The relationship between organizational culture and the deployment of agile methods

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A R T I C L E   I N F O

A B S T R A C T

Context: Systems development normally takes place in a specific organizational context, including organizational culture. Previous research has identified organizational culture as a factor that potentially affects the deployment systems development methods.
Objective: The purpose is to analyze the relationship between organizational culture and the post-adoption deployment of agile methods.
Method: This study is a theory development exercise. Based on the Competing Values Model of organizational culture, the paper proposes a number of hypotheses about the relationship between organizational culture and the deployment of agile methods.
Results: Inspired by the agile methods thirteen new hypotheses are introduced and discussed. They have interesting implications, when contrasted with *ad hoc* development and with traditional systems development methods.
Conclusion: Because of the conceptual richness of organizational culture and the ambiguity of the concept of agility the relationship between organizational culture and the deployment of agile systems development forms a rich and interesting research topic. Recognizing that the Competing Values Model represents just one view of organizational culture, the paper introduces a number of alternative conceptions and identifies several interesting paths for future research into the relationship between organizational culture and agile methods deployment.

1. Introduction

Agile methods have received considerable attention during the last 10 years [26]. When compared with other systems development methods, they seem to be exceptionally well-received by practitioners. What is the explanation for this success? One possibility is, of course, the fashion factor, i.e. the early excitement with the idea. Although we cannot exclude this possibility, one can conceive of more fundamental changes in the systems development terrain that favor agile methods.

When arguing for agile systems development methods (SDMs), its proponents often refer to the increased turbulence and unpredictability of the world around us, that organizations and enterprises need to be more agile, more responsive to changes [76]. Ideally, agile methods support this organizational agility. Software development – also in the information systems (IS) context – is increasingly commodified and/or outsourced making it a relationship between an identifiable customer and a supplier. Although the

requirements may be vague and volatile, the customer is assumed to be able to decide about them without potentially complex and time-consuming negotiation between different stakeholders on the customer's side. Much of software development is also evolutionary development of existing software product with a given architecture and technical design. The abundance of requirements and their prioritization is the problem in this evolutionary development rather than the identification and elicitation of requirements [21]. It may well be that under conditions like these agile methods really are better in terms of the speed and efficiency of development and the quality of developed system than alternative methods. Although a recent study of Lee and Xia [56] casts doubt on the significant positive relationship between software development agility and the project success, there is not definite empirical evidence on this relationship [26].

Despite the above positive trends, the adoption of the agile methods is not necessarily unproblematic. Compatibilities and incompatibilities between agile methods and organizational culture have been recognized as one explanation of the encountered difficulties [19,10,62,17,86,16]. There are also more specific studies on the relationship between organizational culture and agile methods [70,77,81,82,79].

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The purpose of the present paper is to analyze the relationship between organizational culture and the post-adoption deployment of agile methods, which is a largely neglected area in the case of agile methods [1]. The analysis is inspired by Iivari and Huisman [46], who studied the relationship in the case of traditional SDMs. They found that the hierarchical culture orientation increased the deployment of these methods as perceived by IS developers and the rational culture decreased it as perceived by IT managers. As an outcome they suggested a number of propositions and hypotheses to explain the findings. The present paper attempts to contrast agile methods with their findings.

The composition of the paper is the following. Section 2 attempts to explicate our interpretation of agile methods as a systems development approach [44], arguing that one should distinguish agility as an *a priori* characterization of some SDMs and agility as an emergent feature that can be assessed only by hindsight. Section 3 introduces organizational culture and the Competing Values Model [23] as a theoretical background of the present paper. The Competing Values Model distinguishes four culture types: hierarchical culture, group culture, rational culture and developmental culture. Agile organization or enterprises in this framework represents the developmental culture. Section 4 proceeds to the analysis of the relationship between organizational culture and the deployment of agile methods, contrasting agile methods with traditional ones and suggesting a number of hypotheses to describe the relationship. Finally, Section 5 concludes the paper.

This paper is an extension of a book chapter [47], extending it in three respects. First, Section 2 problematizing the concept of agility is totally new material. Second, the discussion of organizational culture in Section 3 is broadened so that it does not only focus on the Competing Values Model, but provides a much fuller account of this rich concept. Third, Section 5 is considerably expanded to summarize the findings and limitations of the present paper and to introduce opportunities for future research.

2. Agility as an a priori characteristic and as an emergent property

It is not necessarily self-evident what methods are agile, since they are not based on any clear common core idea (such as the systems development life-cycle in the case of the waterfall model, prototype in the case of prototyping, the concept of object in the case of object-oriented methods), except on the concept of agility. Unfortunately, agility seems to provide quite a complicated definitional basis for agile methods.

To our knowledge Conboy [20] is the most serious analysis of the concept of "agility" in Information Systems and Software Engineering. He notes that the term is used there in so many different ways that it has lost much of its meaning.[2] He carefully reconstructs a very rich concept of agility:

"The readiness of an ISD method to rapidly or inherently create change, proactively or reactively embrace change, and learn from change while contributing to perceived customer value (economy, quality, and simplicity), through its collective components and relationships with its environment" [20, p. 340].

Based on the focus group analyses of two projects he also applies the aspects of "agility" implicit in the above definition to assess if various principles and techniques (or "practices") of agile

methods may or may not support agility.[3] His conclusion is that they do not necessarily support agility in all situations.

Conboy's analysis leads to the question if "agility" can be attributed to individual techniques and principles or if it is a property that characterizes the whole method. The architects of XP, for example, emphasize that uniqueness of XP lies in the integration of complementary principles and techniques, which individually are not new [83]. This would suggest that "agility" of XP lies in that unique combination. The concepts of "economy" and "quality" in the above definition of agility also implies that agility is not *a priori* characterization of "agile" SDMs, but an emergent property of certain methods.[4] A method would be agile in the emergent sense, if it would exhibit emergent agility sufficiently regularly, if followed reasonably faithfully by qualified software developers.

Emergent agility would be an empirical question rather than definitional one, but potentially dependent on how faithfully a method is followed. Cao et al. [15], for example, report that the faithful appropriation of XP led to better project success. The question is, however, on what criteria we should evaluate if a method is followed sufficiently faithfully. Each method has, of course, its own criteria based on principles and techniques of the method (for example, the "practices" of XP). This option has a problem that it easily leads to a dogmatic interpretation of "agile" methods, which does not allow adaptations [6,30,15].[5]

The focus of individual methods also results into fragmented research, which easily misses the potential commonalities between "agile" methods. Therefore it might be intellectually economic to focus on agile methods as a whole – in more formal terms on the agile systems development approach as a class of agile methods that share some common characterizing features of agility (cf. [44]). But is it meaningful to speak about a single agile approach or are we just dealing with an arbitrary collection of methods and related techniques that happen to be called "agile"?

One possibility to define the agile approach is to derive its characterizing features as a synthesis of the principles and techniques of different agile methods. It seems, however, that in the current stage of development, agile methods differ so much from each other that the synthesis is not straightforward. An alternative is to trust on published statements such as the Agile Manifesto (http://agilemanifesto.org/principles.html) as an authoritative list of characterizing features, although its "values" and principles require considerable interpretation of what are essential and what less essential. For example, if we interpret that Principle 8, emphasizing face-to-face conversation, expresses a preference for co-located projects, does it exclude geographically distributed projects by definition from agility [39]? Despite these interpretation problems, it seems obvious that some subset of the Agile Manifesto could provide a starting point to characterize the agile approach. Table 1 lists a number of "values" and principles (all from the Agile Manifesto) and two of assumptions from Turk's et al. [83] list of 14 assumptions.[6]

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[2] There is a tendency to characterize all flexibility and adaptivity as agility. Sarker and Sarker [71], for example, distinguish seven agilities in the context of globally distributed software development.

[3] We prefer to speak about techniques and principles rather than about practices to point out that the latter refer to "real" ways of doing things. In other words, "practices" are not just on paper.

[4] Agility as an emergent property would imply that different agile methods could include even contradictory techniques and principles such as collective vs. individual code ownership (see [20]). In terms of systems theory the question is about equifinality. Alternative techniques and principles when appropriately combined might lead to the same emergent property (agility) at the level of the whole method.

[5] If deviations are allowed, they should be specified separately.

[6] Table 1 attempts to be as short as possible. Referring to the fourteen assumptions in Turk et al. [83], we have included only those, which are associated with six principles from the Agile Manifesto included in Table 1. Furthermore, we have excluded assumptions that are just re-statements of the principles (e.g. the self-organization assumption), controversial in our opinion (e.g. the application-specific development assumption), primarily empirical questions (e.g. cost-of-change assumption) or feasibility assumptions (e.g. the iteration assumption).

Table 1
A characterization of the agile approach.

Goal	To satisfy the customer through early and continuous delivery of software that is of value to the customer (Principle 1)
Guiding principles	Individuals and interactions are more significant in software development than processes and tools (Value 1)
It is more significant to respond to changing requirements than to follow a plan (Value 4)
The visibility assumption: Project visibility can be best achieved through the delivery of working code [83]
The documentation assumption: Developing extensive (relatively complete) and consistent documentation and software models is counterproductive [83]
Fundamental concepts	Software as an emergent system: The best requirements, architectures, and design emerge (Principle 11)
Principles of the development process	Continuous or frequent delivery of working software (Principles 1 and 3)
Focus on the software rather than other documentation (Value 2 and Principle 7)
Welcoming changing requirements (Principle 2)
Close collaboration between developers and customers (Value 3 and Principle 4)

Of course, it would be preferable, if the developers of the agile methods could characterize the agile approach in more exact terms. Yet, in line with Iivari et al. [45] we are ready to regard the agile methods as a whole as a separate systems development approach that is sufficiently different from others. In our view the focus on the working code right from the beginning rather than on prototypes, which may also represent working code, distinguishes agile methods from the Scandinavian trade-unionist approach, for example, and also from the spiral methods (see [60]).

The following analysis of the relationship between organizational culture and agile methods will focus on the agile approach as a whole in the sense of the characterization of Table 1. Before proceeding to the analysis let us introduce the concept of organizational culture.

3. Organizational culture and the Competing Values Model

The section starts with a brief introduction to organizational culture. After it different conceptions of cultural compatibility or fit between organizational culture and various IS efforts are discussed before reviewing existing research into the relationship between organizational culture and agile methods. Finally, the specific view of organizational culture – the Competing Values Model – to be applied in the present paper will be introduced.

3.1. Organizational culture

In cultural anthropology culture is viewed as an inescapable context in which life (in communities, organizations) takes place (e.g. [33,52,58]). As a corollary organizational culture forms the context in which systems development takes place. Although there is not much prior research into the relationship between organizational culture and the deployment of SDMs [57], there are good *a priori* reasons to believe in a relationship between the two. However, before going into detail in that connection it needs to be emphasized that culture is a very complex concept with a multiplicity of definitions even in anthropology from which the concept originates [53]. One of the widely accepted definitions of culture

positions it as a symbolic system consisting of learned, shared, patterned sets of meanings guiding the actions of cultural members (e.g. [33,52,58]).

Also organizational culture has been approached from numerous viewpoints [78]. One reason is that it can be construed to cover almost everything in an organization – basic assumptions and beliefs, attitudes, values, norms, morals, models of behavior, customs, rituals, practices, habits, specific languages, ideas and symbols, heroes, art, artifacts, knowledge and technology (cf. [53,31,38,52]). Therefore it is understandable that it has several interpretations [78,3,22,57]. Despite the differences, there seems to be an agreement that organizational culture includes several levels with a varying degree of awareness on the part of the culture-bearers [72,38].

Schein [72] distinguishes three levels of organizational culture. The deepest level consists of patterns of basic assumptions that the organizational members take for granted without being aware of them. At the surface level there are artifacts such as the visible and audible patterns of the culture. The intermediate level covers values and beliefs, concerning what 'ought' to be done. The Competing Values Model [23] to be discussed in Section 3.4 specifically focuses on organizational values.

3.2. Cultural compatibility and IS efforts

There are also divergent conceptions of the relationship between organizational culture and different kinds of IS efforts, such as the introduction of an information system or the deployment of SDMs.[7] Several researchers have emphasized the importance of cultural compatibility or fit [32,48,49,57], postulating that organizational culture should be compatible with the IS effort in question in order to succeed. The studies on cultural fit differ, however, related to their prospective recommendations. Some studies solely identify compatible culture types for the IS efforts and argue that one is likely to encounter difficulties in incompatible ones, while some studies outline compatible implementation strategies trying to fit the IS effort to different types of culture. In these studies culture is at least implicitly viewed as an independent variable, which is assumed to affect the success of the IS effort. Certain studies, on the other hand, offer guidance on how to change the cultures towards more compatible direction. In these studies culture is viewed as a dependent variable to be influenced by IS efforts, which are expected to change culture towards the desired direction [48].

Studies originating in cultural anthropology (e.g. [33,52,58]) typically do not search for any causal relations, but instead life in a particular cultural context is examined in-depth from the cultural members' point of view. Also in some IS studies this type of culture conception can be found. There are differences, however, related to the conception of the relationship between culture and an IS effort adopted in these studies. One possibility is to rely on a mutually reinforcing view of the relationship, which perceives it as bidirectional and highly complex. This view maintains that the cultural context may reinforce certain aspects of the IS effort in question while deeming some other aspects as less important, possibly even hindering their emergence, and also that the IS effort is capable of modifying the cultural context in a reciprocal relationship [32,48]. It might again be assumed that compatibility is to be aimed at, the complex interplay between culture and the IS effort possibly leading to the achievement of compatibility.

Finally, an emergent view can also be identified from some studies in the IS field [32,49]. This view adds even more complexity to the relationship. This view warns that the relationship between

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[7] IS efforts are interpreted to include efforts related to the development, implementation, adoption, use, operation or management of information systems (cf. [50,57])

culture and an IS effort is continuously evolving and dynamic, and mechanistic, universal, context-free guidelines do not work – at least in the way they are supposed to work. Instead, one should be aware that the IS effort as well as the cultural context will always be interpreted, reinterpreted and negotiated in an emergent process of sense making that is not controllable by the management [32,49]. Within this line of thought, compatibility is not necessarily searched for. It may or may not emerge, but in either case the outcome is always viewed as momentary, continuously evolving, unpredictable and unmanageable.

Especially the mutual reinforcement and emergent views may imply an idea of enculturation, which – inspired by Brown et al. [11] – can be characterized in the following way:

> "From a very early age and throughout their lives, people, consciously or unconsciously, adopt the behavior and belief systems of new social groups. Given the chance to observe and practice *in situ* the behavior of members of a culture, people pick up relevant jargon, imitate behavior, and gradually start to act in accordance with its norms. These cultural practices are often recondite and extremely complex. Nonetheless, given the opportunity to observe and practice them, people adopt them with great success." (p. 34)

Cultural members always socially construct the meanings and purposes of their activities. Enculturation thus refers to gaining an implicit sense of those meanings and purposes [11]. Hence, enculturation refers to the process during which newcomers gradually learn by doing and observing how it is appropriate to talk and behave in a community [55]. Enculturation in connection to IS efforts is interpreted to refer to modifying the IS efforts so that they are in line with how it is appropriate to talk and behave in the cultural context is question, the IS efforts thus being culturally modified in these contexts.

3.3. Existing research into the relationship between organizational culture and agile methods

There are a few studies that have investigated the relationship between organizational culture and agile methods [70,77,81, 82,79]. They clearly demonstrate that organizational culture and cultural compatibility can be conceptualized in a number of ways. Robinson and Sharp [70] apply a categorization of four culture types from Cockburn [18] to analyze the relationship between organizational culture and XP in three empirical cases, finding that XP is culturally flexible so that it can thrive in different organizational cultures.[8] Siakas and Siakas [77] identify an ideal organizational culture to embrace an 'agile professional culture' by relying on a typology of organizational cultures influenced by the cultural dimensions identified by Hofstede [37]. The culture types are labeled as Clan, Democratic, Hierarchical and Disciplined, of which the Democratic culture type is brought up as the most suitable one [77]. Tolfo and Wazlawick [81] discuss six dimensions of organizational culture using one case organization to illustrate each dimension.[9] They identify a number of favorable and unfavorable aspects in relation to XP adoption in the case of each dimension. Tolfo et al. [82] applies Schein's [72] framework to contrast organizational culture of three case companies from Tolfo and Wazlawick [81] with an idealized agile culture. Finally, Strode and colleagues [79] study the relationships between 24 culture indicators adopted from the Competing

Values Model (see below) and the weighted sum of agile (XP) technique usage in nine projects, four of which are characterized as non-agile. The Spearman correlations coefficients show most consistently significant associations with the group culture (with five of six indicators of group culture) and more weakly with the developmental culture (with two of the six indicators of developmental culture).

All these studies rely on the assumption of cultural compatibility or fit. They identify characteristics of an ideal organizational culture for agile methods. However, there are clear differences in their recommendations related to how to achieve the compatibility. Some studies argue for changing the culture so that it is compatible with agile methods [81,82], although acknowledging that this is difficult and reminding that researchers are dealing with a complex anthropological and sociological phenomenon that is quite unique in every organization.

A number of studies imply that there might be difficulties involved in separating the 'organizational culture' from the 'agile method usage' and that there might be interaction between the cultural context and the agile methods.[10] Robinson and Sharp [70], emphasize the cultural flexibility of agile methods, based on the finding that XP has succeeded to thrive in very divergent organizational cultures as interpreted in their study. Siakas and Siakas [77] underline that the agile approach should be considered a culture of its own [77], in a way analogous to professional cultures.[11] Sharp and Robinson [73] identify characteristics of a 'XP culture', which is not presented as an ideal one *per se*, but is based on an ethnographic examination of a particularly mature XP team.

Although, these studies imply that there might be interaction between the cultural context and the agile methods, they remain silent about the emergent view. This view emphasizes the importance of understanding and appreciating the complex interplay between agile methods and organizational culture, instead of giving advice on how to introduce and adapt agile methods into organizational culture, and without suggesting how to direct or manipulate the outcome.

Following Iivari and Huisman [46], this paper will apply the Competing Values Model [67,66,23] as a theoretical model of organizational culture, and identity a number of hypotheses connected to the relationship between organizational culture and agile method deployment. The model has already been relatively widely used in IS research in general (see e.g. [48,57]). The model focuses on values as core constituents of organizational culture and therefore helps us to avoid the problem of overlap between the 'organizational culture' and the 'agile method use'.

3.4. Competing Values Model

Competing Values Model (CVM) is based on two distinctions: *change* vs. *stability* and *internal focus* vs. *external focus* (Fig. 1). Change emphasizes flexibility and spontaneity, whereas stability focuses on control, continuity and order. Internal focus underlines integration and maintenance of the socio-technical system, whereas external focus emphasizes competition and interaction with the organizational environment [23]. The opposite ends of these dimensions impose competing and conflicting demands on the organization.

Based on the two dimensions, one can distinguish four types of culture. *The group culture* (change and internal focus) is primarily

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[8] The four culture types are *hierarchical* (central command and control), *random* (little or no central command and control), *collaborative* (consensus-based on command and control) and *synchronous* (where work is co-ordinated with no explicit evidence of command and control).

[9] The dimensions are: innovation and risk, detail orientation, outcome orientation, people orientation, team orientation, aggressiveness, and stability.

[10] Taking into account the semantic broadness of the concept of "culture" the difficulty is understandable.

[11] Although Siakas and Siakas [77] speak about "agile professional culture", we are hesitant to characterize it professional for two reasons. First, software developers or engineers or similar occupations cannot be considered "professionals" in the sense of being members of "professions" as understood in sociology of professions. Second, it may well be that many software developers or engineers do not regard agile methods particularly "professional" in the sense of representing the "best practices".
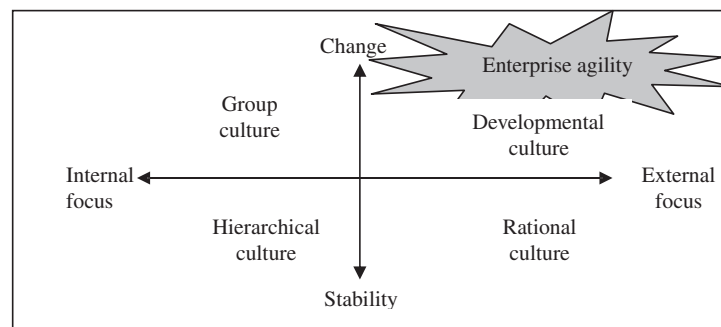
Fig. 1. The competing values framework for organizational culture and enterprise agility.

concerned with human relations and flexibility. Belonging, trust and participation are its core values. Effectiveness criteria include the development of human potential and member commitment. The *developmental culture* (change and external focus) is future-oriented, considering what might be. The effectiveness criteria emphasize growth, resource acquisition, creativity and adaptation to the external environment. The *rational culture* (stability and external focus) is achievement-oriented, focusing on productivity, efficiency and goal achievement. The *hierarchical culture* (stability and internal focus) is oriented towards security, order and routinization. It emphasizes control, stability and efficiency through the following of regulations. Each of the cultural types has its polar opposites [23]. A group culture, which emphasizes flexibility and internal focus, is contrasted with a rational culture, the latter stressing control and external focus. A developmental culture, which is characterized by flexibility and external focus, is opposed by a hierarchical culture, which emphasizes control and internal focus.

Organizational or enterprise agility in this framework represents the developmental culture. Sherehiy et al. [76] provide a recent review of the concept rooting it into contingency theory and especially into the distinction between mechanistic and organic organizational forms [13], and Overby et al. [64] and Van Oosterhout [85] discuss it more from viewpoint of IT. Enterprise agility is usually associated with adaptivity and flexibility, i.e. an organizations' ability to adjust in response to changes in the environment [76] implying external focus and change.

The four culture types are ideal types in the sense that an organization is unlikely to reflect only one type [23]. CVM stresses a reasonable balance between the opposite orientations, although some cultural types may be more dominant than others. This imposes paradoxical requirements for effective organizations [14].

Agile methods illustrate this need for a reasonable balance. Although they are usually introduced as adaptive and flexible methods responsive to the environmental volatility (especially requirement change) corresponding to the developmental culture [19] and emphasize values of the group culture such as trust, motivation and commitment [82], features such as timeboxed deadlines [6] and team effectiveness (The Agile Manifesto) reflect values of the rational culture. Furthermore, agile methods are often applied in a business context that tends to emphasize values of the rational culture such as productivity and goal achievement. The CVM suggests that it is naïve to believe that there are not contradictions with agile methods in their emphasis of productivity and efficiency as demonstrated by Tolfo et al. [82], for example.

4. Organizational culture and the deployment of agile methods

4.1. The theoretical model

Iivari and Huisman [46] conducted a survey on the relationship between organizational culture, measured in terms of CVM, and

the deployment of SDMs, "deployment" referring to method support, method use, and method impact. The survey was targeted to IT departments in South Africa. They received completed IT manager questionnaires from 73 organizations and completed IS developer questionnaires from 234 developers from 71 organizations. The total number of organizations was 80 and the number of responses from organizations with both IS developer and IT manager responses was 64.

Recognizing that large organizations tend to develop a number of subcultures [35,78], Iivari and Huisman [46] analyzed organizational culture of IT departments, since they can be expected to be most closely associated with the behavior of IS developers and the deployment of SDMs. Furthermore, they focused on the cultural perceptions of one occupational community [84], IS developers. The reason for this focus was to avoid associating culture with the IT managers' view of the desirable culture to be imposed on the IT department. IT managers' views of organizational culture may represent an organizational ideology that they exercise in their normative control over IS developers [54]. This ideology may differ radically from the organizational culture perceived by IS developers.

In the case of SDM deployment, Iivari and Huisman [46] studied both IS developers' and IT managers' perceptions. One reason for this is the possible common method bias brought by a research design in which the same respondents (i.e. IS developers) assess both organizational culture and SDM deployment. This research design allowed inter-group analysis in which organizational culture is assessed by IS developers and deployment by IT managers.

Descriptive data analysis showed that the their data were dominated by the classical structured and information modelling approaches and phased process models, characterized by sequential phases such as feasibility study, requirements analysis, design, implementation and installation [40], whereas more modern approaches such as object-orientation and agile methods were not well represented. Only Rapid Application Development represented the lighter and less bureaucratic ways of developing systems.

To test the effect of individual culture orientations, Iivari and Huisman [46] used regression analysis, using seven measures of SDM deployment as the dependent variable and the four indicators of organizational culture as the independent variables. One striking finding was the positive relationship between the hierarchical culture orientation and SDM deployment in the case of IS developers: the more hierarchical a culture was perceived to be by IS developers, the more support SDMs was perceived to provide and the more they were used. The developmental culture was also found to have a positive association with SDM deployment, but not systematically. Quite interestingly, the more rational the culture orientation, the more critical IT managers were with regard to SDM support and impact. This was intriguing, since Huisman and Iivari [41] found IT managers to have more positive perceptions of SDM deployment than IS developers.
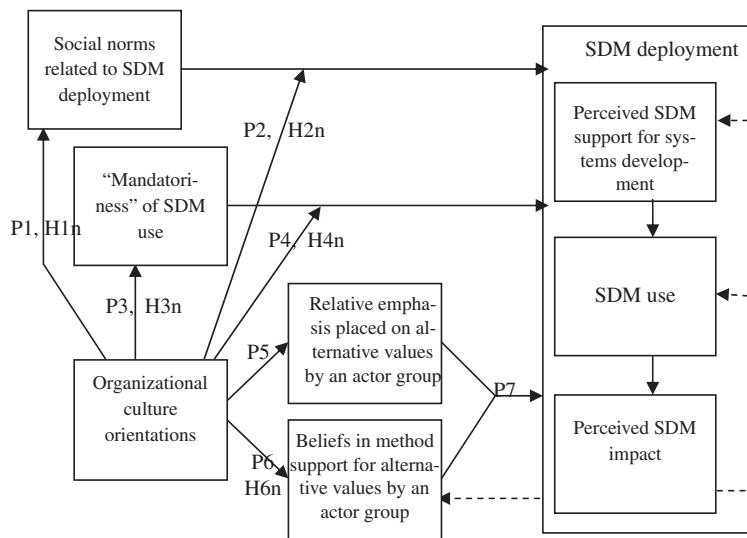
Fig. 2. The theoretical model (adapted from [46]).

To explain these empirical findings, Iivari and Huisman [46] proposed a theoretical model depicted in Fig. 2, which essentially views SDMs as norm systems [59]. The model makes a distinction between propositions and hypotheses based on their generality. Propositions are more general, whereas hypotheses are more bounded in time and space.[12] Hypotheses confined to traditional methods and agile methods (see Tables 1–3 below) illustrate the significance of boundaries in our case.

The following three sections will contrast agile methods as a whole (see Section 2) with traditional methods discussing Propositions P1 and P2 in Section 4.2, Propositions P3 and P4 in Section 4.3, and finally Propositions P5–P7 in Section 4.4. By traditional methods we mean model/documentation-oriented methods that apply a sequential phased process model akin to the linear waterfall model.[13] Contrary to Iivari and Huisman [46] we do not limit the focus on in-house IT departments only, but our interest lies in any software development organizations. Therefore, instead of IS developers we speak about software developers. We also have non-safety critical software in mind rather than safety–critical software.

4.2. Agile methods as social norms and their use

Social norms in Fig. 2 cover SDMs as norm system [59] and norms about their use (e.g. subjective norms in [29]). Agile methods are often characterized as less prescriptive than more traditional ones [81]. One can distinguish two aspects in the prescriptiveness – the degree of formalization of systems development implied by the method (see Proposition 1) and its mandatoriness (see Proposition P3). The degree of formalization implied a SDM can be conceptualized as the sum of concreteness [2] of the social norms (SN_i) embedded in the method, i.e.

$$\text{Degree of formalization} = \sum_i \text{Concreteness}(SN_i), \ SN_i \in SDM$$

Mandatoriness to be discussed in Section 4.3 describes the extent to which the social norms embedded in the SDM are made mandatory in the organization. The distinction between the degree of formalization and mandatoriness is significant, since agile methods tend to be formalized to a lesser extent than traditional methods and therefore are lighter [10,27], but the mandatoriness of principles and techniques of agile methods may be equally high as in the case of traditional methods [65].

Table 2 suggests a number of hypotheses related to Propositions P1 and P2, contrasting agile methods with traditional ones. The major attention will be paid to hypotheses associated with agile methods in the following discussion. Hypotheses associated with the traditional methods (column 2) are argued in more detail in Iivari and Huisman [46].[14]

Hypothesis H11 is a direct consequence of the hierarchical culture orientation that emphasizes following regulations and routinization [23]. Hypothesis H12 concerns all SDMs equally. Recognizing that SDM methods may differ in their heaviness, we suggest that there is an inverted u-shaped relationship between the degree of formalization implied by a method and perceived method support for systems development and consequently with method use. The reasoning is that if the method is close to empty, i.e. includes quite few social norms at an abstract level, it does not provide much support for the systems development and consequently will not be used. On the other hand, we recognize that a method may grow too heavy, too complex to understand and to use, and therefore – although possibly including useful knowledge – may remain unused. The question is where is the peak of the inverted u-shaped curve.

Hypothesis H21 claims that – independently of the degree of formalization – the hierarchical culture orientation affects positively the extent to which social norms concerning method use influence actual method use. Hypothesis H22 on the other hand suggests that the developmental culture orientation affects the inverted u-shaped relationship between the degree of formalization implied by a SDM and the perceived method support and consequently with method use (see Hypothesis H12) so that the inverted u-shaped curve achieves its maximum value sooner. The idea is that people in organizations with a strong development culture are less tolerant to heavy methods. Note that since the strong

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Table 2
Propositions P1 and P2 with associated hypotheses.

Propositions	Hypotheses (adapted from [46])	Hypotheses (inspired by agile methods)
P1 Organizational culture orientations affect social norms related to SMD use	H11 The hierarchical culture orientation increases the degree of formalization of systems development	Note that a high developmental culture orientation implies a lower hierarchical culture orientation H12 There is an inverted u-shaped relationship between the degree of formalization implied by a SDM and the perceived method support for systems development and consequently with method use
P2 Organizational culture orientations affect the extent to which social norms concerning SMD use influence actual method use	H21 The hierarchical culture orientation affects positively the extent to which social norms concerning systems development influences the real systems development practice i.e. method use	H22 The developmental culture orientation affects the inverted u-shaped relationship referred to in H12, moving its maximum value to the left
		H23 The group culture orientation affects positively the extent to which the degree of formalization implied by an agile method influences real systems development practice i.e. method use

Table 3
Propositions P3 and P4 with associated hypotheses.

Propositions	Hypotheses (adapted from [46])	Hypotheses (inspired by agile methods)
P3 Organizational culture orientations affect the extent to which SDMs are made mandatory	H31 The hierarchical culture orientation affects positively the extent to which SDMs are made mandatory	Note that a high developmental culture orientation implies a lower hierarchical culture orientation
P4 Organizational culture orientations affect the extent to which "mandatoriness" of SDM use influences actual method use	H41 The hierarchical culture orientation affects positively the extent to which "mandatoriness" of SDM use influences actual method use	H42 The development culture orientation affects negatively the extent to which "mandatoriness" of SDM use influences actual method use

developmental orientation implies lower hierarchical orientation, organizations with a strong developmental culture tend to have lower formalization of systems development (see Hypothesis H11) and as a consequence lighter methods.

Hypotheses discussed above have been independent of the nature of methods – whether traditional or agile. Hypothesis H23 on the contrary concerns only agile methods. Much of the literature on agile methods concludes that they are highly people-oriented, implying an agile culture of minimal hierarchy, self-organization, equity, empowerment, commitment, responsibility, participation, learning and continuous improvement, consensus, respect, compromises, trust, honesty, openness, communication [77,80,82]. These characteristics reflect the group culture in the Competing Values Model. Although altogether they sound idealistic, it is interesting to test to what extent the group culture orientation really facilitates agile method use as expressed in Hypothesis H23.

4.3. Mandatoriness of agile methods and their use

Mandatoriness describes the extent to which the social norms embedded in the SDM are made mandatory in the organization. It can be contrasted with "voluntariness" [61], which is a more subjective view of the extent to which SDM use is perceived as voluntary. Table 3 suggests three hypotheses related the mandatoriness of SDMs.

Hypothesis H31 proposes that the hierarchical culture orientation tends to increase the degree of mandatoriness of SDMs and Hypothesis H41 claims that the strength of the hierarchical culture affects the extent to which mandatory methods are used. Although there is no prior research on the relationship between mandatoriness and SDM deployment, the negative association between

voluntariness and the acceptance of SDMs and related software process innovations [43,68,34] partially support H41, which claims that this is especially so in organizations with a strong hierarchical culture.

Hypothesis H42 assumes that the developmental culture orientation has a negative effect on the degree to which "mandatoriness" of method use influences actual method use. There is a long research tradition on method adaptation or tailoring to fit the project (e.g. [8,36]), and recently the issue has been raised in the context of agile methods [6,30,65,74,15,75]. Hypothesis H42 does not address exactly this, but the question of to what extent the mandatoriness of the method – tailored or not – is followed, the assumption being that the higher developmental culture is the more method use comprises method improvisation.[15] Method improvisation means that the method is not read, interpreted and followed literally, but its various principles, models and techniques may be adapted, modified, changed, skipped, substituted, combined possibly in an innovative way on the fly.[16]

4.4. Alternative values and agile method use

Iivari and Huisman [46] concluded that propositions P1–P4 with their related hypotheses are not effective in explaining the critical attitude of IT managers towards SDM deployment in organizations with a strong rational culture. To explain this they introduced values and actors' beliefs into the SDM support for alternative values in Fig. 2. Based on CVM Proposition P5 suggests that organizational culture orientations affect the relative emphasis put on alternative values by different actor groups:

- *Hierarchical culture orientation*: control, stability and efficiency through the following of regulations.
- *Group culture orientation*: underlining development of human potential and member commitment.
- *Developmental culture orientation*: growth, resource acquisition, creativity and adaptation to the external environment.
- *Rational culture orientation*: productivity, efficiency and goal achievement.

Proposition P5 allows for the fact that not all actor groups (e.g. managers and developers) necessarily emphasize the alternative

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[15] Improvisation in the context IS development and software engineering has been of increasing interest during the last years [25,7].

[16] The idea of method improvisation has some similarity with dynamic method adaptation in Aydin et al. [6], but they regard the project manager as the key actor of the dynamic adaptation. Hypothesis H42 concerns IT managers, project managers and ordinary software developers equally. Suscheck and Ford [80] discuss jazz improvisation in the context SCRUM, but they do not really address method improvisation.

values equally, even though they may share the same organizational subculture. Despite the difference in the absolute emphases on different values, P5 assumes that the direction of the influence of the culture will be consistent between the groups: the stronger the culture orientation, the stronger the emphasis on the values of that orientation in each actor group.

At the same time, the culture orientations may also have an impact on the actor groups' beliefs in the SDM support for alternative values (Proposition P6). Inspired by their two most striking empirical findings, Iivari and Huisman [46] proposed Hypothesis H61 and Hypotheses H62, pointing out that these two hypotheses are specific to traditional SDMs (Table 4).

When considering hypotheses related to Proposition P6, one should be explicit about the anchor to which one compares the methods in question. The anchor may be totally *ad hoc* development in the case of traditional methods. Now when there is a transition going on from traditional methods to agile ones, the former may provide a natural anchor in the agile case. One should note, however, that there are increasingly software development organizations that do not have any experience with traditional methods. In their case *ad hoc* development would be a natural anchor.

Table 4 includes a number of hypotheses concerning both cases. Hypotheses H63a and H65a–H67a concern agile methods, *ad hoc* development as the anchor. Hypothesis H63a claims, that when compared with *ad hoc* development, also agile methods imply more discipline, although they are claimed to work at the edge of chaos or close to it (e.g. [87,51]. Hypotheses H65a–H67a suggest that there is an inverted u-shaped association between the culture orientations and IT managers and software developers' beliefs in agile method support for the values of the respective culture

orientation, i.e. after some point on the culture orientation dimension the respondents see agile methods to provide less and less support for the values in question. There are at least three explanations for this. First, as pointed out above, agile methods aim at balancing values of different culture orientations. Second, according to the CVM there are contradictions between the culture orientations – especially between diagonally opposing ones (hierarchical vs. developmental and group vs. rational). Third, when a culture orientation gets higher the expectations of the support also grow higher, and when high enough the support will be perceived to be lower.

Hypotheses H63b and H65b–H67b compare agile and traditional methods. Hypothesis H63b argues that the hierarchical culture orientation has a negative impact on IT managers' and software developers' beliefs in *agile method* support for control, stability and efficiency through following regulations, when compared with traditional methods. Together H63a and H63b suggest that the lack of discipline is not an absolute property of agile methods and that it is related to the hierarchical culture orientation. This allows the possibility that in organizations with a strong developmental culture and a low hierarchical culture people may perceive agile methods to imply more discipline than traditional ones, the latter appearing more or less crazy to them.

Hypotheses H65b–H67b claim that except in the case of hierarchical culture each culture orientation has a positive impact on IT managers' and software developers' beliefs in agile method support for the corresponding values, when compared with traditional methods. One should note here that these three hypotheses do not claim that the agile methods support better the values of development, group and rational cultures, even though they may well do so. They only state that a stronger culture orientation in each of

Table 4
Proposition P6 with associated hypotheses.

Propositions	Hypotheses (adapted from [46])	Hypotheses (inspired by agile methods)
P6 Organizational culture orientations affect the beliefs in SMD support for alternative values	H61 The hierarchical culture orientation has a positive impact on software developers' beliefs in traditional method support for the values of the hierarchical culture	H63a The hierarchical culture orientation has a positive impact on IT managers' and software developers' beliefs in agile method support for the values of the hierarchical culture
	H62 The rational culture orientation has a negative impact on IT managers' beliefs in traditional method support for the values of the rational culture	H63b The hierarchical culture orientation has a negative impact on IT managers' and software developers' beliefs in agile method support for the values of the hierarchical culture when compared with traditional methods
		H64 The hierarchical culture orientation has a negative impact on IT managers' and software developers' beliefs in agile method support for the values of the rational culture when compared with traditional methods
		H65a There is an inverted u-shaped relationship between the rational culture orientation and IT managers' and software developers' beliefs in agile method support for the values of the rational culture
		H65b The rational culture orientation has a positive impact on IT managers' and software developers' beliefs in agile method support for the values of the rational culture when compared with traditional methods
		H66a There is an inverted u-shaped relationship between the group culture orientation and IT managers and software developers' beliefs in agile method support for the values of the group culture
		H66b The group culture orientation has a positive impact on IT managers and software developers' beliefs in agile method support for the values of the group culture when compared with traditional methods
		H67a There is an inverted u-shaped relationship between the developmental culture orientation and IT developers' and software developers' beliefs in agile method support for the values of the developmental culture
		H67b The developmental culture orientation has a positive impact on IT developers' and software developers' beliefs in agile method support for the values of the developmental culture when compared with traditional methods

these three cases favors agile methods, when compared with traditional ones. We believe that it is especially so in the case of the development and group culture orientations. In our view Hypothesis H65b is most questionable among the three, whether the assumed disappointment in agile methods in organizations with a strong rational culture (see Hypothesis H65a) starts to exceed the corresponding disappointment with traditional methods.

In addition to "intra-cultural" hypotheses, which have the same culture orientation on both sides of the hypothesis (Hypotheses H63a, H63b, H65a–H67a, H65b–H67b), one could state "cross-cultural" hypotheses, illustrated by Hypothesis H64 in Table 4. It claims that the hierarchical orientation has a negative impact on IT managers' beliefs in agile method support for the values of the rational culture, when compared with traditional methods. Together with Hypothesis H63b it assumes that in highly hierarchical organizations respondents believe that traditional methods do not only support order and discipline, but also productivity, efficiency and goal achievement better than agile methods.

Proposition 7 suggests that the relative emphasis placed on alternative values by actor groups and their beliefs in SDM support for these alternative values influence SDM deployment in an interactive manner (see Fig. 2). This implies that if an actor group (IT managers, for example) places strong emphasis on certain values (e.g. productivity and efficiency) and see SDMs as supporting these values, this promotes method deployment. If, on the other hand, they see that SDMs support these negatively, this will have a negative influence on method deployment.

5. Discussion and conclusions

5.1. Summary of the results and their implications

The relationship between organizational culture and the deployment of agile systems development is a rich and interesting issue. Reasons for this are the richness of the concept of "organizational culture", the ambiguity of the concept of agility in the context of agile systems development methods, and the variety of ways the two may be related with each other. The paper was started with the concept of agility, suggesting a distinction between agility as an *a priori* characterization of systems development methods and agility as their emergent property.

After a review of the literature on organizational culture and the deployment of SDMs, Tables 2–4 proposed thirteen new hypotheses inspired by the agile methods. The number of hypotheses is to a great extent explained by the four dimensions of organizational culture identified in the CVM and by the fact that agile methods are contrasted with *ad hoc* development and with traditional methods.

The hypotheses have quite interesting implications. First, not surprisingly they are consistent with the current understanding that agile methods are most incompatible with the hierarchical culture orientation (Hypotheses H63b and H64), although they also imply more discipline than *ad hoc* development (Hypothesis H63a). Furthermore, assuming that agile methods are adopted in an organization with a relatively strong hierarchical culture, Hypothesis H11 would predict that they will be formalized further by combining complementary features of different agile methods, for example, such as XP and Scrum [30] and agile modeling. This makes these combined models heavier and as a consequence they may start to loose some of their emergent agility.

Quite interestingly, Hypotheses H31, H41 and H42 suggest that there may be a paradox between the hierarchical culture and the developmental culture, if the goal is faithful enactment of methods. According to Hypothesis H31, in organizations with a strong hierarchical culture SDMs are made more mandatory than in organizations with a strong developmental culture (implying a weaker hierarchical culture). Yet, less mandatory methods may be more effectively enacted in organizations with a strong hierarchical culture than in organizations with a strong developmental culture, because the desired behavior will be followed more faithfully in the former case (Hypothesis H41) than in the latter case where we expect more method improvisation (Hypothesis H42).

Hypotheses H63a, H65a–H67a suggest that, when compared with *ad hoc* development, each culture orientation favors agile methods but only up to some point in the case of rational, group, and development culture orientations. Furthermore, one can conjecture that the more formalized an agile method becomes (Hypothesis H11), the sooner it will be considered dysfunctional in organizations with strong developmental culture (Hypothesis H22).

Tables 2–4 also contrasted agile methods with traditional methods, interpreting the latter to be modeling/documentation-oriented methods that follow sequential phased process. We hypothesized that each culture orientation, except the hierarchical one, favors agile methods, but as pointed out above that does not imply that agile methods are better ones, even though they may well be.

5.2. Limitations of the paper

The major limitation of the present paper is the conception of organizational culture implied by the CVM and the focus of culture as a predefined set of measurable independent variables. As pointed out in Section 3.1, organizational culture and related context can be interpreted to include aspects such as basic assumptions and beliefs, attitudes, values, norms, morals, models of behavior, customs, rituals, practices, habits, specific languages, ideas and symbols, heroes, art, artifacts, knowledge and technology, with varying degrees of awareness by the cultural members. The CVM focused only on values among this variety.

As implied in Section 3.2, there are alternative views of culture and the relationship between organizational culture and the deployment of agile method. Although we share with many researchers (e.g. [4,5,22]) skepticism towards the view that organizational culture can be designed and manipulated towards a desired (more agile, for example) direction at least in a short run, one can conceive a culture change as an outcome of a more lengthy process of adoption, diffusion and enculturation of agile methods and related "agile culture" [77,82].

One can also adopt mutually reinforcing and emergent views when looking at the relationship between organizational culture and the deployment of agile methods. The adoption and prospective deployment of an agile method might then be conceptualized as continuous, evolving process of enculturation in the cultural context of systems development organizations. The mutually reinforcing view perceives this process and relationship as bidirectional, maintaining that the cultural context may reinforce certain aspects of the agile methods in question while the agile methods may modify the cultural context in a reciprocal relationship. The emergent view adds even more complexity to the process, reminding that the relationship between organizational culture and the deployment of agile methods is continuously evolving and dynamic, and mechanistic, universal, context-free guidelines do not work – at least in the way they are supposed to work.

The Competing Values Model applied in the present paper represents quantitative, nomothetic research into organizational culture, while the majority of organizational culture studies are qualitative and idiographic. In the case of the mutual reinforcing and emergent views, in-depth qualitative research methods focusing on one or a few cases and using ethnography seem most

appropriate. As will become clear in the following section, we see significant research opportunities adopting these alternative views and applying in-depth qualitative research. At the same time we wish to point out that these different research lines are not necessarily mutually exclusive. Although the mutually reinforcing and emergent views assume that the process of enculturation is dynamic and unpredictable in each individual case, it does not exclude the possibility that organizational values exert influence as suggested by hypotheses in Tables 2–4, influence that is discernable only at the population level. However, researchers relying on the alternative views draw on very different conceptions of culture and therefore the results from these different research lines are unlikely comparable.

5.3. Future research

Despite the limitations, the present paper opens avenues for interesting future research. First of all, the distinction between agility as an *a priori* characterization and as an emergent property leads to two interesting research questions, which to our knowledge are unexplored.

(1) How agile are different agile methods (belonging to the agile approach) in terms of the emergent agility?
(2) How do different techniques and principles of agile methods support emergent agility?

The main contribution of the present paper, the hypotheses (Tables 2–4) associated with the theoretical model of Fig. 2, is ready for empirical testing once the relevant variables are operationalized. Although the model looks fairly complex, it is still testable using quantitative confirmatory methods. We wish to be able to proceed to the empirical validation of the model as soon as possible.

The proposed hypotheses reflect the view of culture as a set of independent variables, which are assumed to influence the deployment of agile methods. In order to have a deeper and richer understanding of the relationship at the level of individual organizations, researchers can adopt alternative conceptions of organizational culture, implying a number of additional, interesting research questions. Researchers could approach culture as a dependent variable to be influenced by a 'treatment', possibly as an outcome of gradual adoption, diffusion and enculturation of agile methods and related "agile culture". Future research could in this case consider what this "agile culture" should entail, how to change organizational culture in that direction, and how realistic such "agile culture" and culture changes are in practice.

Reflecting more the mutual reinforcement and emergent views, the idea of enculturation could imply at least three additional different strands of studies. First, one could focus on how agile methods are appropriated and adapted in particular cultural settings in a similar way as Robinson and Sharp [70]. Enculturation in this case is examined as a process in which the agile methods embed and assimilate the practices and values of the cultural context into which they are introduced, i.e. they are culturally modified (cf. also [48,49]). Researchers could try to identify in what kinds of forms the agile methods are encountered in organization, and outline the variety of the constellations of agile "practices" in practice. They could try to identity how it is appropriate to talk about and approach the agile methods in these particular cultural contexts (cf. [12,55]).

Second, researchers could also more strongly emphasize the mutual reinforcement view, which implies that agile methods also necessarily modify the cultural context in which they are used, the culture adapting to and assimilating at least something related to the agile ways of working and thinking imposed by methods. The

researchers could concentrate in identifying this kind of 'agile cultures' – not in prescriptive but in descriptive sense (see also [73]). This type of research would probably question the need to identify an ideal culture for agile methods, but the point would be to try to understand the complex dynamics between the use of any SDM (including the agile methods) and its cultural context. The research would probably also argue that a clear-cut division between these two is impossible and needless to make.

Finally, the researchers could also adopt the emergent view (see e.g. [32,49]) and examine the continuous, evolving process of negotiating and modifying agile practices and their cultural context. Culture would thus be perceived to consist of continuous spinning and re-spinning of the fragile webs of meaning [49,63]. It would be acknowledged that cultures is organizations are always contested, changing and emergent, and meanings are constantly created, recreated, negotiated and struggled over in organizations (cf. [5,22,69]). The focus should be on meaning-making, not on the system [49,63]. The meaning-making would be constantly going on both related to cultural context and the agile practices, and the researchers should try to figure out new ways for approaching and representing these fragile and contently changing constellations and their evolution in everyday life, without, this time, considering 'compatibility' as more preferred outcome than anything else.

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