What Leads to the Success of Agile Transformation Initiatives? A Study on Critical Success Factors

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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 previous research, we identified twelve critical success factors of agile transformations from a project management perspective and evaluated their relevance with practitioners. In this research, we also identified other factors suggested by the study's participants. *Objective*: In this article, we extend our investigation of how practitioners perceive the relevance of these factors and whether other factors should be considered. In addition, we investigate the relevance of the effects these factors have on agile transformations. *Method*: We conducted a survey involving project managers from several organizations undergoing agile transformations. We analysed the data quantitative and qualitatively. *Results*: The participants' perceptions provided valuable insights into the relevance of the critical success factors. Additionally, we identified four new critical success factors: capacity building and continuous learning, improving processes to meet business needs, organizational change management, and focusing on product quality. These newly identified factors foster the understanding of organizations' challenges during an agile transformation and contribute to a more comprehensive depiction of the challenges involved with such endeavour. Based on the results and the literature, we present three propositions representing recommendations capable of promoting agile transformations. *Conclusions*: The evidence gathered in this article indicates that the factors and effects investigated are highly relevant. Moreover, organizations should consider them to enhance the chances of success of agile transformation initiatives.

Keywords: *Agile Transformation, Agile Software Development, Critical Success Factors, Project Management, Survey*

1 Introduction

To meet the constant IT industry changes, agile methods and practices have been used increasingly as alternatives to traditional software development processes (Campanelli and Parreiras, 2015; Reginaldo and Santos, 2020; Mishra et al., 2021). The agile approach has continued attracting organizations over the years since the agile manifesto publication (Beedle et al., 2001). The greater use of agile approaches denotes the relevance of improving management processes referred to at the time (Hohl et al., 2018; Jovanović et al., 2020). Some benefits of agile adoption include quality, costs, flexibility, short delivery times, speed, and efficiency in software development processes (Reginaldo and Santos, 2020; Mishra et al., 2021).

Agile transformations are associated with the transition or migration from the traditional software development process to agile and affect all areas of the organizations (Campanelli et al., 2017). To foster their advantages and benefits, challenges, obstacles, and critical success factors (CSFs) should be considered during the undertaken process change as the problems arising from the agile transformation can affect the entire organization (Gandomani et al., 2013; Javdani Gandomani et al., 2013). CSFs are associated with practices, strategies, methods, tools, and other actions that can increase the probability of success, achieving organizational goals and objectives, and competitiveness (Andrade and Tait, 2012). When properly managed and maintained, they can significantly impact an organization's success (Bullen and Rockart, 1981; Oliveira et al., 2018). Issues that can affect the success of agile adoption include those related to culture, leadership, communication, managerial support, and others associated with management performance (Srinivasan and Lundqvist, 2010; Mishra et al., 2021; Russo, 2021).

Properly managing a software project can interfere with the project's chances of success or failure (Andrade and Tait, 2012; de Oliveira Santos and de Carvalho, 2022). Noteworthy, project management plays an essential role in agile transformation initiatives. For instance, Toledo et al. (2008) argue that the degree of success of a project depends on factors related to management practices; Mishra et al. (2021) argue that management support is one of the success factors in agile transformation; and, according to Dikert et al. (2016), management support is an absolute necessity to support agile transforma-

tions and that in large-scale agile transformations managers have a key role in making the change stick. Therefore, to minimize the impact of adversities arising from adopting an agile initiative, careful planning is required, in addition to an efficient management process (Oliveira et al., 2018). Furthermore, Vasylieva et al. (2024) found that 'Management and Leadership' is the second most frequently cited generic success factor class reported in software process improvement research, encompassing factors related to management support, commitment, involvement, management, and leadership.

Despite the relevance of CSFs, there is little visibility about CSFs aimed at agile adoption (Mishra et al., 2021), especially associated with the project management perspective (Andrade et al., 2023). In general, studies on CSFs 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.

In a previous study, we executed a systematic mapping study (Andrade et al., 2023) in which we identified twelve CSFs for agile transformations from a project management perspective: 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. We also identified seventeen effects of these factors: Commitment to Change, Collaborative Decision-Making, Effective Customers Feedback, Team Collaboration, Agile Culture Building, 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. The findings reinforced the importance of project management during agile transformations.

In a subsequent study (Fortuna et al., 2023), we executed a survey to improve our understanding of the CSFs based on the participants' experience in real organizational contexts. We asked agile project managers from different organizations undertaking agile transformation initiatives about the relevance of the CSFs as well as whether other factors should be considered. Their contribution provided evidence that the CSFs can influence and be relevant to the success of an agile transformation. We identified five new factors: Organizational Ambidexterity, Use of Tools and Automation, Breaking down Organizational Silos, Team Commitment, and Alignment of Organizational Goals and Expectations. Moreover, we summarized our findings into three propositions relating to the "Organizational Orientation to Agile Transformation," "Management Support to Agile Project," and "Support for Building Sustainable Agile Teams."

In this article, we present the results of a new survey that extended both previous studies. First, we reanalyzed the survey's data and identified two new critical success factors from the participants' contribution: psychological safety, and risk management. Then, we executed an extended version of the previous survey to capture the relevance of all nineteen

factors and the effects associated with the twelve original factors. As a result, we extend our prior results by updating the answers for the two original research questions in (Fortuna et al., 2023) and presenting two new research questions. The research questions aim at, respectively, (i) identifying the relevance of the identified critical success factors associated with agile transformation initiatives, (ii) capturing other critical success factors based on the participants' feedback and experience, (iii) identifying the significance of the critical success factors' effects, and (iv) presenting actions that can foster these effects.

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

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 (Gandomani et al., 2014; Dikert et al., 2016; Reginaldo and Santos, 2020; Mishra et al., 2021) may differ. Based on 19 failure factors and 36 success factors, Chow and Cao (2008) 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 CSFs as they considered that some might be anecdotal. So, only ten hypotheses were supported by the data, allowing the identification of six CSFs 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 subsequent work, Stankovic et al. (2013a) 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 (Chow and Cao, 2008). 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 CSFs 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. (2017) 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 CSFs 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 CSFs in agile transformation, the focus and objectives differ from our work. However, some CSFs are similar to those in (Andrade et al., 2023) and used in this study, e.g., Changes in the mindset of project managers, Changes in management style and decentralized decision-making, and Business goals.

Alhroub and Jaaron (2019) discussed 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 CSFs that are implied in agile project management. The work brings a case study validated by a questionnaire and semi-structured interviews. Regarding the CSFs, some of them are similar to CSFs 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 ours.

Mishra et al. (2021) examined CSFs 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. CSFs investigated in their work refer to organizational factors influencing the decision to implement agile methods in projects. Among them, Managerial support and Team structure relate to the factors evaluated in our work. The CSFs set is considered crucial and comprises 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 impact the agile adoption.

The transition to agility also represents a software process improvement (SPI) initiative, although that term is usually not explicitly associated with agility per si. The MPS.BR Program (Santos et al., 2012, 2015) is a long-term program promoting software quality in Brazil. Its main goal is to develop and disseminate a Brazilian software process reference model (named MPS-SW) (Softex, 2024) that aims to establish a feasible pathway for software development organizations to achieve benefits from implementing SPI by reducing the costs for its implementation and assessment, and providing means for obtaining its benefits in a shorter time frame. MPS-SW adheres to ISO/IEC 12207 (ISO/IEC/IEEE, 2016) and is compatible with CMMI (ISACA, 2023). In (Santos et al., 2015), the authors present evidence characterizing the performance results of organizations appraised in the MPS-SW. The research evaluated, via a survey, whether organizations implementing the MR-MPS model increased revenues, productivity, quality, schedule estimate precision, overall satisfaction with the model, number of clients, and number of employees. Consensus on the multiple data stratification provided by the survey is that companies have improved their software development processes in terms of cost reduction, schedule, and increase of quality. This study and ours used a survey to collect data but with different approaches. We asked participants their opinions about the relevance of possible effects identified in a literature review. In research described in (Santos et al., 2015), the results are based on comparing results the organizations had accomplished in subsequent years. Also, the

investigated effects/benefits differ but have some similarities with our effects, such as E08 – Customer satisfaction, E13 – Increased software quality, E16 – Facilitate effort estimation, and E17 – Reduced delivery time.

Stettina et al. (2021) present results from a survey whose objective was to analyze the impact of agile transformation on organizational performance. The authors identified the benefits perceived by those who went through agile transformation. The study focused on obtaining answers in three organizational layers: team level, programs and portfolios. As a result, the main impacts (i.e., benefits) refer to the Productivity, Responsiveness, Quality, Workflow Health, and Employee Satisfaction dimensions.

The analyzed effects were positive for each dimension and for the different organizational layers, being compatible with the results and metrics evidenced in the literature: (i) regarding the Productivity dimension, agile transformation increases development effectiveness and overall productivity; (ii) for the Responsiveness dimension, the perceived benefit is the improvement of response time to market and customer demands; (iii) for the Quality dimension, there is an increase in product quality and allows defects to be identified early; and (iv) for Workflow Health and Employee Satisfaction the dimensions, the perceived benefits are more organized and planned workflow, increased collaboration and transparency of development and making work more enjoyable.

Regarding the comparison with our study, although the effects investigated are not the same, an association can be indicated between the effects we investigated and the dimensions present in (Stettina et al., 2021). For example: (i) regarding the Employee Satisfaction & Engagement dimension, we investigated the effects E02 – Collaborative Decision-making and E04 Team Collaboration; (ii) regarding the Quality dimension, we investigated the effect E13 – Increased software quality; (iii) in relation to the Responsiveness dimension, we investigated the effect E17 Reduced delivery time; and (iv) in relation to the Workflow Health dimension, we investigated the related effects E06 – Work control, E07 – Self-organized Teams and E09 – Better Communication. Another difference refers to the objective of the studies. We seek to investigate the effects of critical success factors for agile transformations. In (Stettina et al., 2021), the focus is on the impact of agile transformations on organizational performance in teams, programs and portfolios.

As mentioned before, in a previous work (Andrade et al., 2023), we presented the results of a systematic mapping study on CSFs of agile transformations from the project management perspective. It is important to notice that project managers are essential to increasing the agile transformation initiative's chance of success and must be adequately involved in it. We found few studies focused on this subject despite its relevance. We identified twelve relevant studies from four important databases for the Computer Science and Information Systems areas. The most cited CSFs were Top Management Support, Team Empowerment, and Adapting the Process to Agile. In addition, CSFs focused on Good Communication, and Building Strong Teams are also highlighted, although they are less mentioned. Besides the twelve identified CSFs, seventeen effects generated by CSFs were also found: Commitment to change, Decentralized decision-making, Effec-

tive 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. The authors also present the relationship between the identified factors and effects, shown in Table 1.

Later, we executed the first phase of the survey (Fortuna et al., 2023) that is presented in this study. We found that the most relevant critical success factors for the participants – who held management positions during past or ongoing agile transformation journeys – were Good Communication, Top Management Support, and Customer Focus. The least relevant ones were Team Accountability, Adapting the Process to Agile, Experimentation of New Solutions, Decentralized Decision-Making, and Team Personal Characteristics. We also identified seven new critical success factors. Table 2 presents the summarized description of these factors. To characterize these factors, we used the participants' answers, our knowledge and experience in software process improvement and agile transformations, and sources from the academic literature on the involved subjects. The identification of the new factors' relevance was envisioned as future work.

3 Research Method

We executed survey research based on questionnaires (Kitchenham et al., 2015) 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 (Kitchenham et al., 2015). We followed the steps suggested in (Kitchenham and Pfleeger, 2008; Kitchenham et al., 2015): 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*) (Basili, 1992): **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 initiatives.

3.1 Planning

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

- **RQ1**: How relevant are the identified critical success factors for organizations undergoing an agile transformation from a project management perspective?
- **RQ2**: What other critical success factors are relevant for agile transformations from a project management perspective?
- **RQ3**: How relevant are the identified effects of the critical success factors to agile transformations from a project management perspective?
- **RQ4**: What actions can foster the effects of the critical success factors to agile transformations from a project management perspective?

The survey's *target population* comprises project managers with experience in agile transformations. The rationale is built on the fact that (i) an agile transformation initiative is, in essence, a project aimed at implementing software process improvements, (ii) project managers are essential to support the changes required to be implemented in this context, and (iii) their perspective is little addressed.

We executed the survey in two phases. The first phase regarded research questions RQ1 and RQ2. The second phase regarded research questions RQ3 and RQ4. We updated the questionnaire and performed data collection and analysis accordingly, as described below.

3.1.1 Data Collection

The questionnaire presented in Table 3 was designed based on all RQ. The target is comprised of project managers who have been working (or have worked) in organizations executing agile transformation initiatives. The questionnaire consisted of three parts:

- *Part 1*: comprised questions to characterize the participants (ID01 to ID05) and the organizations in which they work (ID06 to ID08). We used the same questions in both phases;
- *Part 2*: comprised questions about the relevance of the factors identified in (Andrade et al., 2023) (ID09) and the identification of new critical success factors (ID10). In the first phase, we presented the original twelve critical success factors identified in (Andrade et al., 2023) and asked for suggestions of new factors using five questions. In the second phase, we presented the original twelve factors and seven new factors identified in (Fortuna et al., 2023). We asked for suggestions of new factors in a single question;
- *Part 3*: comprised questions about the relevance of the effects associated with the original twelve critical success factors (ID11 and ID12). Also, participants were asked about other effects related to the factors and which actions may foster the effects (ID13).

To improve the accuracy of the answers, we also provided a brief definition of each investigated factor based on content in Table 2. Participants were informed that the confidentiality and anonymity of the answers would be ensured. In the first phase, we used Microsoft Forms (`http://forms.office.com/`) to create the electronic questionnaire. The estimated response time was 7 minutes. In the second phase, we used Google Forms (`http://forms.google.com/`). The estimated response time was 15 minutes.

In the second phase, we asked the participants whether they had participated in the first phase and allowed them to answer Parts 1 and 2 of the questionnaire again. Nonetheless, we reviewed the responses from the first phase to identify any discrepancies. Two participants claimed to have participated in the first phase but had not. As a result, we asked them to complete the questionnaire again. We considered these participants' most recent answers for the close-ended questions and both responses for the open-ended questions.

Table 1. Identified effects and their relation with the critical success factors, as presented in (Andrade et al., 2023).

ID	Effect	F01 – Top management support	F02 – Team empowerment	F03 – Adapting the process to agile	F04 – Customer focus	F05 – Decentralized decision-making	F06 – Team accountability	F07 – Team personal characteristics	F08 – Experimentation of new solutions	F09 – Servant leader mindset	F10 – Adoption of participatory management	F11 – Good communication	F12 – Building strong teams
E01	Commitment to change	x	x	x		x		x	x	x	x		
E02	Collaborative decision-making	x	x	x	x	x						x	
E03	Effective customers feedback	x	x	x	x						x	x	
E04	Team collaboration	x	x			x			x		x		
E05	Agile culture building	x	x	x	x							x	
E06	Work control	x	x	x	x							x	
E07	Self-organized teams	x	x	x	x							x	
E08	Customer satisfaction	x	x							x			
E09	Better communication	x	x	x	x							x	
E10	Team adaptability	x	x										
E11	Trust in people	x								x			
E12	Responsibility building					x							
E13	Increased software quality	x											
E14	Increased investment in projects	x											
E15	Management support for teams	x											
E16	Facilitate effort estimation	x											
E17	Reduced delivery time	x											

3.1.2   Data Analysis

To answer the research questions, we summarized the valid answers (see Section 3.2). Valid answers had questions ID1 and ID2 responded with "Yes," and all other mandatory questions were answered.

The answers for RQ1 and RQ2 were derived from the valid answers for questions ID 10 and ID 11 respectively. It is important to note that some answers to ID 11 did not originate a new critical success factor but helped us to improve our understanding of the original factors, thus enabling us to discuss RQ1. All article's authors contributed to answering both research questions.

In the first phase, the response to RQ1 (i.e., closed-ended questions) was provided by authors C.M., A.F., L.R., and A.A. and reviewed by authors E.D. and G.S. In the second phase, author G.S. first analyzed the data, and authors C.M. and E.D. reviewed it.

To answer RQ2, we used the procedures by Saldaña (2013) as exemplified to code patterns and identify new factors. In the first phase, authors C.M., A.F., L.R., and A.A. suggested the initial response to RQ2. They worked in pairs (i.e., C.M. and A.F., and L.R. and A.A.) before coming up with a consensus. Then, data was reviewed by authors E.D. and G.S. In the second phase, data was first analyzed by author G.S. and reviewed by authors C.M. and E.D. First, the contributions associated with software development unrelated to project management (e.g., "well-defined requirements" and "remote work") 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 (Andrade et al., 2023) or whether they could represent a new factor from a managerial perspective.

In both phases, 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 – e.g., those cited in Section 2 and others such as (Niazi et al., 2006; Montoni and Rocha, 2011; Bayona et al., 2012) – that could help define each factor and present evidence of its relevance to such initiatives. Eventually, we decided not to include typical project manager responsibilities, even though we understand them as essential in any project. We were influenced by the sources cited above that do not include tasks associated with project management despite indicating the need to manage the process improvement project using good management practices (e.g., they cite factors such as Improvement Management, Managing the Software Process Improvement Project, and Measurement). Due to that, at first, we disregarded 'risk management' as a new factor.

We re-analyzed the first phase's data while planning the second phase. We identified and removed two duplicate answers and considered only the last contribution of each participant as valid. We also reviewed the suggestions of new critical success factors collected so far. We reached the participant who suggested 'risk management' to understand whether their suggestion was associated with project management or an overall evaluation of the risks associated with conducting a transformation journey. As their answers indicated the latter, we included the factor in the second phase's scope. Also, we considered 'psychological safety' as a new critical success factor as we improved our understanding of the matter and its relationship to Proposition 3 (see Sections 3.3.3 and 4.2.3).

Authors E.D and G.S. worked together to create the groups in Figure 4 and the discussion of results. We considered the definitions of the critical factors in (Andrade et al., 2023) – Table 2 shows a short description only – and of the new factors (i.e., F13 – F19) identified. 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 4). This naming was refined when a new factor was associated with the group. In parallel, we created and refined

Table 2. Short description of the critical success factors identified in studies (Andrade et al., 2023) and (Fortuna et al., 2023).

ID	Factor	Description	Source *
F01	*Top management support*	Support from the highest level of management and control of an organization in an agile transformation.	A [S02, S07, S10, S12]
F02	*Team empowerment*	The degree of freedom, confidence, motivation, and engagement that the organization's top management gives the team experiences in an agile transformation.	A [S04, S05, S09, S12]
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.	A [S05, S06, S12]
F04	*Customer Focus*	Use customer-focused management strategies to increase customer engagement and collaboration with the team.	A [S04, S05, S12]
F05	*Decentralized decision-making*	Autonomy of decisions is given to the team where everyone is responsible for the decisions.	A [S07, S11]
F06	*Team accountability*	The relationship between a team and a project manager establishes a delegation of responsibility and the requirement of "accountability" in the execution of this responsibility.	A [S01]
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.	A [S05]
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.	A [S06]
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.	A [S07]
F10	*Adoption of participatory management*	Management that motivates and engages the team to achieve alignment between agile transformation and business strategies.	A [S08]
F11	*Good communication*	Communication skills that project managers must have when transmitting information to the team clearly, objectively, and accurately.	A [S11]
F12	*Building strong teams*	Team building is carried out by the organization, with members empowered with knowledge and technical skills, as well as positive attitudes towards organizational change and the organization's culture.	A [S12]
F13	*Organizational Ambidexterity*	Refers to an organization's ability to meet simultaneously conflicting demands. It involves balancing the application of resources, acting in uncertain business environments, exploiting opportunities, and managing conflict and change.	B
F14	*Utilization of tools and automation*	The correct choice of tools and process automation can help reduce time, estimate effort, and improve the quality of deliveries, especially in long and repetitive software development processes.	B
F15	*Breaking down organizational silos*	Breaking down or removing barriers (physical and/or psychological) and divisions that may exist among different segments or departments of an organization that may jeopardize the efforts involved in the agile transformation journey. It can promote collaboration, transparency, and achieving common goals and priorities.	B
F16	*Team commitment*	Refers to an individual's identification and involvement in a particular team. 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.	B
F17	*Alignment of organizational goals and expectations*	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.	B
F18	*Psychological safety*	The 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.	C
F19	*Risk management*	Identification, analysis, treatment, monitoring, and continuous reduction of risks quickly and effectively, adapting swiftly to changes in project conditions, are fundamental to delivering better products and services during the agile transformation journey.	C

* Column 'Source' presents the study in which the critical success factors first appear: A = Study (Andrade et al., 2023); B = Study (Fortuna et al., 2023); C = Current study. The studies identified in (Andrade et al., 2023) are S01: (Burga et al., 2022), S02: (Russo, 2021), S03: (Mishra et al., 2021), S04: (Grass et al., 2020), S05: (Alhroub and Jaaron, 2019), S06: (Calnan and Rozen, 2019), S07: (Campanelli et al., 2017), S08: (Wells et al., 2015), S09: (Paasivaara and Lassenius, 2014), S10: (Russo et al., 2013), S11: (Conboy et al., 2011), S12: (Srinivasan and Lundqvist, 2010).

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. In the end, even considering the inclusion of F18 and F19 between phases and F20 to F23 due to the second phase's execution, the groups (and the propositions) presented in (Fortuna et al., 2023) were not modified. Nonetheless, they represent aspects that high, middle, and direct management should pay attention to when conducting improvement initiatives considering the transition to agility.

We asked two questions (see Table 3, questions ID12 and ID13) to answer the RQ3 and RQ4. Author E.G. used thematic analysis procedures (Cruzes and Dyba, 2011) to codify the actions and associate them with the effects. The themes represented the most critical effects identified in RQ3 and author G.S. audited the coding.

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.

Table 3. Applied questionnaire.

ID	Questionnaire Item
1	Have you held or are you currently holding a project manager (leader, supervisor, coordinator, manager, project director, or other management position) role? [Yes; No]
2	Have you participated or are you currently participating in an agile transformation initiative? [Yes; No]
3	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]
4	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]
5	What is your educational level? [High School; Higher Education; Specialization; Master's Degree; Doctorate Degree]
6	In which segment does your organization operate? [Industry; Commerce; Service]
7	Does your organization use the software for internal (own) usage or sale? [Yes; No; Both]
8	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)]
9	* Based on your experience, what is the level of relevance of each presented factor [*In Phases 1 and 2*: 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; In Phase 2 only: Organizational Ambidexterity, Use of Tools and Automation, Breaking down Organizational Silos, Team Commitment, Alignment of Organizational Goals and Expectations, Psychological Safety, and Risk Management] for an organization that wants to undergo an agile transformation? [None; Very Low; Low; Medium; High; Very High]
10	* Please suggest up to 5 new critical success factors that affect agile transformation initiatives from a project management perspective. *In Phase 2 only: Please provide details that help us understand them better and their implications better. (optional)*
11	+ Based on your experience, what is the level of relevance of each presented effect [Commitment to Change, Collaborative Decision-Making, Effective Customers Feedback, Team Collaboration, Agile Culture Building, 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, Reduced Delivery Time] for an organization that wants to undergo an agile transformation? [None; Very Low; Low; Medium; Very High]
12	+ Please feel free to comment on the effects mentioned above. You can also indicate other observed effects resulting from the mentioned factors (if possible, indicate which factor the suggested effect refers to). *(optional)*
13	+ What actions do you suggest to enhance the effects you considered most relevant above in organizations undergoing agile transformation? *(optional)*

In column 'Questionnaire Item,' + marks the questions included in the survey's second phase, while * marks the questions updated between versions.

3.2 Execution

In both phases, before releasing the questionnaire, we conducted a pilot with three participants. Both pilots enabled us to understand the difficulties encountered by the participants. As a result, we improved the questionnaire's questions.

In the first phase, we executed one pilot and disregarded the three answers obtained. In the second phase, we executed two pilots. One participant answered the first one. The second one was answered by three participants (one new and two recurring participants). As a result, we simplified the close-ended questions regarding RQ1 and RQ2, included the open-ended question regarding research question RQ2, and improved the online questionnaire's usability. Consequently, we observed the participants provided more details about the factor, which was beneficial for data analysis. We disregarded the first pilot's answers but considered the others.

The survey's first phase was performed in two periods: from September 29th to November 10th, 2022, and from July 7th to July 16th, 2023. The second phase was conducted from March 25th to April 29th, 2024.

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 PMI Brazil volunteer group. This group is composed of project managers and many of them work in organizations that are going through or have gone through agile transformations. In the second phase, we also send out the questionnaire to the first phase's participants.

Table 4 provides a summary of the answers obtained in both phases. We obtained 65 answers in the first phase and 54 in the second. Four participants (two in each phase) provided duplicated answers. We considered only their last answers. Six participants (four in the first phase and two in the second) have not held a management position. Thirteen participants (ten in the first phase and three in the second) have not participated in agile transformation initiatives. We disregarded these answers. Therefore, we obtained 49 answers to the first phase and 47 to the second phase. Overall, the survey had 68 distinct participants (Section 3.3.1 present their profile).

Table 4. Summary of Responses for Phases 1 and 2.

Responses	1st Phase	2nd Phase
Total Participants	65	54
Duplicate responses	2	2
Non-manager participants	4	2
Participants without experience	10	3
Total valid participants	**49**	**47**

Table 5 summarizes of the valid responses for each phase of the survey. Considering the valid answers, twenty-one participants responded only to the first phase. Therefore, they did not contribute to the answers the third part of the questionnaire. Twenty-eight participants responded to both phases. From those, fifteen participants provided new answers to the questionnaire's first and second parts during the second phase, and thirteen participants decided to answer only the third part (i.e., only the new questions). Nineteen participants responded only to the second phase. Therefore, in the case of double answers, we considered only the last closed-ended answers but both open-ended questions. We did that so the previous

answer to RQ2 (and the discussion we did about it, including the tree propositions) could be extended instead of remade entirely.

Table 5. Number of participants contributing valid answers for each part of the questionnaire: Part 1 – participants' characterization, Part 2 – factors' relevance, and Part 3 – effects' relevance.

Participants' Contributions	1st Phase	2nd Phase
Responses to Parts 1, 2, and 3	28	28
Responses only to Part 1	21	0
Responses only to Parts 2 and 3	19	19
Total valid responses	**68**	**47**

3.3 Results

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

3.3.1 Participants' Characterization

Figure 1 summarizes the participants' characterization. Table 6 shows the distribution of participants based on their experience in agile transformation and project management. For more details, refer to the supplementary material in the Section "Artifact Availability".

Figure 1a shows the approximate time of participation in an agile transformation initiative. Most participants (≈34% or 23 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 (≈57% or 39 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, eight have higher education, 36 have a specialization, 21 participants have master's degrees, and three have a doctorate.

Most managers (≈87% or 59 participants) reported working in organizations in the service segment. Figure 1d also shows that three organizations' segment is commerce, and eight organizations are in the industry sector. We used SE-BRAE's classification (DIEESE, 2013) (see options in question ID08 in Table 3) to characterize the organizations' size. Figure 1e indicates that ≈78% of project managers work in large companies, and ≈11% 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, 30 (≈44%) internally, and 35 (≈51%) 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 in the services sector.

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

Figure 2 presents the level of relevance of the investigated critical success factors according to the participants. We divided the factors into three groups based on Table 7 which presents the list of factors ranked by the number of participants that indicated their relevance as very high or high.

Group A comprises the five top factors: F01 – Top management support, F11 – Good communication, F17 – Alignment of organizational goals and expectations, and F04 – Customer focus. They were associated with high or very high relevance by ≈93% (or 63 participants), ≈91% (or 62 participants), ≈87% (or 41 participants), ≈87% (or 41 participants), and ≈87% (or 59 participants)), respectively.

Group B consists of factors that between 70% and 85% of participants pointed out their importance as very high or high: F02 – Team empowerment (≈79%, or 54 participants), F12 – Building strong teams (≈78%, or 53 participants), F15 – Breaking down organizational silos (≈76%, or 36 participants), F09 – Servant leader mindset (≈77%, or 52 participants), F06 – Team accountability (≈75%, or 51 participants), and F10 – Adoption of participatory management (≈72%, or 49 participants).

Group C comprises the remaining factors. Group C consists of factors F13 – Organizational Ambidexterity (≈68%, or 32 participants), F19 – Risk Management (≈68%, or 32 participants), F18 – Psychological Safety (≈66%, or 31 participants), F03 – Adapting the Process to Agile (≈62%, or 42 participants), F14 – Utilization of Tools and Automation (≈60%, or 28 participants), F08 – Experimentation of New Solutions (≈59%, or 40 participants), F05 – Decentralized Decision-Making (≈56%, or 38 participants), and F07 – Team Personal Characteristics (≈47%, or 32 participants). Still, their relevance to the agile transformation cannot be underestimated as they were also pointed to as having high or very high relevance by the participants.

Table 8 shows a comparison of the importance of the five critical success factors considered most relevant with the answers extracted from the participants' experience (i) in managing projects for up to 10 years and more than 10 years and (ii) in agile transformations for up to 2 years, between 3 and 5 years and more than 6 years. Only F01 – Top management support and F11 – Good communication are present in all stratifications, although they appear in a different order. Besides, only participants with up to 10 years of experience in project management and up to 2 years of experience in agile transformations indicated a diverse set of factors as more relevant. The top five among the participants with up to 10 years of experience in project management include F06 – Team accountability, F09 – Servant leader mindset, and F12 – Building strong teams, tied with ≈38% of high and very high relevant responses. The top five among the participants with up to 2 years of experience in agile transformations include F10 – Adoption of participatory management and F09 – Servant leader mindset tied, respectively, with F01 – Top management support and F11 – Good communication. For more details, refer to the supplementary material in the
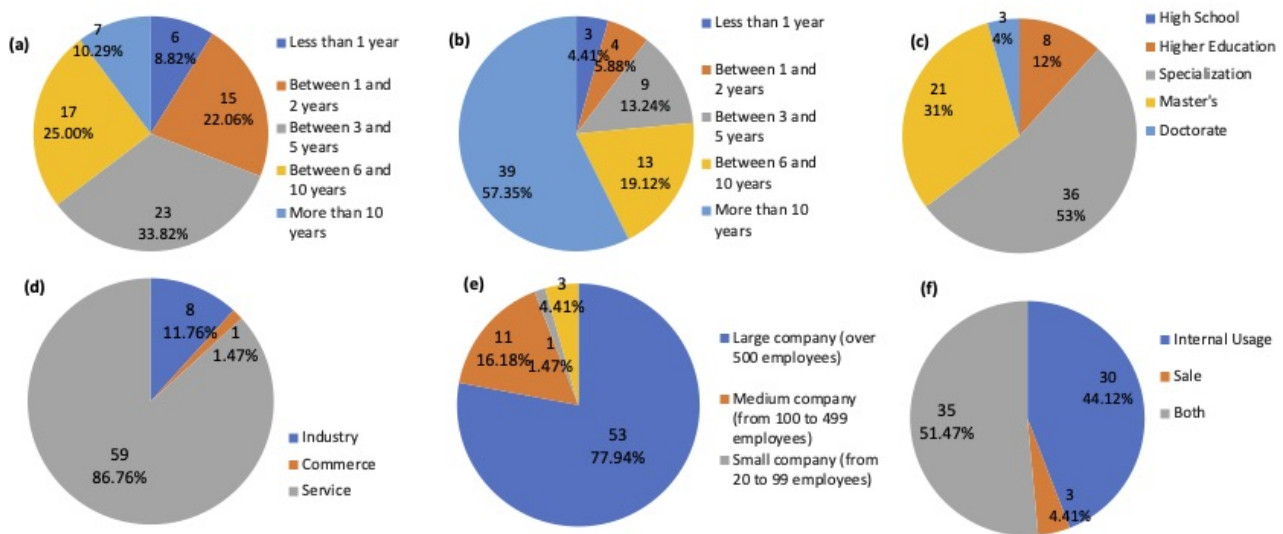
Figure 1. Profile of participants (n = 68) concerning (a) Approximate time of participation in an agile transformation initiative, (b) Time of experience as a project manager, (c) Level of education, and characteristics of the organizations in which they work concerning (d) Segment of activity, (e) Size, and (f) Type of software usage.

Table 6. Distribution of participants based on their experience in agile transformation and project management, grouped by years of experience and according to the size of the organization they work for (large, medium, small, or micro) (n = 68).

Experience (in years)		Organization size			
Agile Transformation	Project Management	Large	Medium	Small	Micro
yrs. <= 2	yrs. <= 2	P09, P30, P66			
	3 <= yrs. <= 5	P02, P38, P49	P27		
	6 <= yrs. <= 10	P44, P67	P26		
	yrs. > 10	P03, P24, P32, P34, P37, P40, P48, P55	P01, P51		P25
3 <= yrs. <= 5	yrs. <= 2	P43, P54, P58			
	3 <= yrs. <= 5	P18, P22, P31	P28		
	6 <= yrs. <= 10	P05, P15, P39, P46	P08		
	yrs. > 10	P10, P11, P12, P16, P21, P29, P35, P47, P50, P60, P61			
6 <= yrs. <= 10	yrs. <= 2	P52, P68			
	3 <= yrs. <= 5		P13		
	6 <= yrs. <= 10	P33, P64		P06	P65
	yrs. > 10	P07, P20, P23, P36, P42, P53	P14, P41, P45, P63		
yrs. > 10	6 <= yrs. <= 10	P59			
	yrs. > 10	P04, P17, P19, P56, P57			P62

Table 7. Critical success factors based on their relevance level considering the percentage of very high or high answers (for F01 to F12, n = 68; for F13 to F19, n = 47).

Order	%	Factors
1	92.60%	F01 - Top management support
2	91.20%	F11 - Good communication
3-4	87.20%	F17 - Alignment of organizational goals and expectations
3-4	87.20%	F16 - Team commitment
5	86.80%	F04 - Customer focus
6	79.40%	F02 - Team empowerment
7	77.90%	F12 - Building strong teams
8	76.60%	F15 - Breaking down organizational silos
9	76.50%	F09 - Servant leader mindset
10	75.00%	F06 - Team accountability
11	72.10%	F10 - Adoption of participatory management
12-13	68.10%	F13 - Organizational Ambidexterity
12-13	68.10%	F19 - Proactive risk management
14	66.00%	F18 - Psychological safety
15	61.80%	F03 - Adapting the process to agile
16	59.60%	F14 - Utilization of tools and automation
17	58.80%	F08 - Experimentation of new approaches
18	55.90%	F05 - Decentralized decision-making
19	47.10%	F07 - Team personal characteristics

Section "Artifact Availability".

We obtained 79 contributions from 40 participants to question ID 10. We used these answers to improve our understanding of the surveyed factors. For instance, from some contributions, we identified additional characteristics or behaviors not explicitly mentioned in (Andrade et al., 2023) but that can be associated with the surveyed factors. As noted, Table 6 presents the participants' experience in agile transformation and project management. This information can help better understand their contributions to answering the research questions.

Regarding *F01 – Top management support*, participant P9 indicated the importance of "the use of agility" and the "institutional guidance towards agile change," while participant P13 highlighted the importance of "sponsoring (...) the changes agile causes to the traditional culture."

Concerning *F03 – Adapting the process to agile*, participant P17 underlined the importance of using "[a wide range of] agile practices that can support the important aspects of the agile transformation." 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." It is noticeable that even
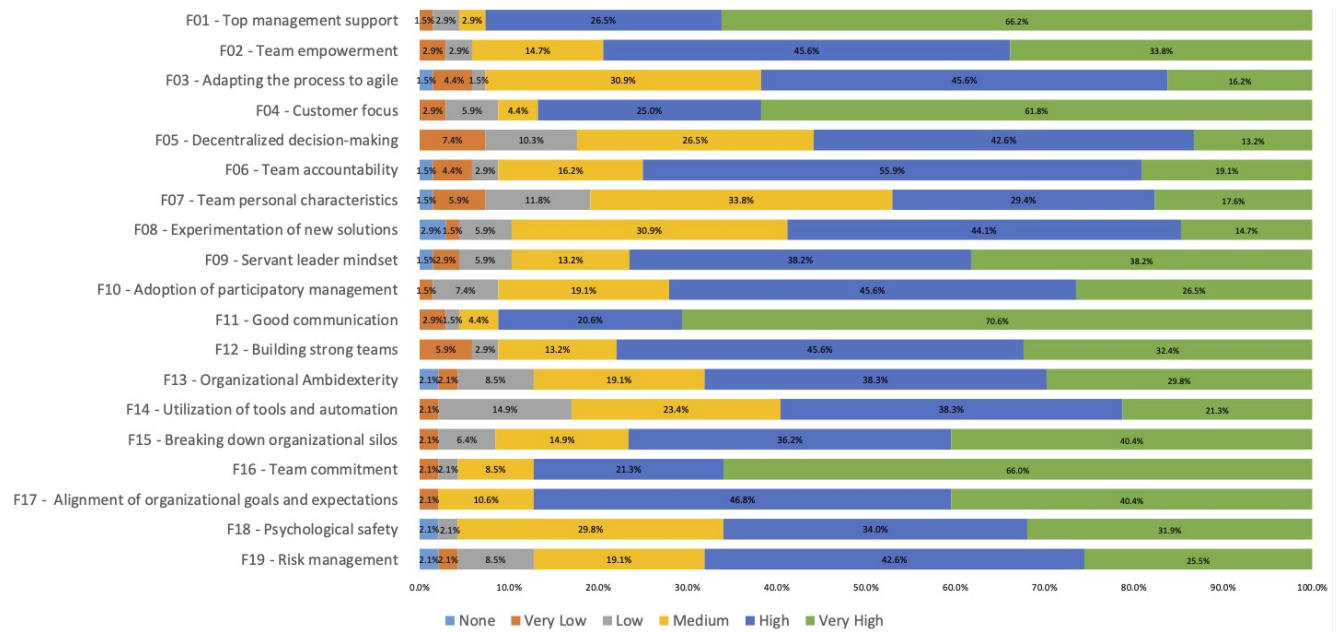
Figure 2. Level of the relevance of the critical success factors (for F01 to F12, n = 68; for F13 to F19, n = 47).

Table 8. Comparison of the relevance of the critical success factors based on participants' general perceptions and their experience in project management and agile transformations (n = 68). For each stratification, the number of respondents (n), the ranking of critical success factors, and the relevance level based on the percentage of high and very high responses are presented.

Critical Success Factor	Order	Experience (in Years)				
		Project Management		**Agile Transformations**		
		yrs. <= 10 (n = 29)	yrs. > 10 (n = 39)	yrs. <= 2 (n = 21)	3 <= yrs. <= 5 (n = 23)	yrs. >= 6 (n = 24)
F01 - Top management support	1 (92.65%)	1-2 (41.18%)	2 (51.47%)	3-4 (27.94%)	3 (32.35%)	3 (32.35%)
F11 - Good communication	2 (91.18%)	1-2 (41.18%)	4 (50%)	1-2 (29.41%)	4-5 (30.88%)	4-5 (30.88%)
F17 - Alignment of organizational goals and expectations	3 (87.23%)		1 (53.19%)	5-6 (27.66%)	2 (34.04%)	2 (34.04%)
F16 - Team commitment	4 (87.23%)		3 (51.06%)	5-6 (27.66%)	1 (36.17%)	1 (36.17%)
F04 - Customer focus	5 (86.76%)	3 (39.71%)	5 (47.06%)		4-5 (30.88%)	4-5 (30.88%)

small steps towards an agile process are important, especially to organizations at the beginning of an agile transformation. For instance, P67 emphasizes the importance of "development teams working in sprints" and ensuring that "each project has a Scrum Master."

Associated with *F04 – Customer focus*, we also identified the need to "involve and motivate (both internal and external) customers" to participate (P20), "support, and engage" (P55) in the transformation.

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 of the] new [way of doing things] should be treated as learning" (P04). That is associated with "accepting errors" (P18) and "psychological safety" (P19) (see the new factor F20 in Section 3.3.3).

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 offered 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." Also, P08 reinforced the importance of agile leader-

ship by enhancing the importance of "having leaders who not only understand agile principles but also practice and promote these principles through their actions and decisions.

A new characteristic associated with *F11 – Good communication* was "management transparency" (P1, P51). Also, P55 pointed out the importance of an "effective communication strategy [to properly] communicate changes in the organization," and P08 mentioned the importance of "establishing mechanisms for constant feedback from all stakeholders, including clients, users, and team members, to carry out development iterations and improve products effectively."

Finally, *F12 – Building strong teams* is associated with "training teams and managers in agile practices" (P20). Moreover, among the characteristics to be fostered are "autonomy, collaboration" (P50), "multidisciplinarity" (P11), and "diversity" (P11, P55). According to P55, "diverse and inclusive teams are more creative, innovative, and better able to respond to the varied needs of customers." Also, P08 highlighted the importance of "multi-functional collaboration, meaning forming teams that include members with different skill sets (e.g., development, design, testing, and operations) to enhance innovation and solve problems more efficiently." Also, P50 mentioned teams must have "autonomy in decision-making and work together, even if they report to a superior."

3.3.3 RQ2: What other critical success factors are relevant for agile transformations from a project management perspective?

Based on the participants' responses in the first phase of the survey, first phase we identified seven new critical success factors. Five (F13 to F17) are presented by Fortuna et al. (2023), while two (F18 and F19) were proposed after we reanalyzed the data collected in the survey's first phase and performed the first pilot of the survey's second phase. Similarly, based on the participants' responses in the survey's second phase, we identified four new critical success factors (F20 to F23). 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 Section 4.1, we discuss their impact on agile transformation initiatives.

Participant P11 suggested *Organizational Ambidexterity* (F13). It refers to an organization's ability to meet simultaneously conflicting demands; at the managerial level, it is associated with acquired managerial skills (Duncan, 1976). It is also related to strategy, flexibility, and efficiency from the existing competencies and the new opportunities that arise (Adler et al., 1999). Balancing the application of resources, acting in uncertain business environments, exploiting opportunities, and managing conflict and change are aspects emphasized in the ambidexterity concept (Duncan, 1976).

Participant P11 suggested the utilization of *Tools and Automation* (F14). Tools and automation can help reduce time, estimate effort, and improve the quality of deliveries, especially in long and repetitive software development processes. Participant P58 also highlighted the "need for tools focused on product, service, and knowledge management to visualize work in progress, measure team capacity, and provide dashboards and metrics for continuous improvement." Aligned with that, participant P08 stresses the need to provide "work visibility [using] kanban boards, scrum boards, and other visual tools to increase the transparency of work progress and facilitate communication."

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 (Motingoe and Langerman, 2019). 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 agile transformation.

Participant P1 suggested *Team Commitment* (F16). Team commitment 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 (Bishop and Scott, 2000). 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 (Bishop and Scott, 2000).

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).

Participant P19 suggested *Psychological Safety (F18)*. 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, speak up with questions, and admit mistakes – all without fear of negative consequences (Gallo, 2023). Therefore, it is associated with "accepting errors," as pointed out by P18.

Risk Management (F19) was suggested by participants P02 and P63. Identification, analysis, treatment, monitoring, and continuous reduction of risks quickly and effectively, adapting swiftly to changes in project conditions, are fundamental to delivering better products and services during the agile transformation journey. According to P63, "each organization should analyze its risk factors [due to] having distinct critical success factors."

Based on the participants' responses in the survey's second phase, we identified four new critical success factors (F20 to F23). They are described below.

Capacity Building and Continuous Learning (F20) was suggested by participants P08, P20, P36, and P55. In the survey's phase 1, we associated the P20 suggestion "training in the team and management in agile practices" to F12 – Building strong teams, but due to the recurrence of suggestions by the other participants and the importance of making training needs and organizations to provide them, so the improvement initiative represented by the agile transformation can succeed. the new factor F20 – Capacity Building and Continuous Learning was proposed. Moreover, other participants pointed out the need to support "continuous training and development (...) of team members in agile practices, tools, mindset" (P55) and a "culture of continuous learning [in which] "continuous learning is valued and encouraged, allowing team members to stay up-to-date" (P08, P36).

Factor *Improving Processes to Meet Business Needs* (F21) was proposed based on contributions from participants P41, P63, and P67 when they called attention to the fact agile transformation initiatives must have an underlying goal defined by the top management. Participants adequately claim that "forcing an organization through an agile transformation solely because upper management decided, even with all other favorable factors, can lead to failure to achieve success" (P41) and "a clear objective of the problem to solve with agility is needed, [not just being agile for] the sake of being agile" (P63). According to P67, organizations must "effectively prioritize what is necessary for generating gains," and that should be accomplished by first "defining the prioritization criteria."

Contributions from several participants (P09, P17, P19,

P36, P50, P53, P55, P57, P59) mentioning aspects associated with having proper organizational change management to conduct the agile transformation journey led us to define it as a new critical success factor named *Organizational Change Management (F22)*.

As mentioned by P19, organizations must "excel in software process improvement," which is not accomplished by only *Adapting the process to agile* (F03). P36 reinforces that "organizational change management involves strategies and practices for managing transitions of people, processes, and technology during agile transformation. These strategies include effective communication, training, support, and adaptation of organizational roles." This factor helps drive the transformation to success by coordinating all efforts involved. It may be facilitated by having a dedicated "transformation office" (P59) that executes proper change management approach that considers the "organizational culture" (P48) and handles possible "cultural clashes that may occur between teams" timely.

The execution of the improvement initiative must be monitored regularly. That may include defining "indicators aimed to achieve with the transition to the agile model" [P14], which might be supported by having a "well-defined OKR[1]." Indicators may help "having teams/people who make data-driven decisions" and "prioritize [projects] by financial contribution and percentage of dedication to structural products." Human resources management practice should not neglected, as P59 cites the need to have "appropriate salary aspects for the profiles involved."

Important behaviors associated with this factor are "organizational resilience, [meaning] the organization's ability to adapt quickly to changes and overcome obstacles" (P55), "commitment of the organization's leaders to the improvement of the change process" (P09) – what may include "low ego of managers to accept changes" (P57). P53 highlights the need to "have clarity on the maturity of the process to define the applicability and suitability of agile development in each situation." Aligned with that, P15 presents two situations that would make it difficult to use an agile approach: "a closed-scope project" (also mentioned by P53) and "a product [whose architecture] is not easily adapted." Also, other participants noted the importance of evaluating the first agile projects' accomplishments from a broader perspective. For instance, P50 mentions that "the first MVP (minimum viable product) may fall short of financial return expectations, and the team should not be penalized for it."

Aspects associated with *Focus on Product Quality* (F23) were suggested by participants P15, P36, and P67. As mentioned before, adopting agile practices in "projects [with] closed-scope" (P15, P53) and "products [whose architecture] is not easily adapted" (P15) might be challenging. P36 highlights that having "flexible systems architecture" might impact the success of agile transformation journeys. Implementing such architecture involves "designing and implementing IT systems in a way that supports rapid and efficient changes,

compatible with agile principles. This aspect involves using practices such as microservices, containers, continuous integration, and continuous delivery (CI/CD)."

Besides being sought by every software development team, quality is not easily obtained. Even basic practices, such as promoting tests, might be overlooked by teams due to resource restrictions or a lack of dedicated personnel. For example, P67 advocates for "a development quality team to apply testing before production deployments effectively."

3.3.4 RQ3: How relevant are the identified effects of the critical success factors to agile transformations from a project management perspective?

Figure 3 presents the level of relevance of the effects of the investigated critical success factors according to the participants. We divided the factors into three groups based on Table 9 which presents the list of effects ranked by the number of participants who indicated their importance as very high or high.

Table 9. Effects of the critical success factors based on their relevance level considering the percentage of very high or high answers (n = 47).

Order	%	Effects
1	89,4%	E09 - Better communication
2-3	85,1%	E04 - Team collaboration
2-3	85,1%	E08 - Customer satisfaction
4-6	78,7%	E15 - Management support for teams
4-6	78,7%	E01 - Commitment to change
4-6	78,7%	E10 - Team adaptability
7-8	76,6%	E05 - Agile culture building
7-8	76,6%	E13 - Increased software quality
9	74,5%	E11 - Trust in people
10-11	72,3%	E03 - Effective customers feedback
10-11	72,3%	E12 - Responsibility building
12	59,6%	E07 - Self-organized teams
13	57,4%	E02 - Collaborative decision-making
14	51,1%	E16 - Facilitate effort estimation
15	48,9%	E17 - Reduced delivery time
16-17	42,6%	E06 - Work control
16-17	42,6%	E14 - Increased investment in projects

Group A comprises the three top effects: E09 – Better communication, E04 – Team collaboration, and E08 – Customer satisfaction. Effect E04 was associated with high or very high relevance by ≈89% (or 42 participants), while E08 and E09 were associated with high or very high relevance by ≈85% (or 40 participants).

Group B consists of effects that between 70% and 85% of participants pointed out their relevance as very high or high: E15 – Management support for teams (≈79%, or 37 participants), E01 – Commitment to change (≈79%, or 37 participants), E10 – Team adaptability (≈79%, or 37 participants), E05 – Agile culture building (≈77%, or 36 participants), E13 – Increased software quality (≈77%, or 36 participants), E11 – Trust in people (≈75%, or 35 participants), E03 – Effective customers feedback (≈72%, or 34 participants), and E12 – Responsibility building (≈72%, or 34 participants).

Group C comprises the remaining effects. Group C consists of effects E07 – Self-organized teams (≈60%, or 28 participants), E02 – Collaborative decision-making (≈57%, or 27 participants), E16 – Facilitate effort estimation (≈51%, or 24 participants), E17 – Reduced delivery time (≈49%, or 23

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[1] OKR (Objectives and Key-Results) emerged in the '70s and gained popularity after begin was later adopted by Google in the late '90s (Wodtke, 2016). Since then, it began to be widely used and known and emerged as a lightweight framework for business objectives measurement and strategic alignment (Silva and Santos, 2024).
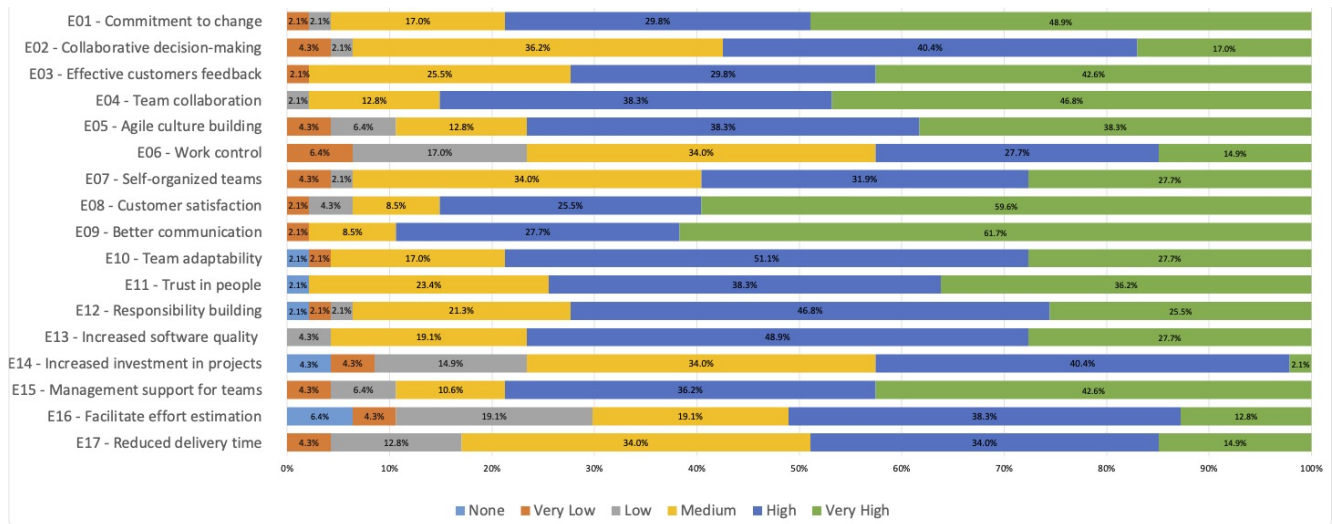
Figure 3. Level of the relevance of the effects of the critical success factors F01 to F12 identified in (Andrade et al., 2023) (n = 47).

participants), E06 – Work control (≈43%, or 20 participants), and E14 – Increased investment in projects (≈43%, or 20 participants). Nonetheless, their relevance to the agile transformation cannot be underestimated as they were also pointed to as having high or very high relevance by the participants.

We obtained contributions from 13 participants to the open-ended question ID 12 that aided in understanding the indicated relevance of both factors and effects. Some are discussed below.

Participant P55 indicated some effects of aspects associated with three critical success factors. According to them, (i) "effective communication strategy" (associated with F11 – Good Communication) can "reduce resistance to change," "diversity and inclusion" (associated with F12 – Building Strong Teams) can "enrich problem-solving and innovation," and "customer support and engagement" can lead to "increased customer satisfaction" (thus, associated with F04 – Customer Focus).

We investigated only the relevance of the effects presented in (Andrade et al., 2023); therefore we did not consider factors F13 to F23 in our analysis. Nonetheless, some participants provided us with some insights on that. For instance, P18 indicated the improvement in talent retention as a possible effect of F18 – Psychological Safety and F16 – Team Commitment. According to participant P23, E05 – Agile Culture Building is only accomplished by sponsorship and change management, which relates to F01 – Top Management Support, and F22 – Organizational Change Management, respectively. Participant P36's contribution was crucial to defining the new critical success factors F20 – Capacity Building and Continuous Learning, F22 – Organizational Change Management, F23 – Focus on Product Quality. Also, they mentioned some effects that might be associated with them: (i) for F20, more innovation and fast adaptation to changes; (ii) for F22, reduction in resistance to change; and (iii) for F23, operational resilience due to unpredicted faults or changes.

A factor can influence many effects; similarly, an effect can be fostered by many factors, as depicted in Table 1. Participant P08 also acknowledged that. According to their contribution: (i) effects E01 to E05, E07, E09, and E12 reflect the improvement in organizational culture and team dynamics promoted by factors F13, F15, F16, F18; (ii) effects E06, E10, E16, and E17 are linked to factors F14 and F19, showing how tools and risk management enhance adaptability and efficiency; and (iii) effective alignment of goals (F17) and a collaborative and secure approach (F18) improve customer satisfaction (E08) and software quality (E13).

3.3.5 RQ4: What actions can foster the effects of the critical success factors to agile transformations from a project management perspective?

To answer this research question, we analyzed the responses to Question ID13. Below, we discuss the suggested actions to enhance the effects the participants considered most relevant (see Table 9): E09 – Better communication, E04 – Team collaboration, E08 – Customer satisfaction, E15 – Management support for teams, E01 – Commitment to change, E10 – Team adaptability, and E05 – Agile culture building.

Table 10 presents the 33 actions we identified, their effects, the critical success factor they relate to, and the participants whose answers contributed to defining each action. It is important to note that some actions may be linked to others. For example, not penalizing teams for mistakes (A06) is associated with a psychologically safe environment (A11).

It is essential to highlight an overlap among the critical success factors, effects, and actions. However, they represent different concepts. Thus, we have chosen to code factors, effects, and actions separately. This methodological choice implies some similar names for some of them. Hence, it is possible to distinguish various similarities and other relationships between the investigated concepts. For example, the factor F02 – Team empowerment has a similar description to the action A08 – Promoting team empowerment, or the effect E08 – Customer satisfaction is associated with the factor F04 – Costumer Focus and is worded similarly to the action A14 – Assessing customer satisfaction. Furthermore, factors, actions, and effects are interconnected. An action to improve an impact can be to ensure that a critical success factor is achieved. For example, the action 'do not penalize teams for their mistakes' (A06) may increase the team's psychological safety (F18) and team collaboration (E04).

We did not make value judgments on the suggestions of the participants. One may find some actions too harsh to tackle a given effect. For example, P50 suggested that the organization structure should be reorganized (A24). We did not reach the participant for further clarification but assumed the suggestion was based on their experience, as we reinforced that in many survey questions. Therefore, before using these actions, one must evaluate whether they apply to their organizational setting and agile transformation characteristics. Additionally, it should be noted that we did not investigate all the possible relationships between causes and consequences among factors, effects and actions.

When analyzing the actions in Table 10, we identified actions that management could implement to address (i) the improvement of the initiative's planning and communications, (ii) the promotion of continuous learning about agility for those involved in the agile transformation initiative, (iii) enabling collaborative team building, and (iv) increasing customer engagement. Below, we present excerpts from the responses of the participants who helped in this understanding.

To improve the initiative's planning and communications (E09 – Better Communication), participant P16 suggested, "The project's objectives must be clearly and well communicated through a single shared vision with the team and key stakeholders." This statement was contributed to the description of action A01. Concerning training and the enhancement of the effect EF05 – Agile Culture Building, participant P64 reported "training on agile culture, techniques and tools for managers and teams." This excerpt was associated with actions A27 and A33.

We highlight that some actions are more elucidative and have more widespread procedures in practice. For example, (i) actions from A27 to A33 describe the need for constant team training about agile ceremonies, principles, and values, and (ii) A08 can be enhanced, promoting autonomy for team decision-making during the iteration planning meeting. On the other hand, other actions can be challenging to implement and require expert practitioners who understand the context and promote changes in how those involved act. For example, for 'encouraging diversity and inclusion within teams' (A10), the human resources department or the technical manager should establish and follow guidelines for team composition that represent diversity in race, gender, age, people with disabilities, or even personality traits.

Participants also suggested actions that allow the construction of more collaborative and empowered teams (EF04 – Team Collaboration). Participants wrote about this by saying, "constantly promote collaboration" (P51) and "empowerment directed to IT professionals" (P02). These considerations were associated with actions A03 and A08, respectively. The actions from A12 to A18 represent the importance of defining a formal CRM (Customer Relationship Management) process to enhance the effect E08 – Customer Satisfaction. Participant P11 highlighted the need of "having the practice of measuring [customer] satisfaction" (A14).

Thus, we grouped the actions into four strategies that practitioners can consider to potentiate the most critical effects in agile transition initiatives: "*Building high-performing diverse teams*," "*Building genuine customer satisfaction and engagement*," "*Driving organizational cultural change*," and "*Fostering continuous organizational learning to agile*." Table 11 shows the actions that contributed to the definition of the strategies, besides relating the effects addressed by the strategies. The strategies are discussed in Section 4.3.

4 Discussion

To answer RQ1, we executed survey research to identify the relevance of seventeen critical success factors for agile transformation initiatives from the project management perspective. Table 7 presents the list of factors based on their level of relevance (very high or high). From 68 respondents, only five stated that eight investigated factors – presented in light blue in Figure 2 – are irrelevant to the agile transformation from a management perspective. Despite that, all eight mentioned factors were considered as highly relevant or relevant by at least 58% of 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.

Similarly, to answer RQ3, we asked participants to evaluate the relevance of the seventeen effects presented in (Andrade et al., 2023) for agile transformation initiatives from the project management perspective. Table 9 presents the effects based on their level of relevance (very high or high). Of the 47 respondents, only five stated that five investigated effects – also presented in light blue in Figure 3 – are irrelevant to the agile transformation from a management perspective. Despite that, three mentioned effects (E10 – Team adaptability ($\approx$%79), E11 – Trust in people ($\approx$%75), E12 – Responsibility building ($\approx$%72)) were considered as highly relevant or relevant by at least 50% of respondents ($\approx$%79, $\approx$%75, and $\approx$%72, respectively). Thus, based on the responses and practitioners' experiences, we have evidence that these effects identified in the literature are relevant to agile transformations.

Conversely, the other two effects, namely E14 – Increased investment in projects ($\approx$%43) and E16 – Facilitate effort estimation ($\approx$%51), are at the lower end of the ranking presented in Table 9. Both effects are generally associated with the benefits of software improvement initiatives. For example, they are among the benefits reported by organizations that implemented the Brazilian reference model for software process improvement (MPS-SW) (Santos et al., 2015). Therefore, further investigation into why the participants do not value them highly is needed. Nonetheless, based on Figure 3, we cannot discard their relevance either.

4.1 Impact of the New Factors to Agile Transformations

In addition, we asked the respondents for new indications of critical success factors for agile transformations from a project management perspective to answer RQ2. While many contributions could be traced to the existing factors, we identified seven possible new factors during the survey's first phase and four during the second phase. As mentioned in Section 3.2, we consulted sources related to project management, agile methods, and software process improvement to better

Table 10. Actions for addressing the effects of critical success factors suggested by the participants (n = 47).

Column legend (factor codes):
F02 – Team empowerment; F03 – Adapting the process to agile; F04 – Focus personal characteristics; F07 – Customer personal characteristics / mindset; F09 – Team personal leader; F11 – Servant leader / communication; F12 – Good communication; F16 – Building strong commitment of organizational teams; F17 – Team commitment of organizational safety; F18 – Alignment organizational goals and expectations; F21 – Psychological safety / improving organizational processes to meet business needs; F22 – Improving organizational collaboration; E01 – Commitment to change management; E04 – Organizational collaboration to change building; E05 – Agile culture; E08 – Better customer communication satisfaction; E09 – Customer adaptability; E10 – Team adaptability support for teams; E15 – Management.

ID	Actions	Source	F02	F03	F04	F07	F09	F11	F12	F16	F17	F18	F21	F22	E01	E04	E05	E08	E09	E10	E15
A01	Ensuring all organizational members are informed about the changes, rationale, and benefits	P36, P66, P16								x						x					
A02	Management should maintain direct and effective communication with teams	P20						x								x					
A03	Forming teams with collaborative individuals	P01, P51, P08				x										x					
A04	Forming teams with members from different areas of the organization	P36														x					
A05	Providing clear guidelines for teams to communicate with other impacted stakeholders and organizational areas	P34						x								x					
A06	Do not penalize teams for their mistakes	P53, P51									x					x		x			
A07	Empower leadership to foster team autonomy, decision-making, and self-organization	P08					x									x		x			
A08	Promoting team empowerment	P02	x													x		x			
A09	Organizing events to foster innovation	P36														x		x			
A10	Encouraging diversity and inclusion within teams	P55							x							x		x			
A11	Fostering an environment of psychological safety	P16										x				x		x			
A12	Implementing a customer satisfaction management process	P11, P50			x														x		
A13	Promoting customer commitment	P02			x													x			
A14	Assessing customer satisfaction	P11			x													x			
A15	Promoting stakeholder engagement	P67, P55			x													x			
A16	Listening to customers and involving them in the agile transformation process	P28			x													x			
A17	Management should maintain direct and effective communication with customers	P20						x										x			
A18	Promoting continuous communication with the customer to support prioritization	P11, P16						x										x			
A19	Implementing a formal change management process	P23, P36											x		x						
A20	Involving employees in the planning and execution of agile transformation to ensure their active engagement	P36								x			x		x						x
A21	Secure commitment from the entire organization for the agile transformation project	P67								x					x						
A22	Foster leadership support for the agile transformation.	P61, P67								x											x
A23	Support for adaptation and flexibility of organizational processes	P13		x									x								x
A24	Restructuring the organization's structure	P50													x						
A25	Informing employees about the rationale behind the organization's adoption of an agile culture	P28									x				x						
A26	Recruiting qualified individuals to participate in the agile transformation project	P28							x						x						x
A27	Training management in an agile culture	P02, P64							x								x				
A28	Disseminating agile concepts to employees	P28							x								x				
A29	Promoting agile culture among employees to nurture a mindset shift	P34, P36							x								x				
A30	Training the team in agile culture, techniques, and tools	P02, P63							x								x				
A31	Promoting continuous learning in agile methods	P24							x								x				
A32	Training the team in soft skills and hard skills	P64							x								x				
A33	Encouraging the adoption of agile practices	P64	x														x				

Table 11. Strategies associated with the most relevant effects.

ID	Strategy	Effects	Actions
S01	Building high-performing diverse teams	E09, E04, E10	From A01 to A11
S02	Building genuine customer satisfaction and engagement	E08	From A12 to A18
S03	Driving organizational cultural change	E15, E01	From A19 to A26
S04	Fostering continuous organizational learning to agile	E05	From A27 to A33

characterize their impact on 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' skills in project management. Managers must be prepared to handle conflicting and 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 strategies and solutions and build teams capable of handling unforeseen demands and situations while often having to adapt processes to meet personalized customer demands (Napier et al., 2011; Severgnini et al., 2019), which can challenge the efficient allocation of resources. Moreover, customer demands, or the foreseen project results may conflict with top management expectations regarding the agile transformation goals. At high management levels, ambidexterity is also essential due to the difficulty of aligning all stakeholders' expectations with the organizational and transformations goals.

The correct choice of tools and process automation (Chow and Cao, 2008; Stankovic et al., 2013b) 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 (Chow and Cao, 2008; Stankovic et al., 2013b). Moreover, adapting existing tools is a challenge to overcome in agile journeys (Reginaldo and Santos, 2020).

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 (Motingoe and Langerman, 2019). 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 (Dikert et al., 2016; Reginaldo and Santos, 2020). Project managers must ensure effective and close communication among teams and between departments 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 qual-

ity must be a commitment of everyone directly involved in the improvement process and the entire organization (van Manen and van Vliet, 2014; Reginaldo and Santos, 2020). Motivators are built into this factor, which influences the agile teams' commitment and effectiveness, according to Trzeciak and Banasik (2022). Top management support and other CSFs investigated in this study are relevant to the team's commitment (Sharif, 2014; Gandomani and Nafchi, 2015; Reginaldo and Santos, 2020). However, commitment cannot be built without confidence, transparency, good communication, 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 team engagement (Trzeciak and Banasik, 2022).

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 CSFs also in other contexts (Chow and Cao, 2008; Dikert et al., 2016; Abdalhamid and Mishra, 2017; Campanelli et al., 2017). 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.

F18 – Psychological Safety is closely linked to collaborative relationships and interaction within teams. It also concerns open communication, sharing experiences, and the degree of trust that a psychologically safe environment provides to individuals, as they can feel secure enough to experiment and take risks, fostering constructive dialogue when conflicts arise. Thus, collective decision-making (see F04 – Decentralized decision-making) and leadership ownership (see F10 – Adoption of participatory management) are key for psychological safety (Alami et al., 2023; Barros et al., 2024). Top management (F01 – Top Management Support) must support and act to create a collaborative culture that encourages participation and promotes greater engagement within the organization. Other factors also impact or are impacted by psychological safety, such as F02 – Team empowerment, and F11 – Good communication.

F19 – Risk Management is considered a critical success factor, serving as an important mechanism to improve a project's chances of success (Sharma et al., 2013). Traditionally, risk management is not associated with agile methods (Albadarneh et al., 2015). However, factor F19 was indicated as necessary since it is essential to continuously assess and monitor risks quickly and effectively, adapting to the project's rapid changes and improvement conditions, suggesting an associ-

ation with F22 – Organizational Change Management. Additionally, we can highlight other interrelated factors, such as F05 – Decentralized decision-making and F08 – Experimentation of new approaches due to the importance of the shared, interactive, and feedback-driven effort of the team that decides and implements the best solutions to address the identified risk.

Factor *F20 – Capacity Building and Continuous Learning* refers to the need for ongoing development of teams. Training and management support regarding the empowerment of agile teams are considered critical success factors, as learning and knowledge provide teams with greater expertise and mastery of methods and practices used, capable of enhancing and increasing team performance (Alami et al., 2022). The appreciation of a culture of continuous learning is a frequent concern of ambidextrous organizations (F13 – Organizational Ambidexterity), which manage knowledge to stimulate innovation and remain competitive. The clearest relationship of this factor with others concerns F12 – Building strong teams, as it interferes with the construction of high-performance teams (Tam et al., 2020). Finally, it should be noted the relationship with factor F21 – Improving Processes to Meet Business Needs, because, for process improvement to occur, specific capabilities and knowledge are required that may require training (Kitapçi and Çelik, 2014).

F21 – Improving Processes to Meet Business Needs is associated with the need for processes not only to be suitable for the agile philosophy (see F03 – Adapting the Process to Agile) and seek to improve the quality of services or software (see F23 – Focus on Product Quality), but also to meet the organization's business objectives. This concern is reinforced in process improvement maturity models – for example, (ISACA, 2023; Softex, 2024) – and cannot be overlooked during agile transformations. Therefore, this factor is associated with factor F01 – Top management support, as the senior management defines what is strategic for the organization. It is also related to factor F17 – Alignment of organizational goals and expectations, due to the need to have a set of strategies, structures, and methods aligned with business objectives. Additionally, there is a need to plan for process change (F22 – Organizational Change Management) to minimize possible obstacles and resistance to change during the transformation (Gandomani et al., 2013; Dikert et al., 2016; Mishra et al., 2021).

F22 – Organizational Change Management refers to the strategies and planning that the organization devises to confront better the organizational mutation that occurs with the transition to agile. Transitioning from a traditional to an agile model requires special attention, and the organization must plan and manage the change carefully, mainly because there are significant issues that are among the main obstacles involved in agile transformations, such as processes, people, management, and cultural and technical problems (Gandomani and Nafchi, 2015). Therefore, proper change management can assist the agile transition and impact the success or failure (Gandomani et al., 2013; Gandomani and Nafchi, 2015; Mishra et al., 2021). Associated factors include F01 – Top management support, due to the responsibility of top management to devise strategies and plan execution providing necessary support and infrastructure, F13 – Organizational

Ambidexterity, as it concerns the organization's ability to manage conflicts and change; and F17 – Alignment of organizational goals and expectations, due to the need for a set of strategies, structures, and methods capable of guiding organizations to achieve superior performance and agility.

F23 – Focus on Product Quality expresses concern about the quality of software products resulting from using agile approaches. It is no secret that with technological advancements and the highly competitive IT market, managing and ensuring the quality of software products or services has become an organizational imperative (Behutiye et al., 2020). Quality management is not only necessary but essential in determining the success of projects in agile software development (Behutiye et al., 2020). To achieve product quality and innovation, mechanisms and strategies need to be created to enable and improve development practices, not only in terms of management but also involving the customer (F04 – Customer Focus) and other stakeholders (see, for instance, F16 – Team Commitment). The preeminent role of top management (F01 – Top Management Support) in defining and outlining clear strategies focused on product quality must be highlighted. Also, middle management and teams must commit to this goal (F17 – Alignment of Organizational Goals and Expectations). It is important to remember that since increasing quality is one of the organizational objectives, software processes should be directed towards making this a reality (F21 – Improving Processes to Meet Business Needs).

4.2 Putting the Factors' Relationship into Perspective

Based on the contributions of the study's participants, we found that CSFs cannot be seen only as isolated factors. These factors are crucial to a successful agile transformation journey and make a difference for project managers in isolation or groups. Thus, we created an integrated view of all factors (Figure 4), 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." They are discussed next.

4.2.1 Organizational Orientation to Agile Transformation

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 (Andrade et al., 2023), 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,
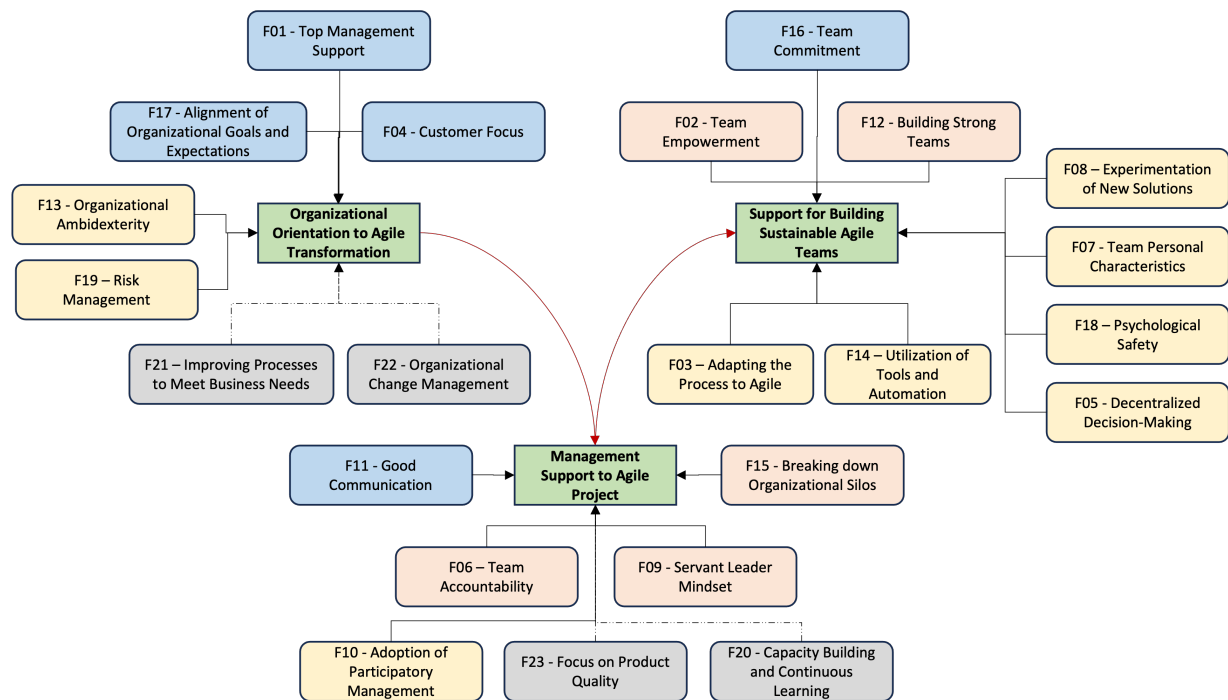
Figure 4. Integrated view of the critical success factors of agile transformations from a project management perspective. Green boxes represent the primary group of factors that high, middle, and direct management should pay attention to. Factors associated with the relevance of Groups A, B, and C (see 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.

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 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.

4.2.2 Management Support to Agile Project

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 (Andrade et al., 2023). That is also in line with the literature (Chow and Cao, 2008; Campanelli et al., 2017; Alhroub and Jaaron, 2019; Mishra et al., 2021), 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 (Beedle et al., 2001), 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.

4.2.3 Support for Building Sustainable Agile Teams

Regarding *"Support for Building Sustainable Agile Teams,"* reinforcing the idea of organizational mutation understood in the agile transformation (Gandomani et al., 2013), 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 (Gandomani et al., 2014; Junior et al., 2015; Silva and Santos, 2015; Ayed et al., 2017; Reginaldo and Santos, 2020). Nonetheless, aspects associated with national culture cannot be neglected. According to Hofstede et al. (2010), 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* (Hofstede et al., 2010), defined as the degree to which a society accepts unequal power between people. According to

Hofstede (Hofstede et al., 2010), 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 (Ayed et al., 2017) and may affect the new critical success factors. For instance, team commitment (F16) can affect organizations with hierarchical structures (Altuwaijri and Ferrario, 2022). The imposition of new agile methods and practices from the top down by top management can generate impacts for on the entire organization (Dikert et al., 2016; Altuwaijri and Ferrario, 2022). In this case, power distance can create a climate of uncertainty, making team engagement difficult (Ayed et al., 2017; Motingoe and Langerman, 2019; Altuwaijri and Ferrario, 2022).

High psychological safety elicits a performance response with innovation as the goal, whereas low psychological safety elicits a fear response with survival as the goal. When team members stop asking questions, admitting mistakes, exploring ideas, and challenging the status quo, they stop being agile (Clark, 2022). High power distance makes some aspects of psychological safety more challenging. For instance, it makes it difficult to encourage employees to contribute to discussions and challenge decisions when this is seen as disrespectful in the workplace (Brace, 2021).

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 (Ayed et al., 2017; Motingoe and Langerman, 2019; Altuwaijri and Ferrario, 2022). Furthermore, power distance can affect organizational ambidexterity (F13) by creating aversion and resistance to change (Rodriguez and Hechanova, 2014; Ayed et al., 2017), 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.

4.3   Strategies to Enhance the Most Relevant Effects

We discuss the strategies outlined in Section 3.3.5 next. Additionally, we provide further excerpts from the participants' contributions that support these strategies.

4.3.1   Building high-performing diverse teams

The strategy "S01 – Building high-performing diverse teams" requires a multifaceted approach that incorporates several management actions to promote collaboration, trust and experimentation by teams. In addition, management must maintain direct and open communication with the team about the transformation project guidelines and the role of the team in this transformation.

Initially, management must define, share, and communicate a single vision for the agile transformation project. Corroborating with this statement, participant P36 argues that communication on management transformation for teams should be transparent and continuous. P36 stressed that it is necessary to "keep everyone informed about what is changing, why it is changing and how it benefits the organization and its members" (A01 – Ensuring all organizational members are informed about the changes, rationale, and benefits; see others actions in Table 10). It is also the responsibility of management to implement an effective communication strategy. Participant P55 argues that an "open active communication channel should be implemented" (A02 – Management should maintain direct and effective communication with teams). By doing so, managers can promote a participatory safety culture in which team members feel comfortable expressing their ideas and concerns, leading to more effective communication and collaboration. Related to this, P16 said that "It is essential to create a healthy environment where the team feels confident, heard, challenged, and responsible for its tasks" (action A11 – Fostering an environment of psychological safety).

Regarding the action A03 – Forming teams with collaborative individuals, participant P51 wrote, "One must constantly promote collaboration and caution when punishing errors not to inhibit experimentation (A06 – Do not penalize teams for mistakes). About action A09 – Organizing events to foster innovation, participant P36 suggested "promoting hackathons and innovation sprint: holding regular events focused on innovation encourages employees to think outside the box and collaborate on new ideas." Finally, leadership should be empowered to foster team autonomy, decision-making and self-organization (A07). According to P08, "leadership that actively supports team autonomy, encouraging collaborative decision-making and self-organization should be promoted."

4.3.2   Building genuine customer satisfaction and engagement

To define the strategy "S02 – Building genuine customer satisfaction and engagement," we categorized the suggested actions described by the participants who indicated, in general, the need to implement the Customer Relationship Management (CRM) Process (A12). We understand that it is the responsibility of management to define and implement a specific CRM for the transformation project. The deployment of the CRM process should build genuine customer satisfaction and engagement.

Regarding implementing a customer satisfaction management process (A12), P11 suggested "having the practice of measuring customer satisfaction [implemented] and applying effective actions [that address problems]" (A14 – Assessing

customer satisfaction). Ahmed (2024) argues that CRM transcends its role as a mere business strategy, emerging as a catalyst for organizational transformation. For this, the role of business managers in the implementation is multifaceted and pivotal for the success of CRM initiatives within an organization. Management should define clear objectives and performance metrics, and business managers should provide direction and accountability for CRM implementation, guiding teams toward measurable outcomes (Ahmed, 2024).

Aiming to build genuine customer satisfaction and engagement, Participant P28 reported, "it is necessary to listen to customers and let them be part of the transformation process" (A16 – Listening to customers and involving them in the agile transformation process). With regard to increasing customer commitment, it is important that "the customer believes in the transformation when they see in practice the positive results that directly and indirectly benefit them" (P2) (A15 – Promoting stakeholder engagement). To improve customer satisfaction, P11 suggested reducing the delivery time "based on the customer's needs and prioritization, suggesting reducing the number of requirements to be dealt with in a delivery to bring value to the customer." According to P16, you should "seek continuous and structured communication and feedback from the customer to support prioritization, which will result in satisfaction and quality" (A18 – Promoting continuous communication with the customer to support prioritization).

4.3.3 Driving organizational cultural change

Strategy "S03 – Driving organizational cultural change" represents a set of actions designed to demonstrate to teams the commitment of top management to the cultural changes that the agile transformation requires. Russo (2021) argued that settling for an extraordinary development team and committed middle managers will not be sufficient if top management support is lacking. Management commitment is perceived by the team when (i) top management recognizes and supports the team's efforts to develop software based on agile processes, (ii) top management periodically reviews the effectiveness of the agile process, and (iii) there is an understanding by middle management of how agile is applied to the business (Russo, 2021). For teams to be able to be part of the cultural change, the members of the agile transformation initiative planning teams must execute activities.

The action A19 – Implementing a formal change management process was suggested by participants P23 and P36. For P36, "effective change management minimizes employee resistance, facilitating a faster transition to new processes and practices." For P67, "the fundamental factor is the cultural factor. The whole company needs to be 'bought in' to this methodology, starting with the leadership" (A21 – Secure commitment from the entire organization for the agile transformation project, and A22 – Foster leadership support for the agile transformation).

4.3.4 Continuous organizational learning to agile

As for strategy "S04 – Continuous organizational learning to agile," the participants mentioned the need for qualification actions, capacity building and training in the agile culture for

all those involved in the transformation process. These learning actions differ according to each person's role in the transformation and should include everyone from management to technical team members. On effect E05 – Agile culture building, according to participant P36, "organizations with a strong culture of continuous learning adapt more quickly to changes in the market or technology, as they are used to learning and changing."

Rialti and Filieri (2024) argue that leaders will find it impossible to practice agile principles without first knowing the basics of agile or understanding agile-based thinking. Supporting the need for effective training for managers, P2 stated that the cultural change towards agility should provide training for those involved in the business areas: "Training on agile culture, techniques and tools should be conducted for managers and teams" (A27 – Training management in an agile culture). A commitment must be created to encourage continuous organizational learning of the agile culture. Participant P36 defended two benefits that can be obtained through a culture of continuous learning: "the constant promotion of learning leads to an increase in innovation, as team members are always looking for and applying new ideas and technologies" and "organizations with a strong culture of continuous learning adapt more quickly to market or technology changes, as they are used to learning and changing."

5 Limitations and Threats to Validity

For Kitchenham and Pfleeger (2008), surveys based on questionnaires are not simple, despite being a simple way to collect 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. In both phases, we piloted the questionnaire. Their feedback helped us improve the questions' wording and adequacy and organize them better. Despite the required participants' profile experience in agile transformations and management positions, we cannot guarantee all participants have an equal understanding of the factors and effects investigated.

There are also imposed limits related to the short period in which 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 (Andrade et al., 2023). This type of sampling approach is characterized by researcher judgment. It is useful when it is necessary to include a small number of sample units (Oliveira, 2001) – or obtain a "deliberately biased sample" (Leone et al., 2018). Due to the non-random and non-representative nature of the sample, it is not possible to generalize the results.

As Kitchenham and Pfleeger (2008) pointed out, question-

naires tend to have low response rates. As such, some related works had a low number of valid responses, for instance, (Stankovic et al., 2013b) and (Mishra et al., 2021), 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 note that our focus was to understand the critical success factors from a group that is not quite prevalent (i.e., project managers with experience in 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 (53 out of 68). If the survey had been 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 68 participants, 52 have six or more years of experience as managers, and 24 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. It is also important to note that, although the number of participants was not large, the contributions made by the participants in the open questions are valuable, as they reflect their experience and have contributed to a better understanding of the phenomenon studied, as seen in Sections 3.3 and 4.

The survey was executed in two phases, as described in Section 3.2. The possible bias of having entirely different participants in both survey iterations includes that the responses from the two populations may not be comparable due to participant characteristics or may vary depending on the conditions under which the questions were asked. To reduce the bias of having totally different participants in both execution iterations and receiving multiple answers from the same participant, we actively acted to ask the participants of the first phase to participate again. We allowed them to decide whether to review the former answers or provide a new one. Also, we worked to consolidate both participants' answers and contacted them in case of need. Data collection, treatment, and analysis are discussed in Section 3.1 and in the supplementary material (see Section "Artifact Availability").

As the survey participants did not evaluate the newly suggested factors (i.e., F20 to F23), we cannot argue for their relevance in the same manner as we did with the factors presented in both prior studies. Another limitation is that we only investigated the relevance of the effects associated with factors F01 to F12 described initially in (Andrade et al., 2023). Also, we cannot state that we reached theoretical saturation; new factors may emerge if new survey iterations are executed with new participants. Thus, we recognize the need for further investigation and intend to identify new factors, explore the newly suggested factors, and the identification of new effects and their relevance 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" (Digital.ai, 2021). Transitioning to agile involves numerous factors, challenges, and obstacles that organizations must consider when migrating from traditional processes (Gandomani et al., 2013; Gandomani and Nafchi, 2015; Reginaldo and Santos, 2020). However, there is a need for reports on critical success factors 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 survey research conducted to analyze the relevance of seventeen critical success factors, formerly investigated in (Andrade et al., 2023; Fortuna et al., 2023), in the context of agile transformation from a project management perspective. Additionally, we explored the consideration of other potential factors and also sought to identify the relevance of the effects associated with some of these factors. All survey participants had 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 the factors and effects and highlights the crucial role of project managers in the success or failure of agile adoption (Oliveira et al., 2018; Alhroub and Jaaron, 2019). It is also worth acknowledging the importance of the senior management's role associated with F01 – Top Management Support, which is the most relevant factor according to the participants and promotes the most effects according to the literature). Compared to our prior research, this study presents six new critical success factors, updated discussion on the relevance of the original factors, evidence of the effects relevance and actions to foster them based on the perception of practitioners.

Our findings can significantly contribute to planning and executing the agile 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 factors 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. Also, we will execute studies to improve our understanding of the factors' effects and benefits to other effects, factors, the agile transformation as a whole, and the overall organization goals. Additionally, we will investigate the influence of cultural aspects on agile transformations, such as power distance.

Artifact Availability

The survey results and the questionnaires used are available at `https://osf.io/e6db3/`.

Acknowledgements

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