

How do Scrum methodologies influence the team's cultural values? A multiple case study on agile teams in non-software industries

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Paper published in "IEEE TRANSACTION ON ENGINEERING MANAGEMENT".

Please cite as: A. S. Patrucco, F. Canterino and I. Minelgaite, (2022). "How do Scrum Methodologies Influence the Team's Cultural Values? A Multiple Case Study on Agile Teams in Nonsoftware Industries," in IEEE Transactions on Engineering Management, doi: 10.1109/TEM.2022.3146717.

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Abstract

The cultural component of the project team is recognized as one of the most critical factors in the implementation of agile project management (APM), especially in non-software industries, where the diffusion of APM still involves several challenges. Particularly, the successful implementation of Scrum – the most diffused APM methodology – seems related to the project teams' sub-culture, which may differ from the overall organizational culture of the company. This study contributes to the APM literature in non-software contexts by studying the cultural values that develop inside agile teams and the Scrum principles and practices that are particularly relevant for fostering these values. Using interview data collected from seven manufacturing and service organizations, we use the Competing Value Framework as the theoretical model to understand the cultural profiles of their organizations, how they deploy into the project teams' sub-culture, and what, if any, connections exist with the adoption of Scrum principles and practices. We find that Clan and Market values are the dominant sub-cultures in agile teams. These cultural values are fostered at a strategic level by a subset of scrum values (i.e., courage, openness, respect) and pillars (i.e., transparency and adaptation). At an operational level, retrospective meetings and the definition of particular artifacts also contribute to developing these dominant cultural values.

Managerial relevance statement

First, the findings of the study inform managers about the type of leadership needed to manage agile teams successfully. With Clan and Market being the dominant sub-cultures in agile teams, an aggressive leadership style is not necessary to focus teams towards goal achievement, than stage-gate project management. A goal value is fostered through mentoring, facilitation, and coaching with the support of the Scrum Master.

Second, we provide empirical evidence that open communication, trustworthiness, and transparency can be considered enablers for successful Scrum implementation. Organizations need to invest in tools and mechanisms to create such collaborative environments rather than in the design and implementation of rules, procedures, and control systems.

Finally, we also identify and discuss several Scrum operational practices that non-software companies should use to support the diffusion of the APM philosophy in their organizations. These are particular artifacts such as the “one-to-one” formula for solving impediments; the “form-storm-norm-perform” for team definition; the “meet after” technique for conflict management; the “personality building” approach for team building; the “liberating structure” technique for conflict resolution; and “enlarged planning” for scope and milestone definitions.

Keywords – Agile methodologies, Competing Value Framework, Organizational culture, Scrum

Paper submitted for the Special Issue: “Agile beyond software – In search of flexibility in a wide range of innovation projects and industries”

I. INTRODUCTION

During the last ten years, project management (PM) literature has focused on researching how agile project management (APM) philosophy and practices can be effectively introduced into organizations to increase their ability to manage project activities more efficiently and effectively [1] [2].

Compared to traditional stage-gate (SGPM) approaches, APM principles are based on an iterative structure of the planning and execution cycle of activities, driven by the project team rather than by the project manager [3].

The full introduction of such a disruptive approach poses a serious challenge. Companies often fail to introduce APM practices because of organizational barriers, such as skepticism from management and/or project team members, lack of understanding of APM principles, and/or lack of capabilities in implementing APM practices [4][5][6]. For these reasons, it is still rare for companies to abandon established and successful project management methodologies in favor of APM [7]. Especially in non-software industries, where APM is less widespread [2], organizations are more likely to adopt a mixed approach for managing their project portfolio, combining APM methodologies with more traditional SGPM methodologies, such as waterfall [8] [9].

In these situations, companies need to consider several internal and external factors when deciding on the most suitable PM approach for a given project [10]. In this regard, previous literature has discussed how a team's characteristics and values strongly influence the ability of companies to implement specific PM methodologies [11]. The cultural components of a project team are a critical determinant of increased internal project complexity [12][13][14]. To successfully manage projects, understanding and managing the differences in values, norms, and behaviors among team members should be a priority for project managers. They must be aware of the potential influence of these cultural differences on the adopted methodologies and team performance [15][16][17]. While an overall shared culture characterizes organizations, working units and teams can often develop a particular sub-culture influenced and characterized by specific working practices [17]. While this is critical in traditional waterfall project settings, it is even more so in APM, where effective implementation of agile methodologies strongly depends on the human factor [18].

The APM philosophy, which bases its principles on the Agile Manifesto [19][20], emphasizes the relevance of individual decision-making, workable product development, continuous improvement, and customer orientation. Successful implementation of the iterative-planning APM methodologies is possible with an "agile-ready" project team, characterized by a solid customer-oriented culture and committed to agile principles to compete in turbulent environments [7] [21]. This is particularly true for organizations using Scrum PM, the most well-known agile methodology, grounded on the possibility of shifting the decision-making responsibilities to team level — from managerial to operational levels [22] — where self-organized teams develop the product through multiple incremental steps, i.e., "sprints" [21]. For the Scrum method to be used effectively for project execution, the team needs to be organized in a completely different way compared to SGPM [23], requiring the development of new team culture and values [24][25].

Using Scrum as a reference methodology for APM, this study explores in detail the connection between the particular sub-culture that characterizes agile teams, which might diverge from the overall organization's dominant culture and the successful implementation of Scrum. In particular, we aim to answer the following research questions:

How does the adoption of Scrum methodologies influence the sub-culture of agile teams within established organizations in non-software industries?

We use a multiple case study approach and analyze seven manufacturing and service provisioning organizations operating in high-tech environments, where Scrum is widespread. Using non-software industries as a unit of analysis for studying this research problem is particularly important. Unlike software, the development of products and hardware components is connected to challenges related to the use of Scrum methodologies. For example, tangible outputs are more challenging to break down and organize in rapid iterations, and they often require coordination within cross-functional teams spanning

multiple departments, often geographically dispersed [2][26]. Under these conditions, appropriate agile values and culture could represent a key driver for project success, as they can act as an implicit coordination mechanism to overcome these sources of complexity.

Senior Scrum masters in each company were interviewed to understand the main cultural features of their organizations, how they were deployed into the project teams to create the team sub-culture, whether any possible connections with the effectiveness of Scrum adoption and implementation existed, and if so, how.

The Competitive Value Framework [53] was adopted as the theoretical lens of the study to interpret the results. Using the four archetypes of values outlined by this model as a reference point, we explore how the implementation of specific Scrum practices contributes to generating these values and, ultimately, outline what types of cultural value profiles characterize agile teams. Without any claim of causality, our results provide a better understanding of the factors behind the relationship between Scrum adoption and team culture, an under-researched aspect, especially in non-software organizations, contributing to the theoretical advancements and providing meaningful implications from a managerial perspective.

II. THEORETICAL BACKGROUND

In this section, we review the main aspects related to APM principles, Scrum methodologies, and organizational culture models, representing the theoretical foundation of this work, and consider how authors previously studied the connection between these aspects.

A. *Agile Project Management in non-software industries*

Since the 1980s, dramatic changes in the business environment have required PM activities and practices to be re-engineered to effectively address new challenges and balance efficiency, speed, and quality [27]. As a result, traditional SGPM began experiencing performance deterioration when product development activities involved increasing unpredictability and uncertainty, requiring rework and change even in the later stages [28]. In this new environment, the suitability of traditional waterfall PM methodologies has been increasingly questioned, and companies have begun to develop more innovative and flexible PM approaches [2][3][9]. This first happened in the software industry, where the APM approach was developed and formalized with the publication of the Agile Manifesto, including a list of core principles of this new philosophy [19].

Compared to SGPM, which relies on the robust long-term planning of project activities [29], APM follows the idea that prototypes and intermediate outputs are needed as soon as possible to collect feedback from the main project stakeholders, particularly customers [5]. The inputs received about the working product are used to appropriately execute and eventually adjust subsequent iterations, arriving at a final output that best incorporates stakeholders' expectations and requirements [30].

Its successful application to software projects has resulted in the APM philosophy gradually evolving from a specific PM strategy for software development to an innovative and more flexible way to manage projects [31][32], in combination with traditional approaches [33]. Consequently, an increasing number of non-software industries are adopting APM to boost project performance [34][35][36], but this transition to large-scale non-software contexts is not free of problems. Agile principles were initially conceptualized to support PM in a specific context (software industry) with smaller teams and outputs characterized by strong modularity [9][34]. When implemented in non-software projects, these initial assumptions are no longer valid, and the effective implementation of APM methodologies depends on the agile culture of the organization and the ability of project teams to adapt and adopt agile principles [37][38]. Adjusting the agile philosophy in these contexts is particularly critical when Scrum is the primary methodology for managing agile project [39]. In Scrum project management, the project team, led by the project manager, consists of the product owner (responsible for maximizing the value of the product), the Scrum master (accountable for ensuring that the project team follows the Scrum principles), and other cross-functional team members [40]. The Scrum methodology is characterized by short phases or "sprints" when project work occurs. During sprint planning, the project team identifies a small part of the scope to be completed during the upcoming sprint, which is usually a two to four-

week period. After each sprint, a tangible intermediate output is released. This iterative method is beneficial as the project planning efforts are distributed during the project, the product development time can be significantly reduced, and more feedback can be collected from the final customers at each product release [25]. In large-scale non-software projects, this method revolutionizes the project team's way of working, as it requires self-organization of the cross-functional teams, continuous communication, and the adoption of the five core Scrum values: commitment, courage, focus, openness, and respect [24][40]. Only by nurturing and developing an appropriate team culture can organizations ensure successful implementation of Scrum PM and obtain commitment, transparency, customer centricity, continuous improvement, and waste reduction [9][35][40][41][42].

In the past, scholars have partially discussed the challenges associated with APM and Scrum implementation in non-software contexts, including insufficient team size, lack of effective communication, poor collaboration with customers, lack of experience in agile methods, and difficulty in scaling in larger projects [43]. Among these factors, organizational unpreparedness is considered the most critical barrier to the diffusion of the agile philosophy [44]. A cultural mismatch with Scrum values and a lack of capability from the top management to persuade team members of the validity of this methodology prevents the successful implementation of APM [42][45]. The challenges associated with the transition from SGPM and waterfall to APM and Scrum continue to be reported in industrial cases [34][37][41].

B. Organizational culture, sub-culture and the competing values framework

Organizational culture can be defined as “the pattern of shared values and beliefs that help individuals understand organizational functioning and thus provide them with norms for behavior in the organization.” [46, p.4]. It relates to the deepest underlying values shared by the members of an organization [47], and it includes several aspects to help understand why organizations and their members act in a specific way [48][49]. In this regard, Schein [50] conceptualizes organizational culture at three levels: artifacts and creation; values; basic assumptions – with “values” representing the dominant aspect of culture conceptualization. One of the most commonly adopted models when studying the dominant culture inside organizations is the Competing Values Framework (CVF) [51][52][53]. First proposed in the organization management literature by Quinn and Rohrbaugh [51]. This framework uses two major dimensions to classify organizational culture and effectiveness. One differentiates organizations characterized by flexibility, versatility, and dynamism from organizations characterized by stability, control, and steadiness. The second dimension differentiates between internally focused organizations (relying on values such as collaboration and harmonious relationships) and externally focused organizations (relying on values such as competition and differentiation). The model identifies four clusters, each representing a different value that competes with the others: “Clan,” “Adhocracy,” “Hierarchy,” and “Market,” and contribute to the formation of an organization with different features. The characteristics are detailed in Section 1 of the supplementary material file.

The CVF is a powerful tool, as it helps us understand the shared factors of the dominant culture that motivate and orient individuals to behave in a particular way.

However, trying and managing a one-size-fits-all culture is difficult. Especially in big organizations, people of common company areas gather around their interpretations of the dominant company culture, forming organizational subcultures [54]. Subcultures develop specific values and norms that might diverge from those of the organization's main culture [55]. This happens particularly in project teams where team members might develop their way to manage organizational interactions according to the methodology, targets, and contingencies [54]. These values are usually consistent with their sense of priority, which is why subculture members can act differently [56]. In these contexts, the CVF still proves suitable for application at a specific organizational unit or team level, helping to display the combination of cultural values that can partly differ from the overall organizational culture and evaluate possible misalignments with the desired scenario at the company level.

C. Team sub-culture and agile values: a missing link?

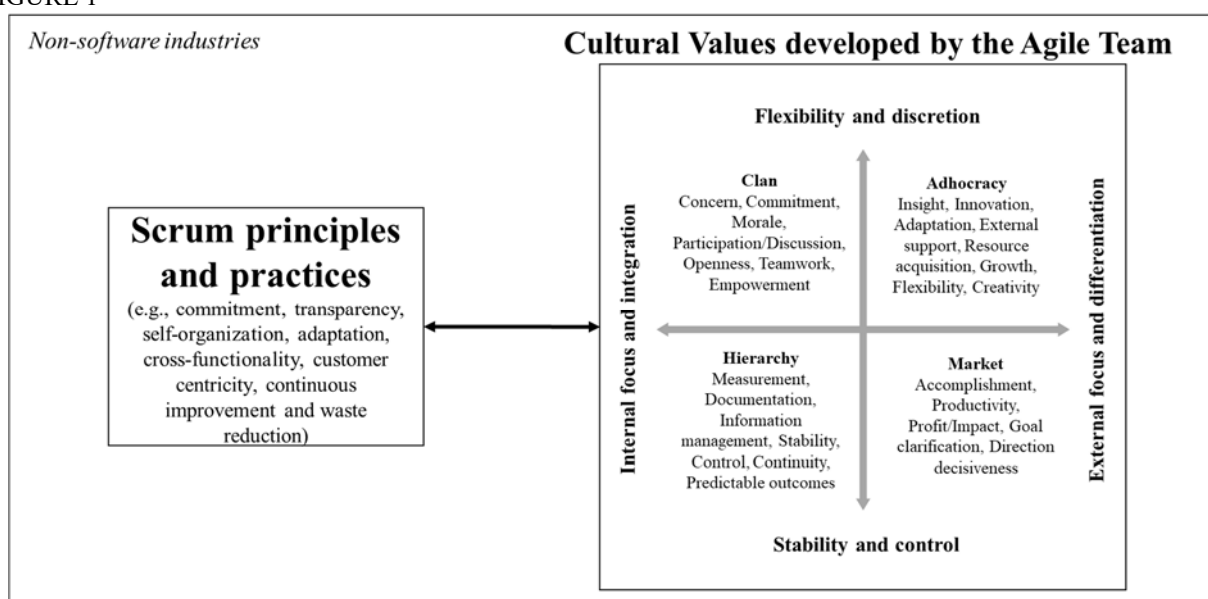
The problem of subculture generation is particularly delicate in agile projects that require a particular

team culture and values to be successfully managed and completed [57]. Although some authors have tried to address the problem of the association between culture and agile implementation, the literature still does not provide a sound theoretical conceptualization of what agile culture is or defines the values that agile teams develop for the successful implementation of complex agile methodologies like Scrum.

Although it is widely believed that implementing agile methodologies requires developing an appropriate organizational subculture and values, the results available are very anecdotal and entirely related to software development and IT. Furthermore, they mainly focus on how culture and values impact the success and performance of agile projects, while limited evidence is provided to define the types of values developed by agile teams and how specific agile methodologies (specifically, Scrum) contribute to creating agile subcultures.

This study aims to fill this gap by exploring the research framework reported in Fig. 1, which combines the main value types included in the CVF [51] and how they relate to the main principles and practices of the Scrum methodology [45].

FIGURE 1



III. METHODOLOGY

As the adoption of Scrum methodologies in non-software industries is relatively recent and empirical evidence on these aspects is limited, we opted for an in-depth exploratory multiple case study approach. The aim is to inductively develop new knowledge about the relationship between Scrum principles and practices and team sub-cultures [58][59]. This is an appropriate method to provide an in-depth understanding of the cultural aspects when the unit of analysis is the team and not the overall organization [60]. Additionally, it has been used successfully in the literature to discuss the relationship between organizational culture and APM practices [46][52].

A. Selection of companies

Theoretical sampling was used to seek similarities in the cultural implications for agile teams adopting Scrum in non-software industries to select companies [61][62]. Therefore, the following criteria were used to build the sample:

First, we included service and manufacturing industries, as firms frequently introduce product innovations over time, making innovation projects a recurrent event for these organizations. In such a scenario, Scrum can provide the highest benefits but can also be a challenge, especially when compared to software industries, as their cultural approach is geared towards innovation. Manufacturing and service companies are usually organized in distinct and sometimes geographically dispersed functions and units. Especially in manufacturing companies, procedures and protocols guide decisions, coordination, and information flow, with control prevailing on speediness [63]. Accordingly, rapid

iterations of intermediate tangible outputs may be challenging to achieve, with culture and mindset affecting the effectiveness of Scrum adoption [2][26].

Second, we decided to include multinational organizations, as big global companies are more likely than smaller firms to have a structured approach for managing projects and a developed culture that can be analyzed.

Lastly, we wanted to involve companies with at least two years of experience using APM and Scrum methodologies and institutionalized Scrum Masters to support project execution.

Consistent with these aspects, we connected seven leading companies in their respective industries (telco, retail, energy, pharmaceutical, plastic, and logistics services) in Europe and the United States.

Each company was contacted and given information about the study's objectives to gauge their suitability for inclusion in the research project.

All seven provided interesting preliminary information about their organizational culture and the level of use of APM and Scrum methodologies. Before conducting direct interviews, we provided details about the aspects we wanted to analyze and a sample of critical questions to be asked. All the companies confirmed their willingness to be involved in the study and provided the contact details of the scrum masters to be interviewed. For all the cases, we were able to reach out to the lead expert Scrum Master for the company; in four cases, the company referred us to two lead expert Scrum masters, so we decided to interview both. Table I summarizes the characteristics of the cases and the data sources.

TABLE 1

Company	Industry	Total employees (approx.)	# Agile Teams	Years of Scrum adoption	Number of interviewees	Secondary sources
Kia	Telco	90,000	46	2	Scrum Master 1 (Kia1) Scrum master 2 (Kia2)	Direct observation of sprint zero and one team meeting Teamwork photos
Phone	Telco	100,000	6	3	Scrum Master 1 (Phone1) Scrum Master (Phone2)	Direct observation of one team meeting Teamwork photos Summary emails
MH	Retail	120,00	30	3	Scrum Master (MH1)	Direct observation of one team meeting and one retrospective Teamwork photos Roadmap photos
Volt	Energy	5,000	6	2	Scrum Master (Volt1)	Direct observation of one team meeting Project reports and emails
Green	Pharmaceutical	354,000	9	5	Scrum Master (Green1)	Direct observation of one team meeting and a one-to-one coaching session Teamwork photos
PLS	Plastic manufacturing	21,000	12	5	Scrum Master 1 (PLS1) Scrum Master 2 (PLS2)	Direct observation of one team meeting Teamwork photos
Trucky	Logistics	500	3	2	Scrum Master 1 (Trucky1) Scrum Master 2 (Trucky2)	Teamwork photos Project reports and emails

The sample could be considered suitable for the study's objective from a descriptive perspective. The companies included are heterogeneous in terms of industry and country of origin, and they satisfy the

outlined selection criteria. However, they are similar in terms of project management approaches and organizations. They build an Agile Team consisting of a product owner, the development team, and the Scrum master in each project and use Scrum methodologies. The projects are discretized in events (i.e., sprint planning, daily stand-up, sprint review, and sprint retrospective), and each of them provides a formal opportunity to inspect and adapt the output. All the companies also adopt Scrum artifacts (in the product backlog and sprint backlog) to give every project stakeholder the same level of transparency on project progress activities.

B. Data collection and interview protocol

Interview data were collected between 2019 and 2020, following a semi-structured interview protocol informed by the research framework and covering two main areas (see Section 2 in the supplementary material file for the list of detailed questions).

First, the Scrum principles and practices were assessed in line with the recommendations of the Scrum guide [40]. We asked about the timeframe of project events (e.g., daily stand-ups, reviews, retrospectives), level of adoption of APM pillars (e.g., individuals and interactions over processes and tools, working software over comprehensive documentation, customer collaboration over contract negotiation, responding to change over following a plan), and Scrum principles and practices (e.g., transparency, adaptation, inspection).

Second, the cultural value aspects were investigated following the Organization Culture Assessment Instrument (OCAI), based on the CVM [51] and allows the mapping of six specific dimensions: dominant organizational characteristics, organizational leadership style, management of employees, organizational glue, strategic emphasis, and success factor. The main purpose is to receive honest and qualitative answers about the organizational culture and subculture(s) characterizing the team under scrutiny. Additionally, the interviewees were asked to fill out the quantitative version of the OCAI instrument, and the results were summarized through radar charts.

The protocol was piloted and validated in the first interview with a Scrum Master [58].

As reported in Table I, to triangulate information collected directly through interviews, two other data sources were used: 1) direct observation through site visits; 2) archival data and secondary source resources provided by the Scrum Masters, such as project documents, teamwork photographs, audios or videos, and other artifacts providing complementary information about organizational culture and Scrum methodology implementation. Direct observations and secondary sources were used to build more robust substantiation of the constructs identified with the coding of interviews [61], providing further examples of findings (e.g., about Clan value, adding insights on one-to-one meetings to foster collaboration, and on digital tools to facilitate open communication through direct observations; about market value, adding insights on roadmap practices through teamwork photographs).

All interviews, which lasted 50–75 minutes each, were recorded and transcribed for coding purposes. If any information was unclear or more data were needed, the informants were contacted by phone to request clarification.

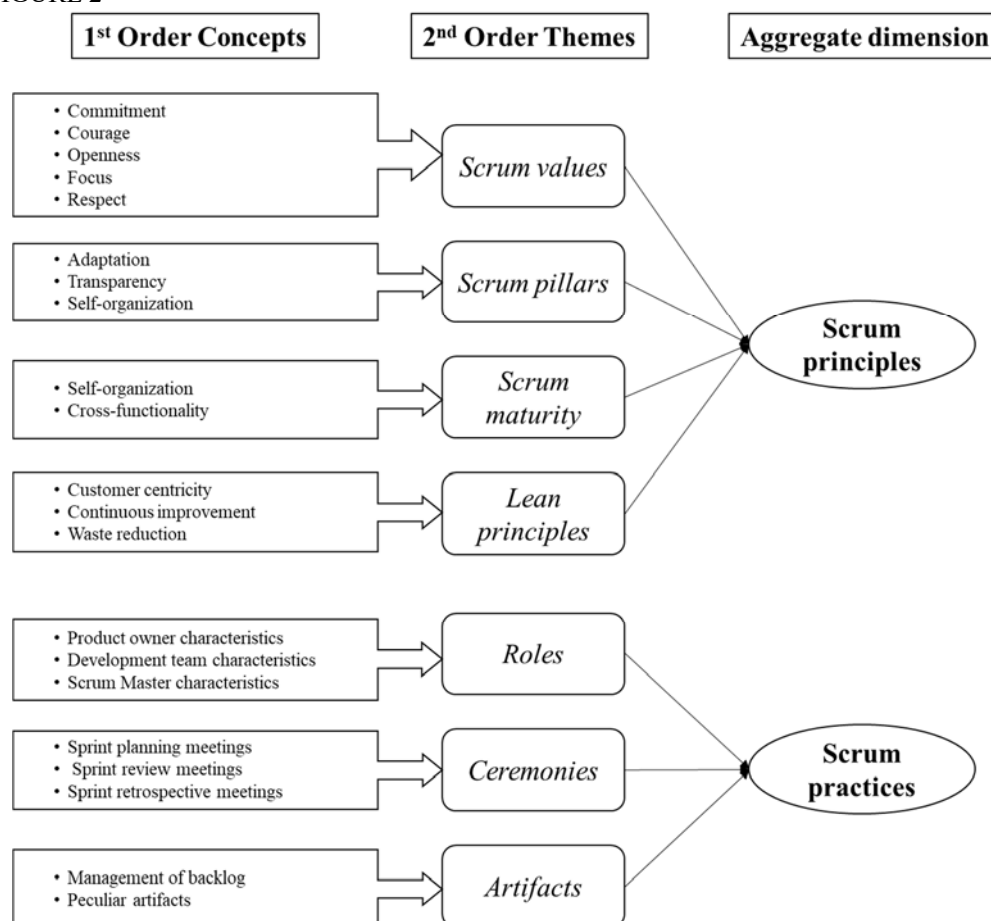
C. Coding approach

The data were then analyzed by three different researchers, with iterative cycles of coding and inter-coder agreement, in line with the procedure of Miles and Huberman [61]. No software was used for data analysis because the datasets were relatively small. Researchers manually searched for themes and codes given the topic and frequent use of metaphors by respondents. The validity and reliability of the information were evaluated according to the approach described by Gibbert et al. [64].

Data were categorized and reorganized according to the main areas we wanted to explore Scrum principles and practices and cultural values developed by Agile teams. We followed the Cameron and Quinn model for cultural values consistent with the OCAI instruments adopted [53]. For Scrum principles and practices, the information provided by the interviewees was sufficient to systematically organize the data following an inductive approach, where the main variables were coded following the suggestions of Strauss and Corbin [65] and Gioia et al. [66]. First, a large set of codes and quotes were

generated due to the fine-grained reading of the raw data. Second, these codes gradually collapsed into first-order and second-order categories through multiple iterations and references to previous research and established theory. The results of this process are shown in Fig. 2.

FIGURE 2



Consistent with this coding approach, within-case analysis was performed to categorize each case and identify recurrent patterns across them (see Section 3 in the supplementary material file for the detailed within-case analysis).

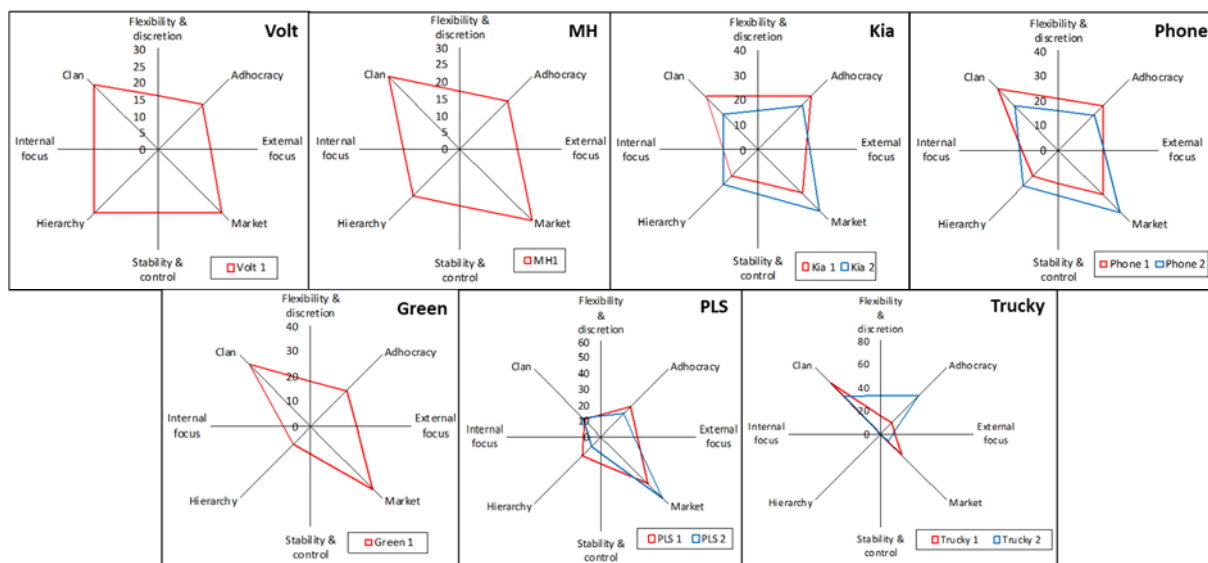
IV. FINDINGS

The analysis of the seven different non-software companies adopting Scrum principles and practices identified recurrent patterns characterizing the sub-culture of agile teams within established organizations. For all the companies under inquiry, both the OCAI instruments and the interviews confirmed that the two prominent subcultures present in the agile team and fostered by the agile mindset are Clan, oriented toward collaboration, and Market, oriented toward customer satisfaction and market competitiveness. Furthermore, adhocracy is less dominant than the values discussed, while hierarchy is discouraged. Furthermore, specific Scrum principles and practices have emerged as particularly relevant.

Fig. 3 summarizes the main sub-culture profiles found in the cases analyzed.

The following sections illustrate these results in detail.

FIGURE 3



A. Clan as the predominant value

Clan represents the most substantial value for agile teams. According to our sample, three out of six competing value dimensions fit the clan subculture: the dominant characteristic, leadership style, and organizational glue.

Collaboration is a must, and it is fostered within all analyzed teams. Scrum-dedicated ceremonies are often designed to enhance this aspect. For example, in the Volt case, at the beginning of each project, the Scrum Master follows the Forming-Storming-Norming-Performing technique to foster team identity and social bonds. The team is created according to this technique, and a simple task is assigned to build more robust team dynamics. If conflicts occur, they are resolved in a one-to-one discussion with the Scrum Master. After a short settling-in period, the agile team should exploit synergies using the complementary competencies that characterize the team members. At the end of this process, the team and product owner create the product backlog.

Conversely, in the Kia and Trucky cases, personality matching is performed during sprint zero to ensure team cohesion and collaboration.

Teamwork and empowerment, two typical traits of Clan value, were frequently mentioned by Scrum Masters, for example, in the Trucky case, *“the successful use of Scrum methods in projects is tied to teamwork participation and empowerment, (...) it allows everyone to contribute and learn from their actions”* (Trucky1)

Open and fair communication and the courage to express feedback are also encouraged. This can *“lead to proactive interaction between colleagues”* (Green). Digital tools such as Trello or Jira are usually adopted for formal exchanges to foster communication and feedback. However, teams can also use informal communication channels, such as WhatsApp and Hangout. The degree of freedom to choose the preferred way to communicate is also a particular characteristic. Scrum masters want to *“put people at their ease, leaving them free to use the tools they need”* (MH). Also, *“transparent communication and information sharing are seen as a way to enhance individual participation and commitment to work activities”* (Phone1).

A *“great sense of belonging”* (Green) is one of the critical success factors of agile teams, as team members usually see themselves as *“part of an extended family”* (Kia1). Therefore, cross-fertilization of knowledge is stimulated, and team members can quickly learn from those with more expertise. For example, in the PLS case, senior scrum masters act *“as learning hubs for more junior people”* (PLS1).

In five out of seven cases, the scrum masters gave the teams the responsibility to self-organize many project aspects. The Scrum Master is then assigned a purely facilitating role, acting only in need, such as for the team composition in the MH case, the management of team building activities in Phone, or the definition of the Scrum ceremonies in the Green organization.

The Scrum master's leadership style is often described as "*mentoring and facilitating*" (Phone, 2). An aggressive leadership style is discouraged as it is considered to "*lead to micro-management*" (MH), an aspect to be avoided in agile teams. One-to-one coaching sessions between the Scrum master or product owner and other team members were performed in all the analyzed cases. For example, for the Green case, these one-to-one coaching sessions focused on learning the agile way of working to avoid inter-team and intra-team competition.

B. *The relevance of the Market value and customer-centricity*

If we focus on result orientation, we may notice that, for all the cases included in the sample, the success factors of the projects are defined according to the market culture. For example, in the Phone case, "*a project is defined as successful if it can outpace the competition, so employees must be trained to be better than their competitors*" (Phone1).

It is important to note that no cases showed evidence of an aggressive leadership style: mentoring always seems to be the preferred leadership style, as it facilitates team collaboration, and it favors the team members' well-being rather than threatening it.

Agile teams are focused on satisfying customers' expectations by "*continuously improving products and solutions*" (MH) and "*producing outputs at planned timing*" (Green). Teams must continuously improve their solutions, as their capability to satisfy customers' expectations is the basis of their success. Scrum masters are called to propose technical training to employees, increase team velocity and resilience, and increase the ability to quickly and flexibly respond to potential changes in demand and output requirements. For example, in the MH organization, every agile team must design a roadmap where the objectives they are targeting and the different activities related to customer needs and requests are clearly outlined. Each activity is then classified as "done" or "to be done." This practice is seen as a way to foster customer-centricity and increase the pace of production. In the PLS case, market value is crucial for focusing the team on addressing industrial customers' requirements related to sustainability issues, particularly for plastic products.

C. *Clan and Market as interdependent values*

Consequent to the discussions in the previous sections (and consistent with the recommendations of the CVF), the Clan and the Market cultural values seem to be interdependent and coexist in all the analyzed cases. Therefore, regardless of the dominant culture, combining these two archetypes of cultural values can provide the best outcomes.

For example, in the Kia case, creating an informal environment and focusing on loyalty and trust (features of the Clan value) represent a way to spur motivation and productivity. This leads to solutions that can succeed in the market and meet customer needs (typical traits of the market value).

Similarly, in the MH case, the company provides technical training to team members to increase their ability to outpace the competition (another characteristic of the market value). This results in a strong emphasis on human development and the creation of high-skilled labor (which characterizes the Clan value again).

In the Truck case, the company regularly issues agile team "open calls" so that employees can voluntarily decide to join the project they think would most valorize their skills and maximize the effectiveness of team performance. In other words, empowerment and freedom are crucial levers for higher market competitiveness.

D. *Different levels of Agile Team maturity are associated with different levels of Market and Clan values*

Our cases also show that companies characterized by agile teams with different maturity levels and working experience show different emphasis on their Clan and Market values. Namely, in mature agile teams (as in the Kia, Phone, and PLS cases), the Clan value is less prominent than the Market one, as social boundaries and effective communication are "*taken for granted*" (Kia2). Individuals must be

proactive and autonomous in finding solutions and achieving the requested results, and the emphasis on facilitation and mentoring is limited.

However, in less mature agile teams, such as in the Volt, MH, Green, and Trucky cases, the Clan value is still predominant. For Scrum principles and practices to be adopted and implemented successfully, team members have a greater need to boost the mentoring, training, and fostering of individual competencies, as *“we give people time to grow, and expectations about individual contributions are limited until the learning process is completed”* (Volt).

E. Adhocracy and Hierarchy values are less dominant cultural values

The Adhocracy and Hierarchy cultural values are less relevant in agile teams.

Regarding the adhocracy value, these cultural values are considered our cases only in the employee management area, where they are encouraged to propose new ideas, take risks, focus on experimentation, and try and fail with no consequences. Thus, in the Volt case, employees are invited to *“propose ideas for increasing the velocity and quality of sprint activities”* (Volt). They are also involved in finding new business opportunities by leveraging the evolving and dynamic regulation of the energy sector.

Hierarchical culture, instead, is less present in the companies interviewed. No formal and standard procedures, mandatory documentation, or stable team compositions were detected in the analyzed cases, as these practices could be detrimental to the success of agile teams. In particular, issues may arise because of coordination needs. For example, in the Phone case, some team members can be hired as freelancers and might not work in the field but remotely from home. In these cases, the Scrum Master assumes a more decisive and formal coordinating role for the different team activities, emphasizing alignment in real-time among team members. For these reasons, *“team members end up being really committed to rules and guidelines”* (Phone2). Additionally, the agile teams could sometimes work together with external infrastructural architects, UX/UI designers, and data analysts in the Volt case. These workers are not fully assigned to one specific team but are part of their functional team, called upon *“when required”* to provide operational support to the different Scrum teams. In this case, the need to exploit these technical competencies must be combined with increased formal coordination and alignment. The transparency of rules and advancements and a clear definition of roles and tasks are crucial aspects, ensuring individual accountability for the project tasks.

F. Scrum principles and practices fostering and fostered by Clan and Market values

Lastly, our cases allow us to identify some of the fundamental Scrum principles and practices most likely to foster and be fostered by the dominant Clan and Market cultural values.

Of all the Scrum values, courage and openness are two of the key ones that need to be pursued by agile teams. In almost every case, we found a strong emphasis on the role of mutual support in solving problems and the possibility that team members might learn from each other.

In the Kia and PLS case, *“everyone is called on to speak and asked to give an opinion”* (Kia2) to propose ideas, communicate possible issues and suggest improvements in the relationships between members.

In MH, timely sharing of constraints during task execution allows others to be proactive in suggesting a possible way to solve problems and connect with senior members and/or external partners to share and acquire knowledge on best practices.

In Trucky, all team members work collaboratively to achieve targets and find innovative solutions.

For the Phone organization, *“risk-taking is a team decision, with no individual responsibilities”* (Phone1), and team members are encouraged to learn by failing and sharing their lessons learned.

This is possible thanks to the establishment of mutual respect and a third Scrum value that emerged during the interviews. To be successful, agile team members need to *“always respect other individuals and their work, even in cases of evident failures”* (Volt). In the Green case, micro-management is discouraged, and every team member is involved in decision-making. Furthermore, people are pushed to discuss issues in the Kia and PLS cases, avoiding all dominance, bias, and aggressiveness towards

other people.

In the MH case, the company tries to establish healthy competition between teams and team members, encouraging mutual support, trust in others' activities, dynamicity, and a willingness to share ideas and best practices.

This leads to the two Scrum pillars: transparency and adaptation.

In all cases, the agile team (as an entity) is considered accountable for success and failure. This should stimulate clarity in team building and management and continuous dialogue between team members. In Kia, for example, ceremonies are the moments used to share and discuss any impediments and the current status of the work; in Green, ad-hoc tools (such as Jira and the physical dashboard) are used to facilitate unique and transparent communication.

Adapting to one's agility is the last fundamental principle to be promoted. In the Volt and MH cases, *"teams can choose when and how ceremonies should be"* (MH). In the Phone, PLS, and Trucky cases, the Scrum Master adapts the ceremonies and agile tools to suit the context, objectives, and team characteristics. Accordingly, the agile teams deal with different practices each time, building resilience to the context. In Kia, the method of writing stories is not standard but depends on stakeholders and developers. The possibility of hiring external freelancers also opens the door to the concept of adapting tools and techniques to involve remote workers.

The role and characteristics of Scrum masters are essential to reinforce these principles. Scrum masters need to have strong leadership abilities without having an aggressive style and need to act as a facilitator and point of reference for every team's issue. In Volt, Phone, PLS, and Kia cases, the Scrum Master is usually an internal employee, while in MH, Green, and Trucky, they are externally recruited. In the Green case, the choice of an external recruit is due to the low maturity level regarding APM implementation and the difficulty in finding appropriate profiles. In the Trucky case, all the Scrum masters are hired from external associations, with the explicit aim of recruiting young professionals, as *"we believe an effective and broad diffusion of agile principles cannot be accomplished by putting people who are biased by 20 years of waterfall methodologies in charge"* (Trucky2).

Regarding Scrum practices, although all the interviewees highlighted the need to implement the Scrum framework in an integrated way, two aspects emerged as particularly interesting: the role of retrospective meetings and the definition of particular artifacts.

During retrospective meetings, the Scrum Team inspects the performance of the last sprint regarding individuals, interactions, processes, tools, and their definition of "done." These are critical moments, as they allow the team to discuss the positives and the improvements for the next sprint. They are also the right time to review compliance with the principles of Scrum. These moments were highly emphasized during the interviews. Unfortunately, in the Kia case, *"these meetings are often rushed, and we have to prioritize what to discuss"* (Kia2), which does not give the team members time to reflect on what they did "well" or "badly" in the previous sprint. The "good" or "bad" or "to be improved" structured format is also used by Trucky. In MH, retrospective meetings occur in the form of collective discussions mediated by the Scrum Master after each team member has shared their thoughts on the sprint in the form of a post-it stuck on a whiteboard. In contrast, Phone, Green, and PLS use retrospective sprints to collect and provide feedback to the team and employ creative thinking techniques (e.g., the "sad, glad, mad" exercise) to stimulate discussion.

Lastly, the success of agile teams also lies in the adoption of particular artifacts. For all the cases, the interviewees described in detail the benefits of using specific techniques, such as the "one-to-one" formula for solving impediments and the "form-storm-norm-perform" for team definition (Volt); the "meet after" procedure for conflict management (MH, PLS, Trucky); the "personality building" approach for team building (Kia, Trucky); the "liberating structure" technique for conflict resolution (Phone); and the "enlarged planning" approach for scope and milestones definition (Green).

V. IMPLICATIONS OF FINDINGS AND MAIN CONTRIBUTIONS

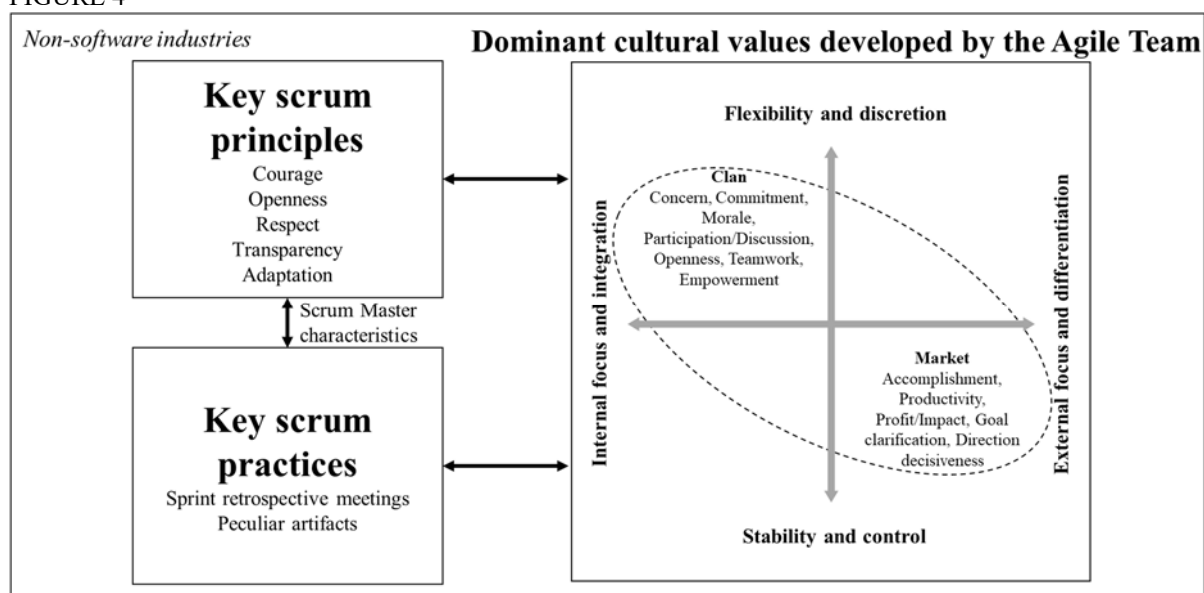
The main objective of this study was to provide exploratory evidence on how the adoption of Scrum methodologies in non-software industries influences the sub-culture of agile teams, an aspect still

unexplored in the PM literature. We interviewed senior Scrum masters in seven multinational companies operating in manufacturing industries and service provisioning, characterized by innovation as a significant competitive priority and where Scrum can represent a vehicle of higher project success while suffering cultural barriers.

By collecting information about the Scrum principles and practices adopted, and the cultural values that characterize the project team, we conclude that Clan and Market are the values that dominate agile project teams. These cultures foster the implementation of a subset of agile scrum principles (i.e., courage, openness, respect, transparency, and adaptation) and practices (i.e., sprint retrospective meetings; particular artifacts). To make this process successful, the role and characteristics of Scrum masters are fundamental.

Fig. 4 summarizes the main results of the study.

FIGURE 4



These findings have several theoretical and managerial contributions and some limitations.

A. Theoretical contributions

From a theoretical point of view, our results confirm the Clan and the Market values as the dominant cultural types in agile teams. This finding is not new in the APM literature, for example, [21][42][45]; however, while this evidence has been recognized in purely software-focused industries, our cases also confirm this validity for non-software contexts.

Second, this study further validates Cameron and Quinn's CVF [53] are unlikely to reflect only one subculture. In contrast, it stresses a balance between opposite values, imposing paradoxical requirements for effective organizations [51]. Particularly in non-software industries, although Clan and Market represent opposite poles of the CVF, they are seen as interdependent and complementary, and they both contribute to shaping the cultural values in agile teams.

Overall, this study contributes to widening the PM studies focused on the conceptualization of agile culture, for example, [42][45][57]. Thus, we profile the agile culture as dominated by cultural values typical of the Clan and the Market value and interconnect the cultural values to specific agile and Scrum principles and practices, thus linking "soft" organizational behavior aspects to "hard" PM issues.

Finally, the results are focused on non-software contexts, thus contributing to the stream of PM literature that specifically focuses on studying the APM philosophy and Scrum methodologies outside the software industry [9][35][34][32][37]. Our findings extend current knowledge about the characteristics of agile culture in these contexts and how these types of environments can be fostered by implementing specific principles and practices, thus advancing theoretical knowledge in this regard.

B. Managerial contributions

The results have several practical implications from an organization and project management perspective.

First, the findings inform managers about the leadership priorities needed when managing agile teams. As Clan and Market are the dominant cultures, compared to SGPM, an aggressive leadership style is not necessary to focus teams towards goal achievement. Instead, goal achievement is fostered through mentoring, facilitation, and coaching, particularly by utilizing the role of the Scrum Master.

In this sense, we emphasize the critical role of the Scrum Master: by leveraging their experience, they represent the point of intersection between team culture, compliance with agile principles, and implementation of agile practices; therefore, companies need to focus on selecting and training these personnel, as they can prove to be drivers or barriers for the agile project success.

In addition to the role of Scrum masters, we provide empirical evidence regarding enablers and obstacles to the effective implementation of agile methodologies in non-software industries. An organization favoring open communication, trustworthiness, and transparency, consistent with an organizational culture oriented towards Clan and collaboration, is an enabler for successful Scrum implementation. Therefore, companies need to invest in tools and mechanisms to create such an environment rather than creating structured rules, procedures, and performance measurement systems.

Within this environment, we also identify and present several Scrum operational practices (i.e., particular artifacts) that companies can use to support and improve the diffusion of agile philosophy.

However, the focus on Clan and Market as interdependent cultural values for agile teams could generate further problems in non-software companies. Only a few organizational members follow agile principles in these contexts, while the rest of the company is more devoted to traditional SGPM methodologies, especially in globally dispersed organizations. This means that acting on both Clan and Market simultaneously could be unrealistic, as contrasts might arise when agile teams interface with the non-agile parts of the company, characterized by hierarchy and adhocracy values. A solution to this problem could be to commit the organization to follow specific rules and procedures; this might become a particular aspect of scrum implementation in non-software companies as, in more traditional software contexts, the use of formal rules and procedures should be avoided.

C. Limitations and future developments

Our multiple case study approach, qualitative and exploratory in nature, is characterized by some limitations.

First, due to the small sample size and the limited number of industries included, it cannot be concluded that the cultural profiles and the principles and practices identified portray the views of the entirety of non-software organizations. Therefore, further research is needed to analyze the cultural values and Scrum methods adopted in other industries. Similarly, the adhocracy and hierarchy values do not see predominant sub-cultures in agile teams need to be further confirmed using a larger dataset.

Second, our research problem explores the subcultural values that characterize agile teams where Scrum principles and practices are adopted. It could also be interesting to analyze the opposite relationship, the types of organizational culture that favor (or not) the adoption and use of Scrum methodologies, again sourcing a larger sample to test causality links.

Third, our interview data collected the view of Scrum masters and, indirectly, product owners, but we could not collect information from team members subjected to Scrum principles and practices. This leaves room for further research to determine whether the same conclusions about the interconnection of Scrum and team subcultures are still valid when the insights of the team members are considered. This should include geographical, seniority, and background differences across teams in dispersed organizations.

Lastly, our analysis does not include the effects of contingent variables at the individual and/or company levels. For example, the influence of an individual's cultural norms and values on work cultural behaviors was not considered. Most importantly, as our sample included multinational

companies, the role of the overall company culture was not considered in the study, as we assume that subcultural values generate and evolve mostly independently in this type of organization. This is not always the case for small and medium businesses; thus, future research should consider this aspect and include the relationship between culture and subculture to increase the validity of this study's findings.

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