Surveying the Relevance of the Critical Success Factors of Agile Transformation Initiatives from a Project Management Perspective

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ABSTRACT

Background: Agile methods and practices have been consistently adopted in recent years as alternatives to traditional software development processes to address the ever-changing needs of IT organizations. In a previous systematic mapping study, we identified twelve critical success factors of agile transformations from a project management perspective. *Objective*: In this paper, we investigate how practitioners perceive the relevance of these factors and whether other factors should be considered. *Method*: We conducted a survey research involving project managers from several organizations undergoing agile transformations. *Results*: The participants' perceptions provided valuable insights into the relevance of the critical success factors. Additionally, we identified five new critical success factors: organizational ambidexterity, use of tools and automation, breaking down organizational silos, team commitment, and alignment of organizational goals and expectations. These newly identified factors contribute to a more comprehensive understanding of organizations' challenges during an agile transformation. Based on the results and the literature, we formulated three propositions representing recommendations that can foster agile transformation. *Conclusions*: The evidence gathered in this study indicates that the factors investigated previously are highly relevant. Moreover, organizations should consider them to enhance the chances of success of agile transformation initiatives.

CCS CONCEPTS

• **Software and its engineering** → **Agile software development**;
• **General and reference** → *Surveys and overviews*.

KEYWORDS

Agile Transformation, Agile Software Development, Critical Success Factors, Project Management

1 INTRODUCTION

To meet the constant IT industry changes, agile methods and practices have been used increasingly as alternatives to traditional software development processes [17, 37, 46]. The agile approach continues attracting organizations over the years since the agile manifesto publication [11]. The greater use of agile approaches denotes the relevance of improving management processes referred to at the time [30, 32]. Some benefits of agile adoption include quality, costs, flexibility, short delivery times, speed, and efficiency in software development processes [37, 46].

Agile transformations are associated with the transition or migration from the traditional software development process to agile and affect all areas of the organizations [16]. To foster their advantages and benefits, challenges, obstacles, and critical success factors (CSF) should be considered during the undertaken process change as the problems arising from the agile transformation can affect the entire organization [26, 31]. CSF are associated with practices, strategies, methods, tools, and other actions that can increase the probability of success, achieving organizational goals and objectives, and competitiveness [7]. When properly managed and maintained, they can significantly impact an organization's success [13, 42]. Issues that can affect the success of agile adoption include those related to culture, leadership, communication, managerial support, and others associated with management performance [37, 47, 52].

Properly managing a software project can interfere with the project's chances of success or failure [7, 49]. Noteworthy, project

management plays an essential role in agile transformation initiatives. Therefore, to minimize the impact of adversities arising from adopting an agile initiative, careful planning is required, in addition to an efficient management process [42]. Despite the importance of CSF, there is little visibility about CSF aimed at agile adoption [37], especially associated with the project management perspective [6]. In general, studies on CSF in agile transformation do not emphasize specific elements of project management or reflect aspects related to managers' attribution and performance, specifically in organizations that develop software [6].

In a previous work, we executed a systematic mapping study [6] in which we identified twelve CSF for agile transformations from a project management perspective that reinforce the importance of project management in that context: Top mMnagement Support, Team Empowerment, Adapting the Process to Agile, Customer Focus, Decentralized Decision-Making, Team Accountability, Team Personal Characteristics, Experimentation of New Solutions, Servant Leader Mindset, Adoption of Participatory Management, Good Communication, and Building Strong Teams.

In this paper, we aim to analyze whether the CSF identified in [6] are relevant in organizations according to the point of view of agile project managers from different organizations undertaking agile transformation initiatives, as well as whether new factors should be considered. We executed a survey research to improve our understanding of the CSF based on the participants' experience in real organizational contexts. Their contribution provided evidence that the CSF can influence and have relevance in the success of an agile transformation. We identified five new possible CSF: Organizational Ambidexterity; Use of Tools and Automation; Breaking down Organizational Silos; Team Commitment, and Alignment of Organizational Goals and Expectations.

This paper is organized as follows: Section 2 presents related work; Section 3 outlines the method; Section 4 shows the discussion; Section 5 brings the limitations; and Section 6 concludes the paper.

2 RELATED WORK

Several studies deal with issues related to agile settings, although the classification used on them (e.g., success factors, difficulties, obstacles, or challenges [22, 27, 37, 46]) may differ. Based on 19 failure factors and 36 success factors, Chow and Cao [18] propose 12 agile project success factors and combine them with four dimensions (quality, scope, time, and cost) to formulate 48 hypotheses to determine the perceived level of overall project success by practitioners. The authors sought to reduce the number of CSF as they considered that some might be anecdotal. So, only ten hypotheses were supported by the data, allowing the identification of six CSF for agile software development projects: Delivery strategy, Agile software engineering practices, Team capability, Project management process, Team environment, and Customer involvement. The unconfirmed success factors were Management commitment, Organizational environment, Project definition process, Project nature, Project type, and Project schedule.

In a subsequent work, Stankovic et al. [53] executed a similar survey with 23 participants from former Yugoslavia. They confirmed factors such as Project management process, Project definition process, Project nature, and Project schedule. Only the first two were

also confirmed in [18]. Compared to our work, both studies focus on agile projects, not agile transformation projects. Moreover, the authors do not emphasize the project management perspective as they discuss results in a more general way. However, the authors suggest the importance of project managers since the three CSF identified depend on their decisions, although they do not directly discuss the role of project management: Choosing a competent team, Practicing rigorous agile software engineering techniques, and Executing an adequate agile delivery strategy.

Campanelli et al. [16] conducted a study on agile transformation to investigate the difficulty level of implementing agile success factors from the practitioners' point of view. The focus was on the difficulties of implementing CSF in a fertile environment for agile transformation. The authors executed a questionnaire-based survey in two phases. As a result, they ranked the most difficult success factors to be implemented according to the practitioners. Although the subject deals with CSF in agile transformation, the focus and objectives differ from our work. However, some CSFs are similar to those in [6] and used in this study, e.g, Changes in mindset of project managers, Changes in management style and decentralized decision making, and Business goals.

Alhroub and Jaaron [3] discuss the changes required to transform traditional projects into agile ones. This work aims to analyze the readiness of agile project management (APM) in software development companies, evaluating the necessary changes to transform projects into agile ones. The authors also address the challenges and risks involved in transformation and explore the agile principles, and CSF implied in agile project management. The work brings a case study validated by a questionnaire and semi-structured interviews. Regarding the CSF, some of them are similar to CSF evaluated in this work, such as Change, Customer-centered approach, and Communication. Their work is focused on management but involves other aspects that are broader than in ours.

Mishra et al. [37] examine CSF involved in adopting agile methods in software development organizations aimed at small and medium-sized companies. The authors used a questionnaire applied to 52 organizations. CSF investigated in their work refer to organizational factors that influence the decision to implement agile methods in projects. Among them, Managerial support and Team structure relate to the factors evaluated in our work. The set of CSF considered crucial comprised Organizational culture, Team structure, and Managerial support. According to the authors, the lack of managerial support, the size of large organizations, and the traditional organizational culture are detrimental to agile adoption.

As mentioned before, in a previous work [6], we presented results of a systematic mapping study on CSF of agile transformations from the project management perspective. It is important to notice that project managers are detrimental to increasing the agile transformation initiative's chance of success and must be adequately involved in it. We found few studies focus on this subject despite its relevance. We identified twelve relevant studies from four important databases for the Computer Science and Information Systems areas. Table 1 shows the twelve CSF identified that served as a basis for the survey research presented in this paper. The most cited CSF are Top Management Support, Team Empowerment, and Adaptating the Process to Agile. In addition, CSF focused on Good Communication, and Building Strong Teams are also highlighted,

Table 1: Critical Success Factors identified in [6].

ID	Critical Success Factors	Description	Study
F01	Top management support	Support from the highest level of management and control of an organization in an agile transformation.	[16, 37, 47, 48, 52]
F02	Team empowerment	Degree of freedom, confidence, motivation and engagement that the team experiences in an agile transformation given by the organization's top management.	[3, 28, 44, 52]
F03	Adapting the process to agile	Effective adaptation of the process used by the organization in an agile transformation to adapt it to the use of agile principles and practices.	[3, 15, 52]
F04	Customer focus	Use of customer-focused management strategies to increase customer engagement and collaboration with the team.	[3, 28, 52]
F05	Decentralized decision-making	Autonomy of decisions given to the team where everyone is responsible for the decisions.	[16, 19]
F06	Team accountability	Relationship between a team and a project manager that establishes a delegation of responsibility and requirement of an "accountability" of the execution of this responsibility.	[14]
F07	Team personal characteristics	Personal characteristics, both of the team and the client, can interfere with the agile transformation. For example, collaborative attitude, honesty, responsibility, readiness to learn, cooperation, technical experience and qualification.	[3]
F08	Experimentation of new solutions	Experimentation to allow teams to explore and test new ways of working to find more effective solutions to create value for the customer.	[15]
F09	Servant leader mindset	The agile project manager profile must change from a planner and controller to a team facilitator concerning collaboration, creativity and group decisions.	[16]
F10	Adoption of participatory management	Management that motivates and engage the team to achieve alignment between agile transformation and business strategies.	[57]
F11	Good communication	Communication skills that project managers must have when transmitting information to the team clearly, objectively and accurately.	[19]
F12	Building strong teams	Team building by the organization with members empowered with knowledge and technical skills, as well as positive attitudes towards organizational change and the organization's culture.	[52]

although less mentioned. Besides the twelve identified CSF, seventeen effects generated by CSF were also found: Commitment to change, Decentralized decision-making and effective customer feedback, Team collaboration, Agile culture construction, Work control, Self-organized teams, Customer satisfaction, Better communication, Team adaptability, Trust in people, Responsibility building, Increased software quality, Increased investment in projects, Management support for teams, Facilitate effort estimation, and Reduced delivery time.

3 RESEARCH METHOD

We executed a survey research based on questionnaires [34] to evaluate the results presented in the systematic mapping study that supported this work. Survey research in the context of software engineering is used to identify the characteristics of a large population of individuals [34]. We followed the steps suggested in [34, 35]: Objectives Definition, Questionnaire Design, Questionnaire Elaboration, Questionnaire Validation, Questionnaire Distribution, and Results Analysis.

The study goal is described based on the GQM model (*Goal-Question-Metric*) [9]: **Analyzing** critical success factors **with the purpose of** characterizing **with respect to** the relevance **from the point of view of** project managers of organizations that develop software **in the context** of agile transformation.

3.1 Planning

We defined research questions (RQ) to guide our study:

- **RQ1**: How relevant are the identified critical success factors for an organization undergoing an agile transformation from a project management perspective?

- **RQ2**: What other critical success factors are relevant to agile transformations from a project management perspective?

The questionnaire presented in Table 2 was designed based on both RQ. The target population comprised project managers who work (or worked) in organizations executing agile transformation initiatives. The questionnaire consists of (i) questions characterizing the profile of the study participants (ID01 to ID05) and the organizations in which they work (ID06 to ID08); (ii) questions about the relevance of the factors identified in [6] (ID09); and (iii) identification of new CSF (ID10 and ID11). To improve the accuracy of the answers, we also provided a brief definition of each CSF investigated based on Table 1's content. Participants were informed that the confidentiality and anonymity of the answers would be ensured. We used Microsoft Forms to create the electronic questionnaire. The response time estimated by Microsoft Forms was 7 minutes.

3.2 Execution

Before releasing the questionnaire, we conducted a pilot with three participants (project managers). The pilot enabled us to understand the difficulties encountered by the participants. As a result, we improved the questionnaire's questions.

The survey was performed in two periods: from September 29th to November 10th, 2022 and from July 7th to July 16th, 2023. The intentional non-probabilistic sampling technique was chosen because it involves a sample used to help answer the main question of an investigation, focusing on a specific subgroup. We sent out the questionnaire to personal contacts in companies we knew were actively engaged in agile transformations and we also made it available via Linkedin and to the volunteer group of PMI Brazil. This group is composed of project managers and many of them work in

Table 2: Applied questionnaire.

ID	Questionnaire Item
01	Have you held or are you currently holding a project manager (leader, supervisor, coordinator, manager, project director, or other management position) role? (Yes; No)
02	Have you participated or are you currently participating in an agile transformation initiative? (Yes; No)
03	If yes, approximately how many years have you participated in it? (Less than 1 year; Between 1 and 2 years; Between 3 and 5 years; Between 6 and 10 years; More than 10 years)
04	What is your time of experience in the role of a project manager? (Less than 1 year; Between 1 and 2 years; Between 3 and 5 years; Between 6 and 10 years and More than 10 years)
05	What is your educational level? (High School; Higher Education; Specialization; Master's Degree; Doctorate Degree)
06	In which segment does your organization operate? (Industry; Commerce; Service)
07	Does your organization use the software for internal (own) usage or sale? (Yes; No; Both)
08	What is the size of your organization? [Micro-company (up to 19 employees); Small company (from 20 to 99 employees); Medium company (from 100 to 499 employees); Large company (over 500 employees)]
09	Based on your experience, what is the level of relevance of each presented factor [Top management support, Team empowerment, Adapting the process to agile, Customer focus, Decentralized decision-making, Team accountability, Team personal characteristics, Experimentation of new solutions, Servant leader mindset, Adoption of participatory management, Good communication, and Building strong teams] for an organization that wants to undergo an agile transformation? (None, Very Low, Low, Medium, High and Very High)
10	Please suggest up to 5 new CSF that affect agile transformation initiatives from a project management perspective. (optional)
11	For each new CSF suggested, what is their level of relevance for an organization that wants to undergo an agile transformation? (optional)

organizations that are going or have gone through agile transformations.

To answer RQ1, we summarized the valid answers. Valid answers had questions ID1 and ID2 responded with "Yes," and all other mandatory questions answered. Four participants reported not having performed a project manager role, and ten participants did not participate in any agile transformation initiative. In the end, we obtained 51 valid answers and disregarded 14.

We obtained 39 contributions from 20 participants to questions ID 10 and ID 11. We used them to identify possible new CSF – thus answering RQ2 – and to improve our understanding of the original factors, thus helping us to discuss RQ1. All paper's authors (mentioned below as ABCDEFG, respectively) contributed to answering both research questions.

The response to RQ1 (i.e., closed-ended questions) was provided by ABCD and reviewed by EG. The initial response to RQ2 (i.e., open-ended questions about new factors) was suggested by ABCD. They worked in pairs (AB and CD) before coming up with a consensus. First, the contributions associated with software development projects (e.g., "well-defined requirements" and "risk management") or lacked context information that allowed the association with agile transformations (e.g., "performance" and "project characteristics") were disregarded. Then, the remaining contributions were analyzed to identify whether they presented additional characteristics or behaviors that help understand the investigated factors but are not mentioned in [6] or whether they could represent a new CSF from a managerial perspective.

To characterize a contribution as a new factor, we first evaluated its possible impact on agile transformation initiatives based on our collective knowledge and experience in project management, agile methods, and software process improvement initiatives. Then, we looked for literature sources (for instance, those cited in Section 2 and others such as [10, 38, 41]) that could help define each factor and present evidence of its relevance to such initiatives. In the end, we decided not to include typical project manager responsibilities such as 'risk management', even though we understand them as fundamental in any project. Moreover, the sources cited above do not include tasks associated with project management despite indicating the need to manage the process improvement project

using good management practices (for instance, they cite factors such as Improvement Management, Managing the Software Process Improvement Project, and Measurement).

Next, the authors FG worked together to create the groups in Figure 3 and the discussion of results. We considered the definitions of the critical factors in [6] – Table 1 shows a short description only – and of the new factors (i.e., CSF13 - CSF17) identified in this study. Each new factor definition provided in Section 4 was intertwined and grounded in the literature. Then, we used each factor's description and explanation to name the primary groups of factors that high, middle, and direct management should pay attention to (in green in Figure 3). This naming was refined when a new factor was associated with the group. In parallel, we created and refined the propositions, maintaining an indirect association between them and the proposed groups. It is worth noticing that the grouping process requires creativity in naming factors and is also iterative and incremental subject to frequent reviewing for consistency and adequacy – it is a qualitative process after all.

Finally, all authors reviewed the study's results and discussion. Adjustments were made accordingly. The work was collaborative and iterative and reflects the consensus of all authors.

3.3 Results

We organized the results according to both RQ and the participants' characterization.

3.3.1 Participants' characterization. Figure 1a shows the approximate time of participation in an agile transformation initiative. Most participants (≈43% or 22 participants) have between 3 and 5 years of experience. Figure 1b shows that most participants have more than 10 years of experience working as project managers (≈63% or 32 participants). The data indicate that all project managers have a level of education equal to or above higher education, as shown in Figure 1c. Among them, six have higher education; 28 have a specialization, 16 professionals have master's degrees, and only one has a doctorate degree.

Most managers (≈82% or 42 participants) reported working in organizations in the service segment. Figure 1d also shows that one organization's segment is commerce, and eight organizations are in
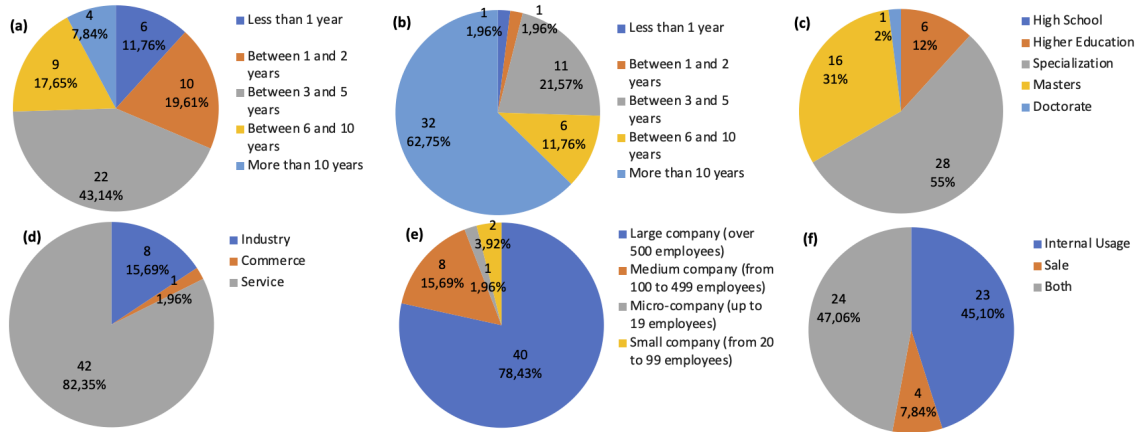
Figure 1: Profile of participants concerning (a) Approximate time of participation in an agile transformation initiative, (b) Time of experience as a project manager, (c) Level of education, and characteristics of the organizations in which they work concerning (d) Segment of activity, (e) Size, and (f) Type of software usage.

the industry sector. We used SEBRAE's classification [5] (see options in question ID08 in Table 2) to characterize the organizations' size. Figure 1e indicates that ≈78% of project managers work in large companies and only ≈15% work in medium-sized ones.

As can be observed in Figure 1f, 24 participants (≈47%) indicated that their organizations only use the developed software externally, 23 (≈45%) internally, and four (≈8%) both internally and externally. Internal use of software characterizes organizations that develop software that supports them in providing services to the population (such as organizations from the telecommunication or financial sectors), while external use of software characterizes organizations whose business is providing external services to third parties (such as consulting firms and software factories). This result is consistent with most organizations being from the services sector.

3.3.2 RQ1: How relevant are the identified critical success factors for an organization undergoing an agile transformation from a project management perspective? Figure 2 presents the level of relevance of the investigated CSF according to the participants.

We divided the factors into three groups. Group A comprises the three top factors F11 - Good communication, F01 - Top management support, and F04 - Customer focus. They were associated with very high relevance by ≈71% (or 24 participants), ≈63% (or 32 participants), and ≈61% (or 31 participants), respectively. Group B consists of factors whose participants mostly pointed out some level of relevance (very high or high): F09 - Servant leader mindset, F12 - Building strong teams, F02 - Team empowerment, F10 - Adoption of participatory management, and F06 - Team accountability. Group C comprises the remaining factors. They were considered medium relevant by at least ≈20% of respondents. Group C consists of factors F03 - Adapting the process to agile, F08 - Experimentation of new solutions, F05 - Decentralized decision-making, and F07 - Team personal characteristics. Nonetheless, their relevance to the agile transformation cannot be underestimated as they were also pointed with high or very high relevance by the participants.

As mentioned, we used the answers to Question ID 10 to improve our understanding of the surveyed factors. Thus, from 12

contributions, we identified additional characteristics or behaviors not explicitly mentioned in [6] but that can be associated with the surveyed factors.

Regarding *F01 - Top management support*, participant P9 indicated the importance of "the use of agility" and the "institutional guidance towards agile change". Concerning *F03 - Adapting the process to agile*, participants highlighted the importance of "excelling in software process improvement" (P19) and using "[a wide range of] agile practices that can support the important aspects of the agile transformation" (P17). Also, P05 suggests avoiding hybrid processes by stating that having a process "part agile and part traditional does not bring the best of either approach, and the company keeps turning in circles." Associated with *F04 – Customer focus*, we also identified the need to "involve and motivate the customer" to participate in the transformation (P20) and the importance of the "customer's commitment" to it (P08).

Regarding *F08 – Experimentation of new solutions*, it deals with "flexibility and adaptation" (P18). It depends on proper "change management" and the understanding "that change will happen and that the [adopting the] new [way of doing things] should be treated as learning" (P04). That is associated with "accepting errors" (P18) and "psychological safety"[1] (P19).

New examples of *F07 - Team personal characteristics* provided were: "predictive capacity" (P2), "personal experience in digital transformation" (P3), "collaboration" (P6), and "trust" (P7). Participant P12 provided an example of behavior associated with *F09 - Servant leader mindset*, which shows that the manager works towards collective success and not just forcing the team to follow pre-established solutions, which is the "ability to identify the best approach/framework for each project that works". A new characteristic associated with *F11 - Good communication* was "management transparency" (P1). Finally, *F12 - Building strong teams* is associated with "training team and managers in agile practices" (P20).

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[1]Team psychological safety is a shared belief held by members of a team that it is OK to take risks, to express their ideas and concerns, to speak up with questions, and to admit mistakes – all without fear of negative consequences [24].
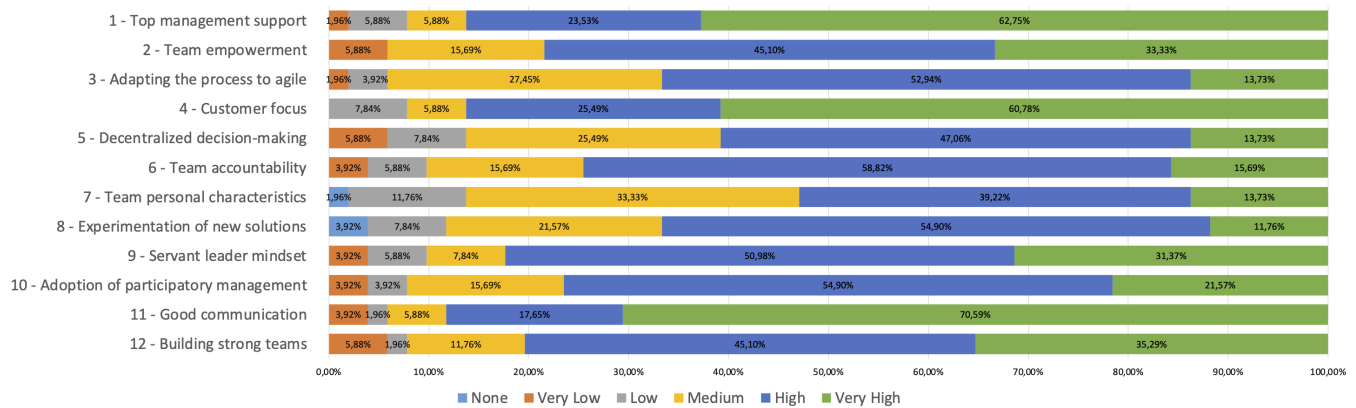
Figure 2: Level of the relevance of the critical success factors.

Moreover, among the characteristics to be fostered are "multidisciplinarity" and "diversity" (P11).

3.3.3   RQ2: What other critical success factors are relevant for agile transformation from a project management perspective? Based on the participants responses, we identified five new CSF. They are described below, with the nomination of participants contributing to their identification. For each one, we provided an ID without following any criterion to order them. Moreover, we used literature sources to define them. In the next section, we discuss their impact on agile transformation initiatives.

Organizational Ambidexterity (F13) was suggested by participant P11. It refers to an organization's ability to meet simultaneously conflicting demands; at the managerial level, it is associated with acquired managerial skills [23]. It is also related to strategy, flexibility, and efficiency from the existing competencies and the new opportunities that arise [2]. Balancing the application of resources, acting in uncertain business environments exploiting opportunities, and managing conflict and change are aspects emphasized in the ambidexterity concept [23].

Utilization of Tools and Automation (F14) was suggested by participant P11. Tools and automation can help reduce time, estimate effort, and improve the quality of deliveries, especially in long and repetitive software development processes.

Breaking Down Organizational Silos (F15) was suggested by participants P6 and P13. The organizational silo is a rigid structure that hinders collaboration and transparency of information among the most diverse sectors [39]. Thus, this factor refers to breaking down or removing barriers (physical and/or psychological) and divisions that may exist among different segments or departments of an organization. Participant P13 cites the need to "adapt the contract and supply team to safeguard the agile principles" as an example of integrating different areas of the company to the changes arising from the transformation.

Team Commitment (F16) was suggested by participant P1. It is related to the very essence of agile methods and practices. Team (or organizational) commitment is the relative strength of an individual's identification with, and involvement in, a particular team [12]. It can be characterized by a strong belief in, and acceptance of, the team's goals and values; a willingness to exert considerable effort

on behalf of the team; and a strong desire to maintain membership in the team [12].

Alignment of Organizational Goals and Expectations (F17) was suggested by participants P06, P12, P14, and P16. It is intrinsically linked to the need to have a set of strategies, structures, and methods capable of guiding organizations to achieve superior performances and agility in business, and such instruments are known by those involved in agile transformations. Three respondents emphasized aspects such as "strategic alignment" (P06), clarity about the "purpose of the organization" (P06), and "level of clarity and alignment with the stakeholders' expectations" (P12 and P14) and the agile transformation's "objectives" (P14 and P16). Other important items are "constant feedback to the team" (P16) and having a "strategic view of the product or service the organization provides" (P17).

4   DISCUSSION

To answer RQ1, we executed a survey research to identify the relevance of twelve CSF for agile transformation initiatives from the project management perspective. Table 3 presents the list of factors based on their level of relevance (very high or high). From 51 respondents, only two stated that certain investigated factors are irrelevant to the agile transformation from a management perspective: F07 – Team Personal characteristics (1 respondent) and F10 – Experimentation of new solutions (both respondents). Thus, based on the responses and practitioners' experiences, we have evidence that the critical factors identified in the literature are relevant to the success of agile transformations.

In addition, to answer RQ2, we asked the respondents for new indications of CSF for agile transformations from a project management perspective. While many contributions could be traced to the existing factors, we identified five possible new factors. As mentioned in Section 3.2, we consulted sources related to project management, agile methods, and software process improvement to better characterize their impact to agile transformation initiatives. We discuss the newly suggested factors below, pointing out the project management perspective.

F13 - Organizational Ambidexterity highlights the importance of organizational and project managers' dexterity in project management. Managers must be prepared to handle conflicting and

Table 3: Critical success factors based on their relevance level (very high or high).

Order	Critical Success Factor
1	F11 - Good Communication
2-3	F01 - Top Management Support
2-3	F04 - Customer Focus
4	F09 - Servant Leader Mindset
5	F12 - Building Strong Teams
6	F02 - Team Empowerment
7	F10 - Adoption of Participatory Management
8	F06 - Team Accountability
9-10	F03 - Adapting the Process to Agile
9-10	F08 - Experimentation of New Solutions
11	F05 - Decentralized Decision-Making
12	F07 - Team Personal Characteristics

contradictory decisions that often require different approaches. In the context of a software development project, managers should possess an agile mindset, be willing to experiment with new solutions, and build teams capable of handling unforeseen demands and situations while often having to adapt processes to meet personalized customer demands [40, 50], which can challenge the efficient allocation of resources. Moreover, the customer demands, or the foreseen project results may conflict with top management expectations towards the agile transformation goals. In high management levels, ambidexterity is also essential due to the difficulty of aligning all stakeholders' expectations with the organizational and transformation's goals.

The correct choice of tools and process automation [18, 54] is inherently linked to factor *F14 - Utilization of Tools and Automation.* Managers must identify the best practices and tools that can optimize the work process and make it more agile. It involves selecting and using technologies and tools that support not only management activities but also tasks executed by the team, such as continuous integration, test automation, version control, and performance monitoring. Choosing the wrong tool support can negatively impact agile adoption [18, 54]. Moreover, adapting existing tools is a challenge to overcome in agile journeys [46].

F15 - Breaking Down Organizational Silos can promote collaboration, transparency, and achieving common goals and priorities. It is particularly important because communication flow can be affected by team-specific jargon and tools, contributing to the misalignment of priorities in development teams [39]. Moreover, in agile initiatives, collaboration and communication among different areas in a software project are essential. Organizational structures that do not promote open interaction are incompatible with agile practices and pose challenges during the transition process [22, 46]. Project managers must ensure effective and close communication among teams and between departments, and/or sectors of the organization to prevent rework and conflicts.

F16 - Team Commitment is essential for achieving the transformation's success. The team must be committed and willing to learn and experience new practices and approaches. Responsibility for continuous improvement and product quality must be a commitment of everyone directly involved in the improvement process and the entire organization [46, 56]. Motivators are built into this factor, which influence the agile teams' commitment and effectiveness, according to Trzeciak and Banasik [55]. Top management support

and other CSF investigated in this study are relevant to the team's commitment [25, 46, 51]. However, commitment cannot be built without confidence, transparency, good communication, a strong sense of importance in change, good organizational climate, and clear definitions of strategies, objectives, and goals. Besides, there must be a system of promotions and rewards, with job and salary plans, performance management, investment in skills and training, and tools and automation support, among other incentives that help to increase the team engagement [55].

F17 - Alignment of Organizational Goals and Expectations refers to the clarity and transparency with which top management transmits the objectives, goals, and priorities, and is considered a CSF also in other contexts [1, 16, 18, 22]. This factor can impact others. For instance, "Participatory Management" can be facilitated when there is a clear and transparent definition of what needs to be achieved in relation to business strategies and how agile transformation fits into this context.

Based on the contributions of the study's participants, we found that CSF cannot be seen as isolated factors only. The factors are fundamental to a successful agile transformation journey that makes a difference for project managers in isolation or groups. Thus, we created an integrated view of all factors (Figure 3) seeking to identify any patterns. We identified three major primary groups of factors that represent aspects that high, middle, and direct management should pay attention to when conducting improvement initiatives considering the transition to agility, respectively: "Organizational Orientation to Agile Transformation," "Management Support to Agile Project," and "Support for Building Sustainable Agile Teams."

Regarding the "Organizational Orientation to Agile Transformation," top management support can influence other factors, such as engagement, motivation and empowerment. Still, we see interconnected strategic issues related to top management support that permeate financial support, cultural change management [6], and how processes are defined to address organizational needs. Furthermore, members of agile teams should have a trusting environment with middle management and a clear and genuine perception that the agile transformation is fully supported by top management. Top and middle management are responsible for clear communication of organizational objectives in the agile transformation, which is achieved through establishing institutional policies and strategies that assist teams during the transformation. Thus, the institutional policy must: (i) support the teams and their decisions; and (ii) ensure that members of agile teams are encouraged to take risks, communicate their ideas, and express concerns about the product and development process.

Therefore, we formulate our first proposition, highlighting that an effective management approach can significantly influence the success of agile transformation initiatives. This influence is achieved by promoting alignment between the organization's needs and objectives and how the teams responsible for executing them adhere to the directives of the agile process.

Proposition 1: Together, top management and middle management should develop an institutional policy that enables
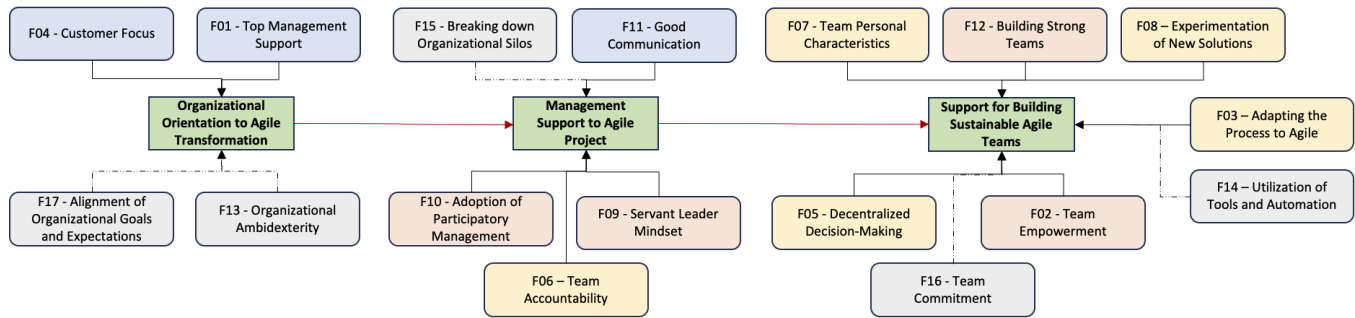
Figure 3: Integrated view of the critical success factors of agile transformations from a project management perspective. Green boxes represent the primary group of factors that high, middle, and direct management should pay attention to. Factors associated with the relevance Groups A, B, and C (see Section 3.3.2) are presented in blue, orange, and yellow, respectively, while the new factors (which did not have their relevance evaluated in the survey) are presented in gray and connected to the primary groups using dashed arrows. Red arrows indicate that one group most likely affects the other one.

the establishment of norms and procedures fostering a culture of self-organization and autonomy for decision-making within agile teams to ensure alignment and commitment from everyone in the organization.

Regarding the "Management Support to Agile Project," although some factors do not directly relate to attributions of a management position, the cultural, leadership, strategy, and technological aspects are related to the field of action of managers [6]. That is also in line with the literature [3, 16, 18, 37], which emphasizes the importance of management practices as determining factors for achieving success. They are also factors that affect people involved in the agile transformation. As people are at the very heart of agile settings [11], such factors cannot be neglected. Based on that, we formulate our second proposition.

> **Proposition 2:** Management plays a vital role in facilitating and supporting the implementation of agile practices within the organization, and they must guarantee the availability of necessary resources. At the same time, they must actively assist the team in promoting a collaborative environment, delegating responsibility, and removing cultural obstacles that can negatively impact the agile transition.

Regarding "Support for Building Sustainable Agile Teams," reinforcing the idea of organizational mutation understood in the agile transformation [26], the cultural aspects pointed out by the participants emphasize that the organizational culture has a relevant influence on how organizational change occurs, as is the case during agile initiatives [8, 20, 27, 33, 46]. Nonetheless, aspects associated with national culture cannot be neglected. According to Hofstede et al. [29], national cultures are part of the mental software we acquired during the first ten years of our lives, in the family, in the living environment, and at school, and they contain most of our basic values. They encompass the majority of our core principles. These cultures predominantly manifest themselves in the practices and behaviors of the organization.

An example of such a cultural aspect is *Power Distance* [29], defined as the degree to which a society accepts unequal power between people. According to Hofstede [29], in a society with high power distance, people accept and expect significant differences in power and authority between people and behave differently towards individuals in positions of power. Conversely, in a society with low power distance, people tend to reject power inequality and expect equal treatment in all spheres of life.

Power relations are intrinsically associated with cultural elements [8] and may affect the new critical factors. For instance, team commitment (F16) can affect organizations with hierarchical structures [4]. The imposition of new agile methods and practices done from the top down by top management can generate impacts for the entire organization [4, 22]. In this case, power distance can create a climate of uncertainty, making team engagement difficult [4, 8, 39]. Power distance can be a challenge for breaking down organizational silos (F15) since the high hierarchical distance can interfere with the teams' collaboration, autonomy, and self-organization, emphasizing the roles within a more vertical configuration [4, 8, 39]. Furthermore, power distance can affect organizational ambidexterity (F13) by creating an aversion and resistance to change [8, 45], which certainly impacts flexibility and adaptability in agile transformation processes. Based on that, we formulate our third proposition.

> **Proposition 3:** The team should be empowered to make decisions, ensuring autonomy and self-management, which involves a cultural shift aimed at reducing the power distance in the organization.

While middle management might occasionally act as Product Owners (in Scrum) during planning activities, empowering the team's self-management has to be a key focus. Moreover, we intend to investigate further how cultural aspects affect the transformation journey in future work.

5 LIMITATIONS AND THREATS TO VALIDITY

For Kitchenham and Pfleeger [35], surveys based on questionnaires are not simple, despite being a simple way to colect and assess opinions, preferences, characteristics, and other particularities. It is necessary to understand its methodological structure to create a

reliable and valid research instrument, minimizing the risk of bias and other threats. The difficulty in participants' correctly understanding the questions and lack of experience are limitations that may occasionally occur. The questions were carefully constructed and thoroughly reviewed to ensure clarity and avoid doubts. We made a concerted effort to create them as objectively as possible, including explicit statements and explanatory items whenever necessary. We piloted the questionnaire with three project managers whose responses we disregarded. Their feedback helped us improve the questions' adequacy and organize them better.

There are also imposed limits related to the short period the questionnaire was made available and the sample size. The non-probabilistic sample was intentionally selected to complement the scarcity of studies on project managers' experience in agile transformations, especially considering the limited number of studies available [6]. This type of sampling approach is characterized by researcher judgment and is useful when it is necessary to include a small number of sample units [43], or obtain a "deliberately biased sample" [36]. Due to the non-random and non-representative nature of the sample, it is not possible to generalize the results. As Kitchenham and Pfleeger [35] pointed out, questionnaires tend to have low response rates. As such, some related work had a low number of valid responses, for instance, [54] and [37], which had 23 and 52 answers, respectively. Our sample size was still small, considering the large Agile community population.

In addition, it is important to noticed that our focus was to understand the CSF from a group that is not quite prevalent (i.e., project managers with experience on active or former agile transformation initiatives). Therefore, we sent out the questionnaire to the practitioners' list and contacts with the desired profile. On the other hand, it may have caused many responses from participants working in large organizations (40 out of 51) - if the survey was conducted with participants from small companies, the results might have been different. Nonetheless, most participants in our study show significant experience on the subject. From 51 participants, 38 have six or more years of experience as managers, and 31 have six or more years of experience participating in agile transformations. The participants were all from Brazil, except for one. Therefore, results may not be generalized to the context of all organizations facing agile transformations in the world.

As the survey participants did not evaluate the newly suggested factors, we acknowledge that we cannot argue for their relevance in the same manner as we did with the original factors. We recognize the need for further investigation and intend to explore these newly suggested factors in future studies. That will allow us to gather more evidence and insights to understand their potential impact on agile transformation initiatives.

6 CONCLUSION

The growth of agile methods and practices has been featured prominently in reports such as the "15th State of Agile Report" [21]. Transitioning to agile involves numerous factors, challenges, and obstacles that organizations must consider when migrating from traditional processes [25, 26, 46]. However, there is a need for reports on CSF of agile transformations. Nevertheless, such factors

can significantly aid the agile transition process by offering insights into successfully implemented initiatives and their achieved results.

We present the results of a survey research conducted to analyze the relevance of twelve CSF, as presented in [6], in the context of agile transformation from a project management perspective. Additionally, we explored the consideration of other potential factors. All survey participants possess experience with agile transformations and hold managerial positions, with the majority having more than ten years of experience. The evidence collected indicates the significance of these factors and highlights the crucial role of project managers in the success or failure of agile adoption [3, 6, 42].

Our findings can significantly contribute to design and plan the transition process in a manner that enhances the likelihood of successful agile implementation. We expect that organizations seeking to increase their chances of success in agile transformation will use the investigated CSF as a reference, given the indication of their relevance in agile adoption initiatives.

For future research, we plan to continue this work and expand its scope by involving project managers from different locations and diverse groups. Our approach will also include a qualitative research method, incorporating field study and conducting semi-structured interviews. Additionally, we will investigate the influence of cultural aspects on agile transformations, such as power distance.

ARTIFACT AVAILABILITY

The survey results and the form used in the opinion survey can be seen at https://figshare.com/s/0e7202c58c54fc6b482a.

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