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LAURIVAL SIQUEIRA CALÇADA JUNIOR

SOCIAL INTERACTIONS AND SOCIAL IDENTITY IN VIRTUAL PROJECT TEAMS

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“As I am little and know little, I do the little that is available to me, giving myself completely"

(Excerpt from the poem Para os que virão by Thiago de Mello (1926-2022))

DEDICATION

To my beloved Nara, my ever-present wife, tireless encourager, and to Davi, 5 years old, my son recently arrived, curious to know why his father is still at school.

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No one gets here alone.

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I am grateful for the inspiration each of you has brought me.

"Those who pass by us do not go alone, they do not leave us alone. They leave a little of themselves, they take a little of us."

(Quote attributed to Antoine de Saint-Exupéry (1900 – 1944))

Abstract

Background and rationale: Global economic growth combined with technological advances have driven the rise of virtual teams, characterized by collaboration between geographically dispersed members. Although these teams offer benefits such as cost reduction and increased productivity, they also present challenges, especially related to building interpersonal relationships. Given the importance of understanding how social interactions affect the effectiveness of virtual teams, this study proposes to investigate the dynamics of social identity and leadership in this context.
Research problem: How does leadership relate to social identity in virtual project teams?
Main objectives: To investigate the relationship between leadership and social identity in virtual project teams, and its impacts on extra-role behavior and individual performance of members.
Methodology: The research adopts a three-study approach:
Systematic literature review to identify the state of the art on social interactions in virtual teams.
Integrative literature review to map measurement scales for these interactions.
Structural equation modeling examines relationships between leadership and social identity, using data from questionnaires applied to virtual teams.
Results: The research revealed that leadership exerts a direct and significant influence on the construction of social identity in virtual teams. It was found that leaders with transformational characteristics can promote a greater sense of shared identity, strengthening member engagement and performance. In addition, the research identified that social identity is positively associated with extra-role behavior and individual performance. The measurement instruments adopted demonstrated high reliability, allowing a robust analysis of social interactions and leadership dynamics in the virtual context. The proposed theoretical model was validated, contributing to the advancement of understanding about the factors that drive effectiveness in virtual teams.
Contributions to Practice: The research provides guidance for managers and leaders of virtual teams, highlighting practices that promote engagement, cohesion, and effectiveness. A technological artifact is also proposed to facilitate the measurement of social interactions, contributing to the management of dispersed teams.
Contributions to Theory: This study advances the theory of social interactions in virtual teams by exploring the influence of leadership on the construction of social identity. It also contributes methodologically with the use of structural equation modeling, allowing in-depth analyses of causal relationships in virtual environments.
Originality and Value: This work is innovative in combining multiple methodological approaches to investigating social interactions in virtual teams. It fills gaps in literature, especially in the understanding of social identity and its relationships with leadership and cohesion, offering solid foundations for future research and practical applications.

Keywords: Virtual teams, leadership, social identity, cohesion, extra-role behavior, social interaction.

LIST OF ABBREVIATIONS AND ACRONYMS

AC	Absorptive capacity
AVE	Average variance extracted
BIM	Coordination of social networ
COVID-19	Corona virus disease, 2019
CR	Composite reliability
ILI	Leadership Identity Inventory
RSL	Systematic literature review
PLS	Partial least squares method
PLS- SEM	Structural equation modeling
SEM	Structural equation modeling
VIF	Variance inflation factor

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SUMMARY

1. INTRODUCTION

Humans have a long history of associative behavior. Two million years ago, our species developed group hunting and food-gathering skills, where teamwork ensured survival and propelled evolutionary success (Dunbar, 2012). Dunbar (1993) suggests that the development of language was an effective method for advancing social relationships, allowing individuals to learn about the behavioral characteristics of other group members. Tomasello et al. (2005) further argue that the difference in cognition between our species and others is a determining factor in the development of collaborative activities with shared intentions and goals, i.e., shared intentionality.

Working in groups allows members to establish norms and processes for shared work, facilitating conflict resolution (Tuckman, 1965). Belbin (2010) reveals that the diversity of skills and competencies enhances effective performance. Competent teams are characterized by a high sense of purpose, mutual responsibility (Katzenbach & Smith, 1993), and participant motivation (Sashkin, 1982). Edmondson (2019), analyzing organizational performance, shows the importance of team collaboration and cohesion in improving company performance. Well-coordinated teams with effective communication can overcome complex challenges (Salas et al., 2015).

Teams are groups of people with complementary skills, committed to a common goal, working together to achieve results superior to those they could achieve individually (Katzenbach & Smith, 2015). Hackman (2002) defines teams as sets of individuals with related occupations who communicate and coordinate to achieve specific goals. Mathieu et al. (2020) summarize teams as groups of people with common goals, interconnected responsibilities, and organized collaboration. Efficient teams are characterized by skill synergy, a sense of unity, mutual trust, and open communication.

Economic prosperity and information technologies, along with the needs of developing global markets, have led to the creation of teams whose members no longer work in the same location but are geographically dispersed and in different time zones (Cascio & Shurygailo, 2008). The term "virtual teams" was coined to describe these groups, despite "virtual" having various meanings (Chudoba et al., 2005). These teams work without time zone and location limitations, using technologies to communicate and operate (Anderson et al., 2007). According to Leenders et al. (2003), virtual teams are groups of individuals who collaborate, often

geographically and temporally distributed, potentially anywhere within or outside their organization.

Virtual teams offer project benefits such as cost reduction (Wijaya et al., 2023), increased productivity, and innovative solutions (Alkoud & Qatamin, 2023), as well as facilitating global market expansion (Piccoli, 2000). Blak Bernat et al. (2023) state that these teams positively influence project success by promoting stakeholder engagement, improving knowledge management, and developing sustainable practices, enabling organizations to operate anywhere in the world. However, new challenges arise, such as trust, cultural differences, and time zones, which can affect team efficiency (Swart et al., 2022). These barriers can be overcome by increasing social interactions, greater work sharing, exchanges of social information, and developing ways to express social presence online (Ala-Kortesmaa & Muñoz, 2023).

Projects have fundamental characteristics: planned tasks with specific and unique purposes involving organization and control (Schlick & Demissie, 2016). They are necessarily temporary, with limited resources (Invernizzi et al., 2020). According to Ktaish and Hajdu (2022), the perception of project success depends on the involved parties, as each has distinct success criteria; however, generally accepted criteria are cost, schedule, user satisfaction, quality, and business performance (Lamprou & Vagiona, 2018).

Virtual project teams have become increasingly common in the organizational environment, driven by globalization and the advancement of communication technologies (Cascio & Shurygailo, 2008; Gilson et al., 2015). However, their effectiveness faces significant challenges, especially due to the absence of face-to-face interactions, considered crucial for the development of trust, cohesion, and social identity among members (Ala-Kortesmaa & Muñoz, 2023; Van Knippenberg et al., 2004). Studies indicate that, in virtual contexts, the absence of a shared social identity can compromise team communication, engagement, and performance (Swart et al., 2022; Wijaya et al., 2023).

Furthermore, effective leadership styles in face-to-face teams do not always translate well to virtual environments, as technological mediation and cultural barriers heighten the need for specific approaches (Jarvenpaa & Leidner, 1999; Lin & Roan, 2022). This evidence highlights a critical gap in the literature: **how can leadership influence the construction of a robust social identity in virtual project teams, mitigating the negative impacts of virtuality on team performance?**

In this research, I adopted the following definitions: In-person teams carry out all their activities in the same physical space, benefiting from face-to-face interactions that foster trust

and cohesion (Katzenbach & Smith, 1993; Edmondson, 2004). Hybrid teams combine in-person and virtual interactions, offering flexibility but facing challenges of coordination and equity between remote and local members (Gilson et al., 2015; Cascio & Shurygailo, 2008). In turn, fully virtual teams operate exclusively through technologies, without physical interactions, which reduces costs but makes it difficult to build trust and social identity (Jarvenpaa and Leidner, 1999; Ala-Kortesmaa and Muñoz, 2023). Leadership is crucial in hybrid and virtual teams to promote cohesion and effectiveness.

The dynamics of proactive social interactions impact project success (Pati & Garud, 2023). Swart et al. (2022) show that the virtual nature of project teams does not reduce stakeholder engagement, knowledge sharing, or management sustainability; these factors continue to positively impact success (Swart et al., 2022) and influence results throughout the project life cycle (Nunes & Abreu, 2020). In this thesis project, I adopt the concept of social interactions offered by Putra and Sari (2022): "They are dynamic relationships involving interactions between individuals, groups, and between groups and individuals. "Social contact and communication are the main requirements for their creation (Aziz et al., 2020).

Virtual teams present a distinct approach to social interactions and team performance. O'Brien and Costin (2022) highlight the challenges in these relationships, where the transition to the online environment can impoverish such interactions, requiring cognitive and socio-emotional development to mitigate this effect. Specifically in projects, they state that these interpersonal relationships significantly affect relationship building, coordination, communication, cohesion, trust, and recognition (Wijaya et al., 2023).

One way to improve the management of social interactions in virtual project teams is to promote a culture of trust, responsibility, and provide technological tools for communication and collaboration (Sharma, 2023). For trust development, Ponomaryov et al. (2022) suggest building managerial competencies, professionalism, and enhancing leadership personal characteristics. Specifically, Becker (2021) points to transformational leadership as a promoter of social identity and engagement, crucial elements in the effective management of these teams. Regarding tools, social media emerge as a means of interaction (Sjølie et al., 2022), and when associated with social sensitivity, they play a crucial role in virtual teams, directly influencing communication and performance (Rogers et al., 2021).

Leadership plays a fundamental role in creating a favorable psychological environment with shared values and ideals, leading to effective team management (Grynchenko et al., 2018). Understanding team dynamics (Salminen et al., 2022) is essential for leaders; they must have social skills and social awareness to understand the context and environment of the teams,

although such social relationships are often neglected (Becker, 2021). To overcome these challenges, leadership must be dedicated to promoting social support and building strong interpersonal relationships, which can lead to greater team member engagement and, consequently, increased team effectiveness (Ram & Titarenko, 2022).

1.1 RESEARCH PROBLEM

Virtual project teams differ from traditional face-to-face teams in several aspects. They benefit from flexibility, location freedom, and reduced stress (Christensen et al., 2023), although they rely more on communication tools than face-to-face teams (Mwamba & Ahmad, 2022). More formal, they adhere strictly to organizational guidelines (Piccoli, 2000) and deeply depend on trust, leadership (Dincă et al., 2023), and psychological safety (Blak Bernat et al., 2023).

Although virtual teams offer cost efficiency and constitute a highly competent workforce recruited globally, they face specific challenges. Among these is the need to build strong virtual interpersonal relationships. Stratone et al. (2022) highlight that a decrease in these interactions can lead to a loss of conversations, resulting in reduced performance and team cohesion. Conversely, Sjølie et al. (2022) point out the necessary dependence on mediated communication and leadership challenges as factors that also hinder the performance and cohesion of virtual teams, resulting in ineffective managerial behaviors.

The COVID-19 (Coronavirus disease, 2019) pandemic increased the use of virtual teams, imposing a transition on leaders (Axtell et al., 2022). It is now vital to encourage a people-oriented leadership style (Nuratri et al., 2022), characterized by frequent communication, clear expectations, and assertive feedback. Despite the promise that these new forms of leadership address such challenges (Piccoli, 2000), it is still not fully understood which leadership behaviors are most suitable for the virtual environment (Weerawardane & Jayawardana, 2022). Wengel (2022) specifically highlights the lack of knowledge about leadership dynamics in virtual project teams, which directly influences project success.

Research emphasizes the positive relationship between cohesion among virtual team members and team performance (Maślikowska & Gibbert, 2022). Berg et al. (2023) go further, stating that team support is a predictor of team success, highlighting the importance of leaders and managers in this positive relationship. However, Liu & Huang (2022) reveal that virtual environments are dynamic and dispersed, where the formation of subteams can reduce cohesion, shifting the focus to individual alignment at the expense of the team, compromising success.

Understanding the construction of cohesion can impact leadership in various aspects, in addition to the performance and success of virtual teams (Rennie et al., 2023). Wijaya et al. (2023) encourage the investigation of cohesion-related challenges that can inhibit creativity in virtual environments. Chaudhary et al. (2022) argue that improvements in both cohesion and a shared sense of identity can lead to high levels of trust and satisfaction, surpassing even collocated teams. Both factors encourage a willingness to take on extra tasks, such as working beyond contracted hours (Patel et al., 2021).

Extra-role behavior is encouraged by both organizational practices and social interactions as pro-social behavior (Ismail et al., 2016). Norhanim and Nas'aiman (2019) observe a relationship between leadership style and personality traits in creating a positive environment where virtual team members are inclined to accept extra tasks. To promote this favorable environment, leaders must enhance a social identity within the team, involving exchanges of support and challenges with their followers (Guegan et al., 2019).

There is an urgent need to understand how individual and group processes can benefit social identification, as stated by Junker et al. (2022), thereby improving the performance of virtual teams. Axtell et al. (2022) suggest investigating how the physical absence of team members hinders the creation of a team identity, recognizing that this gap inhibits work motivation and effectiveness. Weerawardane and Jayawardana (2022) add that the concept of leadership in virtual teams is still nascent in academic literature, making it challenging to understand its influence on virtual team performance.

Based on the presented gaps, this thesis project proposes to investigate social interactions in virtual project teams, specifically addressing the relationship between leadership, cohesion, and extra-role behavior of virtual project team members. Thus, the following research question is proposed: How does leadership relate to social identity in virtual project teams?

1.2 OBJECTIVES

1.2.1 General Objective

Investigate the relationship between leadership and social identity in virtual project teams.

1.2.2 Specific Objectives

a) Identify the state of the art in research on social interactions in virtual project teams in the academic literature.

b) Identify methods and processes for measuring social interactions in virtual project teams in the academic literature.

c) Identify the relationships between leadership and the construction of social identity in virtual teams. (This objective was defined based on the findings from study 2)

1.3 JUSTIFICATION

Progress in global economic and political integration, combined with technological advancements, creates a favorable environment for remote work, and virtual teams are becoming increasingly common (Nilles, J. M., 1998). Bailey and Kurland (2002), reviewing the literature, cite the seminal research of Jack M. Nilles (1998) as pioneering in exploring the benefits and challenges of remote work. Cascio (2000) highlights the nascent academic knowledge about the dynamics of these arrangements. Specifically, regarding the interpersonal relationships of these teams, Kirkman and Mathieu (2005) discuss how virtuality influences social interactions, revealing the lack of effective strategies for coordination and communication to maintain cohesion and productivity in these groups.

O'Brien and Costin (2022) also highlight obstacles in social interactions, clarifying that remote teams are capable of adequately developing these relationships and showing them as forming both group and individual social identities. Haslam et al. (2023) complement this by stating that an approach associated with leadership can potentially induce a shared sense of motivating identity, strengthening team cohesion. They assert that an integrative attitude towards social identity theory will be beneficial for organizations in addressing the challenges of interpersonal relationships in virtual teams (Porck et al., 2019).

Although capable, social identity theory must be studied in the context of virtual teams with their specific characteristics. Liang et al. (2023) exemplifies this by showing that voice calls are potentially positive for feelings of connection and affection. However, face-to-face interaction certainly offers superior benefits for psychosocial well-being. Similarly, videoconferences are associated with a reduction in exchange behavior, negatively affecting subjective cooperation and performance, posing an additional obstacle to interpersonal interactions (O'Brien & Costin, 2022).

Undeniably, the COVID-19 pandemic accelerated the use of virtual teams, making the investigation of their challenges urgent (Op 'T Roodt et al., 2021). Among many, Mirbabaie et al. (2021) report an urgency in understanding the construction of social identity in these groups, particularly its relationship with identity leadership. Research highlights the relevance of factors such as relationship building and leadership styles in these teams (Wijaya et al., 2023).

Olsen et al. (2023) adds that it will be essential to develop quality interpersonal relationships to improve cohesion towards effective work.

There is consensus that informal interactions inside and outside the workplace are positive predictors of cohesion (Rogers et al., 2021), developing a positive shared social identity among team members (Patel et al., 2021). However, in the virtual environment, important non-verbal visual cues are reduced—a glance, a facial expression, a smile—repressing the role of cohesion transmission within groups (Kantharaju and Pelachaud, 2021). These obstacles encourage dispersion and the appearance of subteams, further restricting the sense of team unity (Maślikowska and Gibbert, 2023).

Despite these limitations, Kakar and Kakar (2018) suggest that cohesion is a crucial factor in developing an environment conducive to proactivity, knowledge distribution, creativity, and the willingness of members to accept extra-role activities. Understanding its mechanisms will be vital. Reinforcing this idea, Wang (2022) in a study on team sports indicates that positive interactions between team members, associated with leadership competence, are a readiness condition for participants to accept extra tasks. Creating this conducive environment, according to Depoo and Hyršlová (2022), will require adequate leadership and an organization with rules and processes aligned with the challenges of virtual teams.

Given this context, it is imperative to deepen the understanding of virtual team dynamics, focusing on social interactions and the role of leadership in building a cohesive social identity. Continuous academic investigation, centered on the nuances of interpersonal relationships and the effectiveness of leadership styles in virtual environments, will not only contribute to the development of more effective strategies but also promote more integrated and productive work environments. This study aims to fill these gaps, offering valuable insights for implementing more cohesive and effective virtual teams aligned with contemporary global market demands.

1.4 STRUCTURE OF THE THESIS

This research adopted a thesis structure organized into multiple studies, as proposed by Costa, Ramos, and Pedron (2019). It comprises three studies, outlining the objectives specifically, as illustrated in the thesis methodological framework matrix, Figure 1.

Figure 1
Thesis methodological binding matrix.

Student's name:	Laurival S. Calçada Junior
Advisor's name:	Leonardo Vils
Name of Coadvisor	Marcírio Silveira Chaves
Central question of the thesis:	How does leadership relate to social identity in virtual project teams?
General objective of the thesis:	Investigate the relationship between leadership and social identity in virtual project teams
General justification of the thesis:	There is an urgency to understand how individual and group processes can benefit social identification, thus improving the performance of virtual teams. It will be important to investigate how leadership perception impacts the creation of a team identity, recognizing that this gap inhibits motivation and work effectiveness.

Justification for distinguishing studies	**Justification of interdependence of studies**
Study 1 in response to the research question: what is the state of the art on social interactions in projects with virtual teams? It presents five constructs most covered in the literature when the themes of social interactions and virtual teams are researched together, among which social identity stands out. Study 2 in response to the research question: what scales are adopted to measure social interactions in virtual teams? It presents two important contributions, it shows that scales developed to understand the dynamics in face-to-face teams are now adjusted to understand virtual teams, it also shows which scales are used to measure the most discussed constructs. Study 3 aims to select the scales offered by study 2, and adopting a structural equation modeling methodology, presenting a model for the relationship between leadership and the construction of social identity in virtual project teams.	Study 1, a systematic review of the literature, identifies the constructs most discussed in the research on the central themes of this research. Study 2, an integrative literature review, presents the scales used in research on the topics, in addition to showing that they are the scales originally used to measure face-to-face teams, now adjusted to measure virtual teams. The proposal for study 3 will be to employ these scales in a structural equation modeling approach, present a theoretical model for the relationship between leadership and the construction of team identity, also understanding whether there is a moderating relationship between cohesion and the construction of an environment acceptance of extra responsibilities (Extra-role behavior).

Source: the author

Figure 1
Thesis methodological binding matrix. (Continued)

	Título	Questão de Pesquisa	Objetivo Geral	Tipo de Estudo	Método de pesquisa	Procedimentos de coleta de dados	Procedimentos de análise de dados	Situação academica dos artigos
Estudo 1	Interações Sociais em Equipes Virtuais em Projetos	Qual é o estado da arte sobre interações sociais em projetos com equipes virtuais?	Analisar o estado da arte no relacionamento entre interações sociais em equipes virtuais em projetos	Qualitativo	Revisão sistemática da literatura	Protocolo de pesquisa amparado em Pollock e Berge (2018)	Analise textual dos artigos selecionados. Perceber quais conceitos e teorias sobre relações interpessoais em equipes virtuais são tendencia nos estudos.	Publicado
Estudo 2	Mensurando interações sociais em equipes virtuais: Uma revisão integrativa da literatura.	Quais escalas mensuram as interações sociais em equipes virtuais de projetos	Investigar escalas e indices empregados para medir as interações sociais em equipes virtuias de projetos	Qualitativo	Revisão integrativa da literatura	Protocolo de pesquisa amparado em Torraco (2016) e Snyder (2019)	Analise textual dos artigos buscando escalas para mensuração das interações sociais em equipes virtuais	Aprersentado no Emprad 2023
Estudo 3	A construção da identidade social nas equipes virtuais, o papel da liderança	Qual a relação da liderança com a identidade social das equipes virtuais de projetos?	Investigar a relação entre a identidade social e a liderança nas equipes virtuais	Empirico	Quantitativo	Questionario aplicado em profissionais e praticantes em gestão de projetos.	Analise empregando a sistematica de modelagem de equações estruturais.	Proposta apresentada à banca de defesa.
	Nome e tipo de produto	**Descrição**	**Aderência**	**Impacto**	**Aplicabilidade**	**Inovação**	**Complexidade**	
Produto Tecnológico (Proposta)	Processo de avaliação do relacionamento entre liderança e a identidade social nas equipes virtuasis de projetos	A prosta será auxiliar lideres e praticantes a entender as dinamicas do relacionamento entre a liderança e a identidade das equipes virtuais de projetos	A proposta esta alinhada à linha de pesquisa comportamental em gestão de projetos da UNINOVE.	Compreender as dinamicas sociais em equipes virtuais de projetos poderá conduzir as equipes a um melhor desempenho. Este produto será cnsiderado de medio impacto.	Os fatores impactantes e diretrises propostas poderão auxiliar o desempenho das equipoes virtuais de projetos. Imapcto medio	Nesta proposta a inovação esta na aplicação de tecnicas e mensurações originalmente desenvolvidas para equipes presenciais, agora adaptadas nas equipes virtuais de projetos. Impacto medio.	A proposta deste modelo apresenta media complexidade.	

Source: the author

2. METHODOLOGICAL PROCEDURES

This thesis was developed based on the following research methodologies.

Study 1: systematic literature review.
Study 2: An integrative review of literature.
Study 3: structural equation modeling.

Study 1 seeks the state of the art in academic literature on the relationship between social interactions and virtual project teams, addressing the systematic literature review methodology. The research follows the guidelines of Okoli and Schabram (2010), with searches carried out in the ISI Web of Knowledge and Scopus databases, among articles with free full access permitted free of charge.

The systematic literature review (SLR) methodology allows the construction of academic research based on metadata without the need for empirical data (Kraus et al., 2020). It allows you to unify and integrate the knowledge present in the scientific literature on topics of interest, always in an objective and clear way (Rowley & Slack, 2004). It proposes to answer a research question (Okoli & Schabram, 2010), usually about the status quo of a chosen field of study (Kraus et al., 2020).

Study 2 adopts the methodology of integrative literature review, seeking to identify which scales are used to measure social interactions in virtual teams. Searches carried out on the ISI Web of Knowledge and Scopus databases, among articles with free full access, were permitted free of charge in June 2023.

An integrative review necessarily results in the advancement of knowledge around research addressed (Snyder, 2019), although managed in various ways, replicability and transparency are expected from the researcher in conducting the studies. A critical analysis of the literature is essential (Torraco, 2005), carefully searching for central ideas, concepts and relationships between themes.

Study 3 proposes an approach using structural equation modeling (SEM), a statistical methodology used in the social sciences to test and estimate relationships between observable and latent variables. Allowing the combination of factor analysis and multiple regression, it facilitates the understanding of complex theoretical structures. Ringle, Silva, and Bido (2014) emphasize that SEM allows for the simultaneous analysis of multiple dependency relationships,

which is essential for testing complex theories and models that involve interactions between independent and dependent variables.

Kline (2015) highlights that SEM is particularly useful for testing hypotheses about causal relationships in complex theoretical models, while Byrne (2013) emphasizes its ability to deal with multiple dependent variables simultaneously. Hair et al. (2010) argue that SEM offers significant flexibility in modeling interactions, mediators, and moderating effects, making it an essential tool for robust empirical research in the social sciences.

The application of SEM to the study of team dynamics has expanded significantly, with researchers exploring how latent variables influence team effectiveness and cohesion. For example, Mathieu et al. (2019) used SEM to examine the relationship between transformational leadership, team cohesion and performance, demonstrating that effective leadership can increase cohesion and, consequently, improve team results.

We also have studies by Wang et al. (2020) using SEM to analyze the influence of shared leadership structures on team satisfaction and productivity, highlighting the complexity of interactions within remote work contexts. These examples illustrate how SEM is a valuable tool for understanding the complex interrelationships within teams, providing important insights for improving performance and cohesion in contemporary work environments.

I justify the choice of SEM methodology based on the teachings of Ringle, Silva, and Bido (2014):

Suitability for Non-Normal Data and Small Samples

One of the main justifications for using SEM, specifically through the Partial Least Squares (PLS) method, is its robustness against the violation of multivariate normality assumptions. In many Social and Behavioral Sciences research, it is common to encounter data that do not follow a normal distribution. Additionally, PLS is suitable for situations where the theory is in an early stage of development or when working with small samples. As discussed by Hair et al. (2014) and evidenced by Ringle, Silva, and Bido (2014), the PLS method is preferable in scenarios where models are formative and/or data are limited.

Flexibility and Applicability

The increasing use of SmartPLS® software in Marketing research has demonstrated the robustness and applicability of variance-based SEM. This software facilitates the implementation of complex models and the analysis of non-symmetrically distributed data, providing an accessible and powerful tool for researchers. The flexibility of SmartPLS in handling different types of measurement models (reflective and formative) and its ability to

generate results even with a reduced number of observations make it a robust methodological choice.

Quality and Significance of Results

PLS allows for the evaluation of model quality through various indicators such as the Average Variance Extracted (AVE), Composite Reliability (CR), and path coefficients (β). These indicators help ensure that the measurement and structural models are reliable and valid. The bootstrapping technique, used to assess the statistical significance of the coefficients, is an example of how PLS can provide robust and significant insights even when the ideal conditions of normality and sample size are not met.

Conclusion

Therefore, the use of Structural Equation Modeling via PLS in this thesis is justified by its ability to handle complex theoretical models, non-normal data, small samples, and the robustness of the analyses it enables. This methodological approach not only supports the validation of emerging theories but also offers a detailed and significant analysis of the relationships between constructs, substantially contributing to the advancement of knowledge in the field of Business Administration.

3. STUDY 1:

THE STATE OF THE ART ON SOCIAL INTERACTIONS IN VIRTUAL PROJECT TEAMS

ABSTRACT

Purpose –This paper aims to provide a better understanding on the state of the art of social interactions in virtual project teams based on overarching literature.

Design/methodology/approach – This literature review is composed of 125 papers collected from the ISI Web of Science and Scopus databases, covering 2017 to October 2023.

Findings - Results show that knowledge sharing, social identity, team cognition, psychological safety, and absorptive capacity are often adopted to improve understanding of social interactions in virtual project teams. Previous literature reviews propose research agendas focused on social identity, social capital, and media. Identified research agendas are underdeveloped, presenting opportunities for further examination, emphasizing understanding of social identity, increasing productivity, creativity, and quality of work.

Practical implications - The findings help managers understand which factors drive effectiveness in project management and their main barriers. The factors identified represent the focus of research in literature. Analyzing the relative impact of various processes and outcome factors allows researchers and practitioners to better identify methods for improving overall team performance.

Originality/value - This study shows that the theories adopted to understand social interactions in virtual teams were originally developed for face-to-face teams. Analysis is segmented into three levels, full collection, the most cited papers, and literature reviews, where I highlight recurring constructions, gaps and research proposals.

Keywords: Social interaction, Virtual environments, Virtual teams, Distributed Teams, Remote work, Projects, Team management.

3.1 INTRODUCTION

Nothing will be like it was before the COVID-19 pandemic, however, the crisis offers us opportunities. In the organizational context, digital communication becomes a useful and increasingly necessary tool, with remote work becoming essential (Gaudecker et al., 2020). Despite the increased use of remote work, this was already perceived long before this pandemic, when the globalizing organizational expansion demanded flexible virtual teams (Peters, 1992; Stewart, 1994), with low costs and quick response capacity, effective in environments of change and dynamic and turbulent markets (Mowshowitz, 1997; Snow et al., 1996).

Virtual teams use technology to interact between members beyond geographic and organizational boundaries and increase their effectiveness from repeated and shared social interactions (Jarvenpaa & Leidner, 2006). The transformation from face-to-face to virtual work is a procedural change in which the team needs time to adapt, and communication between members must be accurate, concise, and without room for doubt (Bakshi & Krishna, 2008). Lin

and Roan (2022) highlight the importance of strengthening the development of virtual teams, providing better management, and seeking efficient and effective teams.

Remote teams, with their natural complexity, make higher quality project management vital (Hooijberg et al., 1997), bringing together skills and knowledge to achieve the project objective (Fekry Youssef et al., 2023). Eftekhari et al. (2022) highlights that interpersonal attributes and social skills are fundamental competencies for project managers, effective virtual teams create cohesion among members (Kayworth & Leidner, 2000), and their leaders must be able to listen and perceive the behaviors of all members, helping the team to work together (Odenwald, 1993).

Social interactions refer to reciprocal relationships between individuals or groups, involving the exchange of information, ideas and behaviors (De Felice et al., 2021), where knowledge is constructed (Piaget, 1973). Intrinsically related to the exchange of information between subjects, essential for sharing knowledge and experiences, enabling the development of the individual from the other (Vygotsky, 1978). Its improvement is linked to the construction of a team identity, based on the interaction between the team's capabilities and the members' social identities (Mattarelli et al., 2017). Although Stoica et al. (2023) remember that social identity is more difficult to develop in virtual teams, as its construction is improved over time with interactions between members, which are sparser in virtual teams.

This research analyzes and summarizes the constructs and recurring research proposals at three levels, in the full sample, in the most cited papers and in systematic reviews. I present which authors are dedicated to understanding the dynamics of social interactions in virtual project teams, their theories, and their proposals. I also highlight which research topics are current and which research gaps are highlighted by researchers. Walther (1097) already stated the need for a better understanding of social dynamics in teams, particularly Weigel et al. (2020) show the relevance of this understanding for virtual teams. Therefore, we propose the following research question:

RQ: What is the state of the art of social interactions in virtual project teams?

To answer this question, I adopted the systematic literature review (SLR) methodology, producing academic knowledge resulting from an objective approach, ensuring transparency and replicability (Tranfield et al., 2003). I looked for in the Scopus and Web of Science databases in October 2023, among works published from January 2017 to October 2023. Out of a total of 511 publications available, after applying inclusion/exclusion criteria, we selected 125 publications addressing the topics of this study.

3.2 THEORETICAL FRAMEWORK

3.2.1 Virtual teams

"A team is a collection of individuals who are interdependent in their tasks, share responsibility for outcomes, see themselves and are seen by others as an intact social entity embedded in one or more larger social systems, and manage their relationship across organizational boundaries" (Cohen & Baily, 1997, p. 241). Although broad, this definition is sufficient to encompass virtual and traditional teams when it identifies team-defining factors: common purpose, identity as a social structure, and responsibility shared by participants (Powell et al., 2004).

The concept of virtuality raises the idea of permeable borders and connections (Mowshowitz, 1997; Kristof et al., 1995) as project teams are formed, reorganized, and dissolved quickly. Miles and Snow (1986) show that virtual teams are a progression of network organizations, made possible by technological advances in information and communications, in which individuals with different skills are located across time, space, and cultures (Jarvenpaa and Leidner, 2006).

These teams offer flexibility, responsiveness, lower costs, and better resource utilization to meet growing needs and changing task requirements in highly turbulent and dynamic global business environments (Mowshowitz, 1997; Snow et al., 1996). Present in different workplaces, members of hybrid teams can prioritize which colleagues they will meet, and at what times, via different platforms (Gilstrap et al., 2022).

Studies on virtual teams have increased significantly in recent years. Lin and Roan (2022) show the relevance of the research, relating communication mediated by an information system and its effects on relationships with the team. Gibbs et al. (2021) similarly highlight the importance of dialogical communication in the interpersonal interaction of teams and suggest that dialogue is an efficient way to promote engagement and overcome barriers. However, although Rogers et al. (2021) teach that social interactions are fundamental to creating satisfactory experiences among team members, previously, Alsharo et al. (2017) showed that interactions in virtual teams are disconnected from social ties.

3.2.2 Social interactions

In sociology, social interaction is the most elementary partition, committed to studying the organization of individuals, although Turner (1988) points out that there is no appropriate conceptualization of the construct. Since social interaction is closely linked to positive social identity (Dutton et al., 1994), such relationships promote increased productivity and efficiency in information sharing (Chiu et al., 2006). Their links are like rivers for torrents of resources

and knowledge (Tsai & Ghoshal, 1998), and their strength is a combination of emotional intensity, amount of time, and mutual trust (Granovetter, 1973).

Organizations must realize the differences between virtual and co-located teams under penalty of loss of efficiency, lower performance, and low member satisfaction (Holding Eagle, 2020). Schröder et al. (2021) confirm the idea by emphasizing that the different cultures of the members are a demand to be assimilated by the teams, and, consequently, their absence can be an opportunity to be developed. Team leaders can remedy this deficiency (Enrique & Joel, 2020), as they need to seek progressive improvement in intercultural relations.

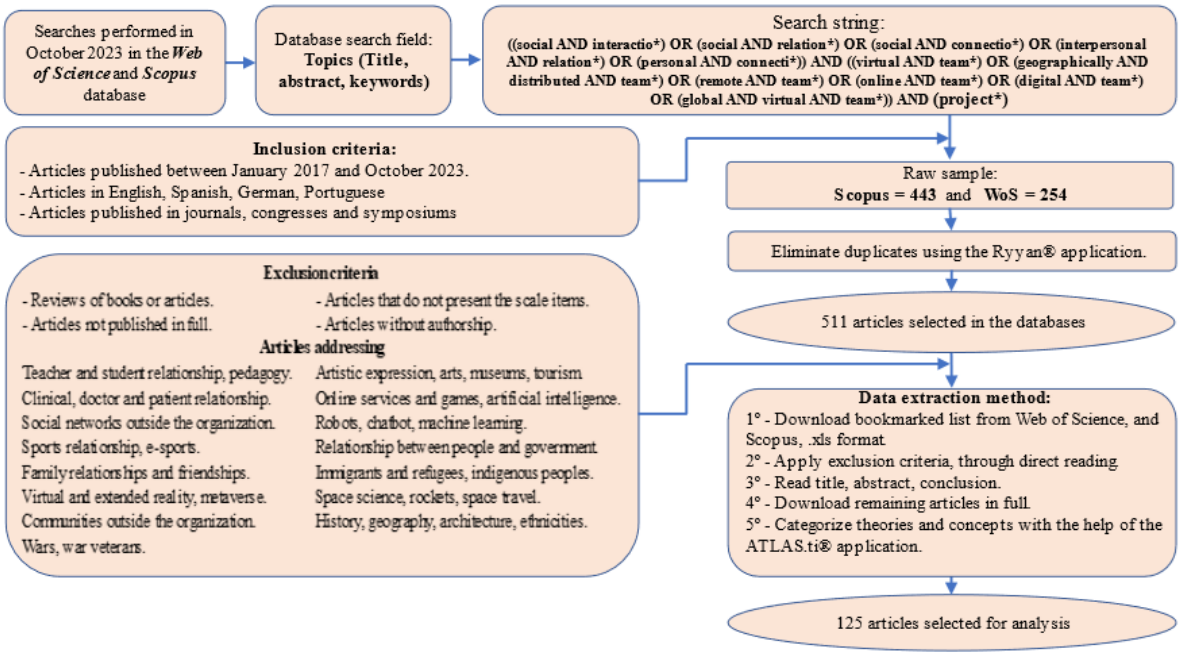
3.3 METHOD

The systematic literature review (SLR) allows the construction of academic research based on metadata without the need for empirical data (Kraus et al., 2020). This research followed the guidelines of Okoli and Schabram (2010). The searches for articles with full access allowed free of charge were carried out on the ISI Web of Knowledge and Scopus databases. The search string was as follows:

((social AND interactio*) OR (social AND relation*) OR (social AND connectio*) OR (interpersonal AND relation*) OR (personal AND connecti*)) AND ((virtual AND team*) OR (geographically AND distributed AND team*) OR (remote AND team*) OR (online AND team*) OR (digital AND team*) OR (global AND virtual AND team*)) AND (project*)

Figure 2 details the application of the protocol for this research, based on Pollock and Berge (2018).

Figure 2: Protocol application



Source: the authors

3.4 ANALYSIS OF THE RESULTS

After compiling the studies, I identified that the publications are dispersed across several journals and conferences/symposia. Table 1 lists journals that published more than one study in the period analyzed. The sample is made up of 79 (63.2%) studies published in journals and 46 (36.8%) conferences/symposia, spread across various areas of knowledge. Publications related to Information Systems (18%) and Management (16%), accounting for more than 30% of the total, indicating interest in the search for understanding social relationships in virtual teams.

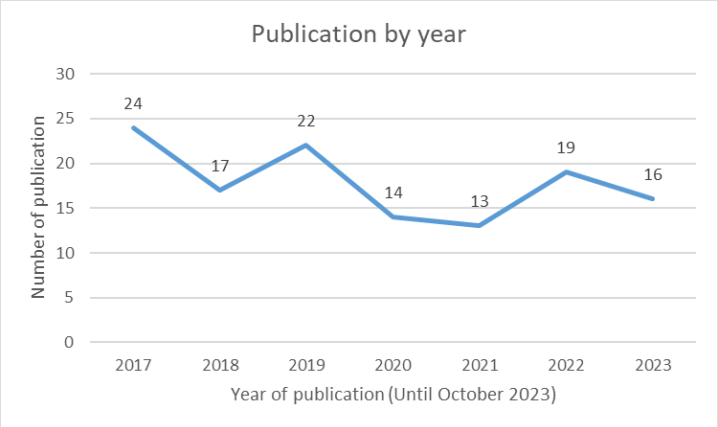
Table 1:
Main outlets publishing about social interaction in projects with virtual teams.

Amt	Journals, Conferences, Symposia	H index [a]	Subject area[a]
4	ASEE Annual Conference and Exposition	39	Computer Science & Engineering
4	International Journal of Project Management	167	Business, Management and Accounting
4	Team Performance Management	40	Business, Management and Accounting
3	Int. Journal of Environmental Research and Public Health	167	Environmental Science & Medicine
3	Technological Forecast And Social Change	155	Business, Management and Accounting
2	Advances in Intelligent Systems and Computing	58	Computer Science & Engineering
2	Clean Technologies and Environmental Policy	68	Business, Management and Accounting
2	Communications in Computer and Information Science	62	Computer Science & Mathematics
2	Computers and Education	197	Computer Science & Social Sciences
2	Construction Management and Economics	105	Business, Management and Accounting
2	IEEE Access	204	Computer Science & Engineering
2	Information Technology and People	71	Computer Science & Social Sciences
2	Int. Journal of Construction Managment	39	Construction Economics
2	International Journal of Information Management	152	Business, Management and Accounting
2	Journal of Universal Computer Science	56	Computer Science & Mathematics
2	Lecture Notes in Computer Science	446	Computer Science & Mathematics
2	ARCOM Conference	12	Engineering
2	Society of Petroleum Engineers	115	Earth and Planetary Sciences
2	Sustainability	136	Computer Science & Energy
2	VINE Journal of Informat. and Knowledge Manag. Syst.	33	Business, Management and Accounting

Note: a: www.scimagojr.com (2023.12.06)
Source: Web of Science and Scopus databases, compiled by the authors.

Figure 3 shows the evolution of publications from 2017 to 2023, showing a decline in the number of papers accepted by journals. The fluctuations in the number of publications over the years can be partially explained by the study by Horbach (2020), who observed the agility of journals in their peer review and publication processes, allowing for faster dissemination of research related to COVID-19.

Figure 3:
Evolution of publications



Source: Web of Science and Scopus, compiled by the authors.

The search for understanding social interactions in virtual teams is indicated by the fact that 55% of methodologies adopt questionnaires and experiments to develop research. Reinforcing this idea, 43% of studies are qualitative, a typical approach for perceiving factors, causes and agents in the phenomena studied (Creswell, 2010). Studies that adopt deductive, descriptive or exploratory approaches (87%) demonstrate the investigative nature of the research (Table 2).

Table 2: Method, Nature of Research and Scientific Approach

Amt	Methodology	Amt	Nature of Research	Amt	Scientific Approach
39	Survey	54	Qualitative	85	Deductive
30	Experiment	39	Quantitative	14	Descriptive
12	Single case study	23	Not applicable	10	Exploratory
10	Theoretical article	6	Mixed methods	4	Inducive
9	Others	2	Grounded-Theory	5	Abductive
7	Not applicable	1	Action-research	4	Not applicable
5	Systematic literature review			3	Explanatory
4	Mixed methods				
3	Multiple case studies				
2	Ground Theory				
2	Action search				
2	Delphi				

Source: Authors

To understand which concepts and theories about interpersonal relationships in virtual teams are popular in studies, I used the VOSviewer® application to identify the co-occurrence of terms. Table 3 presents the focus of the research and the cited authors, listed in the sample. To this end, I only list theories and concepts related to social interactions, social relationships, social connections, interpersonal relationships, and personal connections mentioned in the selected studies. The authors used the constructs based on face-to-face teams, and subsequent research adjusted them to virtual teams.

Table 3:
Constructs

Amt	Constructs	Cited authors
23	Knowledge sharing	Nonaka e Takeuchi (1995); Goffin e Koners (2011); Mueller (201
17	Social Identity	Tajfel (1972); Erikson (1968)
16	Team cognition	Hansen et al. (2012; Hollan et al. (2000); Nemeth et al. (2006)
7	Psychological Safety	Edmondson (1999)
4	Absorptive capacity	Duffield e Whitty (2016); Ali et al. (2018)

Source: Authors

As follows, I describe how the theories and concepts are used in the listed papers, highlighting the main foundations in each study.

- **Knowledge sharing:** Fauzi (2022) claims in the twentieth century, competition is natural in business. Competition combined with digitized globalization demands synergy between team members and sharing of knowledge in companies. Knowledge is a crucial asset in companies, as it promotes competitive advantages in virtual teams, directly relating to the understanding and awareness of social connections, conceived and negotiated through social interactions (Olaisen & Revang, 2017). The construct represents action and development, and Nonaka (1994) conceptualizes it as dynamic, personal, and subjective of a socially constructed nature and, even with limited social ties, it is relevant for knowledge sharing (Granovetter, 1973).
- **Social identity**: In 1972 Henri Tajfel proposed an understanding of identity through sociology, showing that it is a component of the self-concept defined by our belonging to social groups (Akhilesh et al., 2013). Tajfel (1972, p. 292) states that social identity is an "individual's knowledge that he belongs to certain social groups, along with some emotional and value meaning for him as a member of that group." Thus, social identity can be described as a configuration that gradually integrates constitutional data, peculiar libidinal needs, favored capacities, meaningful identifications, effective defenses, successful sublimations, and consistent roles (Erikson, 1968). Group identification can have even greater significance in virtual teams (Walther, 1997). Weigel et al. (2020) highlight the leader's role in this construction, as their responsibility is to foster a culture of belonging, listening, and empathy. In the team, managers must develop the capacity for communication, internal conflict resolution, and awareness of goals (Lin & Roan, 2022). In a broader sense, human resource management must be able to plan the preparation of a remote team for the project (Gallego et al., 2021).
- **Team cognition**: Team cognition is understood as the act of sharing knowledge of the project team among team members, with their processes and task-specific information, directly impacting team performance (Fiore & Salas, 2004). Oliveira, Marques, and Machado (2020, p. 80) highlight the importance of team cognition in efficiency in virtual teams, defined as "the set of knowledge, beliefs, values, norms, and expectations shared by team members that influence how the team processes information and makes decisions". Sharari et al. (2022) concluded that fragmented information is a source of divergence and cognitive limitation, limiting team members from making safe decisions, although trust and strong ties are resources to minimize misunderstandings and eliminate cognitive gaps in teams.

Psychological safety: Edmondson (1999, p. 354) presents psychological safety as: “a belief shared by team members that the team is safe to take interpersonal risks”. This concept has helped researchers in the study of organizational learning behavior (Nembhard & Edmondson, 2006). It is a collective event, in which team members can think independently, feeling protected from taking risks, because there is trust and mutual respect in the team (Edmondson, 2004). Effective virtual teams develop and maintain trust and psychological safety, resulting in enhancing connections between colleagues and providing determination that the task can be completed, and any doubts can be raised (Sumathipala, 2020).

- **Absorptive capacities:** Absorptive capacity (AC) is the ability of a company to absorb knowledge from various sources and employ it in the management of upcoming projects (Duffield & Whitty, 2016). The relevance of AC stands out in the fields of strategic management (Lane & Lubatkin, 1998; Nahapiet & Ghoshal, 1998), technology management (Schilling, 1998), and global markets (Glass & Saggi, 1998). Although used, the AC construct is ambiguous in its definitions (Zahra & George, 2002). Joglekar et al. (1997) corroborates the thought by declaring that there is a demand for a greater understanding of the domain and its operationalization. A study by Gao et al. (2021) investigated the relationship between absorptive capabilities and efficiency in virtual teams. The authors claim that AC is positively related to the efficiency of virtual teams. The authors go further, suggesting that open communication and collaboration among team members are crucial to improving AC in virtual teams. In a similar survey, Cabrera et al. (2002) examined how absorptive capabilities affect performance in virtual teams. They conclude that the combination of individual and team absorptive capacities is a significant indicator of performance in virtual teams.

Snyder (2019) highlights the assertiveness of all systematic literature review (RSL), this approach must present research agendas relevant to the topics listed, or propositions on which researchers develop the field of study, in addition to offering the opportunity to build a theoretical basis for future research (Alves-Mazzotti, 2002).The analysis synthesized the research proposals in the selected articles, based on the criteria of clearly understanding the research question or objective and methodology, together with the suggestions for future studies presented by the authors, always associated with the relationship between virtual teams and social interaction.

Table 4 summarizes the research proposals and future studies of the thirteen most cited articles. In addition to the themes of this research, I highlight the incidence of themes related to social systems (BIM) and knowledge sharing. The survey and theoretical paper approaches are the most common.

Table 4:
Research proposals and future studies of the thirteen most cited papers.

Paper title	Authors and year of publication	Citations[a]	Purpose or Research Question	Methodology and approaches	Proposal for future studies	Theme[b]
Factors for effective BIM governance	Alreshidi et al. (2017)	**127**	Investigates the development of a BIM governance framework (G-BIM) with support of Cloud technologies	Survey	Further socio-technical validation are to be done under real construction projects.	**Social system (BIM), Projects**
How typical is your project? The need for a no-model approach for information management in AEC	El-Diraby (2023)	**98**	Discuss the merit of using a no-model approach (no common product models or ontologies, etc.) for managing information in the AEC	Theoretical paper	Supporting innovating and virtualizing possibilities in the digital world before implementing them in the real world.	**Knowledge, and social interaction**
Working smarter and greener: Collaborative knowledge sharing in virtual global project teams	(Olaisen & Revang (2017)	**82**	Explore how to facilitate the sharing of high-quality knowledge in a virtualglobal project team context.	Case Study (Multiple)	Research, development, and innovation grow online. **Social relationship**s also develop online.	**Knowledge and projects**.
Competition matters! Self-efficacy, effort, and performance in crowdsourcing teams	Dissanayake et al. (2019)	**50**	The question is whether competition is a key crowdsourcing characteristic that influences how teams allocate their effort.	Survey	Study others crowdsourcing platforms, to examine how the self-efficacy-effort-performance relationship is enacted.	**Social interaction** and **share knowledge**
Mobile social media in inter-organizational projects: Aligning tool, task and team for virtual collaboration effectiveness	Zhang et al. (2018)	**49**	Posits that how well team-tool, task-tool and team-task relationships are handled shape virtual collaboration effectiveness.	Survey	Future studies can take such macro- and micro-level factors into account for a better understanding of the phenomenon.	**Virtual** collaboration
Understanding Interactions between Design Team Members of Construction Projects Using Social Network Analysis	Herrera et al. (2020)	**39**	Understand the interactions in the design teams of construction projects using Social network analysis metrics.	Theoretical paper	New types of interaction and new metrics can be added to analyze and understand the **interaction**s of design **teams.**	**Social Interactions**
Elevating the human experience (HX) through service research collaborations: introducing ServCollab	Fisk et al. (2020)	**36**	Elevating the human experience through research collaborations is the purpose of this article.	Theoretical paper	Help us serve humanity through service research collaborations that reduce human suffering and improve human well-being	**Social interaction**
A continuous improvement approach to social and emotional competency measurement	Davidson et al. (2018)	**30**	Develop a self-reportmeasure of student social and emotional competency to identify at-risk students.	Survey	Future projects may examine the extent to which the current measure captures growth in SECs after interventions	**Social** competence.
Information Support of Scientific Researches of Virtual Communities on the Platform of Cloud Services	Artem et al. (2019)	**30**	Creating a system of informational scientific research conducted by virtual research teams.	Theoretical paper	Establishing effective communication in conducting research on information provision of the virtual team.	**Virtual teams, Knowledge sharing and interactions**
A social network perspective of building information modelling in Greek construction projects	Badi & Diamantidou (2017)	**28**	A comparative study of two construction projects in Greece: one that utilized BIM, and one that did not.	Case Study (Multiple)	Further work also needs to be done to establish whether BIM is influenced by the procurement route adopted.	**Social system (BIM), Projects**
A sustainable sociocultural combination of building information modeling with integrated project delivery in a social network perspective	Maskil-Leitan & Reychav (2018)	**27**	Highlight the importance of implementing BIM as a social system.	Case Study (Unique)	Adapting this BIM application model to a social network perspective may help improve the integration between them.	**Social system (BIM), Projects**
A sustainable sociocultural combination of building information modeling with integrated project delivery in a social network perspective	Kaldeli et al. (2019)	**27**	CultureLabs aims to develop digital tools that can facilitate the organisation projects around cultural heritage.	Survey	Develop Social innovation via cultural heritage creates a whole new set of questions for humanities and technology.	**Social interaction**
What do we know about hackathon outcomes and how to support them? a systematic literature review	Angarita & Nolte (2020)	**22**	Systematic overview of the current state of the art about hackathon outcomes.	Literature review, qualitative, descriptive	Plan an interview study with hackathon organizers, mentors and participants to identify potential outcomes.	**knowledge sharing**

Notes: a: The number of citations was extracted from the WoS and Scopus databases (2023.12.06).
b: The criteria for choosing the topics is its alignment with the objects of this research, it does not mean that they are the central themes of the paper.
Source: The authors

Table 5 summarizes the five literature reviews found in the sample, all recent research carried out in the last five years. I highlight the recurrence of themes; knowledge sharing and social relationships (Social integration and social identity).

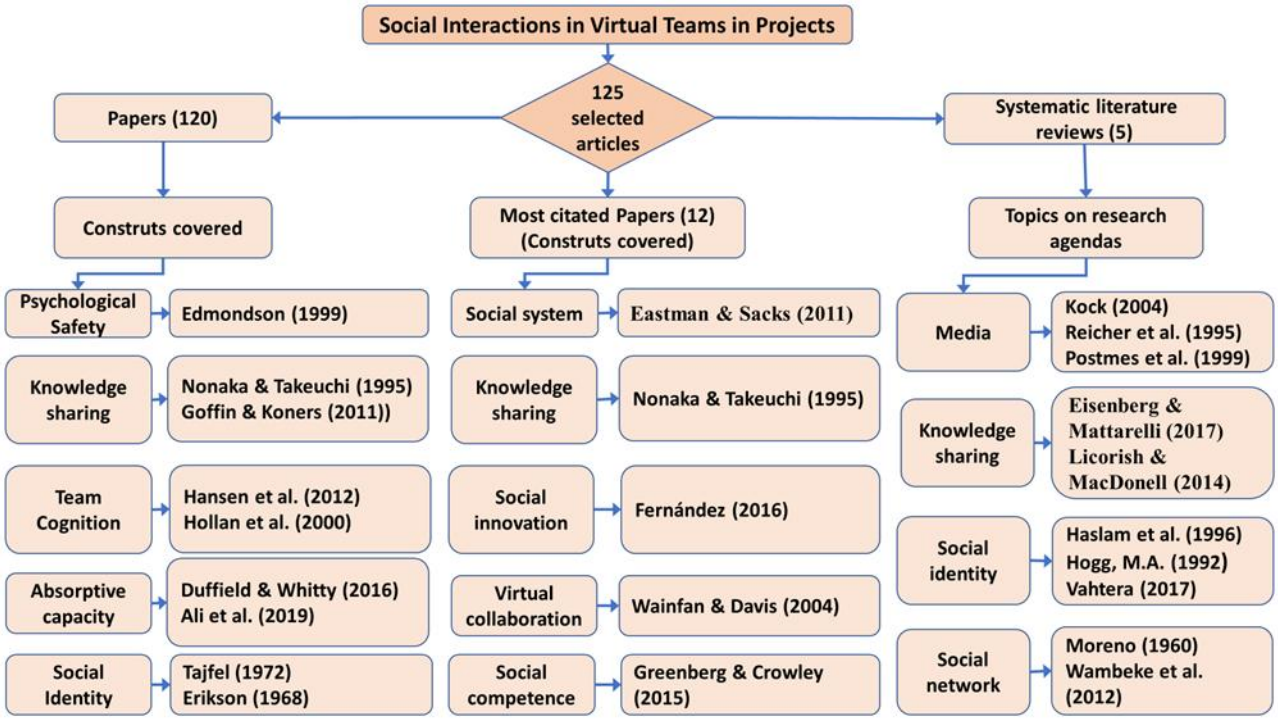
Table 5: Research agendas proposed in five literature reviews found in this SLR.

Paper title	Authors and year of publication	Purpose or Research Question	Methodology and approaches	Proposal for future studies	Theme[a]
Trends in Social Network Research in Construction Teams: A Literature Review	Kereri & Harper, (2018)	Investigate trends in the use of social network analysis in construction management research.	Literature review, qualitative, descriptive	Further inquiries on the social behaviors that can influence interactions and interpersonal relationships between construction team parties	**Social Integration** in projects teams.
What Do We Know About Hackathon Outcomes and How to Support Them? – A Systematic Literature Review	Medina Angarita & Nolte, (2020)	Systematic overview of the current state of the art about hackathon outcomes.	Literature review, qualitative, descriptive	An interview study with hackathon organizers, mentors, and participants to identify potential outcomes and design aspects that have not been addressed in previous research.	**Knowledge sharing**
Social Network Analysis in Software Development Projects: A Systematic Literature Review	Schreiber & Zylka (2020)	Examines the importance of the application of social network analysis (SNA) in software development projects.	Literature review, qualitative, descriptive	Additional research is needed regarding the identification of knowledge brokers and their importance in software projects.	**Knowledge sharing**
Toward an integrated theory of computer-mediated social interaction	Santucci (2021)	Describe an integration of the media naturalness theory, the continuum model of impression formation and the social identity model of deindividuation effects.	Literature review, qualitative, descriptive	The social identity model of deindividuation effects has yet to be tested with the specific intention of discovering how media characteristics	**Social identity** e **media**
From the periphery to the centre: a bibliometric review of global virtual teams as a new ordinary workplace	Tavoletti & Taras, (2023)	Bibliometric analysis of the already substantial and growing literature on global virtual teams (GVTs).	Literature review, qualitative, descriptive	Provide frameworks and hints to form and manage GVTs that can combine both process advantage and the level of creativity needed in a global economy.	**Social interactions**

Note: a: The criteria for choosing the topic is its alignment with the subjects of this research, it does not mean the central theme of the paper.
Source: The authors

Figure 4 schematically summarizes the answer to the research question proposed in this study: What is the state of the art of social interactions in virtual project teams? I present five recurring constructs in the 120 selected papers and research proposals in five literature reviews, highlighting the recurrence of the themes of social identity and knowledge sharing. I also highlight that the recurring constructs based on studies for face-to-face teams are now adapted for virtual teams in projects.

Figure 4
Summary of findings, answering the research question.



Source: the authors

3.5 DISCUSSION

3.5.1 Full analysis

This research shows that social interactions in virtual project teams are a positive factor for project performance. Effective social practices in the virtual environment, with their characteristics of interactivity and presence, induce a positive cycle, increasing the possibility of success in the project (Opdenakker & Cuypers, 2019). Publications on the themes, although decreasing, are diluted in several relevant journals (H index > 33) on the themes, business, management, accounting and computer science. Congresses and symposiums represent 36.8% of the sample, showing possible relevance in the studies of the topics.

Realizing that 55% of the methodologies are questionnaires and experiments, associated with both 43% qualitative approaches and 85% deductive studies, shows the search to find factors and characteristics in the relationship proposed as the theme of this study (table 2). In the sample of 120 papers, there is a concentration on five main constructs; knowledge sharing, social identity, team cognition, psychological safety, and absorptive capacity (Table 3), where the seminal authors cited in the papers developed their studies addressing face-to-face teams, constructs that are now used to study virtual teams (Figure 4). However, when the analysis focuses on the five systematic reviews found in the sample, I realize that, although there are some alignments in the most discussed constructs, the SLRs now cite authors already focused specifically on virtual teams.

3.5.2 Constructs covered

By researching social interactions and virtual project teams, I can build paths to develop mediated communication and build social bonds, leading to better performance and satisfaction of virtual project teams (Ala-Kortesmaa & Muñoz, 2023). One way will be to identify the factors that influence psychological safety (Edmondson, 1999), and the well-being of project professionals inserted in this context (Dzandu et al., 2023), although Lechner & Mortlock, (2022) warn us about the proactive effort required to cultivate such factors. It will also be essential to understand the individualities of project workers and the peculiarities of the work, as both impact psychological safety in virtual teams (Lim, 2022). Specifically, in agile teams, recall Castro et al. (2022), psychological safety is built through openness to dialogue, absence of blame, collective decision-making and leadership with ownership.

When members perceive a certain degree of psychological safety, they are likely to be more open to speaking up, taking risks, and exchanging information (Hao et al., 2022). Knowledge sharing (Nonaka & Takeuchi, 1995; Muller, 2015) in virtual teams is developed based on trusting relationships (Chen et al., 2021) and collaborative interactions between members, based on both technical and social factors, simultaneously (Davidavičienė et al., 2020). Successful sharing will focus on trust, cultural diversity, technological tools for collaboration, communication and leadership (Swart et al., 2022), as well as job stability, organizational norms, integrity and commitment (Chumg et al., 2022). Online media platforms have a facilitating effect on this relationship (Alsharo et al., 2017), involving effective routines for creating, transferring, retrieving and applying knowledge (Olaisen & Revang, 2017).

Team cognition crucially influences project management (Fiore et al., 2023), underlies team behaviors and attitudes, and improves team performance (Byrne & Eddy, 2023). Dispersed members and different time zones are challenges faced by virtual teams, however, as highlighted by Fachrunnisa et al. (2018) we must understand the relevance of team cognition and seek solutions to overcome them. Global teams have much to benefit from team diversity, knowledge heterogeneity and collective learning potential, factors that promote team cognition (Florea & Stoica, 2019), thus developing absorptive capabilities (Duffield & Whitty, 2016; Ali et al., 2018). , both the organization and the team, improving their abilities to acquire and assimilate new knowledge, increasing the effectiveness of teams (Backmann et al., 2015).

Individual differences, cognition and learning orientation are factors that positively influence the ability to acquire and retain knowledge in virtual project teams (Batarseh et al., 2018). Specifically, Lumseyfai (2020) teaches us that internal team diversity, both at a deep and functional level, positively impacts absorptive capabilities. Batarseh et al. (2018) reinforces that the specific characteristics of projects, such as scope, team perceptions and time are antecedent conditions for an efficient absorption capacity.

3.5.3 Topics on research agendas

Synthesizing the trends and research proposals in the sample of 120 papers (without the five literature reviews), we noticed the recurrence of the need for in-depth investigations into the influence of online communications oriented to project tasks, as well as socialization in project performance. (Seetharaman et al., 2019). In addition to deepening the categorization of conflicts (procedural, relational and task) (Flus et al., 2023), Mistry et al. (2023) further specify the need for a better definition of how virtual teams develop clear routines for learning (Duffield & Whitty, 2016; Ali et al., 2018) and knowledge sharing (Eisenberg & Mattarelli, 2017; Licorish & MacDonell, 2014). As another perspective, Eslahchi (2022), perceiving the current context, shows the unique opportunity to understand social interactions in virtual project teams, and unveil the challenge of understanding how they can be efficiently managed.

When we specifically analyzed the twelve most cited studies, we noticed other proposals, such as 1. Alreshidi et al. (2017) show us the urgency of an in-depth investigation into collaboration, governance and data management practices, along the same path; and 2. Artem et al. (2019) highlight the need for research on non-technological factors of integration, such as the coordination of social networks (BIM), noting occupational backgrounds and different interests. Systems integration is also highlighted by Badi & Diamantidou, (2017) when

they show a gap in the development of stakeholder management and social responsibility criteria. Looking at academia, Herrera et al. (2020) shows the lack of developing effective scientific communication associated with the exchange of scientific data between participants in virtual teams, particularly Maskil-Leitan & Reychav (2018) demands more studies on the heterogeneous and high-level needs of stakeholders, combined with functional requirements for digital platforms.

We noticed alignments in the proposals raised in the reviews, such as Santucci (2021) defending greater empirical support for the model of social identity in different media, supporting Seetharaman et al. (2019) when they highlight the need for better understanding of socialization in virtual project teams. Similarly, the review by Tavoletti & Taras, (2023), proposing further research on computer-mediated collaboration, supports the proposals of Alreshidi et al. (2017) when highlighting the importance of further studies on collaboration practices in teams.

3.6 FINAL REMARKS

This systematic literature review sets out to answer the question: What is the state of the art of social interactions in virtual project teams? To this end, I selected 125 papers from 2017 to October 2023. Searching for constructs and proposals for future studies, I present developing authors and proposals for future studies, and gaps in scientific knowledge. Our analysis identified five groups of constructed in the sample, five articles developed a systematic review of the literature, from which I present a summary of proposals for future research.

Regarding the future research agenda, our analysis of the 125 articles identified several suggestions. However, it is possible to highlight that the search for understanding social identity in virtual teams is a relevant topic. The concept of social identity, present in most of the twelve papers studied, is proposed as an agenda for studies in systematic literature reviews. Liu et al. (2021) also argues for more research into the relationship between team identity and virtual team effectiveness in software projects. The authors identified that a strong team identity is positively related to virtual team effectiveness, measured in terms of product quality, project completion time, and customer satisfaction.

This article adds an update of constructs, proposals and gaps in knowledge about social interactions in virtual project teams to the team management literature. I identified the constructs addressed by the authors dedicated to studying the themes and highlighted research

agendas in the selected articles and specifically in the literature reviews listed in the period analyzed.

As limitations, I point out that several papers do not clearly present proposals for future studies. Although the search string is broad, some studies might use similar semantic expressions, escaping selection. Although the sample selection was carried out independently by the three authors, I know that some studies may not have been selected.

4. STUDY 2:

Measuring social interactions in virtual teams, an integrative literature review.

Summary

Understanding the dynamics of relationships between members of remote teams has aroused the interest of researchers for some time, the impact of COVID-19 has added relevance and pressing application in organizations. This research aims to identify scales to measure interpersonal interactions in virtual teams. Through an integrative review of the literature, in a sample of 232 articles collected in the ISI Web of Science and Scopus databases, published until June 2023. The semantic expressions, "virtual teams" or "distributed teams" are adopted by the literature to define multidisciplinary teams. allocated, with the search for measuring the characteristics of virtual teams prior to COVID-19 but accelerating in its period. Confidence scales are in 60.8% of the selected articles, with four scales identified, scales for measuring group identity were not found. The measurements of dispersed teams are based on theories and concepts developed primarily for face-to-face teams, although proposed research agendas are not developed. For theory, I consolidated scales, concepts and particularities of fifteen scales. This research offers practitioners a compilation of scales and models to measure factors in their virtual teams, presenting their characteristics and applications.

Keywords: interpersonal relationships. social interactions. dimensions. rosters, virtual, teams, COVID-19

4.1. INTRODUCTION

Working in groups is efficient, two million years ago, humanity developed associative strategies for hunting and gathering food (Dunbar, 2012), making social cooperation a decisive factor in human evolution (Hrdy, 2009). The progress of humanity is linked to the construction of complex social systems and cooperation between teams with a common objective (Boehm, 1999), which are associated with the maturation of language (Dunbar, 1993) and the ability to share intentions (Tomasello et al., 2005).

The development of teamwork is a basic concern for organizations (Aritzeta et al., 2007), it is not enough to hire intelligent and productive people (Edmondson, 2019), members must perceive a work environment conducive to sharing knowledge, concerns, questions and errors, as well as incomplete ideas. Effective teams bring together characteristics of complementary skills, synergy and shared responsibilities (Katzenbach & Smith, 2015). Technology has changed how we socialize and work, the offer of digital means of communication encourages organizations to implement virtual teams, geographically dispersed, allowing members to communicate in different time zones, always with a common objective (Abarca et al., 2020).

Team building is a science, not an art, although Pentland (2012) reveals the difficulty in understanding the dynamics of these groups, which are observable, quantifiable and measurable. Investigating the trajectory from in-person to virtual teams, Vuchkovski et al. (2023) suggest further considerations considering antecedents and their results in the digital transition, allowing for a broader generalization and confirming Verhoef et al. (2021) when they highlight the need to find which organizational structures are suitable to improve the digital agility of virtual teams. Looking at psychological safety in social interactions in teams, Cikara and Van Bavel (2014) perceive that the context and dynamic nature of social identity delineate intergroup relations, warning of a pressing search for improving the understanding of these factors, Jay J. van Bavel will reaffirm this importance when he presents the relevance of building intra-group identity in facing the COVID-19 pandemic (Bavel et al., 2020).

Social identity can be more difficult to develop in a virtual team, as the construction of team identification is improved over time with interactions between team members, which are sparser in virtual teams (Stoica et al., 2023). Its development starts with the interaction between the team's capabilities and the members' social identities (Mattarelli et al., 2017), this interpersonal improvement increases trust and positively impacts performance (Davidaviciene, 2020; Taras, 2019). Davidaviciene (2020) reiterates that it is necessary to develop a structure to encourage group identity, as it is a critical factor for trust in virtual teams.

The originality of this research lies in the compilation of scales available to measure the characteristics of virtual teams, in particular distinguishing scales for group identity, knowing that the search for a better understanding of intragroup dynamics has been of academic interest for decades (Walther, 1997) and pressing in virtual teams (Weigel et al., 2020). In 2023, the challenges triggered by the pandemic confinement are clear (Vuchkovski et al., 2023a), including the necessary digital transformation of face-to-face teams into virtual teams, involving the survival of organizations.

There is a need for dynamic approaches to understanding remote teams, research is in a divergent and exploratory phase (Shuffler et al., 2020), new theories require new measurement methods that allow different conceptualizations of team dynamics (Rosen et al., 2015). Abarca et al. (2020), after a systematic review of the literature on virtual teams, indicates that emotions should be further researched. Thus, the general and specific research questions of this article are:

RQ1: What scales are adopted to measure social interactions in virtual teams?

RQ1a: What scales are dedicated to measuring group identity in virtual teams?

This research adopts the methodology of an integrative literature review, presenting a conceptual structure around the topics covered (Torraco, 2016), allowing a synthesis of academic knowledge resulting from an objective approach, and ensuring transparency and replicability (Tranfield et al., 2003). The search was carried out in the Scopus and Web of Science databases in June 2023, with a total of 445 publications available. After applying inclusion or exclusion criteria, 232 publications addressing the topic of this study were selected.

In response to the research question, I listed and characterized fifteen scales adopted to measure characteristics of virtual teams, presenting five themes responsible for 91.5% of citations: trust (60.8%), presence (14.7%), cohesion (7.0%), behavior (4.9%), and intercultural (4.1%). I highlight that the search for stopovers predated COVID-19, but during this period, an acceleration was noticed. I listed scales constructed after 2020, highlighting the themes of leadership (2.1%), mental models (1.0%), effectiveness (1.0%), and engagement (0.8%). I show that scales were created to measure virtual teams, built on concepts and theories primarily developed for in-person teams, such as Chaudhary et al. (2022) scale for engagement.

4.2. THEORETICAL FRAMEWORK

4.2.1 Social Interactions

For Piaget (1973), the meaning of social interaction is closely linked to the concepts of reciprocity, where at least two actors are involved, and contact, an encounter that leads to changes in these actors. Knowledge is constructed through social interactions, with social life being fundamental to its formation, development and growth (Piaget, 1973). Homans (1958) shows that social behaviors are an exchange of goods, whether material or immaterial. Deriving from this idea, Thibaut and Kelly (1959) conceptualize social interactions based on rewards, costs and mutual dependence between individuals.

Hinde (1976) argues for the need for a typology of social interactions to measure the limits of generalizations about their functioning. What do I understand by social interactions? What are their dynamics? Butler (1951, p. 280) already tried to conceptualize: “the individual man is an individualized form of society, an individual counterpart of it. To think of the individual as completely isolated from social interactions is to make him an abstraction.” Addressing virtual relationships, Liu and Burn (2009) show that relationship building is a vital mediator in the virtual social relationship model.

Social presence, postulated by Short, Williams and Christie (1976, p. 65), represents the "degree of relevance of the other person in the interaction and the consequent relevance of interpersonal relationships. . . ", implies the degree to which a person is perceived as a "real person" in mediated communication, social presence is a factor of both the environment and the communicators. It has a mediating role or direct effect on learning behavior, so instructors and leaders should encourage it (Lim, 2023). Activity awareness practices can increase feelings of social presence and the desire to work harder for the team (Haines, 2021), motivating distributed members to make greater effort at work and increasing loyalty to the team.

There is permanent motivation in individuals to feel good about themselves, maintaining self-esteem achieved through personal achievement or identification with a social group (Worley, 2021), seeking a positive distinction in the group. Tajfel (1981) conceptualizes such a positive distinction as social identity, composed of three distinct and sequential processes:

1. Social categorization: There is a natural tendency for people to group things together. Social categorization is likely to produce numerous overlapping categories, the number of which is limited only by what is useful to the individual. A group is a social category. Categorization systematizes the social world and provides a system of guidance for the author about each person's place in society.

2. Social identification: After categorization, members then identify themselves as belonging to one or more groups. Self-assessment is carried out through social identity. As members of a group, individuals adopt salient aspects of that group's behavior, including an understanding of normative behavior.

3. Social Comparison: Individuals now turn to intergroup social comparison, that is, comparing their ingroup (the social group with which a person psychologically identifies as a member) with relevant outgroups (the social group with which an individual does not identify), seeking positive aspects of the ingroup or seeking negative aspects of an outgroup seeking to improve self-image. An individual strives to achieve and maintain a positive social identity, and a positive social identity is largely based on favorable comparisons between groups.

4.2.2 Team identity

Team identity represents the sense of unity among team members (Ashforth and Mael, 1989). It comprises three factors: cognitive belonging, affective emotional attraction, and behavioral joint effort towards a common goal for the group (Ashforth 2001). It meets individuals' needs for belonging, such as predictability, inclusion, order, and structure (Fiol

2002). Tajfel and Turner (2001) show us that human identity is composed not only of character traits and individually unique physical factors, but also of the notion of belonging to certain social groups as individuals seek certainty and validation in their perceptions, seeking to reduce the uncertainty.

Liu et al. (2021) argue that virtual team identity is strongly associated with team efficiency. They suggest that identity construction is facilitated through activities promoting social interaction between team participants, such as regular videoconference meetings and creating a shared virtual work environment. It is urgent for companies to differentiate the dynamics of in-person and virtual teams (Holding Eagle, 2020), with the risk of low efficiency, reduced performance and decreased member satisfaction. Schröder et al. (2021) complement it with the different cultures of the participants, a question to be answered, a need to be filled.

When participants in virtual teams share a common identity, they are motivated to cooperate and communicate effectively (Van Bavel et al., 2018). Hertel et al. (2018) state that social identity influences teams, acting on team efficiency and cohesion. Both prescribe continuity in research seeking a better understanding of the impact of building a sense of interpersonal identity in virtual teams.

4.2.3 Virtual teams

Virtual teams or distributed teams require technological mediation for communication between members (Beranek 2000), Saunders (2000) suggests that the increase in their adoption is driven by globalization, outsourcing and alternative work arrangements, such as sharing and teleworking. They allow flexibility and collaboration between members beyond geographic and temporal limits, they can shorten trips and expand the meeting of talents, making it possible to build diverse teams (Chiu & Staples, 2011). Bell and Kozlowski (2002) show that virtual teams are an improvement over face-to-face work, with virtuality being a potential characteristic of all teams (Griffith, Sawyer and Neale, 2003).

Members of teams, virtual or not, seek differentiation from others through self-attributed positive characteristics (Haslam 2004), in the workplace, such characteristics can be team cohesion or quality of work (Mirbabaie et al., 2021). Although Vahtera et al. (2017) demonstrate that collaboration mediated by technology can lead to low social identity in virtual teams. Santucci (2021) confirms that individualization is filtered by the media, thus influencing the promotion of social identity, demonstrating that they are the means of communication with a greater degree of naturalness, less demanding in cognitive effort, as face-to-face meetings

transmit a greater range of indicative of individualization, which facilitate the construction of personal identity.

4.2.4 Scales and methods for measuring social interactions in social sciences.

Observing and subsequently formulating is one of the most challenging and crucial actions in scientific endeavors, it is the process of interpreting theory and operationalizing concepts (Greer, 1969). Zeller and Nock (1982) show that this is the moment where creations in the world of possibilities must be adjusted to the world of probabilities. Synthesizing the notion of interdependence of logical reasoning and sensory perception, Immanuel Kant teaches that concepts without perceptions are empty, perceptions without concepts are blind (Kant, I., 1998).

Not all quantification derives from a measurement (Uher, 2020). Quantifying means assigning numerical values, whereas measurement is a multistep process where operational structures make such assignments reliably (Mari et al., 2017). Uher (2020) warns that physical technologies are not appropriate for intangible objects researched in psychology and social sciences, in these situations, the data is generated directly by people, psychometric theories and classification scales, among others. Kalkbrenner (2021) adds that evaluation indoctrination is a pertinent question in social science research, as researchers are led to measure latent variables such as personalities and morals, among others of an abstract nature.

4.3 METHOD

Literature reviews can be seminal touchstones in the evolution of research on a topic, and integrative reviews specifically stimulate new relationships and perspectives that have not yet been explored (Torraco, 2016). An integrative review necessarily results in the advancement of knowledge around research addressed (Snyder, 2019), although managed in various ways, replicability and transparency are expected from the researcher in conducting the studies. Critical literature analysis is essential (Torraco, 2005), carefully searching for central ideas, concepts and relationships between themes. This synthesis, a creative activity, must show a new conceptual structure, a new model always associated with understanding the themes the authors perceive.

The structure of an integrative review can be organized by investigating concepts about the topics researched, seeking clarity and coherence in the literature about the topics reviewed and how the topics come together (Torraco, 2016). For Doty and Glick (1994), this

methodology can develop a conceptual classification of constructs, supporting new theories. However, without clear and declared methods, a systematic bias can be induced in the research, Whittemore and Knafl (2005) offer a strategy aimed at mitigating such risks. Table 6 summarizes the stages of an integrative literature review applied to this research.

Table 6
Stages of an Integrative Literature Review applied for this research.

Integrative review stage	Illustration of decisions and issues
Problem identification	Academic studies suggest the importance of better understanding the dynamics of virtual teams. Although it is difficult to measure group dynamics, whether by differentiating between face-to-face and virtual teams, or by validating specific scales for each situation. A compilation of existing scales accepted in academia for measurement in virtual teams will be fundamental for any studies that aim to expand the understanding of this relationship.
Literary research	The research focuses on the ISI Web of Science and Scopus databases, with the central criteria adopted being that the articles are accepted, in addition to being related to the research themes, presenting the scales clearly, with all their items declared. Search carried out in June 2023.
Data evaluation	The characterization of the sample makes it clear that the semantic expressions "virtual teams" and "distributed teams" are the most used by researchers to refer to virtual teams. Among the 15 themes in the scales found, 91.5% are restricted to five focuses: trust (60.8%); presence (14.7%); cohesion (7.0%); behavior (4.9%) and intercultural (4.1%). The categorization also highlights recent topics, published during the COVID-19 pandemic.
Data analysis	The research indicates that there was an interest in measuring the dynamics of virtual teams prior to the pandemic, with the first article published in 2004. An acceleration in publications was noted after the start of the pandemic, in March 2020 (table 5). A synthesis of the scales, their intentions and validations and main characteristics is presented.
Presentation	The results are presented in the form of explanatory text, tables and figures, in an attempt to elucidate which measurement scales are appropriate to measure the dynamics of social relationships in virtual teams.

Source: authors, adapted from Whittemore and Knafl (2005).

Searches carried out in the ISI Web of Knowledge and Scopus databases among articles with full access permitted free of charge in June 2023. To include the most significant possible number of articles in the databases, minimizing the risk of unintentional exclusion, I selected the “topic” option in the search key. Seeking to include all publications related to the topic and proposing semantic terms like the expression “virtual teams”, I defined a comprehensive search algorithm (string) based on the wording of the objective, as shown in Table 7, where each search term was applied individually, to identify in the literature which semantic expression is most used to express virtual teams.

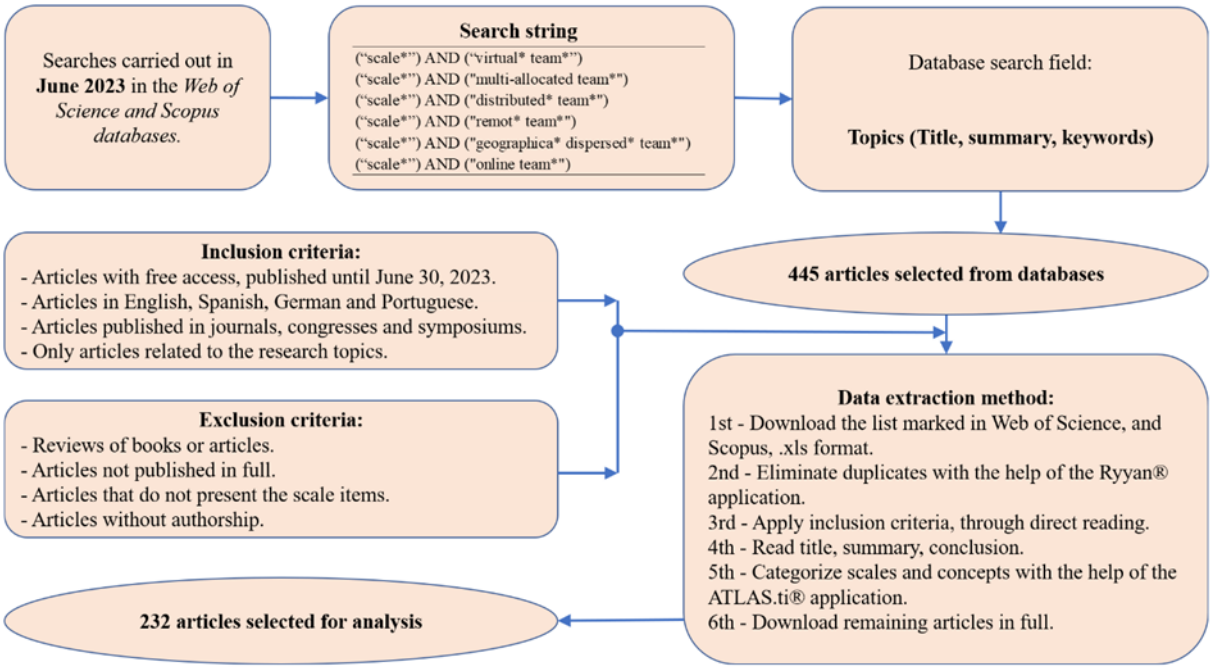
Table 7:
Search terms (strings used to search papers)

(“scale*”) AND (“virtual* team*”)
(“scale*”) AND ("distributed* team*")
(“scale*”) AND ("global team*")
(“scale*”) AND ("online team*")
(“scale*”) AND ("remot* team*")
(“scale*”) AND ("geographica* dispersed* team*")

Source: authors.

Figure 5 presents the protocol developed for this research, based on Pollock and Berge (2018). I describe the research roadmap in a transparent and replicable way, showing all the steps for constructing the sample of selected articles.

Figure 5
Analysis protocol.



Source: authors, adapted from Pollock and Berge (2018).

4.4 ANALYSIS OF RESULTS

The analysis of the results is organized into sections as follows: characterization of the sample of selected articles (topic 4.1); presentation of fifteen scales and authors and articles that will develop them (table 5), concepts covered in the social identity communication scale (topic 4.2).

4.4.1 Characterization of the sample of selected articles

The investigation into the databases shows that the expressions “virtual teams” and “distributed teams” are used in 81% of the selected studies when the authors want to refer to

virtual teams (table 9). In this research I will adopt the term virtual teams for fully virtual team arrangements and partially virtual, hybrid ones.

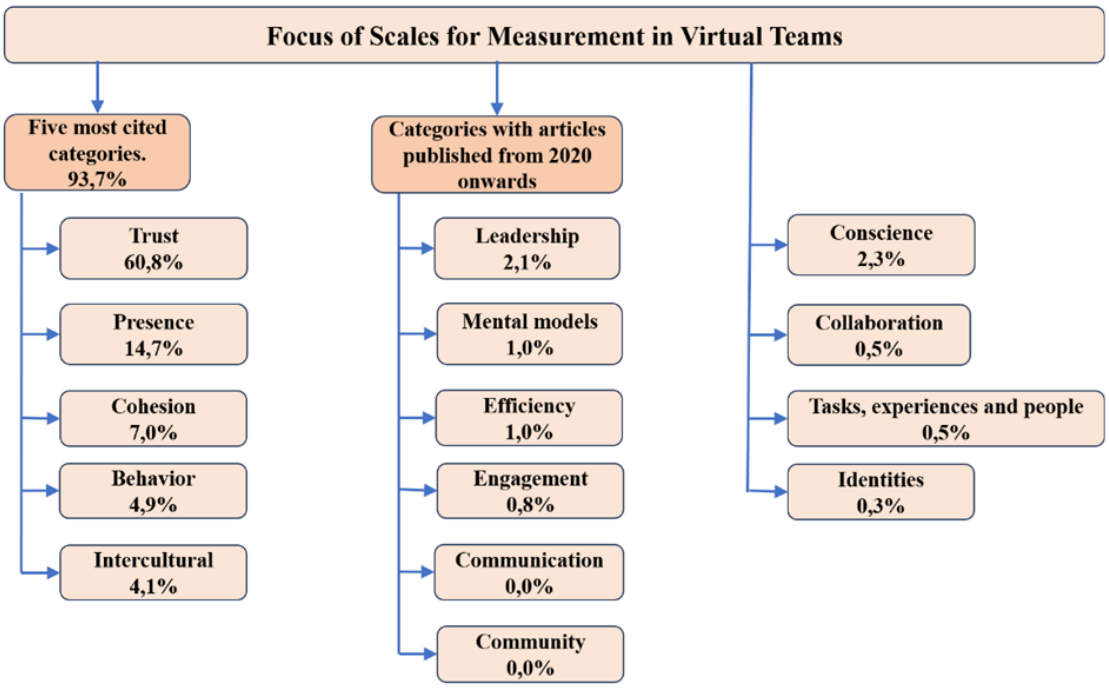
Table 9:
Semantic expressions and string

	Scopus	*WoS*	Selected	%
(“scale*”) AND (“virtual* team*”)	133	78	100	43%
(“scale*”) AND ("distributed* team*")	103	58	87	38%
(“scale*”) AND ("global team*")	25	16	13	6%
(“scale*”) AND ("online team*")	19	11	16	7%
(“scale*”) AND ("remot* team*")	12	8	7	3%
(“scale*”) AND ("geographica* dispersed* team*")	12	7	9	4%
		Total:	**232**	**100%**

Source: Authors.

Figure 6 presents a schematic representation of the core of the scales found, with emphasis on the five categories that received 91.5% of total citations. It is significant to note that the focuses of the scales are themes related to the measurement of interpersonal relationships, where the interest of almost all the researchers approached is to understand the dynamics of social interactions between team members. An exception can be made on the topic of mental models, although attention to the proposed scale makes clear the importance of interpersonal relationships in this approach. Figure 4 highlights articles published from 2020 onwards, in times of COVID-19, where the topic of leadership stands out with 2.1% of total citations.

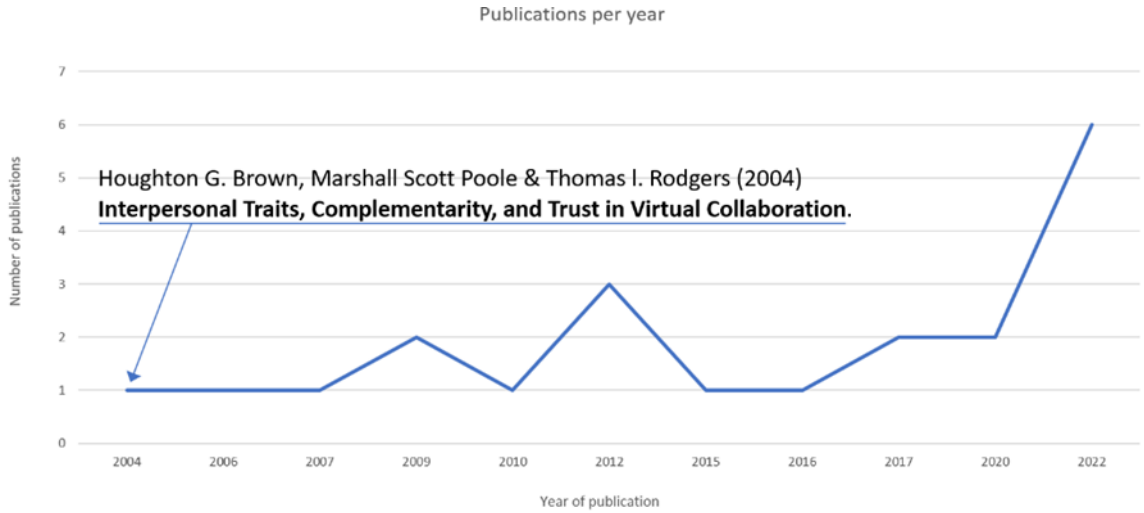
Figure 6
Focus of the scales about virtual teams.



Source: Authors.

Figure 7 shows the evolution of publications. The most cited article also begins the historical series of publications on rosters for virtual teams. Equally notable is the academic interest in measuring the dynamics of dispersed teams before the start of the COVID-19 pandemic in March 2020 (Shorten et al., 2023). However, the acceleration after this date can be seen.

Figure 7
Publications by year.



Source: compiled from databases by the authors.

Table 10 lists fifteen scale focuses with articles and authors who developed them, revealing that the search for understanding trust in virtual teams is the most relevant among the topics listed, with four studies, this subject covers the two most cited articles and 60, 8% of total citations, demonstrating the significance of measuring trust in virtual teams.

Table 10
Selected articles with declared scale

	Scale	Selected article, with declared scale	Quotes	
1	**Trust scales**	Lippert, Helge & Dulewicz, Victor. (2017). **A profile of high-performing global virtual teams**. Team Performance Management: An International Journal. 24. 10.1108/TPM-09-2016-0040.	19	4,9%
		Rusman, Ellen & Bruggen, Jan & Sloep, Peter & Koper, Rob. (2010). **Fostering trust in virtual project teams: Towards a design framework grounded in a TrustWorthiness ANtecedents (TWAN) schema**. International Journal of Human-Computer Studies. 68. 834-850. 10.1016/j.ijhcs.2010.07.003.	63	16,2%
		Houghton G. Brown, Marshall Scott Poole & Thomas l. Rodgers (2004) **Interpersonal Traits, Complementarity, and Trust in Virtual Collaboration**, Journal of Management Information Systems, 20:4, 115-138 http://dx.doi.org/10.1080/07421222.2004.11045785	153	39,4%
		Sarah Fischer & Arlene Walker (2022) **A qualitative exploration of trust in the contemporary workplace**, Australian Journal of Psychology, 74:1, 2095226, DOI: 10.1080/00049530.2022.2095226	1	0,3%
2	**Sense of presence scales**	Malbos, Eric & Rapee, Ronald & Kavakli, Manolya. (2012). **Behavioral Presence Test in Threatening Virtual Environments**. Teleoperators and Virtual Environments - Presence. 21. 268-280. 10.1162/PRES_a_00112.	22	5,7%
		Carol A. Thornson, Brian F. Goldiez, Huy Le, **Predicting presence: Constructing the Tendency toward Presence Inventory**, International Journal of Human-Computer Studies, Volume 67, Issue 1, 2009, Pages 62-78, ISSN 1071-5819, https://doi.org/10.1016/j.ijhcs.2008.08.006.	35	9,0%
3	**Perceived Cohesion Scale**	David, Salisbury & Carte, Traci & Chidambaram, Laku. (2006). **Cohesion in Virtual Teams: Validating the Perceived Cohesion Scale in a Distributed Setting**. ACM Sigmis Database. 37. 147-155. 10.1145/1161345.1161362.	27	7,0%
4	**Behavioral scales**	Andersson, D., Rankin, A. & Diptee, D. **Approaches to team performance assessment: a comparison of self-assessment reports and behavioral observer scales**. Cogn Tech Work 19, 517–528 (2017). https://doi.org/10.1007/s10111-017-0428-0	19	4,9%
5	**Intercultural Effectiveness Scale**	Petrovskaya, I., Shaposhnikov, S. **Enhancing intercultural effectiveness in international virtual student teams: an exploratory study**. Educ Res Policy Prac 19, 345–361 (2020). https://doi.org/10.1007/s10671-020-09262-w	7	1,8%
		Wolfgang Messner , (2015),"**Measuring existent intercultural effectiveness in global teams**", International Journal of Managing Projects in Business, Vol. 8 Iss 1 pp. 107 - 132	9	2,3%
6	**Leadership Scale**	Batirlik, Sema & Gencer, Yasin & Akkucuk, Ulas. (2022). **Global Virtual Team Leadership Scale (GVTLS) Development in Multinational Companies**. Sustainability. 14. 1038. 10.3390/su14021038.	8	2,1%
7	**Shared Mental Models Scale**	Müller, Rebecca & Antoni, Conny. (2020). **Scale development and validation of shared mental models of information and communication technology (ICT SMM)**. Team Performance Management: An International Journal. 26. 391-407. 10.1108/TPM-03-2020-0025.	4	1,0%
8	**Team Effectiveness Scale**	Kunte, Monica & Bhattacharya, Sonali & Neelam, Netra. (2020). **Shall we ever meet; does it matter: unfreezing the constructs of virtual team effectiveness**. International Journal of Networking and Virtual Organisations. 23. 128-148. 10.1504/IJNVO.2020.10028863.	4	1,0%
9	**Work Engagement Scale**	Vijesh Chaudhary, Smrutirekha Mohanty, Poonam Malik, A. Apsara Saleth Mary, Jnaneshwar Pai Maroor, M.Z.M. Nomani, **Factors affecting virtual employee engagement in India during Covid-19**, Materials Today: Proceedings, Volume 51, Part 1, 2022, Pages 571-575, ISSN 2214-7853,	3	0,8%
10	**Communication Behaviors Scale**	Hartner-Tiefenthaler, M., Loerinc, I., Hodzic, S., & Kubicek, B. (2022). **Development and validation of a scale to measure team communication behaviors**. Frontiers in Psychology, 13, 961732.	0	0,0%
11	**Psychological Sense of Community Scale**	Arnold, W., Arnold, D., Neher, A., & Miles, M. P. (2020). **Developing a contemporary measure of employee perceptions of their work unit's psychological sense of community**. Journal of Workplace Learning, 32(1), 16-34.	0	0,0%
12	**Awareness scales**	Scielzo, S., Strater, L. D., Tinsley, M. L., Ungvarsky, D. M., & Endsley, M. R. (2009). **Developing a Subjective Shared Situation Awareness Inventory for Teams**. Proceedings of the Human Factors and Ergonomics Society Annual Meeting, 53(4), 289–293. https://doi.org/10.1177/154193120905300427	3	0,8%
		Daassi, Mohamed & Favier, Marc. (2007). "**Developing a Measure of Collective Awareness in Virtual Teams**". IJBIS. 2. 413-425. 10.1504/IJBIS.2007.012543.	6	1,5%
13	**Collaboration Intention Scale**	Alsharo, Mohammad and Gregg, Dawn, "**Intention to Collaborate: Investigating Online Collaboration in Virtual Teams**" (2012). AMCIS 2012 Proceedings. 22. https://aisel.aisnet.org/amcis2012/proceedings/VirtualCommunities/22	2	0,5%
14	**Scale of tasks, experiences and people**	Mohamed Ariff, Mohamed Imran & Milton, S.K. & Bosua, Rachelle & Sharma, Rajeev. (2012). **Transactive memory systems: Exploring task, expertise and people (TEP) unit formation in virtual teams: Conceptualization and scale measurement development**. Proceedings - Pacific Asia	2	0,5%
15	**Escala de Comunicação de Identidade**	Brown, Susan & Thatcher, Sherry & Wilson, David. (2016). **Measurement and Outcomes of Identity Communication in Virtual Teams**. 888-897. 10.1109/HICSS.2016.114.	1	0,3%

Source: Authors.

Table 11 lists concepts and authors highlighted in study 01, with scales found in this research. It is pertinent to note that scales built for virtual teams have their foundations and concepts developed for face-to-face teams.

Table 11:
Concepts and scales

Concepts	Most cited authors	Authors with scales derived from concepts	Quotes	%
Knowledge sharing	Nonaka (1994)	Cummings, J. L., & Teng, B.-S. (2003)	607	**20%**
		Lewis, K. (2004)	497	**16%**
		Donate, M. J., & Sánchez De Pablo, J. D. (2015)	441	**14%**
	Goffin e Koners (2011)	Arnett, D. B., Wittmann, C. M., & Hansen, J. D. (2021)	16	**1%**
	Muller et al. (2015)	Not found		
			Total=	**51%**
Social identity	Tajfel (1974)	Pamela J. Hinds, Mark Mortensen, (2005)	773	**25%**
		Tsai, H.-T., & Bagozzi, R. P. (2014)	368	**12%**
		De Vries, R. E., Van Den Hooff, B., & De Ridder, J. A. (2006)	358	**12%**
	Erikson (1968)	Li, X., Hess, T. J., & Valacich, J. S. (2008)	354	**12%**
		Cheng, X., Yin, G., Azadegan, A., & Kolfschoten, G. (2016)	53	**2%**
		Rose, J., & Schlichter, B. R. (2013)	34	**1%**
			Total=	**64%**
Team cognition	Hollan et al. (2000)	Not found		
	Nemeth et al (2006)	Lewis, K. (2004)	497	**16%**
			Total=	**16%**
Psychological safety	Edmondson (1999)	Pirson, M., & Malhotra, D. (2011)	207	**7%**
		Zhang, Y., Fang, Y., Wei, K.-K., & Chen, H. (2010)	202	**7%**
		Hoch, J. E. (2013).	197	**6%**
			Total=	**20%**
Absorptive capacity	Duffield e Whitty (2016)	Not found		
	Ali et al. (2018)	Not found		

Source: the authors.

Below, I present the only scale with measurements related to group identity.

4.4.2 Identity Communication Scale

The researchers, Brown et al. (2016), noting the essential empirical basis in identity research in non-mediated teams (face-to-face teams), develop the idea that perceived virtual identity is a factor with a positive impact on the trust and efficiency of virtual teams. They offer a scale to measure the identity communication resources of a medium and users' perceptions of virtual communication, arguing for people's natural need to communicate their identities (Swann, 1983).

They developed the Scale for Identity Communication Capabilities and Perceived Virtual Identity, enabling research into media factors that support identity communication and the perceived virtual antecedents of identity communication. Brown et al. (2016) believe that communication capabilities can support or hinder the efficiency of perceived identity communication in virtual teams, and a better understanding of this relationship can help professionals improve the performance of virtual teams.

4.5 DISCUSSION

Table 5 answers the research question RQ1 (Which scales are adopted to measure social interactions in virtual teams?), showing that the search for measuring the dynamics of virtual teams began before the COVID-19 pandemic, with the assessment of trust between team members being the primary theme and cited in more than 60% of the articles analyzed. This partially confirms the statements of Hertel et al. (2018), where trust is a prominent factor in the success of virtual teams. Although research indicates it is the most studied topic, Weigert (1985) highlights the lack of instruments to measure institutional trust in virtual teams.

With the growth of dispersed teams from 2020 onwards (figure 5), concerns about measuring teams have increased, and more scales are being presented, although still limited and lacking validation, as stated by the authors Batırlık et al. (2022), with their leadership scale proposal, and Müller & Antoni (2020), with the mental model’s scale. The research shows that scales for virtual teams are derived from concepts and theories originally developed for face-to-face teams, such as the proposal by Chaudhary et al. (2022) for the UWES scale for engagement, derived from the concepts of Schaufeli et al. (2002) and (Shimazu et al. (2008), to characterize work engagement (table 5).

Knowledge sharing scales, found in three studies totaling 1,545 citations (table 6), present Nonaka (1994) as the builder of concepts and theories. Nonaka (1994) exposes the idea

of differentiating between information, a flow of messages, and knowledge, a flow of information created and organized, with two dimensions: explicit, or declared knowledge, and tacit, procedural knowledge. They highlight three factors in creating knowledge: intention, autonomy and a level of environmental fluctuation. They present four ways to convert knowledge: 1) tacit to tacit (socialization); 2) explicit to explicit; 3) tacit to explicit; and 4) explicit to tacit. Organizational knowledge creation occurs when the four modes are managed to form a single, continuous cycle.

Measurement scales for social identity, with six studies perceived in the sample in a total of 1,499 total citations (64%) (Table 6), show that the taxonomy of Tajfel (1974) and Erikson (1968) is fundamental for the studies. However, this research reveals the lack of specific scales for measuring group identity (Table 5). Tajfel (1974) aims to form a theory relating social psychological aspects of (face-to-face) intergroup behavior, conceptualizing social categorization as "a process of gathering social objects or events into equivalent groups about an individual's actions, intentions and belief system" (Tajfel, 1979, p. 254). Three fundamental concepts of this author are: intergroup phenomena require categorization to occur, social identity is the aspect of the individual's self-image in each social category and the notions of value of this belonging result from processes of social comparison.

Table 5 also defines the research question RQ1a (Which scales are dedicated to measuring group identity in virtual teams?). It is demonstrated that the only scale present in this selection does not answer the research question RQ1a, as the focus is not on measuring group identity. In this study, I showed that the scales developed to measure the characteristics of virtual teams are based on concepts and theories built for face-to-face teams. However, the selected articles did not see an adaptation of measurements to study group identity in virtual teams. However, there are proposals from authors with scales for researching group identity in face-to-face teams, such as Ashforth and Mael (1989), Van Zomeren, Spears and Leach (2008), and Postmes, Haslam and Swaab (2005).

The analysis of the scales found reveals an important gap in the adaptation of theoretical instruments created for face-to-face contexts to the virtual environment, particularly with regard to social identity in virtual teams. According to Tajfel (1974), social identity emerges from categorization, identification, and social comparison. However, these dynamics are affected by virtuality, since technology-mediated interactions can limit the exchange of nonverbal signals and other elements essential for strengthening intragroup identification (Santucci, 2021). Thus, the challenges of developing scales that capture these nuances in the virtual context remain a

fertile field for future research, highlighting the need to address the fragmentation of interpersonal connections in dispersed teams.

Another relevant point is the role of trust, identified as the most studied theme in the scales analyzed. Although authors such as Edmondson (2019) and Hertel et al. (2018) point to trust as a central element for team success, the instruments found often fail to consider the dynamic and situational dimension of trust in virtual environments, where factors such as cultural heterogeneity and the mediated nature of interactions play crucial roles (Cikara & Van Bavel, 2014; Schroeder et al., 2021). This suggests that, in addition to measuring trust, it is essential that future scales investigate how it is formed, maintained, or deteriorates over time in virtual teams, especially considering cultural and technological barriers.

Finally, the acceleration of digital transformation in response to the COVID-19 pandemic has brought new challenges and opportunities for research on virtual teams. As pointed out by Bavel et al. (2020), reinforcing social identity was essential to maintain cohesion and efficiency during times of uncertainty. However, studies such as those by Liu et al. (2021) and Abarca et al. (2020) indicate that the effectiveness of virtual teams depends on intentional practices to strengthen social presence and promote meaningful interactions. This highlights the importance of developing theoretical models that integrate concepts of social identity and trust into the specific dynamics of virtual teams, thus creating a solid foundation for practical interventions and organizational development.

4.6. FINAL REMARKS

This research suggests that the semantic expressions “virtual teams” or “distributed teams” are adopted by the literature to define multi-allocated teams. I answered the research question by presenting fifteen scales aimed at measuring interpersonal characteristics in virtual teams and demonstrated that the construction of scales predated COVID-19, however, the search accelerated during this period. Highlights are trust measurement scales, with four scales presented.

This research corroborates a literature review by Calçada Jr. et al. (2023) in two ways: first, I prove that research on interpersonal relationships in virtual teams is based on concepts and theories developed primarily for face-to-face teams. Next, I show that the research agendas presented in literature reviews have not yet been developed. Of the three themes identified as central, only social identity presents a correlated scale, although in a non-objective way (Identity Communication Scale).

This research adds a compilation of scales to measure virtual teams to theoretical knowledge. It shows that several of them are supported by concepts and theories primarily developed for face-to-face teams. Several scales were recently constructed, lacking validation and proof. I also highlighted the knowledge gap when we noticed the lack of scales for the identity of virtual teams, although there are scales developed and validated for the identity of face-to-face teams.

For practice, I demonstrate that the search for understanding the dynamics of social interactions in virtual teams is current and necessary. We present a useful compilation that consolidates, characterizes, and shows the current stage of the scales developed to diagnose virtual teams. It allows the practitioner to choose which characteristic they want to measure and find a way to do so. It also presents the studies already carried out, allowing an analysis of the expected results when applying the scales.

This research proposes that the dynamics of virtual teams lack models and scales for their measurement, showing that it is a significant research agenda to seek validation of the scales already constructed. Otherwise, concepts and theories already consolidated for measuring face-to-face teams and understanding the differentiation between the dynamics of virtual teams will be addressed, and new scales will be proposed to understand the specific characteristics of dispersed teams.

Although this study summarizes fifteen scales dedicated to virtual teams, when I relate them to the concepts and research agendas proposed by Calçada Jr. et al. (2023), the gap in models for measuring distributed teams is clear (table 1). Likewise, the authors expose three relevant research agendas highlighted in the developed SLR: social identity, social capital, and media. This research only found a scale minimally related to social identity, with social capital and media awaiting models and scales for measurement.

A limitation found by the research was that in the selected articles, the authors did not declare the scale items. The sample also found articles that, although they respected the search string, were unrelated to the research topics.

5. Study 3

The construction of social identity in virtual project teams: The role of leadership.

5.1 INTRODUCTION

Virtual project teams have become common, driven by the advancement of communication technologies and the globalization of business (Gilson et al., 2015). This emerging scenario presents unique challenges for leadership and team cohesion, as members often collaborate from geographically dispersed locations with different cultures and time zones (Hoch & Kozlowski, 2014). Studies such as those by Purvanova and Bono (2021) reveal that social identity is associated with the perception of leadership in these groups, playing crucial roles in the effectiveness of work and the success of projects.

This proposal aims to investigate the relationship between social identity and leadership in virtual teams, highlighting how these elements interact to influence the dynamics and results of projects (Newman & Ford, 2022). Social identity (Tajfel & Turner, 1979) addresses an individual's sense of belonging to a group and its influences on behaviors and attitudes in the group context. In virtual teams, where members may not have face-to-face interactions, forming and maintaining a cohesive social identity can be challenging but is essential for effective collaboration (Jarvenpaa & Leidner, 1999).

Another challenge is leadership in virtual teams, which requires specific skills to motivate, coordinate and guide team members through digital means (Zaccaro & Bader, 2003). Avolio, Kahai and Dodge (2000), and more recently Lee, Kozlowski and Bell (2022), show that effective leadership in these contexts not only promotes communication and team cohesion, but also induces a shared social identity, facilitating integration and team performance. Although growing, Gilson et al. (2015) reveal significant gaps in studies on virtual teams and leadership in understanding how social identity influences leadership effectiveness in these contexts.

Newman and Ford (2022) corroborate, current literature still does not fully address these dynamics, especially in virtual environments. Even though digital communication supports team cohesion, it does not completely replace face-to-face interactions in building a strong social identity (Hoch & Kozlowski, 2014). Furthermore, Purvanova and Bono (2021) highlight that leadership strategies that are functional in physical environments are not always effective in virtual teams, suggesting the need for adaptive approaches.

The originality of our research project is supported by the conclusions of Al Dilby and Farmanesh, (2023) when they state that current leadership practices are insufficient to fully

address the unique challenges that arise in virtual environments, resulting in a critical gap in knowledge. Kashive et al. (2022) contribute highlight the need for research investigating how leaders can effectively foster a strong and cohesive social identity among virtual team members, thus promoting higher performance and better group cohesion.

This research proposal aims to contribute to this area, offering new perspectives and approaches to leadership in virtual teams. Therefore, I propose the following research question: **What is the relationship between leadership and the social identity of virtual project teams?**

5.2 THEORETICAL FRAMEWORK

5.2.1 Virtual Teams

Teams are groups of individuals interdependent in their tasks, sharing responsibility for results, they perceive themselves and are perceived by others in the group as a single social entity (Cohen & Baily, 1997). Virtual teams characterized by being geographically dispersed, practice collaboration through communication technologies (Watson et al., 2024), offer speed of response, flexibility and low costs (Mowshowitz, 1997) suitable for dynamic global markets (Snow et al., 1996). For Bell and Kozlowski (2002), they are an improvement on face-to-face work, where virtuality is a potential characteristic of all teams (Griffith, Sawyer and Neale, 2003).

Social relationships directly influence performance and collaboration within virtual teams (Sjølie et al., 2022). Although the transition to a virtual environment tends to reduce interactions between members, supportive and supportive practices can restore their positive development (Lacher & Biehl, 2019). Even so, virtuality is recognized as efficient in providing positive social interactions (O'Brien and Costin, 2022), when incorporated into the construction of a social identity, it has the potential to increase the cohesion of these groups (Mirbabaie et al., 2021). Ben Sedrine et al. (2021) add, cohesion plays a mediating role between leadership styles and the effective performance of remote teams.

5.2.2 Leadership

Leadership is a way in which team members influence other members to motivate them to collaborate towards achieving the teams' objectives and goals (Haslam et al., 2015; Hogg et al., 2012a; House et al., 2002; Rost, 2008; van Knippenberg, 2012). Employee-perceived leadership identity is uniquely related to important indicators of leadership effectiveness, including employees' relationships with their team (perceived team identification and support), well-being (job satisfaction and reduced burnout), and performance (citizenship and innovative behavior at work) (Van Dick et al., 2018). To measure these factors, I propose using the Identity Leadership Inventory (ILI) scale, validated in several countries, demonstrating construct, discriminant and criterion validity (Steffens et al., 2014), and translated into 13 languages (Mascarenhas et al., 2018).

5.2.3 Identity Leadership Inventory (ILI)

Empirical evidence shows that effective leadership is fundamental to performance, motivation (Arthur et al., 2011) and cohesion (Smith et al., 2013) in teams. In this context, Brown and Slater (2023) show the growing interest of researchers in approaching social identity (Stevens et al., 2021) as a construction of identity leadership (Slater et al., 2014). Steffens et al. (2014) already highlighted those questions about the relationship between the collective self and identity (“How will we progress?”, “Who are we?”, “What do we believe?”) are central in collaborative tasks, the answers will be crucial to leaders outline behaviors targeting potential followers.

Thus, the Identity Leadership Inventory (ILI) scale appears, presenting leaders' abilities to create and incorporate a shared social identity with their teams, building a collective identity (Van Dick et al., 2018). It aims to improve leadership skills by offering personalized practical interventions, leading to identity-building leadership behavior (McCarron et al., 2023). It comprises four central dimensions: advancement, entrepreneurship, entrepreneur and prototypicality, focused on leadership management attentive to a shared sense of “us”, according to Steffens et al. (2014):

Advancement of identity, doing it for us”

Advancing and promoting the fundamental interests of the group. Defending and, if threatened, defending the interests of the group (and not personal interests or those of other groups). Defending fundamental concerns and ambitions for the group. Contributing to the

achievement of the group's objectives. Acting to prevent group failures and overcome obstacles to achieving group objectives.

Identity entrepreneurship "creating a sense of ourselves"

Bringing people together by creating a shared sense of 'us' and 'our' within the group. Making different people feel like they are part of the same group and increasing cohesion and inclusion within the group. Clarifying people's understanding of what the group stands for (and does not stand for) by defining core values, norms, and ideals.

Identity Entrepreneur "Making Us Important"

Developing structures, events and activities that value the existence of the group and allow members to experience their membership. Promoting structures that facilitate and consolidate shared understanding, coordination and success (not structures that divide or harm the group). Providing a physical reality for the group, creating group-related materials, and providing tangible results for the group. Making the group matter by making it visible not only to group members but also to people outside the group.

Prototypicality of identity, "being one of us"

Representing the unique qualities that define the group and what it means to be a member of this group. Incorporating those essential attributes of the group that make this group special and distinct from other groups. Being an exemplary member and model of the group.

5.2.4 Individual team member performance.

Several studies highlight the importance of social identity and psychosocial processes in promoting group cohesion and creative performance in collaborative virtual environments (Mirbabaie et al., 2021), Evans et al. (2023) present social identity, especially when strengthened over time, as a positive predictor of individual and team effectiveness. Junker et al. (2022) show that high-performance work systems positively influence work performance through social climate, social identification and psychological empowerment, also highlighting the intricate interaction between social identity theory and organizational performance.

Team leaders' identity leadership plays a crucial role in increasing team identification, which subsequently leads to improved individual and team outcomes, including individual performance (Fransen et al., 2022). This approach has benefits and some drawbacks, although

the positive impact of team-level social identification on team performance and the role of team identification in enhancing team outcomes and individual well-being are clear (Thomas et al., 2019). However, disadvantages may arise from the fact that social identification at the individual level may not significantly predict individual performance outcomes (Qi & Song, 2023).

5.2.5 Extra-role behavior of team members

Social identity is related to extra-role behaviors through several mechanisms. Perceived organizational support positively impacts extra-role behavior (Friis et al., 2021), while knowledge hiding behavior negatively impacts it (Wahda et al., 2020). Manifesting itself in various ways, whether through self-stereotyping, social creativity and leader prototyping, shaping how individuals engage in extra-role behaviors within teams (Masinga, 2022). There are several factors highlighted in the literature that motivate an extra-role attitude, inclusive leadership and organizational justice, together with organizational learning have a positive influence (Wahda et al., 2020), Meng et al. (2022) highlight organizational trust, via internal relationships, as a strong motivator.

When employees identify strongly with their organization, they are more likely to exhibit extra-role behaviors (Guan & So, 2022), a perceived consensus of interest and service identity within the organization positively influences extra-role behavior, indicating the impact of identity social impact on such behaviors (Wahda et al., 2020). Overtime at the team level moderates the effect of individual overtime on professional success, highlighting the importance of social dynamics in a team (Liu et al., 2021).

5.2.6 Conceptual Model and Hypotheses

This research proposes investigating the relationship between social identity and leadership in virtual teams, realizing the complexity of interactions in virtual teams, it is necessary to explore how different dimensions of leadership can impact social identity. This study proposes investigating these relationships through the Identity Leadership Inventory (ILI), a tool that assesses how leaders promote group identity. Based on existing literature, I propose four hypotheses to examine the interdependence between leadership, social identity, cohesion, individual performance and extra-role behaviors in virtual project teams (Haslam et al., 2020; Rico et al., 2018).

In the evolving landscape of virtual work environments, understanding the mechanisms that drive team dynamics becomes crucial. Leadership plays a pivotal role in shaping the social identity of teams, particularly in contexts where face-to-face interactions are limited.

Haslam et al. (2020) and Hogg (2001) demonstrate that leaders perceived as prototypical of the group have a significant impact on group identity. Such leaders induce a sense of importance among team members, effectively strengthening the group's social identity. Van Dick et al. (2021) further emphasize that leadership can create a sense of "us" among team members, even in virtual environments where traditional bonding mechanisms are challenged.

Based on these statements, I propose:

H1: The Identity Leadership Inventory (ILI) has a positive relationship with the social identity of the virtual project team.

Hypothesis H1 suggests that leadership practices that promote social identity, such as those measured by the Identity Leadership Inventory (ILI), are fundamental for the development of a strong social identity in virtual teams. Previous studies have shown that leaders seen as prototypical of the group promote the group's identity, inducing a feeling of importance in members, tending to strengthen the group's social identity (Haslam et al., 2020; Hogg, 2001). Leadership that supports social identity can help create a sense of “us” among team members, even in virtual environments (van Dick et al., 2021).

The Identity Leadership Inventory (ILI), as conceptualized by Haslam et al. (2011), highlights the role of leaders who promote a shared social identity among team members. These leaders act as prototypes of the group, aligning individual goals with collective objectives and fostering a sense of "us" within the team (Hogg, 2001; Haslam et al., 2020). In virtual teams, where face-to-face interactions are limited, such leadership becomes even more critical. By reinforcing collective values, leaders enhance team cohesion, which can inspire members to engage in extra-role behaviors, such as helping others, providing support, and assuming responsibilities beyond formal duties (Podsakoff et al., 2009).

Furthermore, Dovidio et al. (2006) argue that strong leadership promoting social identity leads to behaviors that transcend formal roles, benefiting both the individual and the collective. In virtual contexts, these extra-role behaviors are particularly significant for team success, as collaboration and mutual support compensate for the lack of physical presence and traditional bonding mechanisms (Podsakoff et al., 2000; Van Dick et al., 2021). The ILI framework

underscores the importance of leaders as drivers of these behaviors by embedding a shared social identity within the team, ultimately fostering an environment where members voluntarily go beyond their assigned roles for the benefit of the team.

Based on these statements, I propose:

H2: The Identity Leadership Inventory (ILI) has a positive relationship with the extra-role behavior of the virtual project team.

In virtual work environments where face-to-face interactions are limited, social identity becomes a crucial mechanism for maintaining engagement and motivation. Ellemers et al. (2004) demonstrate that a strong social identity significantly improves individual motivation and performance. Rico et al. (2018) emphasize that in the absence of direct personal contact, social identity functions as a cohesion mechanism, enabling team members to maintain their focus and commitment. Van Dick et al. (2021) corroborate this perspective, confirming social identity as a significant predictor of individual performance in virtual contexts.

Based on these statements, I propose:

H3: Social identity has a positive relationship with the individual performance of members of virtual project teams.

Hypothesis H3 is based on the literature that shows that a strong social identity improves the motivation and performance of team members (Ellemers et al., 2004). In virtual teams, where face-to-face interaction is limited, social identity helps maintain engagement and motivation, resulting in better individual performance (Rico et al., 2018). Recent studies also confirm that social identity is a significant predictor of individual performance in virtual contexts (van Dick et al., 2021).

Social identity extends beyond individual performance, encompassing behaviors that transcend formal responsibilities. Dovidio et al. (2006) emphasize that extra-role behaviors, such as assuming responsibilities beyond defined roles and exercising organizational citizenship, are crucial for team success, especially in virtual contexts. Podsakoff et al. (2009) identify that such behaviors are particularly important in virtual teams, where collaboration and mutual support are essential for collective effectiveness.

Based on these statements, I propose:

H4: Social identity has a positive relationship with the extra-role behavior of the virtual project team.

Social identity is also associated with extra-role behaviors, such as the behavior of assuming responsibilities beyond the role, and organizational citizenship. Dovidio et al. (2006)

emphasize that such behaviors are crucial to the success of teams, especially in virtual contexts. Studies by Podsakoff et al. (2009) indicate such extra-role behaviors are particularly important in virtual teams, where collaboration and mutual support are essential for team effectiveness.

Identity-based leadership, as measured by the Identity Leadership Inventory (ILI), plays a fundamental role in aligning individual and collective goals, especially in virtual teams where the absence of face-to-face interactions can hinder cohesion. Haslam et al. (2011) argue that leaders who promote a shared social identity strengthen members' sense of belonging, increasing their motivation to achieve individual goals aligned with team objectives.

Van Knippenberg et al. (2004) complement this perspective, indicating that leadership reinforcing collective values and goals creates an environment that stimulates individual performance. Previous studies by Ellemers et al. (2004) and Van Dick et al. (2008) suggest that leaders acting as group prototypes, advocating for team interests, and promoting social cohesion have a direct impact on member performance.

Based on these statements, I propose:

H5: The Identity Leadership Inventory (ILI) has a positive relationship with the individual performance of the virtual project team.

Identity-based leadership, as measured by the Identity Leadership Inventory (ILI), plays a key role in aligning individual and collective goals, especially in virtual teams, where the absence of face-to-face interactions can hinder cohesion (Haslam et al., 2011). Leaders who promote a shared social identity strengthen members’ sense of belonging, increasing their motivation to achieve individual goals aligned with team objectives (Van Knippenberg et al., 2004). Thus, leadership that reinforces collective values and goals creates an environment that encourages individual performance, even in virtual contexts.

In addition, previous studies suggest that leaders who act as group prototypes, advocate for team interests, and promote social cohesion have a direct impact on member performance (Ellemers et al., 2004; Van Dick et al., 2008). In virtual teams, where technological and cultural barriers are common, reinforcing a collective identity through ILI helps overcome these challenges, allowing members to contribute more effectively and with greater focus to the success of projects.

Positive individual performance is intrinsically linked to extra-role behaviors. Organ (1988) observes that employees who perceive they are achieving personal goals tend to go beyond formal responsibilities to benefit the team and organization. In virtual teams, this effect is amplified when members perceive their individual contributions to have a direct impact on

collective outcomes, encouraging voluntary behaviors like collaboration, mutual support, and problem-solving (Podsakoff et al., 2000). Organizational behavior theory, as suggested by Gilson et al. (2015) and Edmondson (1999), indicates that high-performing individuals develop greater commitment to team success, motivating them to undertake challenging tasks and provide support to colleagues.

Based on these statements, I propose:

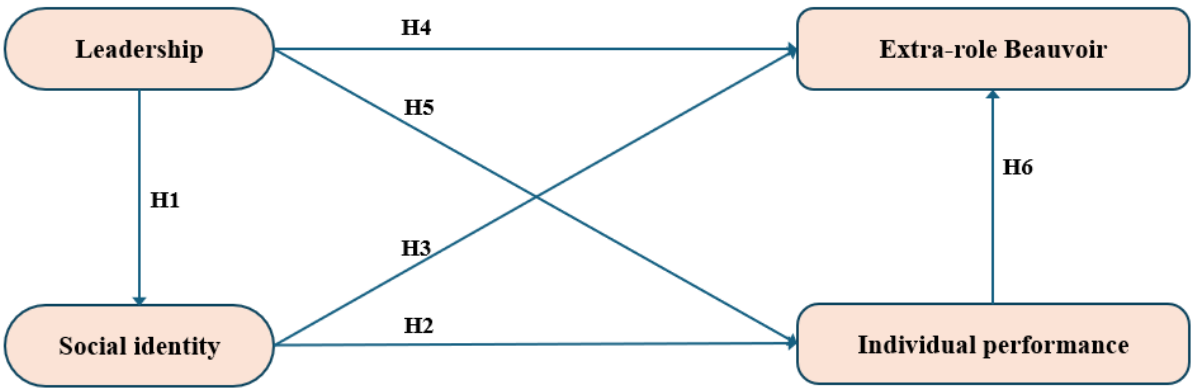
H6: The individual performance has a positive relationship with the extra-role behavior of the virtual project team.

Positive individual performance is intrinsically linked to extra-role behaviors, as employees who perceive that they are achieving their personal goals tend to go beyond their formal responsibilities to benefit the team and the organization (Organ, 1988). In virtual teams, this effect is amplified when members perceive that their individual contributions have a direct impact on collective outcomes, encouraging voluntary behaviors such as collaboration, mutual support, and problem-solving (Podsakoff et al., 2000).

In addition, organizational behavior theory suggests that high-performing individuals develop greater commitment to the team's success, which motivates them to take on challenging tasks and provide support to colleagues (Gilson et al., 2015; Edmondson, 1999). In virtual project teams, these behaviors are critical to overcoming the barriers of technology-mediated communication and strengthening group cohesion, resulting in a virtuous cycle of improved collective performance.

Figure 8 presents the proposed model in schematic form:

Figure 8:
Model proposal



Source: The author

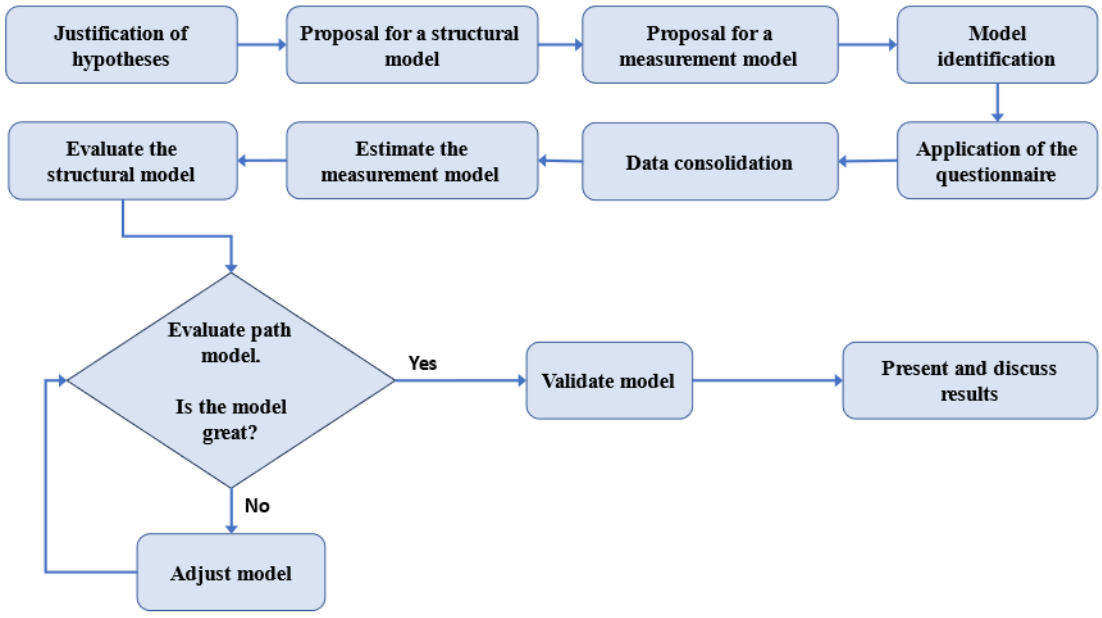
5.3 METHODOLOGY

Descriptive research is proposed, indicated to characterize a phenomenon associated with a chosen population, based on hypotheses proposed from the theory of the themes listed, according to Cooper and Schindler (2016). The aim is to use questionnaires to investigate the hypotheses in a sample of the chosen population, members of virtual project management teams. The forms must be distributed via social networks, personal and professional contacts of the author.

The statistical tool for processing the data will be structural equation modeling (SEM), particularly useful in testing hypotheses about causal relationships in theoretical models (Kline, 2015). Defended by Byrne (2013) for its ability to treat multiple variables simultaneously, offering flexibility in modeling interactions and moderating effects, adapting to the context of social science research (Hair et al., 2010). Bido et al. (2012) teaches us that SEM is a research methodology, much more than a statistical tool, its application requires a series of steps.

Below I propose a script for executing a SEM, based on Bido et al. (2012), starting with the justification of the hypotheses already presented, Figure 9:

Figure 9
Roadmap for applying the SEM methodology



Source: the author based on Bido et al. (2012)

5.3.1. Amostra

The sample collected is composed of members and leaders of project teams, whether hybrid or fully virtual teams. The questionnaire was created using the SurveyMonkey® tool

and distributed via the author's social networks and professional contacts. Responses were collected between October 7th and 24th, 2024. The full text of the questionnaire is available in Appendix B.

To determine the minimum sample size, I used the G*Power® tool, widely used for sample size calculations in regression analyses, as recommended by Faul et al. (2007). I list the parameters adopted for analysis by G*Power®, according to the proposed model (Figure 8) as follows:

Test Family: F test (Multiple linear regression)

Statistical test: Linear multiple regression: Fixed model, R^2 deviation from zero

Effect size: 0,15 (for medium effect)

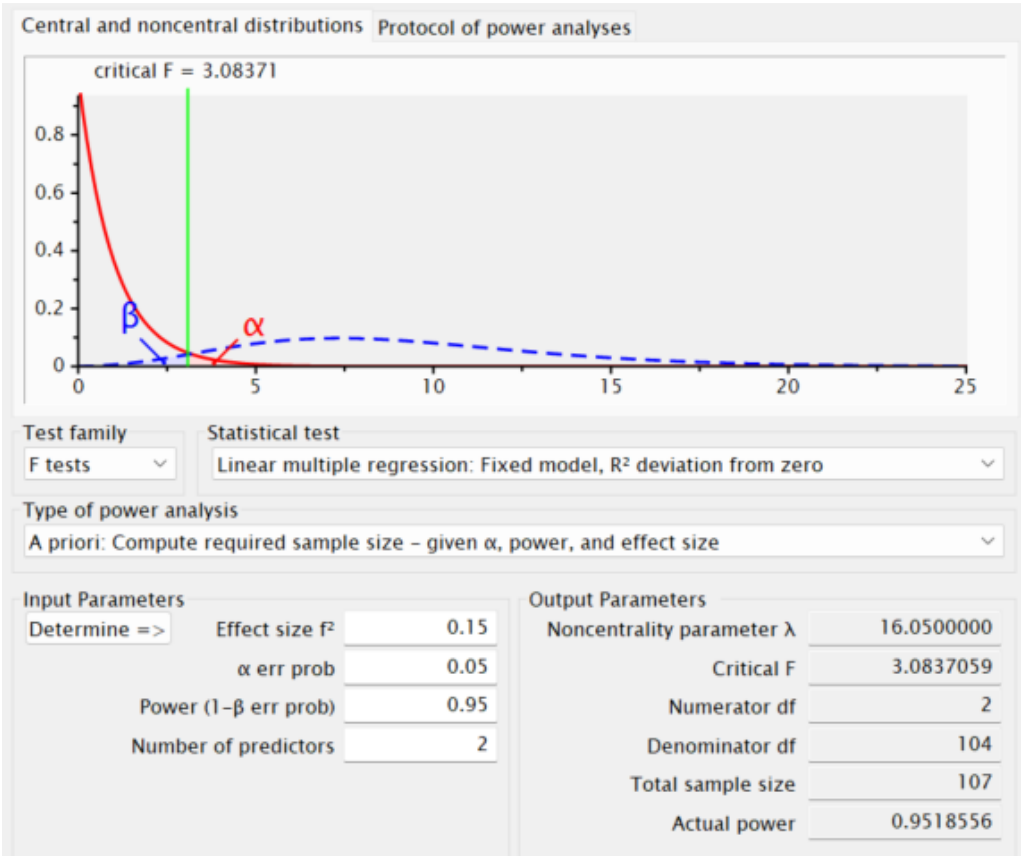
α err prob: 0,05 (probability level as per Silva e Bido (2014))

Power (1-β err prob): 0.95 (statistical power, although the suggested one is 0.8)

Number of predictors: 2 (Two predictors or independent variables, according to the proposed model)

Figure 10 presents the output of the G*Power® tool for the proposed parameters, estimating the minimum sample size at 107 responses.

Figure 10
Sample size estimation



Source: the author

For the proposed model with two independent variables (identification with the group and leadership), the minimum number indicated will be 107 responses to the questionnaire. However, for greater robustness of the model, Ringle, Silva, and Bido (2014) suggest that the goal is to double this evaluation, so Iwill aim to list 214 valid responses for the proposed questionnaire. The collection of responses ended on October 25, 2024, with 232 total responses, of which 194 were useful responses (10.8% below the desired goal of 214 useful responses).

5.3.2. Description of variables and associated scales

I present the scales adopted in this research and demonstrate their measurement capabilities based on three indices:

CFI (Comparative Fit Index), which measures how well the proposed model fits the data compared to a null (or independent) model when it is assumed that there is no relationship between the variables. CFI values range from 0 to 1, where values closer to 1 indicate a good

model fit. A CFI value of 0.90 or higher is considered acceptable, while values above 0.95 indicate an excellent fit.

RMSEA (Root Mean Square Error of Approximation), measures the amount of error in the approximation of the adjusted model in relation to the population data. It considers the number of estimated parameters in the model and penalizes more complex models. RMSEA values close to 0.05 or lower indicate a good fit, while values up to 0.08 are considered acceptable. Values above 0.10 indicate a poor model fit. Being sensitive to the complexity of the model, it is useful for assessing the relative fit of models of different sizes and complexities.

Cronbach's alpha measures the internal consistency of a scale, indicating how consistently the items on a scale assess the same construct. It measures the reliability of a set of items, whether they are aligned and coherently measuring the central concept of the scale. It ranges from 0 to 1, with higher values indicating greater internal consistency. An alpha value of 0.70 or higher is generally considered acceptable for social science research, while values above 0.80 or 0.90 indicate high reliability. Not all scales adopted in this research mention this index, however, when highlighted it will be reported.

5.3.2.1 Dependent variable 1: Individual performance

In this research, I adopted the measurement of individual performance based on the work of Lousã et al. (2024), who adapted the Individual Work Performance Questionnaire (IWPQ) scale to a Portuguese version from Portugal (IWPQ-PT). The authors highlight that the IWPQ-PT is consistent with the original, a confirmatory factor analysis showed a good fit of the model with acceptable indices (CFI = 0.95; RMSEA = 0.06), internal consistency with Cronbach's alpha ranging from 0.72 to 0.88 showing that the items consistently measure the constructs of task performance, contextual performance and counterproductive behavior.

The analyses indicated positive and significant correlations between the performance subscales (task and contextual) and measures of job satisfaction and engagement, supporting convergent validity. And, as expected, the counterproductive behavior dimension presented negative correlations with these variables, confirming its discriminant validity and function as a distinct measure (Lousã et al., 2024).

Table 12
IWPQ-PT scale assertions for individual team member performance

H3 - Individual performance	**1**	I was able to plan my work to finish it on time
	2	I had in mind the work output I needed to achieve.
	3	I was able to set priorities.
	4	I complained about minor work-related issues.
	5	I was able to do my work efficiently.
	6	I managed my time well.
	7	On my own initiative, I started a new task when I finished old ones.
	8	I magnified problems at work more than they really were.
	9	I took on challenging tasks when they were available.
	10	I worked to keep my work-related knowledge up to date.
	11	I focused on the negative aspects of the work situation rather than the positive aspects.
	12	I worked to keep my professional skills up to date.
	13	I came up with creative solutions to new problems.
	14	I talked to people outside the organization about the negative aspects of my work.
	15	I took on extra responsibilities.
	16	I continually sought new challenges at work.
	17	I talked to colleagues about the negative aspects of my work.
	18	I actively participated in meetings and/or consultations.

Source: The author based on Lousã et al. (2024)

5.3.2.2 Dependent variable 2: Extra-role behavior

Blader and Tyler (2009) developed a scale capable of exploring extra-role behavior in the organizational context, focusing on the importance of social identity as a predictor of this behavior. They measure actions that go beyond the contractual responsibilities of employees, when they aim at a collective benefit for the organization. They address voluntary behaviors, helping colleagues or building a healthy work environment, behaviors that are not explicitly requested, but that strengthen team cohesion and effectiveness.

The proposed scale shows that extra-role behaviors are highly influenced by the level of social identification of team members. They reinforce that such behaviors are motivated by intrinsic factors, such as a sense of belonging and commitment to the group, much more than direct economic rewards. This scale offers a reliable measure of the behavior of team members when they adopt a proactive and collaborative stance, which is essential for building a healthy work environment. Blader and Tyler (2009) provide evidence of the scale's psychometric qualities, demonstrating its robustness and statistical validity. The adjusted structure of the model presents robust indicators with CFI (0.95) and RMSEA (0.09) values. A Cronbach's alpha 0.94 indicates high internal consistency, resulting in a robust and reliable measurement.

Table 13
Extra-role behavior scale

H4 - Extra-function behavior	**1**	I volunteer to do things that are not my responsibility but that help the organizatior
	2	I volunteer to help orient new employees.
	3	I help others with work-related problems.
	4	I volunteer to help others when they have heavy workloads.
	5	I can put in extra effort to do my job well, beyond what is normally expected.
	6	I share my knowledge with others, even when I won't get credit for it.
	7	I work extra hours even when I don't get credit for it.

Source: the author based on Blader & Tyler (2009)

5.3.2.3. Independent variable 1: Leadership

The Identity Leadership Inventory (ILI) scale, presented by Steffens et al. (2014), measures four dimensions of organizational leadership: prototypicality, identity advancement, identity entrepreneurship, and identity entrepreneurship. It assesses different aspects of how leaders manage social identity in groups. Each of the four dimensions addresses a distinct facet of leadership, allowing for a richer understanding of the leader's impact on group cohesion and identity.

Prototypicality is the degree to which the leader represents the group's characteristics and values. A prototypical leader is seen as a "role model" for the group, reflecting what is essential to collective identity and reinforcing cohesion. Identity Advancement: measures the leader's dedication to promoting and defending the group's interests. Leaders who advance identity place the group's well-being above personal interests, strengthening member trust and engagement.

Identity Entrepreneurship is the leader's ability to shape and structure the group's identity. An identity entrepreneurial leader defines the group's “we,” helping members understand who they are collectively and what their shared purpose is.

Identity Imprint: measures the leader’s ability to promote the group to the outside world. Leaders with strong identity imprints act as ambassadors, projecting a positive image of the group to increase prestige and social legitimacy.

The scale has strong content, discriminant, and criterion validity, with high goodness-of-fit in confirmatory factor analyses (CFI = 0.97 and RMSEA = 0.08 for the four-factor model). Cronbach’s alpha values were high for all subscales, indicating robust internal consistency (Author’s note: the article in question does not provide numerical explanations of Cronbach’s alpha values).

Table 14
Identity Leadership Inventory–Short Form (ILI–SF)

H1 - Leadership	**1**	Our leader is a role model for the team
	2	Our leader acts as an advocate for the team.
	3	Our leader creates a sense of cohesion within the team.
	4	Our leader creates helpful structures for team members.

Source: the author based on Steffens et al. (2014)

5.3.2.4. Independent variable 2: Identification with the group

Roccas et al. (2008) offer a validated scale, The Measure of Identification with Groups, which addresses four dimensions of identification with groups: importance, commitment, superiority, and deference. Importance refers to the extent to which the group is part of the individual's identity; commitment measures the individual's willingness to contribute to the well-being of the group; superiority captures the perception that the group is superior to others; and deference assesses respect and adherence to group norms and leaders.

It is adaptable to various types of groups, including nations and organizations, enabling its application in studies of social and organizational identity. It presents values such as CFI = 0.94 and RMSEA = 0.066, demonstrating an adequate fit between the theoretical model and empirical data. These fit indices support the robustness of the scale structure and its validity for capturing different modes of identification with groups.

Table 15
The Measure of Identification with Groups

Identification with the group	**1**	I feel strongly about this team.
	2	Other teams can learn a lot from us.
	3	Belonging to this team is an important part of my identity.
	4	In difficult times, the only way I know what to do is to trust the team leaders.
	5	I am happy to contribute to this team.
	6	Compared to other similar teams, this team is particularly good.
	7	It is important for me to be seen as a member of this team.
	8	All team members must respect the customs, institutions, and leaders of the group.
	9	I am strongly committed to this team.
	10	Compared to other teams, we are a very ethical group.
	11	It is important for me that others see me as a member of this team.
	12	It is unfair to criticize this team.

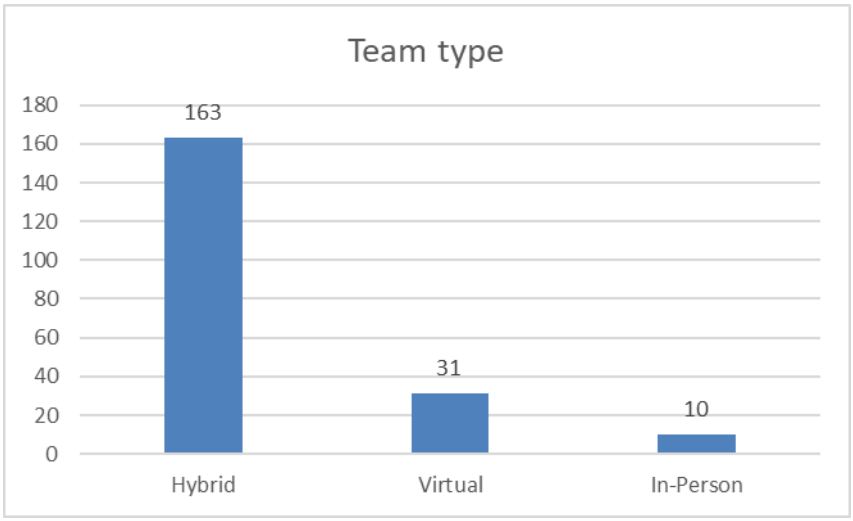
Source: the author based on Roccas, S., S., Sagiv, L., Schwartz, S., Halevy, N., & Eidelson, R. (2008).

5.4 RESULTS

5.4.1 Sample characterization

I closed the response collection on October 24, 2024, with 232 responses. Figure 11 shows the distribution of team types in the sample. 28 incomplete responses have already been removed, leaving 204 responses. In this research, Iwill only analyze responses from members of hybrid and virtual teams for a total of 194 responses.

Figure 11
Characterization of the sample according to the type of team of the respondents

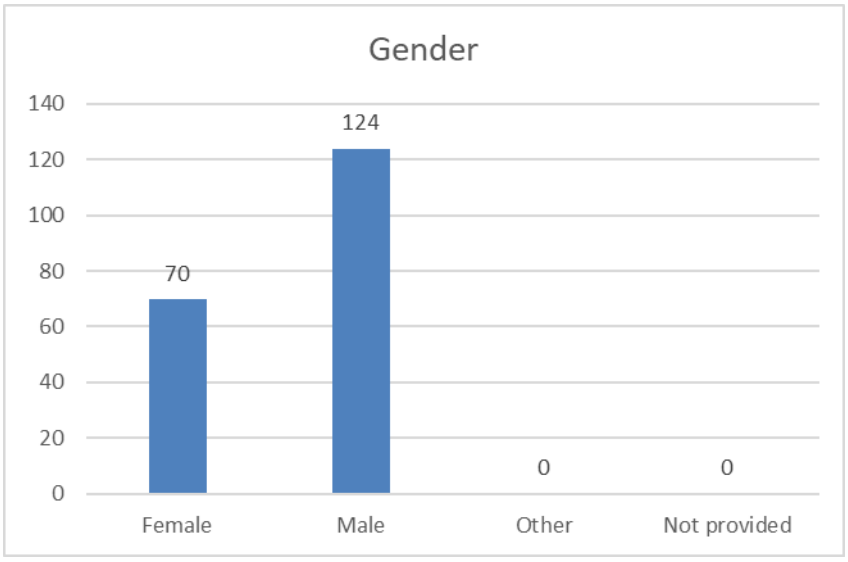


Teams	Amount	%
Hybrid	163	80%
Virtual	31	15%
In-Person	10	5%
Total=	**204**	**100%**
Useful=	**194**	

Source: the author

Figure 12 presents the gender distribution in the 194 useful responses, showing that 64% of respondents are male.

Figure 12
Gender distribution

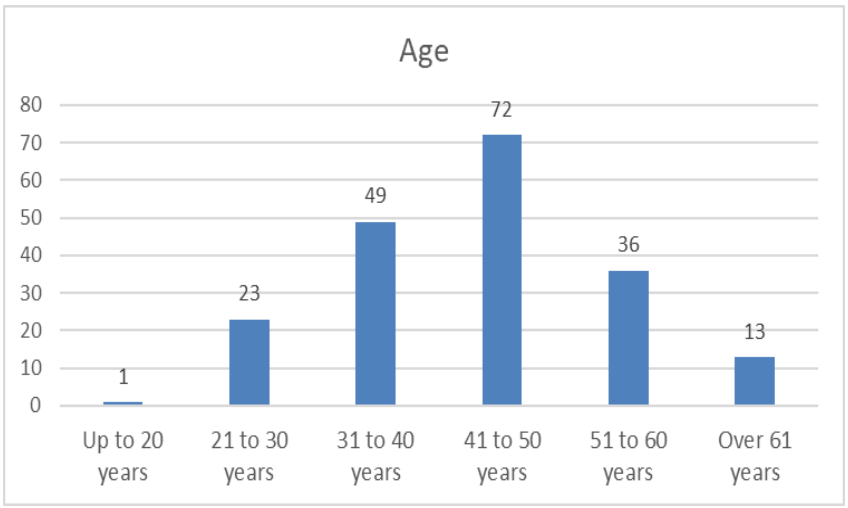


Gender	Amount	%
Female	70	36%
Male	124	64%
Other	0	0%
Not provided	0	0%
Total=	**194**	**100%**

Source: the author

Figure 13 shows the age distribution of the 194 respondents:

Figure 13
Distribution by age group

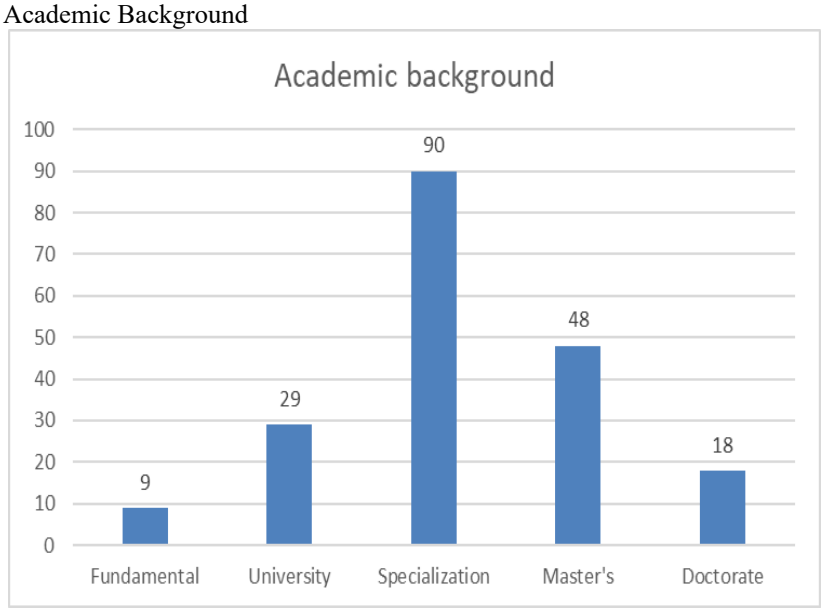


Age (years)	Amount	%
Up to 20	1	1%
21 to 30	23	12%
31 to 40	49	25%
41 to 50	72	37%
51 to 60	36	19%
Over 61	13	7%
Total =	**194**	**100%**

Source: the author

Figure 14 presents the academic background of the respondents, showing that 80% of the sample has at least one level of specialization.

Figure 14
Academic Background

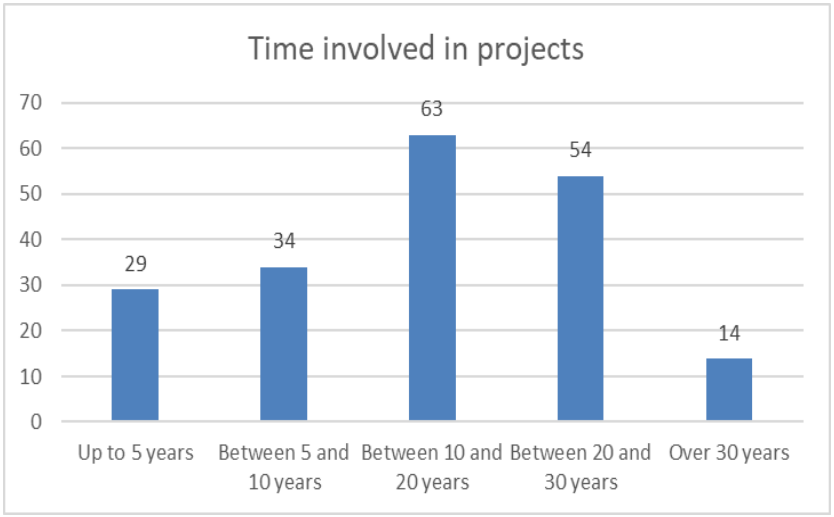


Baxckground	Amount	%
Fundamental	9	5%
University	29	15%
Specialization	90	46%
Master's	48	25%
Doctorate	18	9%
Total=	**194**	**100%**

Source: the author

Figure 15 shows how long respondents have been involved with projects, showing that 68% of respondents have been involved with projects for more than ten years.

Figure 15
Time involved in projects

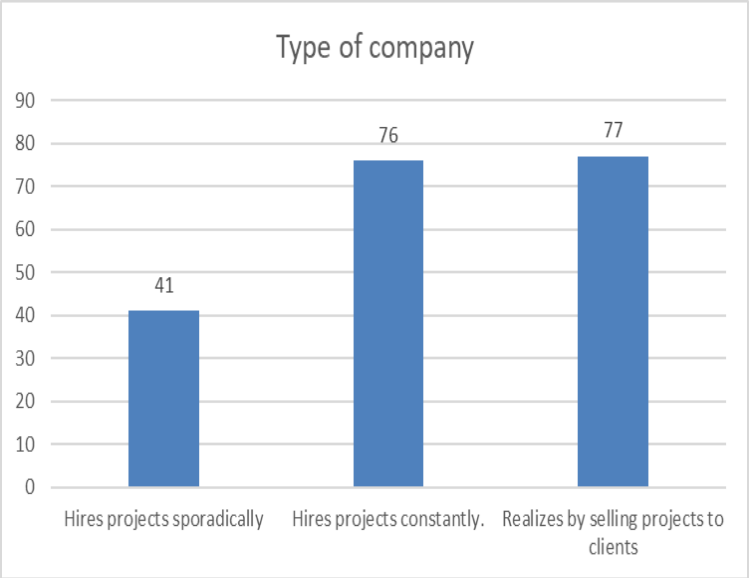


Years	Amount	%
Up to 5	29	15%
5 to 10	34	18%
10 to 20	63	32%
20 to 30	54	28%
Over 30	14	7%
Total=	**194**	**100%**

Source: the author

Figure 16 shows how the companies where the respondents work are related to projects, highlighting that 79% of them have constant involvement with projects.

Figure 16
How companies are related to projects

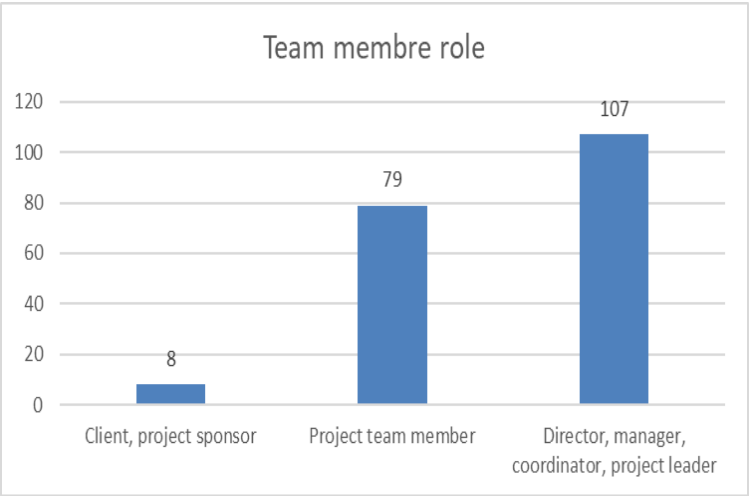


Type	Amount	%
Projects sporadically	41	21%
Projects constantly.	76	39%
Selling projects	77	40%
Total=	**194**	**100%**

Source: the author

Figure 17 shows which roles respondents play within project teams, 96% of respondents hold leadership positions.

Figure 17
Team Member Role



Role	Amount	%
Client, sponsor	8	4%
Team member	79	41%
Leader	107	55%
Total=	194	100%

Source: the author

5.4.2 – Statistical analysis

5.4.2.1 – Statistical relevance analysis of the sample

5.4.2.1.1 - VIF - Variance Inflation Factor

Index is used to assess multicollinearity between independent variables in a regression model. Multicollinearity occurs when two or more independent variables are highly correlated, which can distort regression coefficients and compromise the interpretation of results. VIF quantifies the degree to which the variance of a regression coefficient is increased due to collinearity with other independent variables (Hair et al., 2014).

A VIF value above 10 indicates a potentially problematic level of multicollinearity, although some authors suggest that values above 5 already deserve attention (Kutner et al., 2005). When the VIF is high, it means that the independent variable has a strong correlation with other independent variables in the model, which can lead to unstable coefficients and misleading interpretations. The use of VIF is essential in regression analyses, as it allows the identification and correction of multicollinearity, ensuring the accuracy of the results (Mansfield & Helms, 1982).

VIF values below 5 indicate that each independent variable contributes uniquely to the model, without presenting excessive overlap with other variables (Diamantopoulos & Siguaw, 2006). This increases the reliability of the coefficients and the precision of the estimates, since collinearity is not inflating the variances of the regression coefficients. Table 16 presents the VIF values obtained with our sample, showing that the highest index found was 3.394 and, being less than 5.00, Ican state that there is no significant presence of multicollinearity among the independent variables of the model. This indicates that the predictor variables are sufficiently distinct from each other to provide stable and reliable estimates of the regression coefficients, according to Hair et al., (2014).

Table 16
Variance Inflation Factor (VIF)

Collinearity Statistics (VIF)					
Variables	**VIF**	**Variables**	**VIF**	**Variables**	**VIF**
ExtraR1	1.361	IndGrp5	1.529	PerfInd13	1.434
ExtraR2	1.754	IndGrp9	1.526	PerfInd9	1.258
ExtraR3	1.183	Lideran1	1.912	fun1	1.000
ExtraR4	1.467	Lideran2	2.237	fx1	2.273
Genero	1.000	Lideran3	**3.394**	fx2	2.273
IndGrp1	1.414	Lideran4	2.525	temp1	1.000
IndGrp2	1.566	PerfInd1	1.147	tip1	1.209
IndGrp3	1.730	PerfInd12	1.322	tip2	1.209

Source: author with SmartPLS4®

5.4.2.1.2 Convergent validity

Fundamental to assessing whether the indicators of a construct measure the same underlying theoretical concept (Hair et al., 2022). This analysis verifies whether the indicators share a significant portion of variance, ensuring that they consistently reflect the proposed construct. In structural equation modeling, convergent validity is crucial to validate the quality of the measurement model, ensuring that the theoretical constructs are adequately represented by the observed variables (Fornell & Larcker, 1981).

Convergent validity is assessed mainly by the value of the Average Variance Extracted (AVE), which, according to Fornell and Larcker (1981), must be equal to or greater than 0.50. This criterion indicates that the construct explains, on average, at least 50% of the variance of its indicators. In addition, the outer factor loadings must be greater than 0.70, as suggested by Hair et al. (2022), to indicate a high correlation between the indicators and the construct. Values below these limits may indicate problems with the adequacy of the indicators to the construct and should be investigated individually. Table 17 presents the results offered by SmartPLS4®.

Table 17
Convergent validity

	Construct reliability and validity			
	Cronbach's alpha	Composite reliability	Composite reliability	Average variance extracted (AVE)
Comportamento Extra Função	0.701	0.706	0.815	0.524
Identidade Social	0.782	0.783	0.851	0.534
Liderança	0.885	0.891	0.920	0.743
Performance individual	0.668	0.681	0.800	0.502

Source: author with SmartPLS4®

5.4.2.1.3 Discriminant validity

The essential criterion to ensure that the constructs of a measurement model are distinct from each other is that each construct measures a unique concept and does not overlap with other constructs (Hair et al., 2022; Fornell & Larcker, 1981). This analysis is crucial for the theoretical reliability of the model, as it avoids redundancies between constructs and ensures that the indicators of a construct are more correlated with it than with other constructs. In practical terms, discriminant validity is a requirement to establish that the relationships between the constructs of the structural model are valid, contributing to the robustness and credibility of the results (Henseler et al., 2015).

Discriminant validity can be assessed using the Fornell-Larcker criterion, where the square root of the AVE of each construct must be greater than the correlations between this construct and the others, indicating that the construct shares more variance with its own indicators than with other constructs (Fornell & Larcker, 1981). Table 18 presents the indices found for our sample.

Table 18
Discriminant validity

Discriminant validity - Fornell & Larcker (1981)						
	Comport. Extra Função	Genero	Ident. Social	Liderança	Perf. individual	Tempo de emp.
Comport. Extra Função	0.724					
Genero	0.032	1.000				
Identidade Social	0.332	0.172	0.731			
Liderança	0.112	-0.022	0.460	0.862		
Perf. individual	0.471	0.077	0.524	0.253	0.709	
Tempo de empresa	0.028	-0.035	0.019	-0.013	0.037	1.000

Source: author with SmartPLS4

5.4.2.1.4 Cross Loadings

Fundamental to verifying the discriminant validity of a measurement model, ensuring that each indicator is more strongly associated with the theoretical construct to which it belongs than with other constructs in the model. This criterion assesses whether the indicators exclusively measure the construct they represent, avoiding redundancies or overlaps between constructs (Hair et al., 2022). When indicators have significant loadings on multiple constructs, this may indicate theoretical or practical problems, such as a poor definition of the constructs or issues in the formulation of the observed variables, compromising the quality of the model.

Indicators are expected to have higher loadings on the construct to which they belong than on any other construct, as recommended by Chin (1998). In practical terms, the loading of

an indicator on its own construct should be ≥ 0.70, while the loadings on the other constructs should be considerably lower. When this occurs, it is evident that the construct is distinct and that the indicator is aligned with its theoretical definition. If an indicator presents similar loadings in more than one construct, it is necessary to review its allocation or even consider its exclusion, as this indicates a lack of discriminant validity (Hair et al., 2022; Chin, 1998). Table 19 presents the indices found for our sample.

Table 19
Cross Loadings

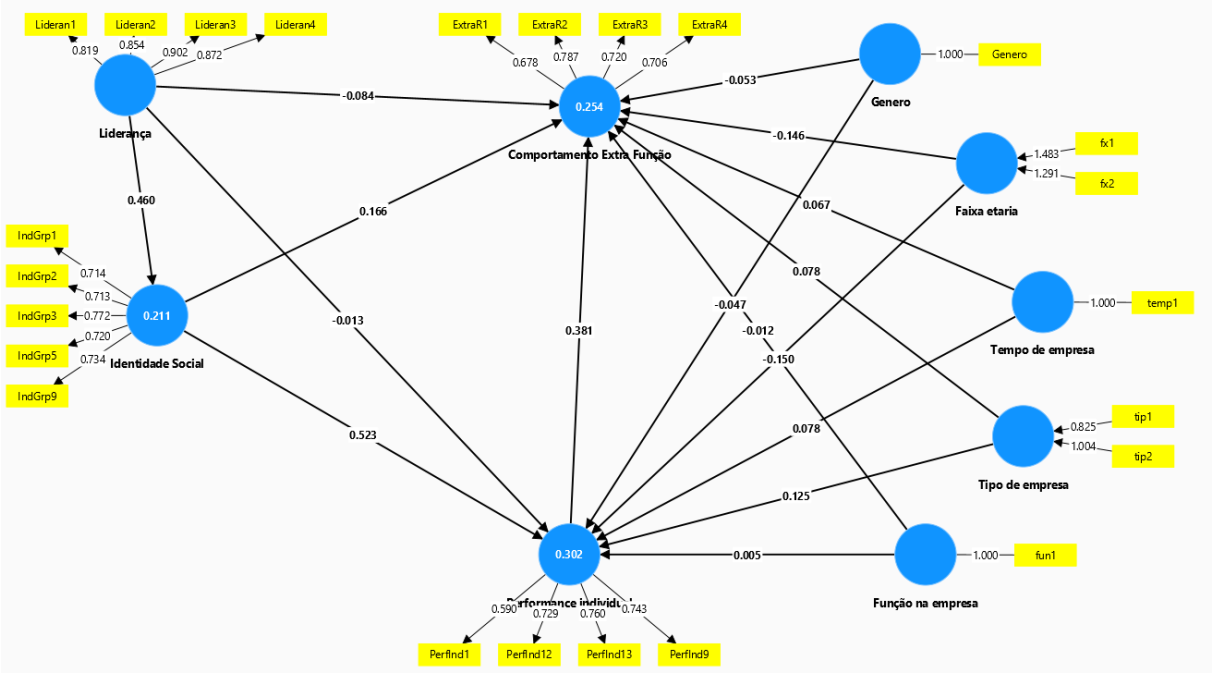
	Cross Loadings								
	Comp. Extra Função	Faixa etaria	Função na emp.	Genero	Iden. Social	Liderança	Perf. individual	Tempo de emp.	Tipo de emp.
ExtraR1	0.678	-0.065	0.044	-0.013	0.258	0.073	0.284	0.086	0.127
ExtraR2	0.787	-0.096	-0.027	0.048	0.258	0.112	0.311	0.059	0.041
ExtraR3	0.720	-0.201	-0.015	0.042	0.262	0.081	0.427	-0.004	-0.006
ExtraR4	0.706	-0.043	-0.033	0.008	0.166	0.056	0.310	-0.061	0.085
Genero	0.032	-0.084	-0.033	1.000	0.172	-0.022	0.077	-0.035	0.193
IndGrp1	0.260	-0.037	-0.052	0.202	0.714	0.311	0.368	-0.019	-0.001
IndGrp2	0.164	-0.056	0.064	0.071	0.713	0.365	0.416	0.058	0.034
IndGrp3	0.255	-0.093	0.016	0.101	0.772	0.382	0.351	-0.003	0.009
IndGrp5	0.261	-0.141	-0.217	0.128	0.720	0.265	0.391	0.029	-0.065
IndGrp9	0.272	0.026	0.000	0.131	0.734	0.352	0.389	0.006	0.045
Lideran1	0.145	-0.107	-0.084	0.033	0.377	0.819	0.213	0.001	0.063
Lideran2	0.098	-0.125	-0.017	0.029	0.397	0.854	0.212	-0.012	0.085
Lideran3	0.005	-0.096	-0.019	-0.079	0.338	0.902	0.202	-0.033	-0.028
Lideran4	0.121	-0.145	-0.077	-0.062	0.453	0.872	0.237	-0.005	-0.013
PerfInd1	0.212	0.022	-0.029	0.037	0.349	0.182	0.590	0.039	0.122
PerfInd12	0.364	-0.224	0.023	0.064	0.341	0.170	0.729	0.018	0.051
PerfInd13	0.305	-0.076	0.057	0.107	0.359	0.189	0.760	0.052	0.125
PerfInd9	0.421	-0.063	-0.046	0.017	0.430	0.181	0.743	0.005	0.006
fun1	-0.011	0.268	1.000	-0.033	-0.048	-0.060	0.000	0.279	0.293
fx1	-0.095	0.516	0.289	-0.140	-0.043	-0.084	-0.047	0.543	0.108
fx2	-0.009	0.182	-0.124	0.096	-0.013	-0.012	-0.045	-0.299	0.022
temp1	0.028	0.418	0.279	-0.035	0.019	-0.013	0.037	1.000	0.067
tip1	-0.011	0.153	0.121	0.058	0.113	0.018	0.073	-0.010	0.408
tip2	0.086	0.062	0.192	0.145	-0.085	0.017	0.038	0.074	0.661

Source: author with SmartPLS4®

5.4.3 – Adjustments to the proposed model

Starting from the model initially proposed, Figure 8, I arrive at the model presented below (Figure 18), where I show the structure of relationships between the latent variables (Constructs) and the observed variables. In this figure, Ishow the items of the scales that are sustained after adjustments and exclusions, thus validating the model initially proposed (Figure 8), following the guidelines of Ringle, Silva and Bido (2014), when they teach that Ishould remove the variables with smaller factor loadings. The process of excluding the observed variables was based on the indication of Hair et al. (2009), with the standard value for factor loadings being >0.70, as this reference ensures greater stability and convergence of the model.

Figure 18
Proposed model after adjustments



Source: author with SmartPLS4®

I began confirmatory tests of statistical significance by testing the validity and reliability of the model to measure the listed variables, ensuring that the latent constructs were measured adequately and consistently by the selected indicators. Thus, I ensured that the inferences made from the model were reliable and valid. I began with composite reliability by evaluating the internal consistency of the indicators that make up a latent construct. Presented by Hair et al., (2017) as more accurate than Cronbach's alpha, especially in PLS-SEM models, as it considers the factor loadings of the indicators.

Values between 0.7 and 0.95 for composite reliability indicate good reliability, values below 0.7 suggest low internal consistency, and values above 0.95 may indicate excessive redundancy among the indicators (Henseler et al., 2016). Therefore, composite reliability values within the appropriate range conclude that the construct is measured reliably. Table 20 presents the composite reliability indicators for the proposed model.

I also analyzed convergent validity (AVE) to measure the amount of variance that a latent construct explains in its indicators. A high AVE indicates that the indicators are strongly related to the construct they are intended to measure (Fornell & Larcker, 1981). An AVE result ≥ 0.5 indicates that at least 50% of the variance of the indicators is explained by the construct.

An AVE < 0.5 suggests that more than half of the variance of the indicators is not explained by the construct, indicating the need to revise or replace the indicators.

Similarly, I analyzed discriminant validity by verifying whether a construct is truly distinct from other constructs in the model. This ensures that the indicators of one construct do not measure something that belongs to another construct (Henseler et al., 2015).

Table 20
Statistical significance indicators of the proposed model

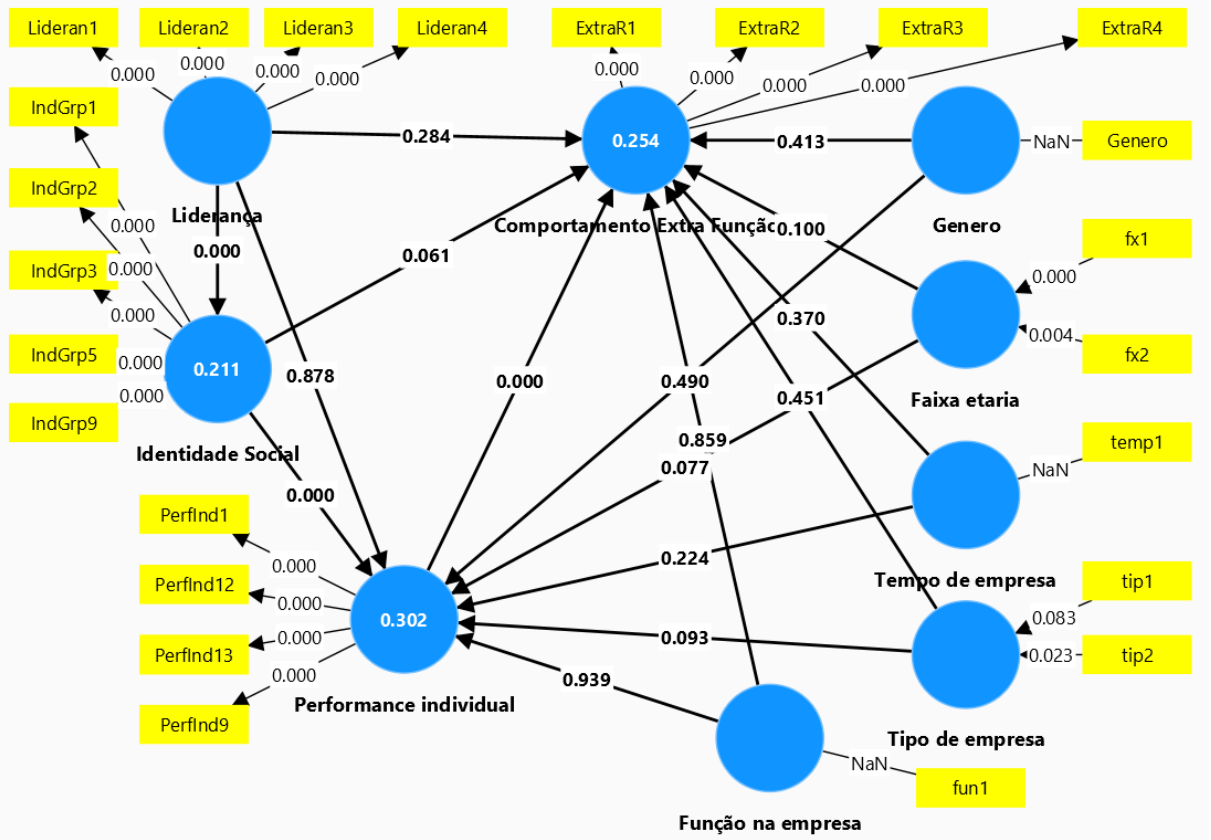
Variables	Cronbach's alpha	Composite reliability	Average variance extracted (AVE)
Comportamento Extra Função	0.701	0.815	0.524
Identidade Social	0.782	0.851	0.534
Liderança	0.885	0.920	0.743
Performance individual	0.668	0.800	0.502

Source: author with SmartPLS4®

The next step will be to evaluate the structural model, verifying its theoretical and predictive adequacy for the relationships between the latent variables in the model. Hair et al. (2017) show that while the measurement model ensures that the latent constructs are well defined, the structural model tests the hypotheses and assesses the strength, significance, and relevance of the proposed relationships.

I begin with the path coefficients, which can measure the strength and direction of the relationships between the latent variables (exogenous and endogenous). Essential for testing the proposed hypotheses and assessing whether the exogenous variables have a significant impact on the endogenous variables (Hair et al., 2017), they confirm or reject hypotheses about the theoretical relationships in the model. They indicate how much a predictor variable contributes to the explanation of a dependent variable, showing whether the relationship is positive or negative, in addition to assessing whether the observed relationship is statistically relevant and not the result of random variation. In the SmartPLS4 application Iwill search for the path coefficients through the bootstrapping test, figure 19 presents the diagram of the proposed model, with the indexes.

Figure 19
Bootstrapping indices for the proposed model



Source: author with SmartPLS4®

Table 21 presents the relationship of the bootstrapping indexes, where I highlight the strongest relationships.

Table 21
Bootstrapping indices for the proposed model

Strong and meaningful relationships	Original sample (O)	Sample mean (M)	Standard dev. (STDEV)	T statistics (|O/STDEV|)	P values
Faixa etaria -> Comportamento Extra Função	-0.146	-0.139	0.089	1.647	0.100
Faixa etaria -> Performance individual	-0.147	-0.142	0.085	1.771	0.077
Função na empresa -> Comportamento Extra Função	-0.148	-0.008	0.067	0.177	0.859
Função na empresa -> Performance individual	-0.149	0.011	0.064	0.076	0.939
Genero -> Comportamento Extra Função	-0.150	-0.048	0.065	0.818	0.413
Genero -> Performance individual	-0.151	-0.040	0.068	0.691	0.490
Identidade Social -> Comportamento Extra Função	-0.152	0.170	0.088	1.874	0.061
Identidade Social -> Performance individual	-0.153	0.527	0.061	8.642	0.000
Liderança -> Comportamento Extra Função	-0.154	-0.083	0.079	1.071	0.284
Liderança -> Identidade Social	-0.155	0.465	0.065	7.067	0.000
Liderança -> Performance individual	-0.156	-0.012	0.082	0.153	0.878
Performance individual -> Comportamento Extra Fun	-0.157	0.387	0.072	5.275	0.000
Tempo de empresa -> Comportamento Extra Função	-0.158	0.065	0.075	0.897	0.370
Tempo de empresa -> Performance individual	-0.159	0.069	0.064	1.216	0.224
Tipo de empresa -> Comportamento Extra Função	-0.160	0.065	0.103	0.754	0.451
Tipo de empresa -> Performance individual	-0.161	0.110	0.075	1.680	0.093

Source: author with SmartPLS4®

Table 22 presents an interpretation of the bootstrapping analysis, showing which inferences are highlighted:

Table 22
Interpretation of bootstrapping analysis

Relationships	Coeficiente (O)	Significância (p ≤ 0,05)	Interpretação
Identidade Social → Performance Individual	**0,523**	**Sim**	**Forte relação positiva e significativa.**
Liderança → Identidade Social	**0,46**	**Sim**	**Forte relação positiva e significativa.**
Performance Individual → Comportamento Extra Fun	**0,381**	**Sim**	**Moderada relação positiva e significativa.**
Identidade Social → Comportamento Extra Função	0,166	Não	Quase significativa, tendência positiva.
Liderança → Comportamento Extra Função	-0,084	Não	Não significativa, relação inversa fraca.
Faixa Etária → Comportamento Extra Função	-0,146	Não	Não significativa, relação inversa moderada.

Source: author with SmartPLS4®

The Coefficient of Determination (R^2) measures the proportion of the variance of the dependent (endogenous) variable that is explained by the independent (exogenous) variables in the model. In other words, it assesses the explanatory power of the structural model, where a higher R^2 indicates that the independent variables better explain the changes in the dependent variable. It allows comparing the performance of different models to explain the same dependent variable, and according to Hair et al. (2017), a high R^2 supports the theoretical relevance of the model.

For $R^2 = 0$: The independent variables do not explain any variation in the dependent variable, and for $R^2 = 1$: The independent variables explain 100% of the variation in the dependent variable. According to Cohen, (1988) I have the effects of R^2, where $R^2 \geq 0.26$: substantial effect, between $0.13 \leq R^2 < 0.26$: moderate effect, between $0.02 \leq R^2 < 0.13$: weak effect, and $R^2 < 0.02$: insignificant effect. Table 23 presents the R^2 coefficients for the sample of this research.

Table 23
Coefficient of Determination (R^2)

Variables	R-square	R-square adjusted
Comportamento Extra Função	0.254	0.222
Identidade Social	0.211	0.207
Performance individual	0.302	0.276

Source: author with SmartPLS

Interpreting Table 23, I can state that 25.4% of the variance of Extra-Role Behavior is explained by the independent variables in the model, a moderate effect, indicating that the model has good explanatory power (Cohen, 1988). Similarly, I can state that 21.1% of the variance of Social Identity is explained by the independent variables in the model, an explanatory power considered moderate to weak.

Finally, 30.2% of the variance of Individual Performance is explained by the independent variables, with the highest R^2 among the dependent variables considered substantial, according to Cohen (1988). This suggests that the model captures the factors that influence Individual Performance well. I can then infer some practical implications of our proposal:

1. Extra-Role Behavior: The model explains Extra-Role Behavior reasonably well, but other variables, such as moderators or mediators, could be explored to increase the R^2.

2. Social Identity: The moderate R^2 suggests that Social Identity may be influenced by factors not yet captured in the model, which provides an opportunity to include additional variables in the future.

3. Individual Performance: This result suggests that the model is robust in explaining Individual Performance, strengthening its theoretical and practical relevance.

5.4.3.1 – Relating statistical results to proposed hypotheses

Table 24 presents possible statements based on the analysis of the data from this research:

Table 24
Evaluation of the proposed structural model

	Hypotheses	Path coefficient	T-Test	P values	R^2	Results
H1	The **Identity Leadership Inventory (ILI)** has a positive relationship with the **social identity** of the virtual project team.	0,460	7,067	0,000	0,211	Supported
H2	The **Identity Leadership Inventory (ILI)** has a positive relationship with the **extra-role behavior** of the virtual project team.	-0,084	Not significant	0,284	0,254	Not supported
H3	**Social identity** has a positive relationship with the **individual performance** of members of virtual project teams.	0,523	8,642	0,000	0,302	Supported
H4	**Social identity** has a positive relationship with the **extra-role behavior** of the virtual project team.	0,166	Not significant	0,061	0,254	Not supported
H5	The **Identity Leadership Inventory (ILI)** has a positive relationship with the **individual performance** of the virtual project team.	-0,013	7,067	0,000	0,302	Not supported
H6	The **individual performance** has a positive relationship with the **extra-role behavior** of the virtual project team.	0,381	5,275	0,000	0,254	Supported

Source: Author

H1: The Identity Leadership Inventory (ILI) has a positive relationship with the social identity of the virtual project team.

The data confirms that the Identity Leadership Inventory (ILI) positively relates to Social Identity. Practically, this means that leaders who exercise identity-based leadership practices (promoting cohesion and a sense of belonging) contribute significantly to strengthening the team's social identity.

The result supports leadership theories highlighting the importance of practices reinforcing social identity in virtual teams. Previous studies suggest that a robust social identity in teams improves collaboration and performance, which can be explored in future studies.

H2: The Identity Leadership Inventory (ILI) has a positive relationship with the extra-role behavior of the virtual project team.

The negative path coefficient (-0.084) indicates that ILI has a weak and inverse relationship with extra-role behavior, contradicting hypothesis H2. This result suggests that identity-based leadership does not directly impact (or negatively impacts) extra-role behaviors in the sample studied.

I have a t-value = 1.071 lower than 1.96, indicating that the relationship is not statistically significant, and a P-Value = 0.284 higher than 0.05, confirming the lack of statistical significance, so hypothesis H2 is not supported by the data. This suggests that ILI, alone, is not a determining factor in promoting extra-role behaviors in virtual project teams.

H3: Social identity has a positive relationship with the individual performance of members of virtual project teams.

The positive path coefficient (0.523) confirms a direct and strong relationship between social identity and individual performance. This supports the hypothesis that members of virtual teams with a more robust social identity have better individual performance. I support this statement based on the p-value (0.000) and t-statistic (8.642) indices; the results indicate this relationship is highly significant. The probability that this relationship is the result of chance is practically zero.

Therefore, hypothesis H3 is supported by the data. Social identity has a positive, strong, and significant impact on individual performance. Another inference is that having an R^2 of individual performance (0.302) suggests that the model captures a substantial proportion of the variance in individual performance. This indicates that social identity, among other independent variables, is a determining factor for performance.

The presence of a solid social identity in virtual teams can motivate members to work more efficiently and effectively, contributing directly to individual performance.

H4: Social identity has a positive relationship with the extra-role behavior of the virtual project team.

The path coefficient (0.166) indicates a weak positive relationship between social identity and extra-role behavior. Similarly, the relationship is not statistically significant, as the t-value (1.851) is below the 1.96 threshold, and the p-value (0.061) is slightly above the 0.05 significance level. These results suggest that social identity alone does not have a direct impact on extra-role behaviors within the virtual project teams analyzed in this study.

H5: The Identity Leadership Inventory (ILI) has a positive relationship with the individual performance of the virtual project team.

The negative path coefficient (-0.013) shows a fragile and practically non-existent relationship between Leadership (ILI) and Individual Performance. The relationship is inverse, but the value is close to zero, suggesting that the direct influence of leadership on individual performance was not identified in the sample.

The sample does not support hypothesis H5. There is no statistical evidence to state that the Identity Leadership Inventory (ILI) has a positive relationship with the Individual Performance of the virtual project team.

H6: The individual performance has a positive relationship with the extra-role behavior of the virtual project team.

By noticing that the path coefficient (0,381) is positive and moderate, I can confirm a direct relationship between individual performance and extra-role behavior. Thus, as individual performance improves, extra-role behavior also tends to increase. I also find that this relationship is highly significant, based on the p-values (0,000) and t-test (5,275), supporting our hypothesis. The R^2 of 0,254 suggests that the independent variables in the model explain a reasonable portion of the variance in extra-role behavior. Individual performance appears to be one of the main predictors.

Individual performance has a positive and significant relationship with extra-role behavior, indicating that better-performing members are more likely to engage in voluntary behaviors that benefit the team. Virtual teams that encourage high individual performance may see an increase in extra-role behaviors, such as mutual aid, volunteering for additional tasks, and proactive behaviors. Individual performance appears to be an essential lever for improving overall team collaboration.

5.5 DISCUSSION

The results of the field research provide robust evidence to support hypotheses H1, H3, and H6, revealing important insights into the relationship between identity-based leadership, social identity, individual performance, and extra-role behavior in virtual project teams. Our results show that identity-based leadership (Identity Leadership Inventory ILI) has a positive and significant relationship with virtual team social identity (coefficient = 0.460; $p < 0.001$). This finding aligns with the theory of leadership as social identity (Haslam et al., 2011), where effective leaders reinforce the shared identity of team members.

In virtual teams, where physical interaction is limited, constructing a collective identity is even more critical (Van Knippenberg et al., 2004; Gilson et al., 2021). Haslam et al. (2011, p. 42) asks, “But what is the meaning of leaders, anyway?” This research shows that this issue is also valid for virtual team leaders, and Igo further by contributing by showing that there is a positive relationship between leadership in virtual teams and social identity.

Similarly, social identity and individual performance (coefficient = 0.523; $p < 0.001$) reinforce the central role of collective identity in promoting superior individual results. For Tajfel

and Turner (1986), internalizing a strong social identity motivates members to align their behaviors with the group's goals. Thus, I connect the literature that links social identity to performance indicators, including productivity and engagement (Van Dick et al., 2008).

The confirmation that individual performance positively influences extra-role behavior (coefficient = 0.381; $p < 0.001$) is in line with theories of organizational behavior (Organ, 1997), indicating that more productive individuals are more likely to engage in voluntary actions, benefiting the group. In the context of virtual teams, Gilson et al. (2021) show that individual behaviors, such as helping colleagues and contributing beyond formal responsibilities, are essential for collective success. The novelty of this study lies in the identification of this relationship in a virtual environment. While the existing literature emphasizes extra-role behaviors in face-to-face contexts, this work shows that individual performance maintains this relationship, even when mediated by technological barriers.

I suggest that leaders in virtual teams should focus on performance and promoting interactions that stimulate spontaneous collaborative behaviors. I also realize that our rejected hypotheses contribute to advancing knowledge about social relationships in virtual project teams. I suggest that leaders who use identity-based leadership strategies directly influence extra-role behaviors (H2). However, studies indicate that altruism and interpersonal helping often emerge from contextual and interpersonal factors, such as work engagement and perceived team support (Organ, 1997; Gilson et al., 2021). In virtual teams, the absence of face-to-face interactions may limit the leader's ability to inspire such behaviors directly.

This result explains that the impact of identity-based leadership on extra-role behaviors may be indirect, perhaps mediated by variables such as social identity or perceived organizational support. This reinforces the need to investigate more complex pathways in the relationship between leadership and interpersonal behaviors in virtual teams.

H4 (not accepted) assumes that a strong social identity within the virtual team would directly lead to high extra-role behaviors. However, Van Dick et al. (2008) argue that the strength of social identity may not be sufficient to generate such behaviors, especially in contexts were distance and technology limit spontaneous interaction. Another reason, now pointed out by Ashforth and Mael (1989), would be the social identity theory that, although group identity is an important prerequisite, it needs to be complemented by factors such as a culture of collaboration and effective communication for extra-role behaviors to manifest fully.

I assume that leaders who use identity-based leadership strategies directly impact individual performance (H5); field research has not confirmed our claim. To understand this lack of acceptance, I found guidelines from Deci and Ryan (1985) that point out that individual performance is often influenced by a combination of factors, including job autonomy,

organizational resources, and intrinsic motivation. In virtual teams, where the focus is on self-discipline and individual management, the direct influence of the leader may be less pronounced. Identity-based leadership can have a significant impact at collective levels (such as social identity). However, its direct effect on individual outcomes may be mediated by factors such as work engagement or job satisfaction (Steffens et al., 2014).

By examining the rejected hypotheses, I intuited the need to explore more complex models, perhaps including mediating and moderating variables, to better understand how social interactions in virtual teams influence individual and collective behaviors. Researching work engagement in virtual teams with their distinct characteristics will increase our understanding of the relationship between identity-based leadership and extra-role behaviors. Another suggestion would be to see whether social identity can mediate the relationship between leadership and individual performance.

Although the hypotheses were not supported, they highlight essential gaps in the literature on social interactions in virtual project teams. The result points to the need for more sophisticated theoretical models integrating multiple layers of influence (individual, organizational, and technological). Original research can advance by exploring how mediators and moderators explain these complex relationships, contributing to a more comprehensive understanding of the role of leadership, social identity, and interpersonal behaviors in virtual environments.

5.6 FINAL REMARKS

This research investigated the relationship between social identity and leadership in virtual teams, highlighting how these elements influence project dynamics and results. With the following research question: "What is the relationship between leadership and social identity in virtual project teams?", I adopted structural equation modeling (PLS-SEM) and analyzed 194 useful responses from a questionnaire applied to members of project teams with virtual or hybrid interactions.

The results revealed that identity-based leadership (ILI) plays a crucial role in the formation of social identity in virtual teams, which, in turn, positively influences individual performance and, to a lesser extent, extra-role behavior. Although direct relationships between leadership and individual performance, as well as between leadership and extra-role behavior, have not been confirmed, the indirect impact of leadership on the construction of a strong social identity stands out as an essential factor in overcoming typical challenges in virtual environments.

The validated theoretical model presents relevant practical implications for managers and leaders of virtual teams. Strategies such as promoting shared values, establishing clear communication mechanisms, and using technologies that foster social presence can significantly improve cohesion and engagement. This study also suggests that organizations prioritize the development of leaders capable of reinforcing collective identities, using practices such as communicating clear objectives, recognizing individual contributions, and promoting meaningful interactions.

However, some limitations should be considered. The analysis was based exclusively on self-administered questionnaires, which are subject to response bias, which limits the generalization of the results. The absence of longitudinal measures prevents the analysis of behavioral changes over time. Another obstacle was that the research was conducted at a single point in time (cross-sectional), making it impossible to analyze changes or evolution of behaviors over time. Although we know that the scales used were originally developed for face-to-face contexts and adapted to the virtual environment, this may have introduced limitations in the validity of the instruments in exclusively virtual contexts.

Another notable limitation is the use of the "leadership" construct as an overarching construct without distinguishing between its different types and approaches, such as transformational, transactional, or servant leadership. While this decision was made to maintain the parsimony of the model and the focus on the relationship between leadership and social identity, it may overlook the nuanced ways in which specific leadership styles influence team dynamics in virtual environments. Future studies can address this limitation by exploring how distinct leadership styles interact with team processes and outcomes, providing a more comprehensive understanding of the role of leadership in virtual project teams. Future studies could explore qualitative approaches, such as interviews and case studies, to deepen the understanding of social dynamics in virtual teams. Longitudinal analyses would also be valuable to investigate the evolution of social identity and cohesion throughout the life cycle of projects. Finally, there is room to examine the impact of mediating and moderating variables, such as engagement and organizational culture, as well as to replicate the study in different cultural and organizational contexts.

Advances in artificial intelligence (AI) offer significant opportunities to enhance social interactions in virtual teams. Tools like virtual assistants and behavior analysis algorithms can monitor team dynamics, identify conflicts, and provide real-time feedback to improve collaboration. AI-driven synchronous tools, such as chatbots and virtual facilitators, simulate face-to-face interactions, fostering trust and cohesion. Asynchronous tools, like sentiment analysis or task prioritization, help align individual contributions with team goals while

promoting a sense of belonging. These innovations have the potential to transform the cultivation of social identity into virtual environments, bridging gaps caused by physical distance and technological barriers. This study contributes significantly to the field of virtual teams, highlighting the importance of the human dimension in the management of dispersed teams and presenting solid foundations for future research and practical applications.

6. TECHNOLOGICAL TECHNICAL PRODUCT

PROPOSAL FOR DIAGNOSING SOCIAL INTERACTIONS IN VIRTUAL PROJECT TEAMS

6.1 INTRODUCTION

The growing adoption of virtual and hybrid teams in projects reflects the transformations of the global market, driven by digitalization and the need for organizational flexibility (Cascio & Shurygailo, 2008; Wijaya et al., 2023). These teams, formed by geographically dispersed individuals and interconnected by digital technologies, offer benefits such as cost reduction, increased productivity, and access to diverse talent (Alkoud & Qatamin, 2023; Blak Bernat et al., 2023).

The third study supports the development of a technical-technological product by highlighting the crucial role of identity-based leadership in building social identity in virtual teams, essential factors for performance and extra-role behaviors (Haslam et al., 2011; Van Knippenberg et al., 2004). Based on these findings, the product can include tools to diagnose social identity, training modules for leaders and scientifically validated monitoring metrics. In addition, suggested practices, such as the promotion of shared values and the use of technologies that foster social presence, can be operationalized to mitigate the challenges of virtuality (Ala-Kortesmaa & Muñoz, 2023; Gilson et al., 2015), offering practical, evidence-based solutions.

However, they present unique challenges related to building cohesion, trust, and social identity, which are essential for project performance and success (O'Brien & Costin, 2022; Edmondson, 2019). Diagnosing the dynamics of these teams becomes essential to understanding how factors such as leadership, social interactions, and cohesion affect the effectiveness and behavior of members (Becker, 2021; Grynchenko et al., 2018). This analysis not only provides support for the strategic management of virtual teams, but also contributes to theoretical advancement in the field of social interactions and leadership in the virtual context.

Social interactions play a central role in the performance and effectiveness of virtual teams, even in environments where communication is mediated by technology. According to Putra and Sari (2022), social interactions represent dynamic relationships that connect individuals and groups and are essential for the exchange of information and the strengthening of interpersonal bonds.

These interactions, when well conducted, promote trust, cohesion and social identity, critical elements for overcoming challenges inherent to virtual work, such as the lack of nonverbal cues and cultural differences (Swart et al., 2022; Ala-Kortesmaa & Muñoz, 2023).

Furthermore, the presence of positive social interactions can mitigate the effects of geographic and temporal dispersion, strengthening collaboration and problem-solving capacity (Edmondson, 2019; O'Brien & Costin, 2022). Thus, understanding and measuring how these interactions occur in virtual teams not only helps to improve performance, but also favors the creation of more inclusive and motivating environments (Blak Bernat et al., 2023; Becker, 2021).

Despite the growing body of research on virtual teams, there are still significant gaps related to the structured assessment of the dynamics that influence the performance and cohesion of these teams. Although previous studies have highlighted the importance of transformational leadership, social identity, and cohesion as determinants of success in virtual teams (Becker, 2021; Wijaya et al., 2023), there is a lack of practical tools that diagnose these dimensions in an integrated manner and adapted to the virtual context. This diagnostic aims to fill this gap by measuring fundamental factors identified in our thesis, such as leadership, social identity, extra-role behavior, and individual performance. By assessing these dimensions based on validated scales adapted to the virtual environment, we seek to provide both theoretical and practical insights, allowing leaders and managers to develop more effective strategies to improve social interaction and engagement in virtual and hybrid teams.

The proposed diagnostic will be operationalized through the application of a structured questionnaire, using validated scales that measure the main dimensions of social interactions in virtual and hybrid teams. The factors to be assessed include transformational leadership, social identity, team cohesion, extra-role behavior, and individual performance, totaling five core dimensions. These factors will be analyzed using advanced statistical tools, such as structural equation modeling (SEM), allowing us to understand the causal relationships between variables and identify the main points of attention for improving team performance. The application will be carried out digitally, ensuring accessibility for geographically dispersed teams, with results consolidated in automatic reports that provide practical feedback for managers and leaders.

6.2 THEORETICAL FRAMEWORK

6.2.1 Social interactions in virtual teams.

Social interactions are a central area of study in the social and organizational sciences, with roots in classical theories that explore how interpersonal relationships shape human behavior. Piaget (1973) highlighted the importance of reciprocity and information exchange as foundations for the development of knowledge, while Tajfel (1972) introduced the concept of social identity, emphasizing the role of social categories and group interactions in the formation of self-concept.

These theoretical foundations were later adapted to the organizational context, with Granovetter (1973) arguing that the strength of social connections, even in weaker networks, can have significant impacts on information exchange and group performance. However, these seminal studies focused predominantly on co-located teams, failing to anticipate the challenges and specificities of interactions in virtual environments.

With the advancement of communication technologies and the emergence of virtual teams, academia has begun to revisit these theories considering technology-mediated dynamics. Jarvenpaa and Leidner (2006) pioneered the exploration of how trust and communication impact cohesion in geographically dispersed teams, highlighting the difficulties in replicating the benefits of face-to-face interactions in a virtual environment. More recently, Edmondson (2019) highlighted the importance of psychological safety in fostering collaboration and innovation in teams that rely on digital technologies.

Contemporary studies, such as those by Wijaya et al. (2023), Ala-Kortesmaa and Muñoz (2023), have consolidated the state of the art by demonstrating that factors such as transformational leadership, social identity, and cohesion play crucial roles in overcoming the challenges imposed by virtuality. Even so, the literature continues to point out gaps related to the accurate measurement of these dynamics and the implementation of practices that favor positive social interactions in virtual and hybrid teams.

6.2.2 Leadership in virtual teams

Leadership has been recognized as a critical factor in team performance and has been widely studied since the classic models of situational and transformational leadership. Bass (1985) introduced the concept of transformational leadership, which emphasizes the ability of leaders to inspire, motivate, and promote a sense of collective purpose, elements that are especially relevant for dispersed teams. In virtual contexts, Jarvenpaa and Leidner (1999) highlighted that building trust and establishing clear and consistent communication are central challenges for leaders, given that the absence of face-to-face interactions can hinder member cohesion and engagement. These early studies laid the foundation for the investigation of leadership in digital environments, highlighting both its opportunities and limitations.

However, despite the advancement of knowledge, significant gaps remain. Recent studies, such as those by O'Brien and Costin (2022) and Wijaya et al. (2023), highlight the lack of clarity about which leadership styles are most effective in virtual teams and how to adapt traditional practices to the specificities of technology-mediated communication. Wengel (2022) reinforces the need to understand how leaders can promote a sense of social identity in dispersed teams, a fundamental element for group cohesion and effectiveness. Furthermore, little is known

about the impact of leadership on the development of extra-role behaviors in virtual environments, a field that, according to Weerawardane and Jayawardana (2022), still lacks robust empirical studies. These gaps highlight the urgency of research that explores the dynamics of leadership in virtual teams and offers practical tools to improve their effectiveness.

6.2.3 Social identity in virtual teams

Social identity theory, introduced by Tajfel (1972), proposes that individuals construct part of their self-concept based on their perception of belonging to social groups. This identification, based on processes of categorization, social comparison, and internalization of group values, is essential to foster cohesion, collaboration, and alignment in teams. In the organizational context, Ashforth and Mael (1989) adapted the theory to understand how the sense of group identity influences behavior in work teams. These authors highlighted that teams with high social identification tend to be more effective, due to the strengthening of interpersonal ties and increased motivation to achieve common goals.

In virtual project teams, building and maintaining a strong social identity faces additional challenges due to the lack of face-to-face interactions and the geographical dispersion of members. Mattarelli et al. (2017) demonstrated that social identity in virtual teams is built from the interaction between technological capabilities and social practices and is influenced by leadership style and clarity of shared goals. Contemporary studies, such as those by O'Brien and Costin (2022), suggest that fostering a social identity in dispersed project teams requires active efforts by leaders to create spaces for interpersonal exchange and strengthen the sense of belonging. However, gaps persist in the literature regarding the accurate measurement of social identity in virtual teams and the impact of different communication technologies on this process, pointing to the need for more empirical investigations in this field.

6.2.4 Individual performance in virtual teams.

Individual performance is a central element for the success of project teams, especially in virtual contexts, where geographic dispersion can make it difficult to assess and manage performance. Hackman (2002) highlighted that the performance of individual members is influenced by factors such as role clarity, alignment with organizational goals, and support received within the team. In the virtual context, these factors are intensified by the need for autonomy and self-regulation, but also by the importance of social interactions and manager-led support. More recent studies, such as that by Wijaya et al. (2023), show that transformational leadership is an essential catalyst for individual performance, as it fosters motivation, trust, and

engagement, promoting an environment of mutual support that facilitates overcoming the challenges of virtuality.

Social identity, in turn, plays a complementary role by reinforcing the sense of belonging and alignment among team members, factors that are directly associated with improved individual performance. According to Tajfel (1972), identification with the group motivates members to dedicate themselves more intensely to shared goals, while Chaudhary et al. (2022) highlights that teams with a high level of cohesion and social identity are more likely to exhibit extra-role behaviors, such as spontaneous collaboration and the willingness to take on additional responsibilities. In virtual project teams, this dynamic is even more critical, as the absence of face-to-face interactions can weaken these ties, requiring leaders to implement proactive strategies to reinforce social identity and, consequently, improve individual performance (Becker, 2021; O'Brien & Costin, 2022). Despite advances, a significant gap remains in the literature on how to integrate leadership and social identity to optimize individual performance in virtual team environments, pointing to the need for more empirical studies and theoretical developments.

6.2.5 Extra-role behavior in virtual teams

Extra-role behavior, defined as voluntary actions that go beyond an individual's formal responsibilities, has been recognized as a crucial factor for the success of project teams. Organ (1988) introduced the concept of organizational citizenship behavior (OCB) to describe such behaviors, highlighting that they contribute to the collaborative environment and the achievement of collective goals. In virtual project teams, where interdependence is mediated by technology, these behaviors are even more valued, as they help to overcome the challenges of geographic and cultural dispersion (Chaudhary et al., 2022).

Leadership plays a central role in fostering extra-role behavior. Transformational leaders, by inspiring trust and alignment with organizational goals, create an environment that encourages team members to engage in actions beyond their assigned roles (Becker, 2021). Furthermore, building a strong social identity within the team is essential to fostering these behaviors. Tajfel (1972) argues that when team members identify strongly with the group, they are more willing to contribute proactively, taking on additional responsibilities, and collaborating spontaneously. In virtual teams, studies such as Wijaya et al. (2023) show that the integration of effective leadership and social identity strengthens group cohesion, creating the necessary conditions for extra-role behavior.

Extra-role behavior is also intrinsically linked to individual performance, as individuals who engage in volunteer actions often demonstrate greater commitment and productivity in their

main roles. According to Norhanim and Nas'aiman (2019), a work environment characterized by trust, mutual support, and shared goals enhances the willingness of team members to contribute beyond what is expected. However, literature still presents gaps in measuring these behaviors and in understanding how variables such as leadership, social identity, and individual performance interact to promote them consistently in project teams, especially in virtual and hybrid environments (O'Brien & Costin, 2022; Chaudhary et al., 2022).

6.3 DIAGNOSTIC METHOD

The diagnosis of critical factors influencing the performance of virtual teams will be carried out using a structured instrument, based on validated questionnaires adapted to the virtual context. This instrument will allow the assessment of five main dimensions: leadership, social identity, extra-role behavior, individual performance and team cohesion. The proposed methodology combines the use of scales already established in literature with advanced statistical techniques for data analysis and interpretation.

Definition of Indicators and Construction of the Questionnaire

Transformational Leadership: Assessed using the ILI Scale (Identity Leadership Inventory), measuring the leader's ability to build and reinforce the group's social identity. The scale includes dimensions such as: group representation, promotion of collective goals, creation of group identity and empowerment of team members.

Social Identity: Use of scales based on Tajfel's social identity theory (1972), measuring the level of belonging and alignment of team members.

Extra-Functional Behavior: Assessment based on scales of organizational citizenship behavior (OCB), such as altruism and volunteerism.

Individual Performance: Scales that capture perception of productivity and achievement of personal goals, aligned with team objectives.

Team Cohesion: Measurement of trust and interdependence through scales specific to virtual environments.

6.4 DATA COLLECTION

The questionnaires will be administered digitally, using secure and accessible platforms, allowing members of dispersed teams to complete the items remotely. The questionnaire will include clear instructions on confidentiality and anonymity.

6.5 DATA ANALYSIS

The analysis will be performed using structural equation modeling (SEM), using software such as SmartPLS. This approach will allow us to identify causal relationships between factors, assessing the impact of leadership and social identity on individual performance and extra-role behavior.

6.6 REPORTS

The results will be consolidated into graphic and textual reports that provide practical insights for managers. For example:

Leadership and cohesion maps, highlighting areas for improvement.

Engagement and extra-role behavior indicators, suggesting intervention strategies.

6.7 FEEDBACK AND SUGGESTIONS FOR IMPROVEMENTS

Reports will be used to guide specific actions, such as training for leaders, initiatives to strengthen social identity, and practices to foster extra-role behavior. The tool will also allow for periodic diagnostics, enabling the monitoring of team progress.

We expect the following benefits:

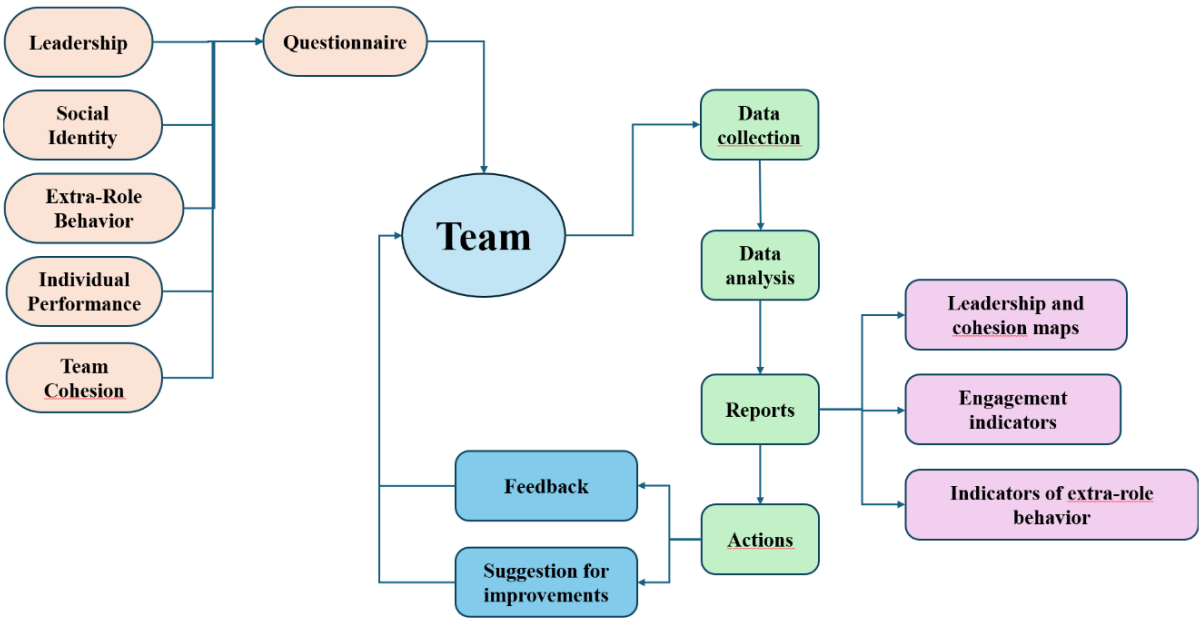
Data-Based Management: Accurate information for strategic decisions.

Improvement of Dynamics: Identification of gaps and potential in social interactions.

Sustained Engagement: Strengthening alignment and collaboration in virtual teams.

6.8 SCHEMATIC DIAGRAM OF THE STRUCTURE OF THE TECHNICAL-TECHNOLOGICAL PRODUCT

Figure 20
Schematic diagram of the structure of the technological technical product



Source: Author

6.8 FINAL REMARKS

The growing prevalence of virtual and hybrid teams in the modern organizational landscape requires innovative approaches to diagnose and improve their dynamics. This study presented a structured proposal to assess five critical factors that impact the performance of these teams: transformational leadership, social identity, extra-role behavior, individual performance, and team cohesion. By applying the ILI Scale to measure leadership, in addition to validated scales for the other factors, the diagnosis will allow a detailed and integrated analysis of social interactions, offering robust insights for the effective management of dispersed teams. This approach, based on consolidated theories and empirical methods, aims not only to contribute to the advancement of academic knowledge, but also to organizational practice, promoting more aligned, cohesive, and productive teams.

Additionally, the application of the proposed methodology has the potential to fill critical gaps in literature, especially regarding the integration of leadership and social identity as key elements to optimize individual performance and extra-role behavior. By offering a practical and replicable tool, this research provides a clear path for managers and project leaders to address the unique challenges of virtual work. However, it is important to emphasize that the diagnostic

described here is only a starting point. Future research can expand this approach by incorporating contextual variables and exploring the impact of specific interventions, reinforcing the role of social interactions as a foundation for success in virtual and hybrid environments.

7. CONCLUSION OF THE THESIS

This thesis explored social interactions and social identity in virtual project teams, investigating the challenges and opportunities present in this constantly evolving context. The research started with the central question: how does leadership relate to the construction of social identity in virtual project teams?. To answer this question, three complementary studies were conducted that employed robust and integrated methodological approaches.

In the first study, a systematic literature review was used to map the state of the art on social interactions in virtual teams, identifying gaps and emerging trends. This survey allowed us to understand the main factors that influence social dynamics, such as social identity, psychological safety and knowledge sharing.

The second study addressed the measurement of social interactions in virtual teams through an integrative literature review. This effort consolidated scales and instruments used in previous research, offering an overview of the methods applied and highlighting the need for adaptation to the specificities of virtual teams, especially with regard to the construction of a shared identity.

Finally, the third study used structural equation modeling to empirically investigate the relationships between leadership, social identity, and extra-role behaviors in virtual teams. The results indicated that transformational leadership plays a crucial role in fostering a sense of shared identity, positively impacting member performance and engagement.

As a summary, this thesis contributes to both practice and theory. From a practical perspective, it offers recommendations for managers and leaders on how to foster cohesion and engagement in virtual teams. Theoretically, it advances the understanding of the dynamics of leadership and social identity, in addition to proposing innovative methodological approaches for the study of dispersed teams.

At a time when the virtualization of teams is increasingly common, this research reinforces the importance of fostering meaningful social interactions and adaptive leadership. Thus, it is expected that the results presented will serve as a basis for further research and practices that strengthen the effectiveness of virtual teams in a globalized and technologically mediated scenario.

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Anexo A – Questionário

Bem-vindo ao Meu questionário

Prezado respondente, muito grato pela sua atenção e pelo seu tempo em responder este questionário que é parte essencial de um projeto de tese profissional no programa de Pós-Graduação em Gestão de Projetos da Universidade Nove de Julho - UNINOVE.

A cada questionário respondido e válido, iremos depositar R$ 1,00 como doação para a instituição GRAACC (graacc.org.br), o primeiro depósito será efetuado quando atingirmos cem questionários respondidos. Iremos publicar o comprovante de depósito nas redes sociais ou enviaremos a pedido dos participantes em seus e-mails.

* 1.

Projetos são um esforço temporário empreendido para criar um produto, serviço ou resultado exclusivo. Possuem início e fim definidos, com objetivo de alcançar resultados específicos.

Sabendo disso, nos últimos 24 meses você esteve trabalhando em algum projeto?

◯ Sim ◯ Não

* 2. **Qual o seu gênero?**

◯ Feminino ◯ Masculino ◯ Outro ◯ Prefiro não declarar

* 3. **Qual a sua idade?**

◯ Até 20 anos ◯ 21 a 30 anos ◯ 31 a 40 anos ◯ 41 a 50 anos ◯ 51 a 60 anos
◯ Acima de 61 anos

* 4. **Qual a sua formação acadêmica?**

◯ Fundamental completo ◯ Universitário completo ◯ Especialização, Latu Sensu, completo
◯ Mestrado, Stricto Sensu, completo ◯ Doutorado, Stricto Sensu, completo

* 5. **Há quanto tempo você tem envolvimento com projetos?**

◯ Até 5 anos ◯ Entre 5 e 10 anos ◯ Entre 10 e 20 anos ◯ Entre 20 e 30 anos
◯ Acima de 30 anos

* 6.

Pense sempre na última equipe de projetos que você participou.

Descreva este projeto que você pensou com uma palavra.

* 7. Quantos meses já se passaram desde a finalização deste projeto? (Preencha 0 caso o projeto esteja em andamento)

* 8. **A empresa onde sua equipe estava inserida:**

- ◯ Vive de vender projetos a clientes
- ◯ Contrata projetos de forma constante, sempre há projetos em andamento
- ◯ Contrata projetos de forma esporádica, de acordo com a necessidade

* 9. **Qual foi a sua relação com o projeto em questão?**

- ◯ Membro da equipe de projetos
- ◯ Diretor, gerente, coordenador, lider de projetos
- ◯ Cliente, patrocinador de projetos

* 10. **No projeto em que você pensou, sua equipe de projetos era:**

- ◯ Presencial, a interação entre os membros era fisicamente em um local especifico, o tempo todo
- ◯ Híbrida, a interação era tanto presencialmente quanto remotamente
- ◯ Virtual, a interação era remotamente o tempo todo

Lembrando sempre do projeto que você deu nome:

* 11. **Responda a cada afirmação abaixo marcando o que melhor reflete seu grau de discordância ou concordância com as assertivas abaixo.**

	Discordo totalmente	Discordo	Nem discordo, nem concordo	Concordo	Concordo totalmente
Eu conseguia planejar meu trabalho para terminá-lo no prazo	○	○	○	○	○
Eu tinha em mente o resultado do trabalho que eu precisava atingir	○	○	○	○	○
Eu fui capaz de definir prioridades	○	○	○	○	○
Eu reclamei sobre questões menores relacionadas ao trabalho	○	○	○	○	○
Eu fui capaz de realizar meu trabalho com eficiencia	○	○	○	○	○

* 12. **Lembrando sempre do projeto que você deu nome:**

	Discordo totalmente	Discordo	Nem discordo, nem concordo	Concordo	Concordo totalmente
Eu gerenciei bem o meu tempo	○	○	○	○	○
Por iniciativa própria, começava uma nova tarefa quando terminava as antigas	○	○	○	○	○
Eu superestimei os problemas no trabalho de forma que pareciam maiores do que realmente eram	○	○	○	○	○
Eu assumia tarefas desafiadoras quando elas estavam disponíveis	○	○	○	○	○
Eu trabalhei para manter meus conhecimentos relacionados ao trabalho atualizados	○	○	○	○	○

* 13. **Lembrando sempre do projeto que você deu nome:**

	Discordo totalmente	Discordo	Nem discordo, nem concordo	Concordo	Concordo totalmente
Eu me concentrei mais nos aspectos negativos da situação no trabalho do que nos aspectos positivos	○	○	○	○	○
Eu trabalhei para manter minhas competências profissionais atualizadas	○	○	○	○	○
Eu criei soluções criativas para novos problemas	○	○	○	○	○
Eu falei com pessoas fora da organização sobre os aspectos negativos do meu trabalho	○	○	○	○	○
Eu assumia responsabilidades extras	○	○	○	○	○

* 14. **Lembrando sempre do projeto que você deu nome:**

	Discordo totalmente	Discordo	Nem discordo, nem concordo	Concordo	Concordo totalmente
Eu continuamente busquei novos desafios no meu trabalho	○	○	○	○	○
Eu falei com colegas sobre os aspectos negativos do meu trabalho	○	○	○	○	○
Eu participei ativamente de reuniões e /ou consultas	○	○	○	○	○
Eu fui voluntário para fazer coisas que não eram minhas obrigações, porém ajudaram a organização	○	○	○	○	○
Eu era voluntário para ajudar a orientar novos funcionários	○	○	○	○	○

* 15. **Lembrando sempre do projeto que você deu nome:**

	Discordo totalmente	Discordo	Nem discordo, nem concordo	Concordo	Concordo totalmente
Eu ajudei outras pessoas com problemas relacionados ao trabalho	○	○	○	○	○
Eu era voluntário para ajudar outras pessoas quando elas tiveram cargas de trabalho pesadas	○	○	○	○	○
Eu colocava esforço extra para fazer bem o meu trabalho, além do que normalmente era esperado	○	○	○	○	○
Eu compartilhei meu conhecimento com outras pessoas, mesmo quando não recebi crédito por isso	○	○	○	○	○
Eu trabalhei horas extras mesmo quando não recebicrédito por isso	○	○	○	○	○

* 16. **No projeto em que você pensou, qual era o seu sentimento em relação à equipe ?**

	Discordo totalmente	Discordo	Nem discordo, nem concordo	Concordo	Concordo totalmente
Sentia-me fortemente inseridonesta equipe	○	○	○	○	○
Outras equipes poderiam aprender muito conosco	○	○	○	○	○
Pertencer a esta equipe foi uma parte importante deminha identidade	○	○	○	○	○
Em tempos difíceis, a única maneira de saber o que fazer era confiar nos lideres da equipe	○	○	○	○	○
Fiquei feliz em contribuir com esta equipe	○	○	○	○	○

	Discordo totalmente	Discordo	Nem concordo, nem discordo	Concordo	Concordo totalmente
Comparado com outras equipes semelhantes, esta equipe era particularmente boa	○	○	○	○	○
Era importante para mim ser visto como membro da equipe	○	○	○	○	○
Todos os membrosda equipe respeitaram os costumes, as instituições e os lideres do grupo	○	○	○	○	○
Estava fortemente comprometido com aquela equipe	○	○	○	○	○
Comparado a outras equipes, éramos um grupo muito ético	○	○	○	○	○
Era importante para mim que os outros me vissem como membro daquela equipe	○	○	○	○	○
Seria desleal criticar aquela equipe	○	○	○	○	○

	Discordo totalmente	Discordo	Nem discordo, nem concordo	Concordo	Concordo totalmente
A maioria dos membros da minha equipe se enquadrava no queacredito ser o membro ideal da equipe	○	○	○	○	○
Sentia que estava suficientemente incluído pela equipe em todas as atividades da equipe	○	○	○	○	○
Considerava gratificante a maioria das atividades em queparticipava como membro dequela equipe	○	○	○	○	○
Se os membros daquela equipe decidissem dissolver a equipe, eu tentaria dissuadi-los	○	○	○	○	○
Se for convidado a participar de outro projeto como aquele, gostaria deestar com as mesmas pessoas que estavam na minha equipe na época	○	○	○	○	○
Eu gostei da equipe com a qual trabalhei	○	○	○	○	○
Acredito que nossa equipe se reunia com bastante frequência	○	○	○	○	○
Sentia que trabalhar com aquela equipe em particular permitia-me atingir os objetivos pessoais para os quais a equipe foi formada	○	○	○	○	○
Em comparação com outras equipes,aquela equipe trabalha bem em conjunto	○	○	○	○	○

Nosso líder era um membro modelo para a equipe	◯	◯	◯	◯	◯
Nosso líder atuava como um defensor para a equipe	◯	◯	◯	◯	
Nosso líder criava um senso de coesãodentro daquela equipe	◯	◯	◯	◯	◯
Nosso lider criava estruturas úteis para os membros daequipe	◯	◯	◯	◯	◯

20. Agradeço com sinceridade seu tempo, interesse e atenção em participar desta pesquisa, caso tenha interesse em receber os resultados ou receber os comprovantes de doação, gentileza informar o seu e-mail

Anexo B – Dicionário de dados

Quest.	Nome da variavel	Tipo da variavel	Abreviatura	Parametro mensurado	Origem da escala
1	Voce esteve recentemente trabalhando em algum projeto?	Variavel de controle	Não Tem	Demografia	Não Tem
2	Qual o seu genero?	Variavel de controle	Genero	Demografia	Não Tem
3	Qual a sua idade?	Variavel de controle	fx1 e fx2	Demografia	Não Tem
4	Qual a sua formação academica?	Variavel de controle	ForAcd	Demografia	Não Tem
5	A quanto tempo voce tem envolvimento com projetos?	Variavel de controle	Temp1	Demografia	Não Tem
6	A qual setor da economia a empresa pertence?	Variavel de controle	tip1 e tip2	Demografia	Não Tem
7	Descreva este projeto que voce pensou com uma palavra.	Variavel de controle	Não tem	Demografia	Não Tem
8	Quantos meses já se passaram desde a finalização desta projeto?	Variavel de controle	Não tem	Demografia	Não Tem
9	A empresa onde sua equipe esta inserida:	Variavel de controle	Não tem	Demografia	Não Tem
10	Qual foi a sua relação com o projeto em questão?	Variavel de controle	fun1	Demografia	Não Tem
11	Sua equipe de projetos é:	Variavel de controle		Demografia	Não Tem
12	Eu consegui planejar meu trabalho para terminá-lo no prazo	Var. Dependente 1	Perfind1	Performance individual	Lousã et al. (2024)
13	Eu tinha em mente o resultado do trabalho que eu precisava para atingir.	Var. Dependente 1	Perfind2	Performance individual	Lousã et al. (2024)
14	Eu fui capaz de definir prioridades.	Var. Dependente 1	Perfind3	Performance individual	Lousã et al. (2024)
15	Eu reclamei sobre questões menores relacionadas ao trabalho.	Var. Dependente 1	Perfind4	Performance individual	Lousã et al. (2024)
16	Eu fui capaz de realizar meu trabalho com eficiencia.	Var. Dependente 1	Perfind5	Performance individual	Lousã et al. (2024)
17	Eu gerenciei bem o meu tempo.	Var. Dependente 1	Perfind6	Performance individual	Lousã et al. (2024)
18	Por iniciativa própria, comecei uma nova tarefa quando terminei as antigas.	Var. Dependente 1	Perfind7	Performance individual	Lousã et al. (2024)
19	Eu aumentei os problemas no trabalho mais do que eles realmente eram.	Var. Dependente 1	Perfind8	Performance individual	Lousã et al. (2024)
20	Eu assumi tarefas desafiadoras quando elas estavam disponíveis.	Var. Dependente 1	Perfind9	Performance individual	Lousã et al. (2024)
21	Eu trabalhei para manter meus conhecimentos relacionados ao trabalho atualizados.	Var. Dependente 1	Perfind10	Performance individual	Lousã et al. (2024)
22	Eu me concentrei nos aspectos negativos da situação no trabalho em vez dos aspectos positivos.	Var. Dependente 1	Perfind11	Performance individual	Lousã et al. (2024)
23	Eu trabalhei para manter minhas competencias profissionais atualizadas.	Var. Dependente 1	Perfind12	Performance individual	Lousã et al. (2024)
24	Eu criei soluções criativas para novos problemas.	Var. Dependente 1	Perfind13	Performance individual	Lousã et al. (2024)
25	Eu falei com pessoas fora da organização sobre os aspectos negativos do meu trabalho.	Var. Dependente 1	Perfind14	Performance individual	Lousã et al. (2024)
26	Eu assumi responsabilidades extras.	Var. Dependente 1	Perfind15	Performance individual	Lousã et al. (2024)
27	Eu continuamente busquei novos desafios no meu trabalho.	Var. Dependente 1	Perfind16	Performance individual	Lousã et al. (2024)
28	Eu falei com colegas sobre os aspectos negativos do meu trabalho.	Var. Dependente 1	Perfind17	Performance individual	Lousã et al. (2024)
29	Eu participei ativamente de reuniões e/ou consultas.	Var. Dependente 1	Perfind18	Performance individual	Lousã et al. (2024)

Anexo B (continuação)– Dicionário de dado

Quest.	Nome da variavel	Tipo da variavel	Abreviatura	Parametro mensurado	Origem da escala
30	Eu sou voluntario para fazer coisas que não são minhas obrigações, porem ajudam a organização	Var. Dependente 2	ExtraR1	Comportamento extra-função	Blader & Tyler (2009)
31	Eu sou voluntário para ajudar a orientar novos funcionários	Var. Dependente 2	ExtraR2	Comportamento extra-função	Blader & Tyler (2009)
32	Eu ajudo outras pessoas com problemas relacionados ao trabalho	Var. Dependente 2	ExtraR3	Comportamento extra-função	Blader & Tyler (2009)
33	Eu sou voluntario para ajudar outras pessoas quando elas tiverem cargas de trabalho pesadas	Var. Dependente 2	ExtraR4	Comportamento extra-função	Blader & Tyler (2009)
34	Eu posso colocar um esforço extra para fazer bem o seu trabalho, além do que normalmente é esperado	Var. Dependente 2	ExtraR5	Comportamento extra-função	Blader & Tyler (2009)
35	Eu compartilho meu conhecimento com outras pessoas, mesmo quando não receberei crédito por isso.	Var. Dependente 2	ExtraR6	Comportamento extra-função	Blader & Tyler (2009)
36	Eu trabalho horas extras mesmo quando não recebo crédito por isso	Var. Dependente 2	ExtraR7	Comportamento extra-função	Blader & Tyler (2009)
37	Sinto-me fortemente inserido a esta equipe.	Var. Independente 2	IndGrp1	Identidade de grupo	Roccas, S., Sagiv, L., Schwartz, S., Halevy, N., & Eidelson, R. (2008).
38	Outras equipes podem aprender muito conosco.	Var. Independente 2	IndGrp2	Identidade de grupo	Roccas, S., Sagiv, L., Schwartz, S., Halevy, N., & Eidelson, R. (2008).
39	Pertencer a esta equipe é uma parte importante da minha identidade.	Var. Independente 2	IndGrp3	Identidade de grupo	Roccas, S., Sagiv, L., Schwartz, S., Halevy, N., & Eidelson, R. (2008).
40	Pertencer a esta equipe é uma parte importante da minha identidade.	Var. Independente 2	IndGrp4	Identidade de grupo	Roccas, S., Sagiv, L., Schwartz, S., Halevy, N., & Eidelson, R. (2008).
41	Pertencer a esta equipe é uma parte importante da minha identidade.	Var. Independente 2	IndGrp5	Identidade de grupo	Roccas, S., Sagiv, L., Schwartz, S., Halevy, N., & Eidelson, R. (2008).
42	Pertencer a esta equipe é uma parte importante da minha identidade.	Var. Independente 2	IndGrp6	Identidade de grupo	Roccas, S., Sagiv, L., Schwartz, S., Halevy, N., & Eidelson, R. (2008).
43	Pertencer a esta equipe é uma parte importante da minha identidade.	Var. Independente 2	IndGrp7	Identidade de grupo	Roccas, S., Sagiv, L., Schwartz, S., Halevy, N., & Eidelson, R. (2008).
44	Pertencer a esta equipe é uma parte importante da minha identidade.	Var. Independente 2	IndGrp8	Identidade de grupo	Roccas, S., Sagiv, L., Schwartz, S., Halevy, N., & Eidelson, R. (2008).
45	Pertencer a esta equipe é uma parte importante da minha identidade.	Var. Independente 2	IndGrp9	Identidade de grupo	Roccas, S., Sagiv, L., Schwartz, S., Halevy, N., & Eidelson, R. (2008).
46	Pertencer a esta equipe é uma parte importante da minha identidade.	Var. Independente 2	IndGrp10	Identidade de grupo	Roccas, S., Sagiv, L., Schwartz, S., Halevy, N., & Eidelson, R. (2008).
47	Pertencer a esta equipe é uma parte importante da minha identidade.	Var. Independente 2	IndGrp11	Identidade de grupo	Roccas, S., Sagiv, L., Schwartz, S., Halevy, N., & Eidelson, R. (2008).
48	Pertencer a esta equipe é uma parte importante da minha identidade.	Var. Independente 2	IndGrp12	Identidade de grupo	Roccas, S., Sagiv, L., Schwartz, S., Halevy, N., & Eidelson, R. (2008).
60	Nosso líder é um membro modelo para a equipe	Var. Independente 1	Lideran1	Liderança	Steffens et al. (2014)
61	Nosso líder atua como um defensor para a equipe.	Var. Independente 1	Lideran1	Liderança	Steffens et al. (2014)
62	Nosso líder cria um senso de coesão dentro da equipe.	Var. Independente 1	Lideran1	Liderança	Steffens et al. (2014)
63	Nosso líder cria estruturas úteis para os membros da equipe.	Var. Independente 1	Lideran1	Liderança	Steffens et al. (2014)