Process, User Process, Customer Availability, User Availability, User Interface (Kalus and Kuhrmann 2013); Level of Customer Participation (Bass et al. 2013); Actor (Customer) (vom Brocke et al. 2016); Customer Project (Lehmann 2016)
SC 6: Business Partner Integration	Integration	Exclusion	Number of Stakeholders, Stakeholder Background (Kalus and Kuhrmann 2013); Inter-Organizational Process (vom Brocke et al. 2016)

Table 1. SCs for SAME

In detail, SC 1 refers to the project maturity and distinguishes whether an agile method fragment is used for generation of ideas and concepts (ideation) or for process improvement in system implementation or improvement (execution). SC 2 describes situations regarding its project's main goal of application, i.e., whether agile method fragments are mainly used for accelerating the engineering process or for acquiring information. SC 3 focuses on the organizational scope of a project and differentiates between an operational level or a strategic level. SC 4 touches on the need for collaboration among different teams within an organization and describes the ability of an agile method fragment to support. SC 5 describes whether an agile method fragment integrates the customer into the process. In SC 6 the ability of an agile method fragment to integrate different business partners on an inter-organizational level is illuminated. SC 1, SC 2 and SC 3 can be categorized as project-related characteristics, whereas SC 4 – SC 6 are related to contextual factors.

For a better understanding an exemplary set of agile method fragments have been filled in with regard to their values for the SCs (cf., Figure 2). The agile method fragments have been identified from a study on

the use of agile methods and techniques in practice by VersionOne (2018) and Komus and Kuberg (2017) and serve as illustrative examples. The numbers in the circles are added for a better readability and easier identification of the method fragment.

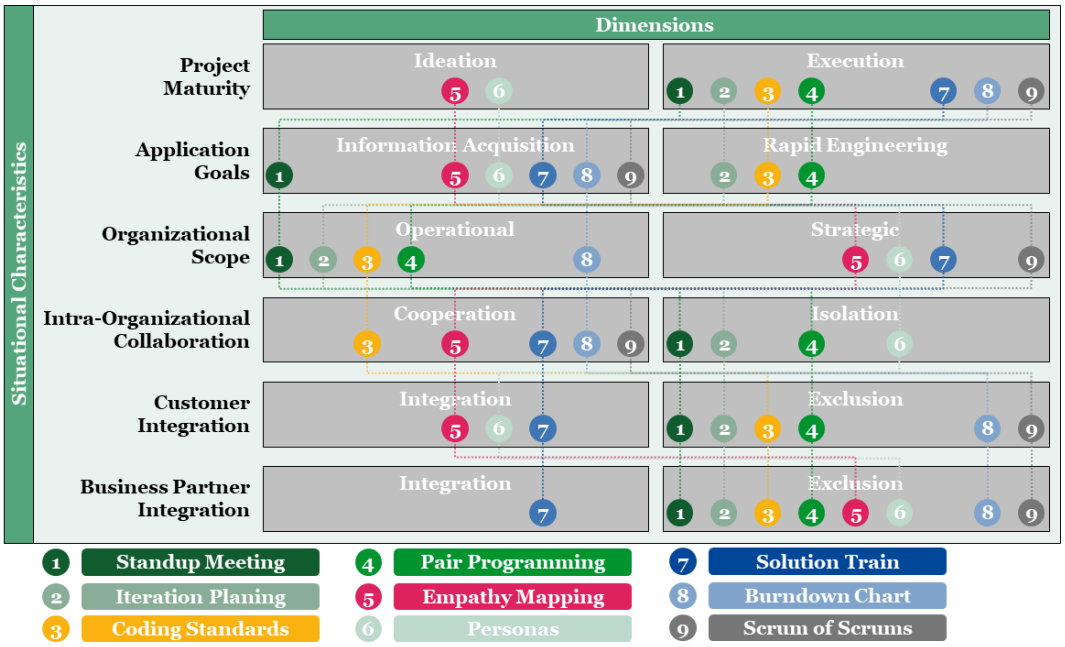

Figure 2: Application of SCs on Exemplary Method Fragments

Evaluation of SCs for SAME

The results of the evaluation of the situational characteristics can be retrieved from Table 2. The representation of the evaluation of the results within the 95%-confidence interval is presented in Figure 3. In Figure 3, one can find on the y-axis the six SCs and the level of appropriateness on the x-axis. The values on the x-axis range from 1 (not appropriate) to 7 (absolutely appropriate). Overall, the data shows that the participants agree that 5 (SC 1, 2, 4, 5, 6) of the 6 SCs are appropriate for the application in SAME as the values lie, with respect to the 95% confidence interval, above the neutrality threshold of 4. The appropriateness of SC 3 (Organizational Scope) cannot be supported within the defined confidence interval. Furthermore, the average acceptance of SC 2 (5,69), SC 4 (5,66), SC 5 (5,66) and SC 6 (5,75) are within a 95% confidence interval higher than for SC 1 (4,66) and SC 3 (4,25). Thus, the data indicates that the defined SCs for the business context (SC 4, 5 and 6) and SC 2 (Application Goal) are more suitable for the description of situations than SC 1 (Project Maturity) and SC 3 (Organizational Scope). Especially for SC 1 the data shows a high variance for the appropriateness assessment. This finding is also affirmed by the discussion, where the participants argued that the dimension “ideation” is important for the choice of agile method fragments, but should be further detailed e.g., into need assessment, ideation and a concept phase. Regarding SC 3, one interviewee argued that method fragments should be seen as atomic sub-parts of methods, always applicable on both, the strategic and the operative layer. In the discussion of SC 2, SC 4, SC 5 and SC 6, the participant broadly agreed, that those SC are very useful for the classification of agile method fragments. One interviewee argued, that his company mainly focuses on the requirements for integration of different stakeholder groups (customers, other business units or business partners) in their choice on methods. These findings are also support by the evaluation data. When it comes to the overall evaluation of the list of SC, the participants confirmed, that the demonstrated SCs are helpful. The interviewees especially appreciated, that the list focuses on the most relevant SC without integration of unimportant factors with low explanatory power.

SCs	Ave.	Std. dev.	LCL (1-α/2)	UCL (1-α/2)
SC 1	4,66	1,16	4,17	5,14
SC 2	5,69	0,85	5,34	6,04
SC 3	4,25	1,06	3,81	4,69
SC 4	5,66	0,81	5,32	6,00
SC 5	5,66	1,27	5,13	6,18
SC 6	5,75	1,12	5,28	6,22

Ave.= Average Level of Appropriateness; Std. Dev. = Standard Deviation; LCL= Lower Confidence Level; UCL= Upper Confidence Level; α=0,05; SC= Situational Characteristic, n= 32

Table 2. Results of Evaluation of the SCs for SAME

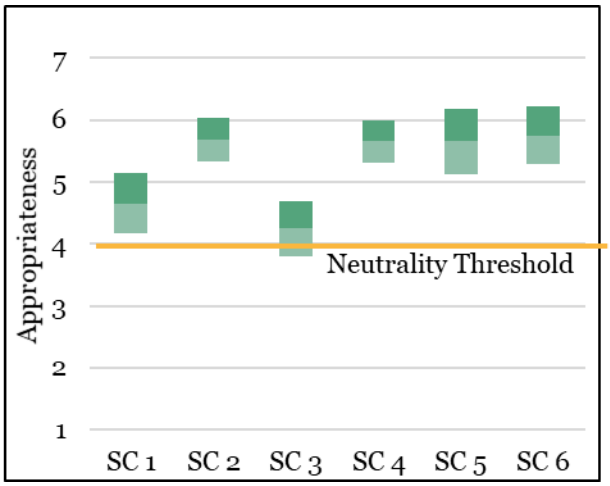

Figure 3. 95% Confidence Levels of SC Appropriateness Evaluation

5. Discussion

This study identifies and evaluates the applicability of SCs to enhance the process of SAME. Based on a literature review and a pair coding procedure, six SCs were identified. By evaluating the SCs in focus group interviews with 32 interviewees, it was shown that 5 of the identified SCs are relevant for SAME, although some SCs appear to be more relevant (SC 2, 4, 5, 6) than others (SC 1). SC 3 was assessed as not appropriate enough for the decision process on SAME. It was shown that these SCs allow for distinguishing between dimensions that favor the choice of specific agile methods.

This study makes several contributions to the field of method engineering by putting a specific focus on agile methods introducing the term SAME. First, prior research on SME has predominantly concentrated on describing SCs that allow for distinguishing between situations that either favor plan-driven or agile methods (e.g. (Boehm 2002). The present study is the first to examine SCs that focuses on the agile domain and supports the selection of different agile fragments. Second, only limited efforts were put on the situational use of agile method fragments, since research on method engineering often focused on general decisions regarding "complete" agile methods, rather than highlighting the process of deliberate and situation-dependent choice of agile method fragments (Cheng et al. 2009). Regarding the contribution to practice, the presented research provides insights for the situation-adjusted use of agile method fragments. A deliberate choice of specific agile method fragments can improve the performance of agile structures in organizations (Diebold et al. 2016). The presented SCs help to describe situations in order to model better fitting agile methods for IS development in organizations. In particular, it supports practitioners to select from the huge variety of agile method fragments and to adapt processes to the SCs of the company, accordingly. With regard to the increasing popularity of self-organizing organizational structures (e.g., holocratic organizational structures or agile scaling frameworks (e.g., SAFe, LeSS, DAD), small business units get more autonomy and individual responsibility for method tailoring. However, a high degree of self-management within small business units requires mechanisms and tools for adjustment of development processes on team or business unit level. The list of SCs supports those team in describing their situations for the tailoring process of their specific development methods, which serves as a base for SAME, so that the performance of the use of agile processes is potentially improved.

6. Limitations and Further Research

Despite the diligent design of the research procedure, the presented findings are subject to limitations. First, only practitioners from the financial service industry and related service providers in Switzerland, Germany and Austria have been included. However, the findings were not related to industry specific questions. Furthermore, the number of participants (n=32) in the focus group interviews was rather low.

Thus, the study should be repeated with more participants and participants from other industries to mitigate industry biases and improve generalizability and reliability of the results. Second, the presented list of SCs and related sub-concepts might underrepresent some relevant factors for the selection of agile methods or agile method fragments, although the participants were not able to add new SCs to the list. However, to further improve the quality of the results, the presented list of could be evaluated against a list, which is derived deductively by expert interviews on how decision on agile methods are made in corporate settings. The presented list can though serve as a starting point for further research on SCs for SAME and can be extended or further detailed. Third, the study could be repeated by other researchers in order to increase reliability of the results and the classification of SCs. In order to enhance the usability of the SC list for SAME, agile method fragments should be identified and analyzed with regard to their SC values as exemplary showed in Figure 2. A list of agile method fragments with validated values for the SC would allow companies to match their respective situations with the choice of agile method fragments. Furthermore, based on the identified shortcoming of SC 1, the identified agile method fragments could be combined to a set of agile reference processes (e.g., using a meta process model) for systems development which include logical connected agile method fragments and preconditions. For such agile reference processes, SC profiles could be derived to improve SAME in practice. Finally, a method for the alignment of situation types and agile reference processes could be developed based on the list of SCs to provide practitioners with a tool to determine agile reference processes based on a respective situation.

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