Agility as a Matter of Degree: An Empirical Study of the Determinants of Agility in Projects

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Agile project management (APM) is supposed to facilitate the response to rapid changes in complex and dynamic environments by applying an iterative planning approach, close customer involvement, and self-organizing teams. The literature has often considered the choice between APM and traditional project management (TPM) as binary and equated the use of APM methods with the desired outcome, i.e. project agility. In this paper, we challenge the assumption of binarity of APM and TPM and focus on project agility as an outcome. We argue that project agility is a matter of degree and is influenced by internal and external determinants. Building on *Qumer* and *Henderson-Sellers*' (2008) four-dimensional analysis tool (4-DAT) framework, we develop a set of hypotheses of the determinants of project agility that are tested empirically using a cross-industry sample of project managers in Nordic countries. In line with the existing literature, we find customer involvement, organizational culture, and less upfront project planning to be positively related to the degree of agility in projects. However, we do not find significant effects of team size and complexity of the environment.

agility, agile, project, project management

Agilität als stetige Variable: Eine empirische Untersuchung zu den Einflussfaktoren der Agilität von Projekten

Agiles Projektmanagement (APM) ist durch einen iterativen Planungsansatz, eine enge Kundeneinbindung und selbstorganisierte Teams charakterisiert. Dadurch ermöglicht APM eine flexible Anpassung an Veränderungen in komplexen und dynamischen Wettbewerbsumfeldern. In der Literatur wurde die Wahl zwischen APM und traditionellem Projektmanagement (TPM) häufig als binär dargestellt und der Einsatz agiler Methoden mit dem gewünschten Ergebnis, d.h. der Agilität von Projekten, gleichgesetzt. Dieser Beitrag stellt die Annahme der binären Wahl zwischen APM und TPM in Frage und fokussiert auf die Agilität von Projekten als Ergebnis. Aufbauend auf dem vierdimensionalen Ordnungsrahmen (4-Dat) von Qumer *and* Henderson-Sellers *(2008) werden Hypothesen bezüglich der Bestimmungsfaktoren der Agilität von Projekten abgeleitet. Diese werden anhand einer branchenübergreifenden Stichprobe von Projektmanagern aus nordeuropäischen Ländern empirisch überprüft. Übereinstimmend mit der Literatur werden die Kundeneinbindung, die Organisationskultur und ein geringer*

Grad an Vorausplanung als Bestimmungsfaktoren bestätigt. Die Größe des Projektteams und der Grad der Komplexität Projektumfeldes haben hingegen keinen signifikanten Einfluss auf die Agilität von Projekten.

Agilität, agil, Projekt, Projektmanagement

1. Introduction

Traditional project management (TPM) builds on a plan-driven approach with upfront, clearly defined requirements and goals. TPM aims at adherence to the plan using strict controls and is mainly suited to rather stable environments with few changes (*Lill et al.*, 2019). The focus of TPM is on reducing and controlling uncertainty and resulting changes (*Wysocki*, 2014). Agile project management (APM), on the other hand, embraces and facilitates change. APM emerged as a response to rapid changes in the environment and in customer requests and the limited ability of TPM approaches to deal with these challenges in an adequate manner (*Augustine et al*, 2005; *Abrahamsson et al.*, 2009; *Hoda and Murugesan*, 2016). APM methods such as SCRUM or design thinking originated in software development (e.g. *Chow and Cao*, 2008; *Sheffield and Lemétayer*, 2012; *van Oorschot et al.*, 2018) but are now also applied to innovation and development projects (*Ghezzi and Cavallo*, 2018; *Lill et al.*, 2019). Research has shown that APM can positively influence project success (*Meyer and Marion*, 2010; *Dingsøyr et al.*, 2017).

For projects other than software development, APM and the respective project management tools and methods need to be adapted to the specific context. For many projects, a combination of APM with elements of more traditional, planning-based approaches might be more appropriate than "pure" APM (*Abrahamsson et al.,* 2009). This implies that using APM or TPM is not a binary choice but rather a matter of degree. However, the literature has often treated APM as an all-or-nothing approach (*Greenfield and Short*, 2004), which limits its applicability to smaller projects only. *Qumer and Henderson-Sellers* (2008) pointed out that organizations might find it difficult to be completely agile in all aspects. This is further supported by *Sheffield and Lemétayer* (2012), who stated that projects might not favor a pure methodology. More recently, empirical research has started to consider different degrees of agility and their effects (*Lill et al.,* 2019). What is important for companies is to achieve agility as a result. We therefore consider agility as an outcome and study potential determinants of agility. The aim is to identify factors that affect the degree of agility. For companies, knowledge of the determinants of agility is essential for designing appropriate PM approaches for different environments.

We build on *Qumer and Henderson-Sellers*' (2008) four-dimensional analysis tool (4-DAT) framework, which was originally suggested for the context of software development projects and adjust it to fit other industries. On this basis, we derive hypotheses on the determinants of agility belonging to five categories, i.e. team size, customer involvement, organizational culture, complexity of the environment, and project planning, which we integrate in a research model. The model is tested empirically using a sample of project managers of companies in Nordic countries.

2. Conceptual foundation

2.1 Agile vs. traditional project management

APM can be defined as "[…] an approach based on a set of principles, whose goal is to render the process of project management simpler, more flexible and iterative in order to achieve better performance (cost, time and quality), with less management effort and higher levels of innovation and added value for the customer" (*Conforto et al.,* 2014, 22). APM originally referred to a set of iterative methods in software development such as SCRUM, eXtreme programming or Lean Software Development. Instead of developing a detailed upfront plan over the entire project life cycle, APM relies on revision and improvement in each project phase using iterative planning (*Conforto et al.,* 2014; *Serrador and Pinto*, 2015). APM includes close customer collaboration, requirement uncertainty, and empowerment of the team (*Dybå and Dingsøyr*, 2008; *Sheffield and Lemétayer*, 2013). Although there are no generally agreed upon definitions of APM and TPM (*Conforto et al.*, 2016), several distinctive characteristics of these approaches have been repeatedly pointed out in the literature. These characteristics are summarized in *Table 1*, which differentiates between TPM and APM as ideal types. In practice, companies may choose to adopt mixed (hybrid) forms, i.e. a combination of more agile and more traditional elements (*Qumer and Henderson-Sellers*, 2008).

Characteristic	**Traditional project management** (TPM)	**Agile project management** (APM)
Planning	upfront	continous
Scope	fixed	flexible
Customers role	important	critical
Customer interaction	low	high
Organizational structure	centralized	decentralized
Role assignment	individual – favors specialization	self-organizing teams – encourages role interchangeability
Management style	command-and-control	leadership-and-collabration
Uncertainty	low	high
Changes	avoid changes	embraces changes
Project type	simple	complex

Table 1: TPM vs. APM (sources: *Nerur et al.*, 2005: 75; *Dybå and Dingsøyr*, 2008: 836; *Larson and Grey*, 2011: 585)

The characteristics of APM shown in *Table 1* are supposed to improve the ability to (proactively) deal with changes in the environment and accommodate changing customer requirements. In this regard, the use of APM as a method must be distinguished from agility as an outcome. Agility can be defined as "*the continual readiness […] to rapidly or inherently create change, proactively or reactively embrace change, and learn from change while contributing to perceived customer value*" (*Conoby*, 2009: 340). The questions of whether and to what extent the use of APM enhances agility are empirical, and it should not be taken for granted that APM is generally superior to TPM or hybrid approaches.

2.2 Research on the enablers and success factors of APM

Based on a cross-country survey of agile software development projects, *Chow and Cao* (2008) investigated 12 potential success factors of agile projects. They classified these factors into five main categories: organizational, people, process, technical, and project. They identified delivery strategy (technical), agile engineering techniques (technical) and team capability (people) as the most critical success factors. In a similar vein, *Sheffield and Lemétayer* (2013) identified factors indicative of software development agility for a successful process. They distinguished between two main categories: the project environment and the project itself. Based on a survey of members of project management associations, they empirically determined factors indicative of agility in both categories. In the project environment, organizational culture, top management support, level of entrepreneurship, and risk-taking willingness were important. In the project category, team empowerment, agility supported by customers, and customer collaboration were the most important factors. In an exploratory study of the applicability of APM to industries other than software development, *Conforto et al.* (2014) identified 40 internal and external "enablers" of APM. Similar to *Chow and Cao* (2008), these enablers were assigned to four main categories: organization, process, project team and project type.

Although existing empirical research on enablers and success factors of APM differs in the granularity and categorization of different factors, there is obvious overlap regarding the main categories. These studies include people-related factors, organizational factors, technical and process-related factors, and project-related factors. However, the factors investigated in earlier research were considered both enablers of APM (*Conforto et al.*, 2014; *Sheffield and Lemétayer*, 2013) and success factors (*Chow and Cao*, 2008; *Sheffield and Lemétayer*, 2013), which may entail endogeneity issues. To study the determinants of agility in projects, we build on existing research on APM enablers and the 4-DAT framework developed by *Qumer and Henderson* (2008) to support the evaluation, adoption and improvement of agile methods in practice. The framework explicitly builds on the assumption that agility is a matter of degree and distinguishes between dimensions that include agility as an outcome and dimensions that include potential determinants of agility.

2.3 The 4-DAT framework

Qumer and Henderson-Sellers (2008) conducted research on several approaches to assist organizations with the transition from a traditional to an agile management approach. In this context, they developed "The Agile Software Solution Framework" (ASSF), which includes the "Agile Toolkit" and the 4-DAT. The latter, also referred to as the Agility Calculator, facilitates the examination of agile methods in four dimensions and measures the degree of agility of a method based on several attributes. The four dimensions of the 4-DAT are method scope, agility characterization, agile value characterization, and software process characterization (see *Table 2*). The second dimension–agility characterization–can be used to measure the agility in projects as an outcome. Although the approach was developed for the software industry, it can be adjusted to fit other industries. *Qumer and Henderson-Sellers* (2008: 1901) state that items or dimensions can be added or subtracted if necessary. Following this suggestion, we use the 4-DAT framework as a guide for developing hypotheses on the determinants of agility in projects.

4-DAT	**1. Dimension** (method scope) *Scope*	**2. Dimension** (agility chracterization) *Features*	**3. Dimension** (agile value characteriszation) *Agile Values*	**4. Dimension** (software process characterization) *Process*
Attributes	- project size - team size - development style - code style - technology environment - physical environment - business culture - abstraction mechanism	- flexibility - speed - leanness - learning - responsiveness	- individuals and interactions over processes and tools - working software over comprehensive documentation - customer collaboration over contract negotiation -responding to change over following a plan - keeping the process agile - keeping the process cost effective	- development process - project management process - software configuration control/support process - process management process

Table 2: 4-DAT (source: *Qumer and Henderson-Sellers*, 2008, p. 1904)

3. Hypothesis development

3.1 Degree of agility

The five attributes of the second dimension (agility characterization) of the 4-DAT framework–flexibility, speed, leanness, learning and responsiveness–characterize agility and will be used to measure the degree of agility in projects. Flexibility is the ability to quickly react to expected and unexpected changes that might occur during a project, whereas speed concerns providing results quickly. Leanness indicates if the method is time efficient and uses economical, simple and quality instruments for production. Learning concerns the application of updated prior knowledge and experience to create a learning environment. The last attribute addresses the responsiveness of the method to changes and problems as they occur, i.e. how sensitive the method is to surrounding factors (*Qumer and Henderson-Sellers*, 2008).

3.2 Team size and expertise

The team is an element of the first dimension of the 4-DAT framework and has also been identified as one of the indicators of success in APM (*Chow and Cao*, 2008). Accordingly, the literature generally assumes that a small team size is conducive and that agile teams should not surpass nine members (*Bustamante and Sawhney*, 2011). However, some authors claim that APM can be just as effective with large teams of up to 150 people (*Lalsing et al.*, 2012). Empirical research on the adaptation of agile methods to large projects and large organizations has shown that APM requires a significant adaptation to this context, as it may face several obstacles (*Hobbs and Petit*, 2017).

The importance of individuals and interactions over processes and tools within a project team is stated in the third dimension of the 4-DAT. Team size can affect the communication and performance of the team. Communication is an important factor for the success of agile methods, as APM attempts to avoid extensive detailed planning and instead uses communication as a coordination tool. The larger the team, the more complicated communication becomes, as there are more people to interact with. This can potentially cause miscommunication or even a lack of communication (*Lalsing et al.*, 2012). Empirical research by *Ambler* (2010) found that the success rate for agile projects was 83% for small teams consisting of not more than eleven people, 70% for medium-sized project teams with a maximum of twenty-five people, and 55% for large teams consisting of more than twenty-five people. Accordingly, we hypothesize a negative effect of team size on the degree of agility.

Hypothesis 1: Team size is negatively related to the degree of agility in projects.

Not only the number but also the expertise and competence of the team members are crucial factors in agile projects (*Conforto et al.*, 2014; *Chow & Cao, 2008*). Members with high competence are usually more reliable and can be trusted to participate in the decision-making process. Agile project organizations thus often focus on hiring a few, highly competent people (*Lindvall et al.*, 2002). We therefore expect the following:

Hypothesis 2: Expertise among team members has a negative moderating effect on the relationship between team size and the degree of agility in projects.

3.3 Customer involvement

Customer collaboration is one of the attributes in the third dimension of the 4-DAT approach, which includes agile values (*Qumer & Henderson-Sellers*, 2008). Agile methods reduce extensive upfront planning because much of the planning is developed incrementally throughout the project life cycle. For this reason, the agile method is dependent on a high level of communication between team members and active customer involvement (*Serrador & Pinto*, 2015). *Misra et al.* (2009) identified three customer-centric issues that are critical for success: customer commitment, customer collaboration, and customer satisfaction. Agile methods attempt to develop projects to satisfy customer needs, and therefore customer commitment and collaboration with the project team are required. Customers should participate early in the project, i.e. when goals are established, and must be motivated and actively provide feedback throughout the entire project life cycle (*Serrador & Pinto*, 2015). Consequently, customer involvement seems to be an important factor regarding the degree of agility in projects. We therefore postulate the following:

Hypothesis 3: Customer involvement is positively related to the degree of agility in projects.

3.4 "Supportive" organizational culture

The organizational culture affects the degree to which agile methods are implemented in organizations. If values like secrecy, timidity, and isolation prevail in an organization, the culture is not compatible with the implementation of agile methods (*Strode et al.*, 2009). A supportive "agile" organizational culture can be characterized by three levels. At the organizational level, agile methods are more compatible with an adhocratic and decentralized structure due to the lower degree of formality in APM (*Strode et al.*, 2009), while TPM is better implemented in hierarchical structures. At the group level, an agile organizational culture is based on good relationships between team members, motivation, shared responsibility, self-management, and the willingness to cooperate and take risks (*Sheffield & Lemetayer*, 2012). The team should also be co-located and participate in daily communication regarding the project. Finally, at the individual level, project team members should have sufficient competence to understand and outline potential risks and changes in the project. They should also be able to affect the outcome of the project, organizational goals, and value provided to customers (*Conforto et al.*, 2014). Based on the three levels of a supportive organizational culture, we derive the following hypothesis:

Hypothesis 4: A supportive organizational culture is positively related to the degree of agility in projects.

3.5 Complexity of the environment

As the first dimension of the 4-DAT, scope includes the physical and technological environments (*Qumer & Henderson-Sellers*, 2008). Rapid changes in the global economy, technology and society have led to increased complexity, and new perspectives on how to manage this complexity have been proposed. These changes call for a management approach that can fulfill the requirements for handling complex and unpredictable environments. Simple project environments are often characterized as stable and linear, with predictable patterns. For such environments, a TPM approach can be suitable, as it facilitates upfront planning and risk calculations (*Saynisch*, 2010; *Sheffield & Lemétayer*, 2013). However, for complex project environments that are characterized as unstable and nonlinear, potential risks and obstacles in a project can hardly be predicted (*Saynisch*, 2010; *Schwaber*, 2004). A more suitable approach for such an environment is APM, where short cycles of discovery are achieved through an iterative approach that facilitates gradual planning throughout the project life cycle (*Vasquez-Bustelo et al.*, 2007). Increased complexity in the environment can therefore be assumed to lead to a higher degree of agility.

Hypothesis 5: Complexity and dynamism of the environment are positively related to the degree of agility in projects.

3.6 Upfront Planning

The development style and "responses to changes over following a plan" are elements of the first and third dimensions of the 4-DAT (*Qumer & Henderson-Sellers*, 2008). Planning a project over the entire life cycle can be challenging when dealing with uncertain and complex environments. Upfront planning requires predictability in order to foresee problems and risks that might occur. However, innovative projects are volatile and therefore exposed to changes and risks in the environment, hindering predictability. Therefore, an incremental and iterative planning approach might be better suited for these types of projects (*Conforto et al.*, 2014; *Serrador & Pinto*, 2015).

In their research on the use of APM, *Conforto et al.* (2014) found that many project managers unconsciously utilized the iterative planning approach to a certain degree, even though they had a traditional mindset and used TPM tools and techniques. In most cases, managers were responsible for planning the project in advance, which was time-consuming and required heavy documentation. These findings indicate that companies using TPM might encounter limitations, mainly when operating in innovative and technologically advanced projects. In general, it seems that less upfront planning leads to an increased use of iterative approaches, which again makes a project more agile. From this, we derive the following hypothesis:

Hypothesis 6: Upfront project planning is negatively related to the degree of agility in projects.

In *Figure 1*, the hypotheses are integrated in the research model.

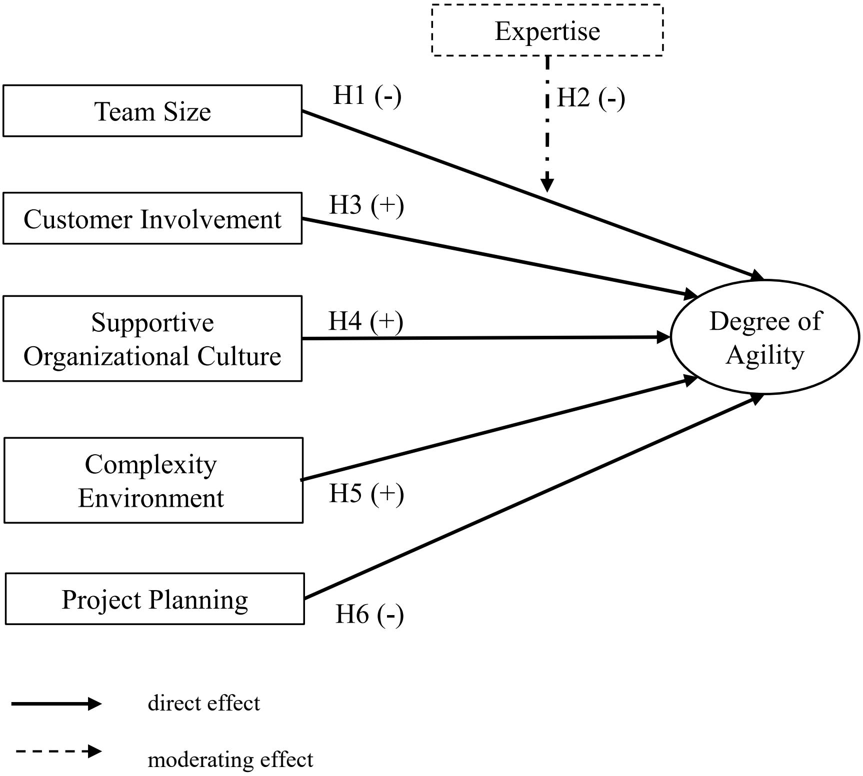

Figure 1: Research model

4. Data and Method

4.1 Sample selection and data collection

Testing the research model empirically requires identifying and targeting a population with a significant record of project work (*Bjorvatn and Wald*, 2018). Following a common sampling procedure in project research (e.g. *Hanisch and Wald*, 2014), we collaborated with project management associations in Denmark, Iceland, Norway and Sweden, which sent a link to the online questionnaire to their members. For reasons of data protection, we were not able to directly contact the associations' members. The link to the questionnaire was sent to 408 individuals. A total of 131 respondents opened the questionnaire, of which 98 (74.8%) completed the survey, yielding a response rate of 23.8%. The sample was composed of 44% female and 56% male respondents. Most respondents were project leaders (64%) and project-team members (34%), with an average project work experience of 13.4 years. A broad variety of industries were represented in the sample, among which IT (41%), public (18%), financial services (15%) and manufacturing (9%) were the most prevalent.

4.2 Measurement

To measure the constructs of the research model, we used 5-point Likert scales (anchored 1= strongly disagree to 5 = strongly agree) and reflective items. As the literature does not provide established, previously validated scales, we had to develop the measurement items from the literature. Customer involvement was measured with six items, supportive organizational culture with ten items, degree of agility in projects with seven items, complexity of the environment with five items, project planning with six items and expertise with three items. When assessing reliability and validity, we dropped several items due to low values for composite reliability, convergent reliability and indicator reliability (*Hair et al.*, 2017).

Table 3 provides an overview of the constructs and the items retained.

Construct (CR, AVE)	**apha**	**Loadings**	**Significance (t-value)**	**Source(s)**
Team size (1.000, 1.000)		1,0000		*Qumer & Henderrson-Sellers* (2008), *Bustamante & Sawhney* (2011), *Lalsing et al.* (2012), *Stankovic et al.* (2013), *Chow & Cao* (2008)
On average, how many people do you normally work with on a project?				
Customer involvement (0.872, 0.536)				*Qumer & Henderrson-Sellers* (2008), *Serrador & Pinto* (2015), *Misra et al.* (2009), *Stankovic et al.* (2013), *Chow & Cao* (2008)
I collaborated closely with customers during the project		0,6640		
Customers participated in the startup of the project		0,5580		
Customers provided feedback throughout the duration of the project		0,7650		
Customer feedback was helpful for the progress of the project		0,7950		
Customer feedback was taken into account in the project		0,8080		
Customers were satisfied with the outcome of the project		0,7720		
Supportive organizational culture (0.846, 0.580)				*Qumer & Henderson-Sellers* (2008), *Strode et al.* (2009), *Sheffield & Lemetayer (2012)*, *Conforto et al.* (2014), *Stankovic et al.* (2013), *Chow & Cao* (2008)
Decisions were made through cooperation within the project team		0,6550		
The project manager and team members shared the same objectives		0,7910		
There was good cooperation between team members		0,8280		
There was shared responsibilitiy between team members		0,7610		
Complexity of the enviroment (0.827, 0.614)				*Qumer & Henderrson-Sellers* (2008), *Saynisch* (2010), *Vazquez-Bustelo et al.* (2007), *Serrador & Pinto* (2015), *Sheffield & Lemetayer* (2012)
The project environment was characterized by high uncertainty and risk		0,7830		
The project was exposed to rapid changes in the environment		0,7530		
It was difficult to foresee problems and risks		0,8130		
Project planning (0.811, 0.589)				*Qumer & Henderson-Sellers* (2008), *Conforto et al*. (2014), *Serrador & Pinto* (2015), *Stankovic et al.* (2013), *Chow & Cao* (2008)
The plan for the project was gradually constructed as the project moved forward		0,7270		
The plan for the project was adjusted according to customer feedback		0,7940		
The plan for the project was adaptable to changes from the environment		0,7790		
Expertise (0.694, 0.540)				*Lindvall et al*. (2002), *Conforto et al.* (2014), *Stankovic et al.* (2013), *Chow & Cao* (2008)
I had sufficient knowledge to work on a project		0,5830		
The people on my team had sufficient knowledge to work on the project		0,8600		
Degree of agility (0.832, 0.558)				*Qumer & Henderrson-Sellers* (2008)
We were able to accommodate expected or unexpected changes		0,8340		
We were able to react to changes in customer's request, and implement solutions accordingly		0,6880		
The management method used produced quick results		0,8400		
The management method used was economically efficient		0,5970		

Table 3: Constructs, items, CR, AVE, outer loadings, and respective literature sources

As both the endogenous and exogeneous variables were assessed by single key informants, our data might be biased by systematic measurement error. Following *Podsakoff et al.* (2003), we applied procedural and statistical remedies to avoid common method bias. As procedural remedies, we clearly separated the endogenous and exogeneous variables in the questionnaire, kept the questions as simple as possible to avoid ambiguity, and guaranteed anonymity. Statistically, we conducted *Harman's* single-factor test (general factor accounts for 21.5% of variance) and *Lindell and Whitney's* marker variable test using the respondent's project position and industry as theoretically unrelated marker variables (highest correlations were 0.142 and 0.125). The results indicated that potential common method bias was not a problem.

4.3 Analysis

We employed structural equation modeling (SEM) using partial least squares (PLS) and the software SmartPLS 3.0 (*Ringle et al.*, 2015). The outer and inner models were estimated with a path weighting scheme, and standard errors were calculated via non-parametric bootstrapping.

To evaluate the measurement model, we calculated the composite reliability (CR), average variance explained (AVE) and outer loadings (see *Table 3*). Except for three items (with values close to 0.6), the items of the reflective constructs have loadings of at least 0.6, confirming internal consistency and content validity. Likewise, the values of CR are higher than 0.7 (except for the construct "expertise", which is slightly below). AVE is above the threshold of 0.5 for all constructs, and the AVE square roots are greater than the intercorrelations between the respective construct and all other constructs. These values fulfill the criteria for discriminant and convergent validity (*Fornell and Larcker*, 1981).

We checked for potential collinearity issues by calculating the variance inflation factors (VIFs) of the exogeneous variables. The highest value is 1.37, and all VIFs are clearly below 5, indicating that collinearity is not present (*Hair et al.*, 2017). To assess the structural model, we examined the coefficient of determination (R^2), effect sizes (f^2), and the predictive relevance Q^2). As control variables, industry, firm size, and the respondents' project work experience were considered and had only small and insignificant effects.

The estimation fits the data well. The model has an R^2 of 0.513 with the moderating variable included (=.502 without) and predictive relevance for the endogenous variable (Q^2=0.232) Except for team size and complexity of the environment, the hypothesized direct effects of the exogeneous variables are significant and in line with the hypotheses (see Figure 2). The effect of team size is small (β=0.035, n.s., f^2=0.002) and not significant, leading to the rejection of hypothesis 1. Likewise, hypothesis 2 is not supported, as expertise does not act as a moderator of the relationship between team size and agility (β=0.067, n.s., f^2=0.002). The effects of customer involvement (β=0.283, $p<0.05$, f^2=0.127), supportive organizational culture (β=0.289, $p<0.05$, f^2=0.130), and project planning (β=0.309, $p<0.05$, f^2=0.149) are positive and significant, supporting hypotheses 3, 4, and 6, respectively. Contrary to hypothesis 5, complexity of the environment has a significant but negative effect (β=-0.272, $p<0.05$ f^2=0.134).

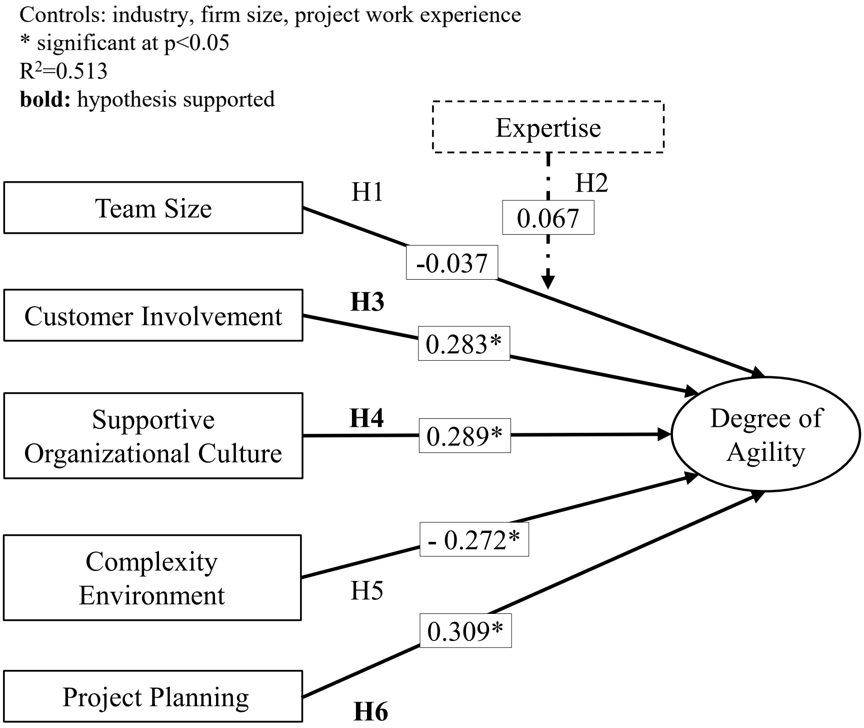

Figure 2: Structural model results

5. Discussion

5.1 Theoretical contribution

This paper contributes to research on the antecedents and consequences of agility in projects in three ways. First, we extend the literature, which has considered agility a binary choice (*Greenfield and Short*, 2004), by examining the phenomenon of agility in a more nuanced way. In line with earlier work (*Abrahamsson et al*., 2009; *Sheffield and Lemétayer*, 2012; *Lill et al*., 2019), we argue that agility is a matter of degree, i.e. it can be more or less pronounced depending on several internal and external determinants. Second, we differentiate between APM as a method and agility as an outcome (*Conforto et al*., 2016). We focus on the latter and empirically investigate potential determinants of the degree of agility in projects. Based on *Qumer and Henderson-Sellers*' (2008) 4-DAT framework and the existing literature, we derive hypotheses on the effects of five potential determinants and a moderating factor on the degree of agility. Third, we follow calls in the literature (*Conforto et al.,* 2014; *Niederman et al*., 2018) and study the phenomenon of project agility in various industries, particularly industries other than software development. This also implies considering projects of various sizes and not only small project teams, which is usually the case in agile software development (*Hobbs and Petit*, 2017).

Hypothesis 1 postulated a negative relationship between project team size and the degree of agility in projects. The literature has mostly assumed that agile methods are more successful in smaller than in larger project teams (*Lalsing et al*., 2012; *Cao and Chow*, 2008; *Bustamante and Sawhney*, 2011). Our findings contradict this hypothesis, as we did not find any significant effect of team size on agility. This implies that APM may also be applied to larger projects as stated by *Hobbs and Petit* (2017) and *Niederman et al.* (2018). Hypothesis 2 suggested that the expertise of the project team has a moderating effect on team size and the degree of agility, as the literature has suggested that organizations using the APM method tend to employ fewer but more competent people (*Lindvall et al.*, 2002). This relationship was rejected, as the respective coefficient was insignificant. This finding may reflect the lack of a relationship between team size and agility. However, the role of expertise in agility should not be neglected in future research, as other relationships may exist.

According to earlier research (*Misra et al.*, 2009), customer commitment, customer collaboration, and customer satisfaction are important factors regarding APM methods, and customer feedback can help to improve the progress of projects (*Conforto et al.*, 2014). Hypothesis 3 therefore proposed a positive relationship between customer involvement and the degree of agility in projects. This hypothesis was supported, indicating that customer involvement positively affects the degree of agility in projects. We also found support for Hypothesis 4. A supportive organizational culture is positively related to the degree of agility in projects. Previous research has revealed the important role of organizational culture in the implementation of APM methods (*Strode et al., 2009; Sheffield and Lemétayer*, 2012). Our findings complement this literature by demonstrating that organizational culture also plays an important role in accomplishing agility as an outcome.

Furthermore, Hypothesis 5 implied that the complexity and dynamism of the environment are positively related to the degree of agility in projects. Based on our empirical results, this hypothesis must be rejected. Despite the significance of the construct, the direction of the relationship is negative, which contradicts the initial assumption. This finding contradicts existing literature in the related field of agile manufacturing. For a sample of Spanish firms, *Vazquez-Bustelo et al.* (2007) found that if firms face high levels of dynamism and complexity, adopting agile manufacturing practices leads to better operational, market and financial performance. Within the context of project management, this seems not to be the case. Our findings suggest that complexity and dynamism do not necessarily prompt firms to apply APM methods that may lead to a high degree of agility in projects.

Finally, Hypothesis 6 suggested that upfront planning is negatively related to the degree of agility in projects. This hypothesis was supported. Research by *Conforto et al.* (2014) and *Serrador and Pinto* (2015) stated that a more uncertain and dynamic project environment makes it more challenging to plan over the entire project life cycle in advance and that project managers tend to unconsciously utilize an iterative planning approach to a certain degree. This is reflected by our results showing that less upfront planning leads to a higher degree of agility.

5.2 Managerial implications

Our findings on the determinants of agility in projects give rise to several managerial implications. First, project managers aiming at a high degree of agility should involve customers throughout the entire project life cycle. Receiving feedback on customers' requirements permits constant updating and improvement of the project plan to adjust to customers' needs. Second, detailed upfront planning should be kept to a minimum, and a more iterative planning approach–including customers' feedback–should be adopted to enhance flexibility and adaptability to changes. Third, to establish agility in projects, a supportive organizational culture is needed. As project managers may only have a very limited influence on the organizational culture, top-management support is essential. Finally, our study also indicates that agility can be achieved independent of the size of the project team. Project managers of larger projects may therefore also establish agility in projects by considering the recommendations above.

5.3 Limitations and future research

The study presented in this paper has several limitations regarding the sample size and selection, cross-sectional data, and selection of variables considered in the research model. The small size sample and focus on Nordic countries may impede the generalizability of the findings. The questionnaire was only distributed in Nordic countries, which form a relatively homogeneous cultural area. To overcome this limitation, future research should aim at larger and more diverse samples to investigate determinants of agility in projects. Future research should also try to consider the different phases of the project life cycle, which would allow for collecting longitudinal data and overcome limitations regarding causalities inherent in cross-sectional research designs. Finally, our selection of potential determinants was based on the existing literature and included project-related variables (team size, project planning, customer involvement), organizational culture, and the macro-environment. These determinants were found to explain an important part of the variance of project agility. Nonetheless, there might be additional determinants, which future research should try to identify.

6. Conclusion

Research on APM and agility in projects has mostly considered software development as industry context and has often failed to clearly differentiate between APM as a method and agility as a desired outcome. Furthermore, agility is often treated as a binary choice between APM and TPM methods. Our study contributes to the literature on APM by focusing on agility as an outcome and considering agility as a matter of degree.

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