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Project Virtual Teams: a state of the art

Francisco José Ferreira Simões

Mestrado em Gestão

Orientador:
Prof. Doutor Carlos Miguel Correia Hernandez Jerónimo, Professor Auxiliar
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Dedico à familia, sempre à familia.

Dedico ao meu orientador, Prof. Doutor Carlos Jerónimo, pelo exemplo que é!

Dedico a todas as pessoas que tive a felicidade de me cruzar e que têm contribuído para a minha evolução pessoal e profissional.

"The major value in life is not what you get. The major value in life is what you become".

Jim Rohn

Abstract

Virtual teams have been developing projects for decades, combining different expertise without the costs of relocation for organisations. Nowadays, due to the pandemic virtual teams are increasingly more common. These teams not only bring together different talent at reduced cost, but also promote sustainable practices. The goal of this research is to provide an up-to-date systematic literature review of virtual teams' research, focusing on papers published from 2015 to 2020. It was possible to identify nine topics that embrace all research: Team dynamics, Technology, Leadership, Communication, Trust, Performance, Knowledge, Project Management and Engagement. This work allowed to find solutions for issues raised in the past and achieve consensus in other aspects regarding best practices for virtual teams. Finally, areas still to be developed were identified, such as team mobility and its influence on workplace's perceptions, and sustainability and environmental benefits.

Resumo

As equipas virtuais têm desenvolvido projetos durante décadas, combinando diferentes áreas de especialização sem custos de relocalização para as organizações. Hoje em dia, devido à pandemia as equipas virtuais são cada vez mais comuns. Essas equipas não só reúnem diferentes talentos a custos reduzidos, mas também promovem práticas sustentáveis. O objetivo desta tese é fornecer uma revisão sistemática da literatura e investigação relativa às equipas virtuais, com foco em artigos publicados de 2015 a 2020. Foi possível identificar nove tópicos que abrangem toda a Investigação, nomeadamente: Dinâmicas de equipa, Tecnologia, Liderança, Comunicação, Confiança, Desempenho, Conhecimento, Gestão de Projetos e Compromisso. Este trabalho permitiu encontrar soluções para questões levantadas no passado e alcançar consenso em outros aspetos relativos às melhores práticas para as equipas virtuais. Por fim, foram identificadas áreas ainda a serem desenvolvidas, como a mobilidade da equipa e sua influência, nas percepções do local de trabalho, sustentabilidade e benefícios ambientais.

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Chapter 1. Introduction

In the last decades, organisations have started adopting virtual teams to complete projects to exploit knowledge without having to relocate employees (Gibbs et al., 2020). These teams are defined by the use of information and communication technologies, by their dispersed geographic location and temporary nature, and are usually assigned to closed projects (Toro et al., 2020). Nowadays, not only they have become a necessity dictated by the pandemic as there are also sustainable reasons to support them (Olaisen & Revang, 2017). Despite all the advantages of virtual teams, issues regarding communication and team-cohesion may arise during the project lifetime (Lumseyfai, 2020). Although virtual teams have been a subject of research for more than 30 years (Toro et al., 2020), it is still a very current topic. These teams have been considered as a powerful structure in the current context, delivering projects with different focus from strategic to operational (Morley et al., 2015). Virtual teams are also an important component of agile systems by contributing team members to work more efficiently, to collaborate, and to share skills (Sampaio, Bastos & Marinho, 2021). Nevertheless, due to their dispersed nature these teams still present some vulnerabilities which are important to acknowledge and resolve so organisations can help these teams to achieve their full potential and value.

Technology, particularly information systems and computer mediated communication technologies, have been rapidly evolving (Velez-Calle et al., 2020). Gilson et al. (2015) provided a very exhaustive review of ten years of research on virtual teams. They were able to identify the 10 key topics included in the literature since 2005 and propose 10 opportunities for the future. The authors highlight the change from studies predominantly done in lab settings to the use of case studies; the focus on team composition, culture and task definition; the evolution of the virtuality concept; the new technologies used by these teams; the increase of dispersion that led to global virtual teams; the importance of leadership, trust and the difficulty in measuring outcomes and improve success. Their recommendations are based on study settings in order to broader the results, analyze the impacts of virtuality in different generations, continue to study new technologies, analyze member mobility, subgroups, team adaptation, member well-being and processes and planning specific to these teams. Virtual teams have been defined by the geographic location of team members and the use of communication technologies, as pointed out by Gilson et al. (2015). From 2005 onwards there is also a great amount of research done on global teams, with increased distance between members. Nevertheless, these teams are

loosely defined in terms of scope or time frame. In this study we aimed to focus on project teams, teams that have a limited task in hands and a restrained deadline (Opdenakker & Cuypers, 2019). The goal of this study is to understand how virtual project teams have evolved, while simultaneously answering the following research questions:

- Which are the main topics researched regarding virtual teams?
- How much do they have in common with the topics found by Gilson et al. (2015)?
- Do the new topics reflect Gilson's suggestions for future research?
- Where should future virtual teams research focus on?

This research provides an updated review on virtual project teams whose importance is continuously growing. The next section presents the methodology used to assure a systematic and reproducible review. The articles collected were first analyzed quantitatively and then qualitatively in order to understand the current trends in virtual teams' research. The research questions are answered and the results discussed on the following section. Finally, the conclusion summarizes the main contributions of this thesis.

Chapter 2. Methodology

To answer this research questions a systematic literature review was performed. A systematic literature review (SLR) assembles, combines and assesses all documents that fit a fixed set of constraints. This allows to compare different authors and identify generalized truths or opportunities for upcoming studies. First the objectives were defined, the databases to use were selected and the criteria were determined. Then all the suitable articles were collected and evaluated. Finally, the information gathered was analyzed and summarized.

The present literature review was performed according to the PRISMA's (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) approach (Moher et al., 2009), to ensure reproducibility of the results. Figure 1 shows all the steps included in the PRISMA methodology; their guidelines were followed to reduce bias and inaccuracies improving the value of this study.
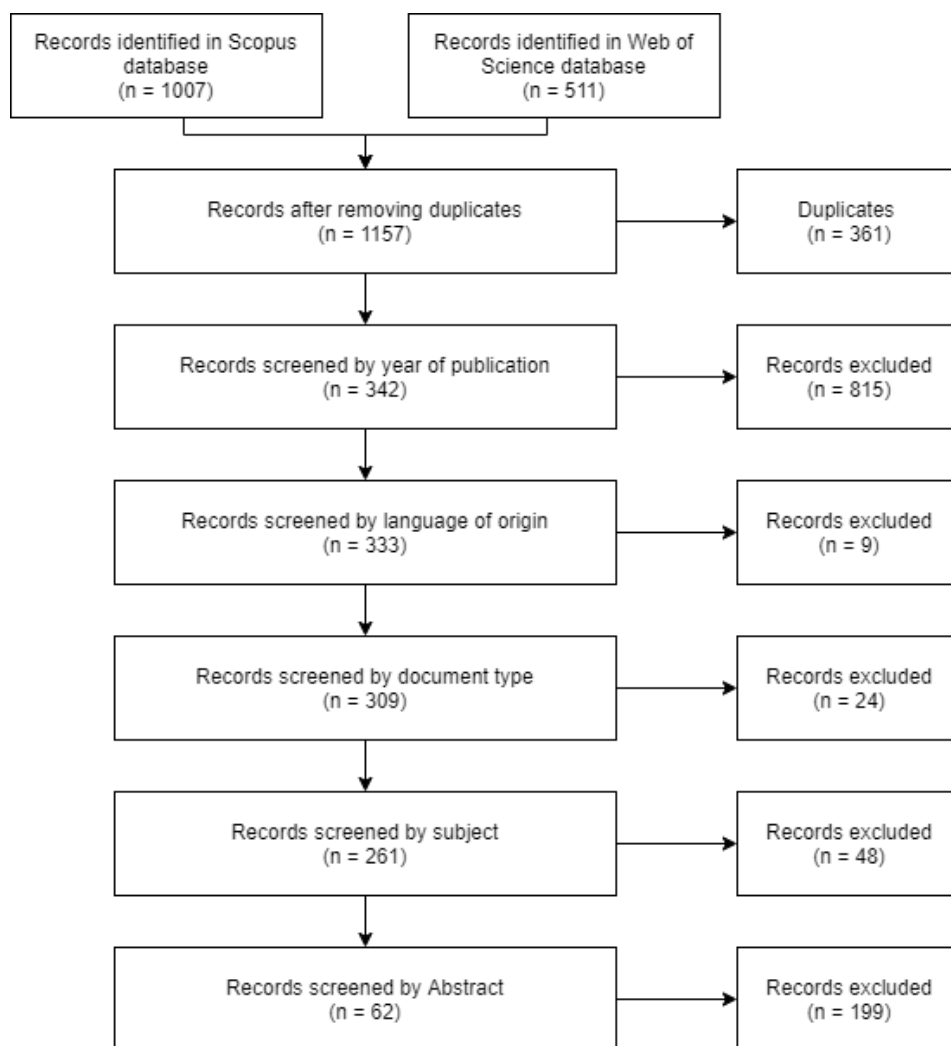
Figure 1 – Records selection process

Scopus and Web of Science databases were searched for English papers with the terms "project" AND "virtual teams" in the title, abstract or keywords. The retrieved results were published between 1994 and 2021. Since two different databases were used, the first step was to remove all duplicates. Then, all records published before 2015 were removed. Afterwards, all the records that were not originally published in English were eliminated. The remaining records were then filtered by type, and only articles, conference papers or reviews were kept. Subsequently, the results were filtered by subject, and only papers from the following areas were considered: business, management, economics, social sciences and decision sciences or communications, telecommunications, computer software and information sciences. Finally, all the remaining abstracts were read and those that were related to the research question were selected. In this final screening papers related to virtual learning or product development were eliminated. The obtained 62 records were fully read and analyzed.

Chapter 3. Results

All the articles selected were analyzed to identify common trends (table 1 in appendix). The 62 selected articles were published from 2015 until now in 52 different sources. Nevertheless, most articles are included in journals focused on Management, Project and Information (table 2).

Source Title	Papers
IEEE Transactions on Professional Communication	3
International Journal of E-Collaboration	3
International Journal of Information Management	3
International Journal of Project Management	3
Journal of International Management	2
Team Performance Management	2
Other Journals	40
Other Conferences	6

Table 2 – List of sources (Source: Own elaboration)

The 22 most cited authors in the select papers are shown in figure 2. Only the 62 papers collected were considered in this analysis, and multiple authors were all considered individually by the number of papers they participated in. Although most authors have written only one paper, the average number of publications is 1,27 for the highlighted authors. It can also be noted that there is a minor negative correlation (-0.24) between the number of papers published and the citations.
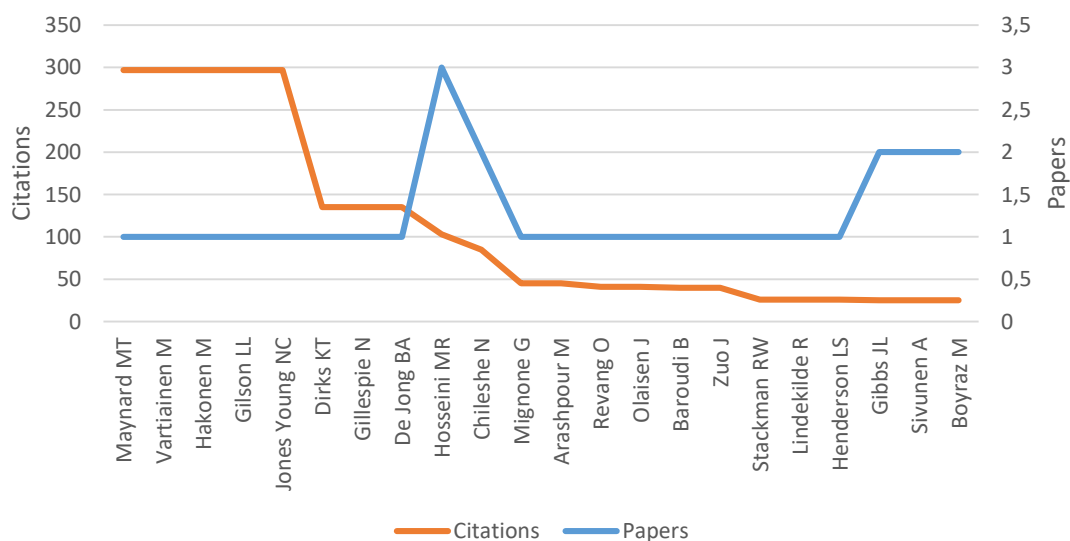
Figure 2 – Most cited authors (Source: Own elaboration)

Figure 3 shows the distribution of the selected papers per subject, according the category classifications provided by the journals as listed in the Web of Science and Scopus databases. Some journals are classified into more than one category and therefore the total number of papers shown in figure 3 may be higher than the referred 62. Although most papers focus on business or management there is also a considerable amount of research done on computer science, which was expected due to the high dependency of virtual teams on technology.
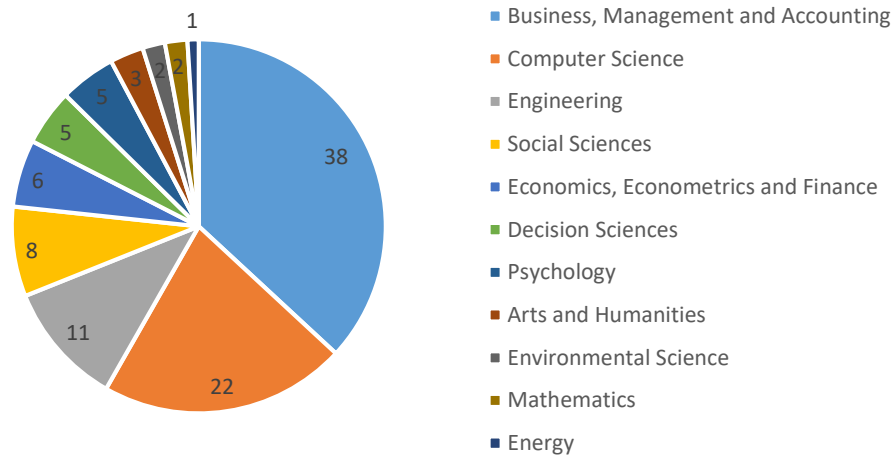
Figure 3 – Papers per Subject (Source: Own elaboration)

The articles analyzed include studies with samples from 32 different countries, which provides a large diversity of contexts. Some papers did not include this information and were thus classified as "unknown"; other studies included more than one country and were considered in each of the countries listed or classified as "multiple" if they did not specify which countries. Some papers were not included at all, for instance literature reviews or conceptual models when there were no countries included in the analysis. Nevertheless, most studies focus on multiple countries (22) or the United States (11) as can be seen in figure 4.

Figure 4 – Papers per Country (Source: Own elaboration)

A first reading identified the methodology used in each paper. It can be seen in figure 5 that there was a marked preference for surveys and field studies or experiments, which are mostly performed with university students.
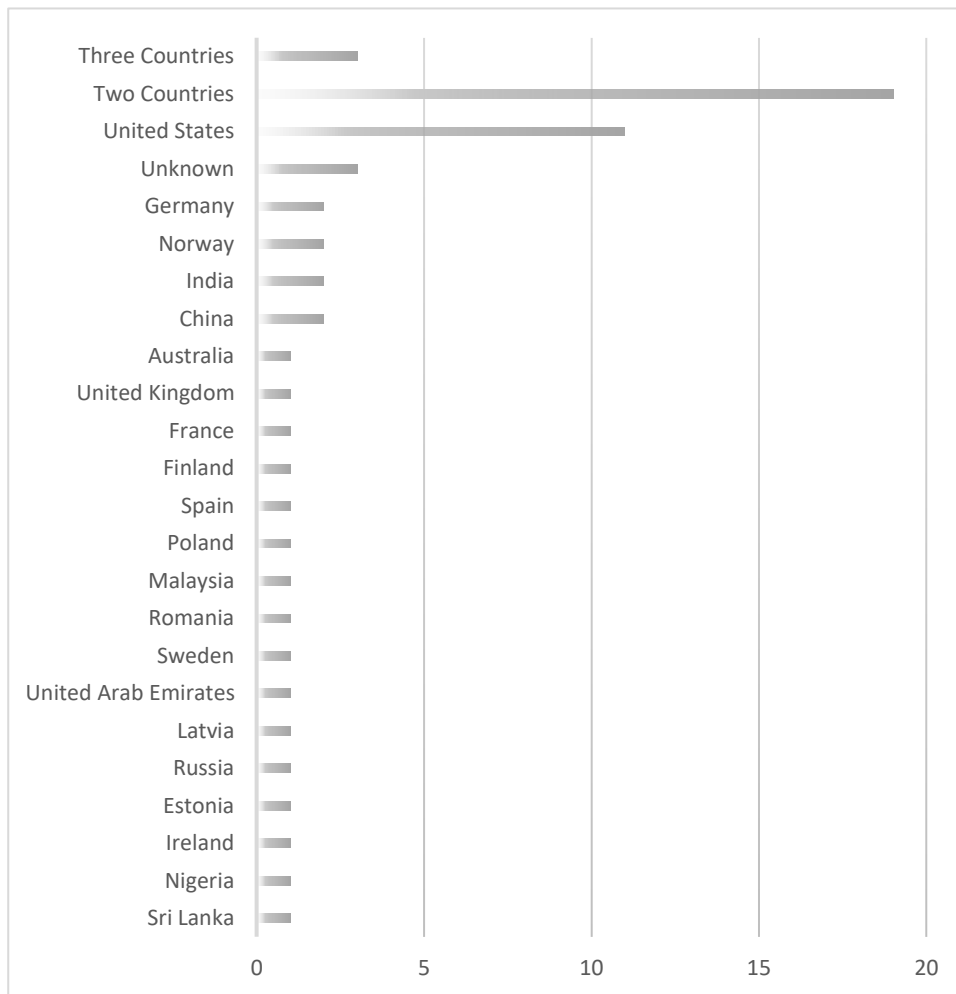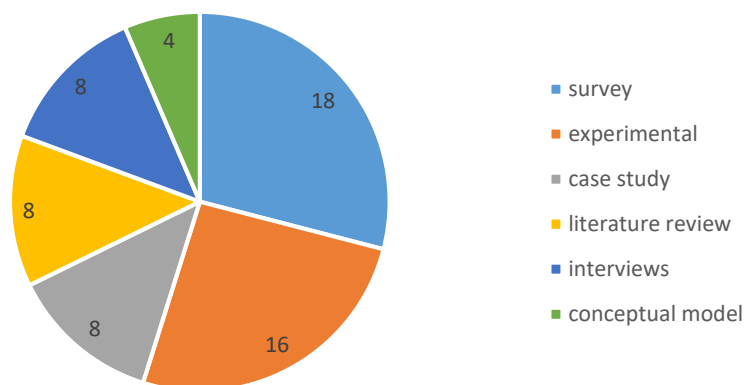

Figure 5 – Papers per Methodology (Source: Own elaboration)

Figure 6 describes all the industries portraited in the selected papers when this information was available. Although a category for "unknown" was included, the total number of papers shown is lower than 62 since the notion of industry was not applicable to all papers, such as those describing conceptual models. Most papers focus either on a collection of several industries or IT companies, engineering and business.
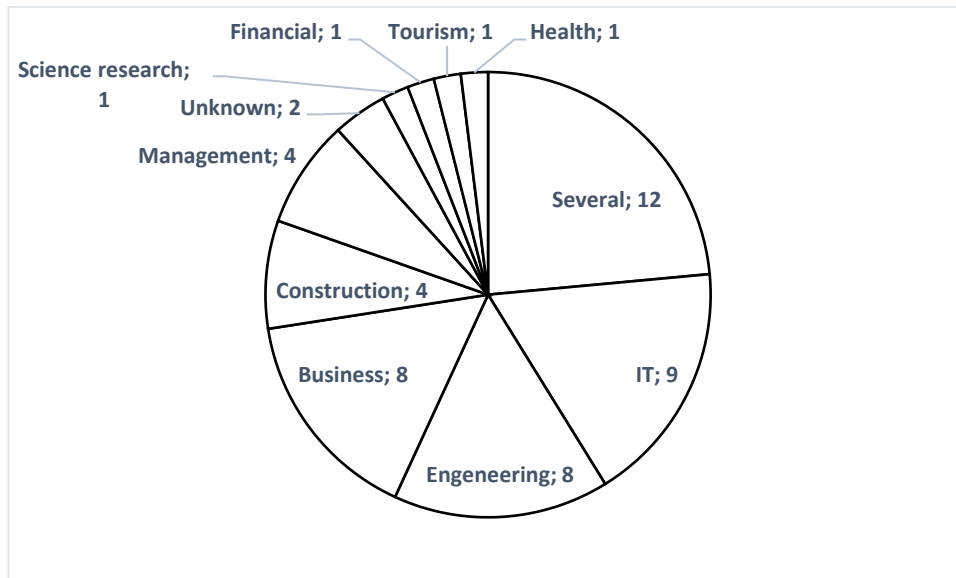
Figure 6 – Number of papers per Industry (Source: Own elaboration)

After the paper selection a word cloud analysis was done with the goal to identify the more frequent words and the relations between them that are more present. To achieve this, it was used the R software version 4.0.5, with packing including content analysis that uses graph theory and neural networks algorithms. These algorithms use the 62 papers selected in the previous stage (figure 1) to rank words and set of words that are use more in these papers as show in table 3. This analysis helped to identify some trends or patterns in the research done on project virtual teams until now. If we exclude the research terms it can be seen that team members ("members", "team member*", "among team members", "virtual team members", "project team members") is the most common term, which is not surprising since teams are composed of people. In second place, "communication" is the most used word even though it does not appear in the bi-grams and has low relevance in the tri-grams. Trust, on the other hand, is present in all three analyses showing that it is still a current topic in virtual teams' research. Management also appears as an important topic, either in project, human resources or information systems. Performance and results are still a main focus of research ("performance", "team performance", "team effectiveness", "virtual team performance", "virtual team

effectiveness" and "performance virtual teams"). This analysis also highlights other research areas such as knowledge, leadership and employee engagement. Finally, although virtual teams are highly dependent on information systems and technology, these are no longer the most researched subtopics of the subject.

Word		Bi-grams		Tri-grams	
team*	11600	virtual team*	3105	global virtual team*	530
virtual	4587	team member*	1762	virtual project team*	210
project*	4319	team performance	669	among team members	129
members	2849	global virtual	615	virtual team members	110
communication	2497	project team*	767	human resource management	92
trust	2382	project management	478	project team members	88
management	2354	information systems	289	virtual team performance	87
research	2318	virtual project	246	virtual team effectiveness	83
performance	2016	team effectiveness	207	transactions professional communication	60
work	1734	social media	202	performance virtual teams	55
study	1484	decision making	157	small group research	54
information	1435	intrateam trust	157	management information systems	53
knowledge	1267	swift trust	156	trust virtual teams	52
leadership	1164	employee engagement	153	trust global virtual	50
technology	1151	project managers	152	trust team performance	50

Table 3 – Word frequency (Source: Own elaboration)

Based on the categories defined by Gilson et al. (2015) and on the text-mining techniques it was possible to foresee how the selected articles should be categorized. After a first light reading the selected papers were distributed into 9 categories (table 4); most papers fit more than one category as they include more than one topic in their research. For a long time virtual teams research was developed with students, and although Gilson et al. (2015) found this trend to be decreasing it is still widely common. Therefore, the selected papers were also divided based on their object of analysis, if they were done based on an organisation or developed with students.

Category	*Organisations*	*Students*
Team dynamics	(Al Zain et al., 2018; Batarseh et al., 2018; Bjorvatn & Wald, 2019; Dumitraşcu-Băldău & Dumitraşcu, 2019; Gibbs et al., 2017; Gilson et al., 2015; Henderson et al., 2016; Hoegl & Muethel, 2016; Mignone et al., 2016; Morley et al., 2015; Plotnick et al., 2016; Radović-Marković	(Crowne, 2020; Eubanks et al., 2016; Graham et al., 2016; Orta-Castañon et al., 2018; Paul et al., 2016; Taras et al., 2019; Tavoletti et al., 2019; Velez-

Category	Organisations	Students
	et al., 2015; Shaik & Makhecha, 2019; Wickramasinghe & Nandula, 2015)	Calle et al., 2020; Zakaria & Mohd Yusof, 2020)
Technology	(Al Zain et al., 2018; Artem et al., 2019; Bjorvatn & Wald, 2019; Bond-Barnard et al., 2016; Dumitraşcu-Băldău & Dumitraşcu, 2019; Gilson et al., 2015; Großer & Baumöl, 2019; Kanagarajoo et al., 2019; Lumseyfai, 2020; Mukherjee & Natrajan, 2017; Oraee et al., 2019; Rozman et al., 2017; Shaik & Makhecha, 2019; Stray et al., 2019; Toro et al., 2020)	(Aritz et al., 2018; Crowne, 2020; Orta-Castañon et al., 2018)
Leadership	(Al Zain et al., 2018; Fernandez & Jawadi, 2015; Gilson et al., 2015; Hoegl & Muethel, 2016; Maduka et al., 2018; Radović-Marković et al., 2015; Toro et al., 2020)	(Eubanks et al., 2016; Iorio & Taylor, 2015; Purvanova et al., 2020)
Communication	(Blenke et al., 2017; Bond-Barnard et al., 2016; Dumitraşcu-Băldău & Dumitraşcu, 2019; Gilson et al., 2015; Henderson et al., 2016; Lumseyfai, 2020; Maduka et al., 2018; Olaisen & Revang, 2017; Oraee et al., 2019; Pozin et al., 2016; Toro et al., 2020)	(Chamakiotis et al., 2020; Crowne, 2020; Fuller, M., Vician, C & Brown, 2016; Paul et al., 2016; Zakaria & Mohd Yusof, 2020)
Trust	(Al Zain et al., 2018; Cheng et al., 2021; De Jong et al., 2016; Gilson et al., 2015; Guinalíu & Jordán, 2016; Henderson et al., 2016; Maduka et al., 2018; Toro et al., 2020)	(Crowne, 2020; Jaakson et al., 2019; Robert, 2016; Zakaria & Mohd Yusof, 2020)
Performance	(Blenke et al., 2017; Dumitraşcu-Băldău & Dumitraşcu, 2019; Fernandez & Jawadi, 2015; Gheni et al., 2016; Gilson et al., 2015; Großer & Baumöl, 2017; Lumseyfai, 2020; Mukherjee & Natrajan, 2017; Ng & Tung, 2018; Pozin et al., 2016; Wickramasinghe & Nandula, 2015)	(Crowne, 2020; Daniel et al., 2017; Graham et al., 2016; Jaakson et al., 2019; Paul et al., 2016; Robert, 2016; Taras et al., 2019)
Knowledge	(Castellano et al., 2017; Faegri et al., 2016; Gilson et al., 2015; Hosseini et al., 2015; Olaisen & Revang, 2017; Ramalingam & Mahalingam, 2018)	
Project Management	(Al Zain et al., 2018; Davidaviciene et al., 2020; Gallego et al., 2021; Gilson et al., 2015; Großer & Baumöl, 2019; Kanagarajoo et al., 2019; Lumseyfai, 2020; Morley et al., 2015; Mukherjee & Natrajan, 2017; Ng & Tung, 2018; Oraee et al., 2019; Rozman et al., 2017; Watfa & Todd, 2017)	(Chamakiotis et al., 2020)
Engagement	(Panteli et al., 2019; Shaik & Makhecha, 2019; Toro et al., 2020)	(Gibbs et al., 2020; Iorio & Taylor, 2015)

*Table 4 – Categorization of the selected papers (Source: Own elaboration)*

From this categorization Team Dynamics, Technology and Performance are the most common topics of research (table 5), validating the trends identified in the past. While

Leadership and Knowledge are becoming less frequent topics of research, Project Management and Engagement are becoming more popular. The research done with students still represents a large part of current studies (30%). Moreover, it cannot be concluded that it has a decreasing trend, since 47% of these studies were published between 2019 and 2020. Nevertheless, it can be noted that some topics used students more than others. For instance, Team Dynamics, Performance and Engagement present approximately 40% of the research done with students; while the last is a new subject which can account for this proportion the others are not. On the other hand, Knowledge and Project Management are the topics that rely less on student experiences.

Category	2015	2016	2017	2018	2019	2020	2021	Total
Team Dynamics	**4**	**7**	**1**	**4**	**4**	**3**		**23**
O	4	4	1	3	2			14
S		3		1	2	3		9
Technology	**1**	**1**	**2**	**3**	**8**	**3**		**18**
O	1	1	2	1	8	2		15
S				2		1		3
Leadership	**4**	**2**		**2**		**2**		**10**
O	3	1		2		2		8
S	1	1						2
Communication	**1**	**5**	**2**	**1**	**1**	**4**		**14**
O	1	3	2	1	1	1		9
S		2				3		5
Trust	**1**	**4**		**2**	**1**	**3**	**1**	**12**
O	1	3		2		1	1	8
S		1			1	2		4
Performance	**3**	**5**	**5**	**1**	**3**	**2**		**19**
O	3	2	3	1	1	1		11
S		3	2		2	1		8
Knowledge	**2**	**1**	**2**	**1**				**6**
O	2	1	2	1				6
S								
Project Management	**2**		**3**	**2**	**3**	**3**	**1**	**14**
O	2		3	2	3	2	1	13
S						1		1
Engagement	**1**				**2**	**2**		**5**
O					2	1		3
S	1					1		2
Total	**19**	**25**	**15**	**16**	**22**	**22**	**2**	

Table 5–Categorization and yearly distribution of the selected papers (Source: Own elaboration)

As mentioned above, most papers include more than one topic in their research, the average being two topics per paper; figure 7 shows the relationship between topics. Communication is never analyzed on its own; on the other hand, Knowledge is the subject most studied individually. Team Dynamics and Communication are commonly analyzed with Technology and Performance. Trust is highly related to Team Dynamics, Communication and Leadership, whereas Project Management is more related to Technology and Knowledge. Engagement is as frequently analyzed on its own as it is related to Technology or Leadership. Nevertheless, half of the papers focused on Leadership also study Team Dynamics. These nine topics are detailed in the following sections.
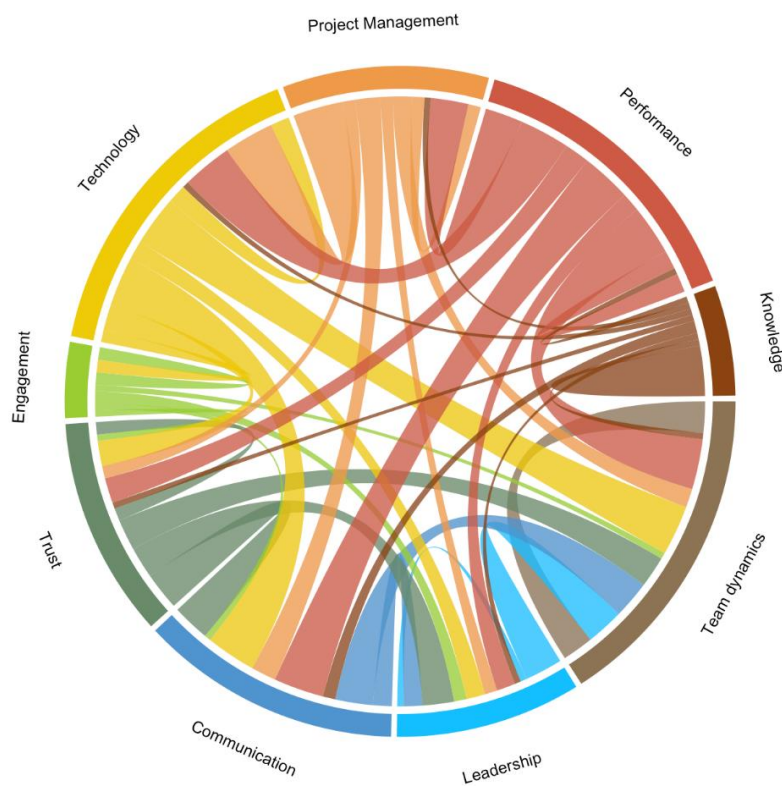
Figure 7 – Relation between categories (Source: Own elaboration)

3.1 Team dynamics

Diversity has been considered to be responsible for conflicts, miscommunication and lack of cohesion in virtual teams (Al Zain et al., 2018; Mignone et al., 2016; Wickramasinghe & Nandula, 2015) and also for reducing effectiveness (Plotnick et al., 2016). On the other hand, Batarseh et al. (2018) concluded that higher levels of functional diversity are positively correlated with innovation. This contradicting ideas can be explained by Taras et al. (2019), who found that different aspects of diversity have different impacts. While

teams with more diversity on a personal level tend to be less effective, contextual diversity has a positive impact on task results. Regardless of the direction of the effect, the authors found these impacts to be weaker than predicted by previous studies. Gibbs et al. (2017) showed that diversity positively impacts organisational studies more than student samples, raising awareness that these two contexts can provide completely different insights. The authors also concluded that subgroups in student teams are likely to impair performance while they can benefit organisational teams. Subgroups are often created based on structural characteristics, such as location, and their effects depend on how they are discursively constructed (Gibbs et al., 2020).

Research on the dynamics of virtual teams has evolved beyond evaluating age, gender or education level towards cultural dimensions (Crowne, 2020). Cultural intelligence appears as one of the most important traits to be shared by virtual team members (Maduka et al., 2018; Shaik & Makhecha, 2019), as well as computer literacy and self-management (Dumitraşcu-Băldău & Dumitraşcu, 2019; Morley et al., 2015; Pozin et al., 2016; Radović-Marković et al., 2015). It is extremely important that everyone knows what their role in the project is and what is expected of them in order to have a cohesive team able to achieve good results (Henderson et al., 2016; Hoegl & Muethel, 2016), which enhances the importance of Project Management described ahead. Furthermore, Eubanks et al. (2016) showed that there is an increased need in teams for people who can transform ideas into actions more than for those that actually do the work, even though both roles are essential. Peer-evaluation and constant feedback have been identified as effective means to increase team spirit and performance (Maduka et al., 2018; Tavoletti et al., 2019).

Millennials are the future of the work-force and the first generation to be born in the midst of the technology era, therefore their inclusion in virtual teams has been widely researched (Graham et al., 2016; Orta-Castañon et al., 2018; Velez-Calle et al., 2020; Zakaria & Mohd Yusof, 2020). Zakaria and Mohd Yusof (2020) found them to be more dependent on cultural behaviours than on nationalities, and that they tend to be more appreciative of diversity than their older peers. Velez-Calle et al. (2020) highlight millennials' main difficulties as lack of coordination and poor understanding of their role, raising once more awareness for the importance of proper project management and role clarity.

3.2 Technology

Technology is the base sustaining virtual teams' communication (Pozin et al., 2016). Nevertheless, the selection of proper tools is crucial to achieve success (Lumseyfai, 2020). The selected technology has to fit the organisation and the team members' experience to avoid problems and misuse (Al Zain et al., 2018; Gibbs et al., 2017; Morley et al., 2015). The complexity of the tools can be a handicap to create effective virtual teams, and that is why it is so important to train members on the technologies that are going to be used (Dumitraşcu-Băldău & Dumitraşcu, 2019; Oraee et al., 2019).

Different technologies can be better for different situations (Bjorvatn & Wald, 2019; Shaik & Makhecha, 2019; Toro et al., 2020), for instance complex projects usually lead to preferred use of rich or semi-rich media (video-conferences, telephone calls or face-to-face meetings when possible). While synchronous communication is usually preferred (Rozman et al., 2017), asynchronous technology is perfectly capable of assisting the coordination process, conveyance of information and integration of individual tasks due to reprocessability (Großer & Baumöl, 2019). Furthermore, Aritz et al. (2018) showed that preferences may change during the course of the project. Bond-Barnard et al. (2016) compared the use of instant messaging with video conference and found the first was used on one-to-one communication for quick questions that arose during work, while the second was mostly used in group communications for open discussions.

The boom of social media started a new trend in virtual teams' research (Kanagarajoo et al., 2019; Mukherjee & Natrajan, 2017). Orta-Castañon et al. (2018) analyzed how social media can improve informal communication while also providing solid platforms to support group work. Not only can these tools increase empathy between team members that cannot meet face to face but for millennials now entering the work force these are already part of their daily lives. More research has been done on specific tools, such as Slack (Stray et al., 2019), or tools designed for new applications of virtual teams, such as scientific research groups (Artem et al., 2019).

3.3 Leadership

There is abundant research on what makes a good virtual team leader. Fernandez & Jawadi (2015) include in this role the coordination of the work flow between groups, and the scheduling of regular meetings to check up on progress and anticipate problems. Al Zain et al. (2018) added that the leader needs to clarify responsibilities, promote interdependence and independency between team members, and resolve conflicts. Ability

to provide constant feed-back, build trust and develop relationships with team members, reliability and encouragement of self-leadership have also been identified as key traits of virtual team leaders (Maduka et al., 2018; Morley et al., 2015).

Radović-Marković et al. (2015) believe that good virtual team leaders should already have experience in team leading before adding the virtual dimension. Moreover, Gibbs et al. (2017) advocate that virtual teams need formal leadership. On the other hand, Hoegl & Muethel (2016) and Iorio & Taylor (2015) defended that virtual teams need shared leadership. Leaders need to redefine their role as facilitators of initiatives proposed by team members and promote share leadership. Nevertheless, having more than one project coordinator has not resulted in a performance improvement (Eubanks et al., 2016). More recently, Purvanova et al. (2020) showed that in a higher virtuality setting leaders emerge by achievement whereas in a lower virtuality context inherent characteristics play a bigger role than achievement in leadership emergence.

3.4 Communication

Bad communication or lack of proper communication is one of the biggest problems faced by virtual teams (Blenke et al., 2017; Maduka et al., 2018; Pozin et al., 2016). These problems may arise due to a diverse combination of cultures, complexity of the project or inability to identify all the stakeholders (Pozin et al., 2016; Toro et al., 2020). Fuller, Vician and Brown (2016) have also showed that team members with computer mediated communications anxiety will participate less in all stages of a project.

Communication norm alignment has been linked with higher performances (Bond-Barnard et al., 2016; Henderson et al., 2016). While formal communication is responsible for building goal and expectation clarity among virtual teams, informal communication is essential to build relationships and develop trust among team members (Morley et al., 2015; Toro et al., 2020; Zakaria & Mohd Yusof, 2020). Shaik and Makhecha (2019) emphasize the importance of non work-related communication as a way to build empathy within the team on different time-zones, work conditions and expectations, helping to understand other teammates' challenges.

The necessity of face-to-face encounters is still one of the main focus of virtual teams' research, and findings have been contradictory. Blenke et al. (2017) and Toro et al. (2020) defend that face-to-face meetings are indispensable to achieve good results. On the other extreme, Olaisen & Revang (2017) found that it is possible to achieve effective

communication without offline interaction. Some defend that if possible, face-to-face meetings could benefit projects specially in the beginning (Al Zain et al., 2018; Fernandez & Jawadi, 2015).

3.5 Trust

Trust had already been accepted as a crucial aspect of virtual teams with positive impacts on performance and job satisfaction (Al Zain et al., 2018; Henderson et al., 2016; Shaik & Makhecha, 2019; Toro et al., 2020). However, not all projects are impacted by trust the same way. Tasks with higher interdependence can benefit more from trust between members, as well as teams with different levels of authority (De Jong et al., 2016).

Nevertheless, building trust is still a challenge either because of diversity or lack of face-to-face interaction (Maduka et al., 2018; Zakaria & Mohd Yusof, 2020). Cheng et al. (2021) found that trust depends on reputation, demonstrated work attitude, and clear and objective goal determination and that it develops easier in longer relationships. Al Zain et al. (2018) proposed that employing a system to keep the whole team updated on everyone's activities and their role in completing the project can enhance trust among team members. Feedback has also proved to be a valued asset in creating trust, as long as the feedback is positive (Jaakson et al., 2019). Robert (2016) found that only affective trust benefits from this internal monitoring.

Leaders need to be able to foster trust and maintain it during the project, which can be achieved by celebrating every small success from the start. It is important though, that team leaders understand that trust does not remain stable during the project and can decline even if achieved early in the team relationship (Jaakson et al., 2019). Research also found that trust is more related to the trustor's characteristics than to the trustee's actions. Guinalíu & Jordán (2016) found that physical attractiveness, empathy and perceived fairness of a leader are all traits that have a positive effect on trust.

3.6 Performance

Performance of virtual teams is still a hot topic of research, usually in combination with one or more of the other identified areas of research. Factors such as cultural diversity (Crowne, 2020), communication (Dumitraşcu-Băldău & Dumitraşcu, 2019; Mukherjee & Natrajan, 2017), motivation, engagement, proper governance and tools (Lumseyfai, 2020), peer review (Taras et al., 2019), trust (Jaakson et al., 2019; Paul et al., 2016; Pozin et al., 2016; Robert, 2016), reward and recognition (Ng & Tung, 2018), supportive

leadership (Fernandez & Jawadi, 2015; Pozin et al., 2016; Wickramasinghe & Nandula, 2015), team work and routines (Großer & Baumöl, 2017) and proficiency in virtual environments and databases (Graham et al., 2016; Graham & Daniel, 2017) have all showed to positively impact performance. Großer & Baumöl (2017) raised awareness on how hierarchy can influence performance; although it is widely accepted that role clarity and proper management are indispensable to achieve good results in virtual teams, they advise against creating hierarchies between locations when teams are disperse across nations or continents.

On the other hand, forced commitment (Daniel et al., 2017), dissatisfaction with communication technologies (Blenke et al., 2017), computer mediated communication anxiety (Fuller, M., Vician, C & Brown, 2016), lack of training (Gheni et al., 2016) and relationship conflict can impair virtual team performance.

3.7 Knowledge

Knowledge management and creativity are important for every team but hard to accomplish due to the short-nature of projects, which makes it even harder to achieve in virtual projects. First, organisational culture is essential to achieve efficient knowledge management practices (Hosseini et al., 2015). These practices can be divided into several stages; for instance Ramalingam & Mahalingam (2018) identified seven different practices of knowledge sharing: querying, displaying clash, assimilating, discussing, simulating, representing and approval. Similarly, Hosseini et al. (2015) divide the diffusion of innovation into six stages: identification, evaluation, commitment, preparation, use and re-evaluation. Olaisen & Revang (2017) defend that as long as the communication platforms allow to share formal and informal knowledge, problem solving in diverse teams will lead to innovation.

Faegri et al. (2016) studied different levels of knowledge, distinguishing between task related, team related, process-related and goal related knowlededge. The authors also concluded that the last one is the harder to establish in virtual teams due to weaker social bonds. Castellano et al. (2017) differentiates three groups of techniques for knowledge sharing: individual-based creativity techniques, such as mind maps, good for knowledge sharing; group-level techniques, such as brainstorming, ideal for iterative context; and eco-system techniques, such as innovation funnel, appropriate for co-creation processes.

3.8 Project Management

The coordination and planning of virtual projects have been steadily gaining importance. In 2015, Morley et al. (2015) had already identified the importance of having someone responsible for maintaining activities and providing support and feedback to virtual teams. Furthermore, the authors raise awareness for proper training; it is important not only to provide team members with good working tools but also to train them in order to make sure that these are fully utilized in a similar way which allows all members to be entirely involved. However, only more recently have coordination practices been positively associated to performance (Davidaviciene et al., 2020; Lumseyfai, 2020). Lack of structure and conflicting roles, such as Project manager and IT manager can harm the performance of virtual teams (Oraee et al., 2019). Projects developed by virtual teams need special attention in terms of planning, ensuring adequate risk management, and proper scope and requirements definition (Gallego et al., 2021). Proper definition of requirements and scope were considered the areas where the use of virtual teams has bigger influence on project planning, and there is still room for improvement in order to reach their full potential.

The relationship between project management and technology has also been studied (Großer & Baumöl, 2019; Rozman et al., 2017). While Watfa & Todd (2017) found that social networks could impair performance, by disturbing the team productivity, Watfa and Todd (2017) show this is rarely the case. Kanagarajoo et al. (2019) studied how social media can be used to improve project management practices. Ng and Tung (2018) raise awareness to the benefits of proper recognition and reward, how they can improve performance and team spirit and can serve different purposes in different project stages. Chamakiotis et al. (2020) found that the time-span of a project influences the coordination needed. Shorter projects should be led with tighter coordination even though this does not foster collaboration behaviors, whereas longer projects can be controlled loosely promoting a more effective collaboration.

3.9 Engagement

It is important that virtual team members are committed to their projects, nevertheless if this commitment is forced it can have a negative impact on performance (Shaik & Makhecha, 2019). Usually it is the leaders' responsibility to create engagement among their teams, which can be achieved by properly knowing the team and choosing appropriate communication means (Iorio & Taylor, 2015; Toro et al., 2020).

Nevertheless, Panteli et al. (2019) found that it is possible to foster engagement only through asynchronous communication, raising awareness to the importance of frequency and content over the technology used. Virtual team members need proper support to create engagement and this is an ongoing process throughout the course of any project.

Finally, it was possible to identify some strategies to promote engagement in all phases. Project clarity, financial benefits, and proper introduction between team members are good ways to develop engagement, while continuous updates can be enough to support it. At last, celebrating the end of the project and reflecting on lessons learnt is an effective way to nourish engagement (Panteli et al., 2019).

Chapter 4. Discussion

Although virtual teams have existed for a long time, new topics are surfacing as technology evolves and some of the old problems are resolved. This first research question was to unveil the current trends of virtual teams' research. All the selected articles relate to one of nine subjects: Team dynamics, Technology, Leadership, Communication, Trust, Performance, Knowledge, Project Management and Engagement.

Topic	Gilson et al. (2015)	Findings
Research Design	Plenty of research done with students and some in-depth case studies	Preference for experiences and surveys, still plenty of research done with students
Team inputs / Team dynamics	Team composition and personality traits of members	Effect of different cultural aspects, cultural intelligence
Technology	Focus on traditional options: email, chat and discussion boards	Different technologies for different ends, beginning of social media research
Leadership	Leader behavior and traits	Introduction of shared leadership
Communication	Only as a mediator of team effectiveness and efficiency	Comparison between formal and informal communication, still no consensus on the need of face-to-face communication
Trust	How to develop trust and why	Continuation of how to develop trust, importance of trust in different stages of the project
Performance	Focus on how to measure performance	Identification of aspects that affect performance and the respective direction of the effect
Knowledge	Knowledge sharing briefly analyzed as mediator of team quality	Processes and technologies that support knowledge management cycles
Project management	Included "Processes and planning" as opportunity	Importance of planning and different member roles
Study settings	Opportunity	Increase of research on architecture, construction and engineering projects
Generational impacts	Opportunity	Studies focusing specifically on Millennials
Methodological considerations	Opportunity	Longitudinal studies
Subgroups	Opportunity	Performance dependent on communication patterns more than creation context

| Team member well being | Opportunity | Mention of anxiety effects among team members |

Table 6 – Comparison of findings with Gilson et al. (2015)

Some of these subjects had already been identified as trends by Gilson et al. (2015), but it was possible to add different findings. The comparisons with previous findings are summarized in table 6 answering the second research question. Although many authors still focus on the diversity of cultures among teams, there is a new awareness to analyze the consequences of different levels of diversity separately (Taras et al., 2019). Furthermore, it can be seen that research in this area moved from measuring virtuality towards understanding the different roles in the team (Eubanks et al., 2016).

Technology will always be a main topic related to virtual teams. Nevertheless, there are less studies focusing only on the "traditional" options, such as email, and more evaluating the capabilities of social media (Mukherjee & Natrajan, 2017; Orta-Castañon et al., 2018).

Leadership is still considered from two different perspectives, which kind of leadership is more efficient and which qualities make a good leader. A new aspect introduced by Iorio and Taylor (2015) is the concept of shared leadership, changing the perspective of what a leader in a virtual team should be.

Research on Communication has not changed much, it is still regarded as one of the weak points of virtual teams, where miscommunications and other problems can arise. Furthermore, there is still no consensus regarding the need for face-to-face communication to achieve a successful project (Al Zain et al., 2018; Blenke et al., 2017; Fernandez & Jawadi, 2015; Olaisen & Revang, 2017).

Trust is still regarded as a very important predictor of performance and highly linked with communication. The way to build trust is still being analyzed; it was possible to add some ideas to those already summarized by Gilson et al. (2015) and the importance of the leader in fostering this feeling among team members was emphasized.

The Performance of virtual teams is still being looked at; some studies confirm key factors identified in the past such as training (Dumitraşcu-Băldău & Dumitraşcu, 2019), and a consensus is starting to present among researchers regarding the most important factors to achieve or impair performance.

Knowledge management had already been identified as an emerging topic and it has matured during the past years. The processes and technologies that support the creation

and diffusion of knowledge have been studied and some of the major drawbacks of virtual teams pointed out. Creativity and how to promote creative work among virtual teams is another topic of increased interest in a recent past (Castellano et al., 2017).

Project Management and Engagement are two new topics that were identified by Gilson et al. (2015) as opportunities. Even though they are quite new it is already possible to look at the relationship between project management and social media and emphasize the importance of proper coordination and planning (Chamakiotis et al., 2020; Gallego et al., 2021). It is already possible to isolate some strategies in order to increase engagement among virtual teams which is increasingly important in the current dynamic market to try to reduce employee turnover (Panteli et al., 2019; Toro et al., 2020).

As suggested by Gilson et al. (2015) there are already several studies focused on millennials and their impact on virtual teams. Furthermore, Iorio and Taylor (2015) proposed shared leadership between two generations in order to combine the technological proficiency of younger generations with the formal knowledge and management of older ones. Some papers also present longitudinal studies, such as Jaakson et al. (2019), on the effects of trust. The effect of subgroups in virtual teams had a starting point with Gibbs et al. (2017, 2020); the effects on project performance depend mostly on the communication between groups and not on how these are created. Team adaptation has not been addressed independently as a topic, but research done on team dynamics and technology raises awareness to the importance of using the tools that best fit the teams' necessities (Al Zain et al., 2018; Gibbs et al., 2017). Despite the research done on Performance and Engagement focus on job satisfaction, team-member well-being still needs some development. Nevertheless, the work of Fuller, Vician and Brown (2016) regarding the effect of computed mediated anxiety on communication is a start.

Answering the third research question, most of the opportunities identified by Gilson et al. (2015) are already being researched. However, member mobility has not yet been addressed in literature. Mobility as a topic is even more important nowadays when working from home or from other places than the office became the new normal. It is important to understand the influence that new perceptions of the workplace can have on project performance and team dynamics. The sustainable facet of virtual teams raised by Olaisen and Revang (2017) should also be developed, in order to understand what are the benefits it can bring to organisations besides the access to more specialized expertise and planet protection. Regarding technology, it is important that literature is kept up to date

with the recent tools that can facilitate either communication, coordination or knowledge management in virtual teams. In summary, answering the last research question, future research on virtual topics should focus on mobility, new workplace perceptions, sustainability and keeping up with new technologies.

Chapter 5. Conclusion

Virtual teams have been employed by many organisations by several years now. Nevertheless, there is still much to learn on how to make the best of these diverse teams. The goal of this research was to build on the previous work of Gilson et al. (2015) and understand the current trends of virtual teams project research. It was possible to identify nine different topics of research; although seven had already been mentioned by previous work it was still possible include new perspectives on the subject.

Team dynamics, technology, communication, trust, leadership and performance are research topics that will always foster new perspectives of analysis as organisations and their practices evolve. Knowledge management is still a relative new subject with space for improvements and the development of creative processes within virtual teams is still in an early stage of research. The engagement and well-being of team members is very important to avoid employee turnover; it could be useful to measure and quantify these effects more precisely. Coordination, planning and project management need further research to better fit the needs of virtual teams; one cannot just try to adjust virtually the procedures of co-located teams. Finally, sustainability is a big concern nowadays, and a perspective that still needs to be explored.

This research compiles a set of very relevant papers in the area of project virtual teams and delivers findings that allow to show what is the main focus of these works. Being agile environments very dynamic places, they benefit / depend greatly on innovation. Today, organisations are being pushed to more situations where project teams must work in virtual environments. This has been confirmed by the research form Sampaio et al. (2021) that identified virtual teams as an important component of agile systems. The results give a solid integration of the more recent and relevant knowledge about virtual teams that can provide very important insight that should help agile system managers improve their processes.

This article also highlights the main success factors identified of large-scale agile transformations, as well as identifying the main challenges of large-scale agile transformations for future investigations.

Also, for Agile Project Management practitioners, it is intended to gain an understanding of the most efficient practices for managing agile systems and how to ensure proper conditions for their implementation.

One of the criticisms of Agile system solutions is that they are too rigid and too bureaucratic (Schwaber, 2015). On the other hand, overly hierarchical levels can block the adoption of Agile principles. For that to happen it is necessary to empower the management team to be more involved in planning sessions and scope reviews and to get frequent feedback from your team to help it circumvent obstacles and increase efficiency (Tengshe & Noble, 2007). Self-organized teams, one of the core principles of agile systems, need to be included in a flexible structure that allows projects to cooperate with each other in response to new challenges (Sweetman & Conboy, 2018). The techniques identified here are defined by Korhonen, (2013) as a 'basic' set of agile practices to consider in Agile Transformations.

Agile methodology has the intention of providing a framework that can deal with future requirements changes, that can come for inside (new customer needs) or outside (changes in the environment) the project. Agile provides flexibility to accommodate these changes and its impact is cost, scope and quality of the delivered product / service (Hayat et al., 2019). The success of the implementation of Agile methodology in project management is support is a set of factors that we highlight: people, training, customers, company culture, planning and the size, capability, and motivation of the teams (Chow and Cao, 2008). Here our findings showed an evolution to the Gilson model as cultural dimension is identified a very relevant and not focusing only on personality traits of team members.

To implement this methodology, PMI (2014) presents the following steps: identification of appropriate methodology, identification of enterprise specific requirements, adaptation, and implementation of methodology. The need for project management to be capable of a high level of adaptation in items like team, internal and external environment, objectives, maturity levels and previous knowledges makes Agile important factor of success (Campanelli and Parreiras, 2015). Concerning the team, it's important to look at size, distribution, turnover, previous cooperation, good cooperation, domain/tool/technology/process knowledges (Kalus and Kuhrmann, 2013). Even if Agile methodology have already proved its value in project management, Rasnacis and Berzisa (2017) collected a set of problems that may impact in the implementation of Agile methodology to project management. The same authors notice the importance of having a method to improve the team motivation, effectiveness, and self-organization. Here our findings were clear in saying that leadership is more than the leader behaviour and traits and a shared leadership is needed to help the development of Agile teams.

As can be concluded, teams and its member are in the core of Agile. Sampaio et al. (2021) stated that in an agile environment must enable software engineers to work efficiently, to collaborate, and to share skills. Here two findings are relevant and that we think bring an evolution to the Gilson model: the importance of team well-being – for Gilson et all (0215) just an opportunity. This research showed that anxiety effect among team members could have a major impact in project implementation; Communication is seen in Agile methodology as a critical factor for success. In the Gilson model communication is view as a mediator for team effectiveness and efficiency. The research findings showed that communication could also have an important role in reinforcing team self-organization and in knowledge sharing. Ashmore et al. (2018) found that decision flexibility was also a very relevant in Agile implementation. Suomalainen et al. (2015) looked at planning and a dimension of Agile and found that continuous planning is not commonly adopted and applied throughout organizations and that it currently involves only a certain kind of planning (e.g., release planning). The results of their showed that the main elements of continuous planning are strongly related and that continuous planning gains increase importance in turbulent business environments. The findings were quite clear in reinforce the importance of planning and of different roles – this is also an evolution to the Gilson model that viewed planning as an opportunity.

The present study only included two databases and English written papers; these filters could be eliminating some pertinent papers written in other languages or not included in the selected databases. Nevertheless, it was possible to provide a systematic literature review on project virtual teams, substantially more updated that the ones currently available. The topics identified can be a starting point for future research, giving other authors an overview of what is already known and which aspects could benefit from further investigation.

Chapter 6. References

Al Zain, N.-L., Vasilache, S., & Incze, C. B. (2018). The significance and managerial challenges of virtual teamworking. *Proceedings of the International Conference on Business Excellence*, *12*(1), 25–33. https://doi.org/10.2478/picbe-2018-0004

Aritz, J., Walker, R., & Cardon, P. W. (2018). Media Use in Virtual Teams of Varying Levels of Coordination. *Business and Professional Communication Quarterly*, *81*(2), 222–243. https://doi.org/10.1177/2329490617723114

Artem, K., Holoshchuk, R., Kunanets, N., Shestakevysh, T., & Rzheuskyi, A. (2019). Information Support of Scientific Researches of Virtual Communities on the Platform of Cloud Services. In *Advances in Intelligent Systems and Computing* (Vol. 871). Springer International Publishing. https://doi.org/10.1007/978-3-030-01069-0_22

Ashmore, S., Townsend, A., DeMarie, S., Mennecke, B. (2018). An exploratory examination of modes of interaction and work in waterfall and agile teams. International Journal of Agile Systems and Management. Volume: 11(1), pp. 67-102

Batarseh, F. S., Daspit, J. J., & Usher, J. M. (2018). The collaboration capability of global virtual teams: relationships with functional diversity, absorptive capacity, and innovation. *International Journal of Management Science and Engineering Management*, *13*(1), 1–10. https://doi.org/10.1080/17509653.2016.1275865

Bjorvatn, T., & Wald, A. (2019). Complexity as a Driver of Media Choice: A Comparative Study of Domestic and International Teams. *International Journal of Business Communication*. https://doi.org/10.1177/2329488419874367

Blenke, L., Gosavi, A., & Daughton, W. (2017). Attitudes towards Face-To-Face Meetings in Virtual Engineering Teams : Perceptions from a Survey of Defense Projects. *International Journal of Project Organisation and Management*, *9*(2).

Bond-Barnard, T., Fletcher, L., & Steyn, H. (2016). Exploring the influence of instant messaging and video conferencing on the quality of project communication. *Acta Structilia*, *23*(1). https://doi.org/10.18820/24150487/as23i1.2

Campanelli AS, Parreiras FS. (2015). Agile methods tailoring – A systematic literature review. J Syst Softw.110. p. 85–100.

Castellano, S., Davidson, P., & Khelladi, I. (2017). Creativity techniques to enhance knowledge transfer within global virtual teams in the context of knowledge-intensive enterprises. *Journal of Technology Transfer*, *42*(2), 253–266. https://doi.org/10.1007/s10961-016-9509-0

Chamakiotis, P., Boukis, A., Panteli, N., & Papadopoulos, T. (2020). The role of temporal coordination for the fuzzy front-end of innovation in virtual teams. *International Journal of Information Management*, *50*(June 2019), 182–190. https://doi.org/10.1016/j.ijinfomgt.2019.04.015

Cheng, X., Fu, S., & de Vreede, G. J. (2021). Determinants of trust in computer-mediated offshore software-outsourcing collaboration. *International Journal of Information Management*, *57*(April), 102301. https://doi.org/10.1016/j.ijinfomgt.2020.102301

Chow T, Cao D-B. (2008). A survey study of critical success factors in agile software projects. J Syst Softw. 81(6). p. 961–971.

Crowne, K. A. (2020). Does National Culture Influence Peer Evaluations on Global Virtual Teams? *Journal of Teaching in International Business*, *31*(3), 191–213. https://doi.org/10.1080/08975930.2020.1831421

Daniel, H., Graham, C., & Doore, B. (2017). Virtual teamwork and commitments impact on project quality. *International Journal of E-Collaboration*, *13*(4), 42–58. https://doi.org/10.4018/IJeC.2017100103

Davidaviciene, V., Majzoub, K. Al, & Meidute-Kavaliauskiene, I. (2020). Factors affecting decision-making processes in virtual teams in the UAE. *Information (Switzerland)*, *11*(10), 1–13. https://doi.org/10.3390/info11100490

De Jong, B. A., Dirks, K. T., & Gillespie, N. (2016). Trust and team performance: A meta-analysis of main effects, moderators, and covariates. *Journal of Applied Psychology*, *101*(8), 1134–1150. https://doi.org/10.1037/apl0000110

Dumitraşcu-Băldău, I., & Dumitraşcu, O. (2019). Research on the behavior of factors that influence the international virtual project team performance, using data modeling techniques. *Sustainability (Switzerland)*, *11*(3). https://doi.org/10.3390/su11030607

Eubanks, D. L., Palanski, M., Olabisi, J., Joinson, A., & Dove, J. (2016). Team dynamics in virtual, partially distributed teams: Optimal role fulfillment. *Computers in Human Behavior*, *61*, 556–568. https://doi.org/10.1016/j.chb.2016.03.035

Faegri, T. E., Stray, V., & Moe, N. B. (2016). Shared knowledge in virtual software teams: A preliminary framework. *Proceedings - 11th IEEE International Conference on Global Software Engineering, ICGSE 2016*, 174–178. https://doi.org/10.1109/ICGSE.2016.22

Fernandez, D. B., & Jawadi, N. (2015). Virtual R&D project teams: From E-leadership to performance. *Journal of Applied Business Research*, *31*(5), 1693–1708. https://doi.org/10.19030/jabr.v31i5.9384

Fuller, M., Vician, C & Brown, S. (2016). Longitudinal Effects of Computer-Mediated Communication Anxiety on Interaction in Virtual Teams. *IEEE Transactions on Professional Communication*, *59*(3), 166–185.

Gallego, J. S., Ortiz-Marcos, I., & Romero Ruiz, J. (2021). Main challenges during project planning when working with virtual teams. *Technological Forecasting and Social Change*, *162*(September 2020), 120353. https://doi.org/10.1016/j.techfore.2020.120353

Gheni, A. Y., Jusoh, Y. Y., Jabar, M. A., & Ali, N. M. (2016). Factors affecting global virtual teams' performance in software projects. *Journal of Theoretical and Applied Information Technology*, *92*(1), 90–97.

Gibbs, J. L., Boyraz, M., Sivunen, A., & Nordbäck, E. (2020). Exploring the discursive construction of subgroups in global virtual teams. *Journal of Applied Communication Research*, *0*(0), 1–23. https://doi.org/10.1080/00909882.2020.1851745

Gibbs, J. L., Sivunen, A., & Boyraz, M. (2017). Investigating the impacts of team type and design on virtual team processes. *Human Resource Management Review*, *27*(4), 590–603. https://doi.org/10.1016/j.hrmr.2016.12.006

Gilson, L. L., Maynard, M. T., Jones Young, N. C., Vartiainen, M., & Hakonen, M. (2015). Virtual Teams Research: 10 Years, 10 Themes, and 10 Opportunities. *Journal of Management*, *41*(5), 1313–1337. https://doi.org/10.1177/0149206314559946

Graham, C. M., & Daniel, H. (2017). Millennial's virtual teamwork and technical proficiencies impact on project quality: Is commitment required in virtual team projects? *International Journal of E-Collaboration*, *13*(1), 10–26.

https://doi.org/10.4018/IJeC.2017010102

Graham, C. M., Daniel, H., & Doore, B. (2016). Millennial teamwork and technical proficiency's impact on virtual team effectiveness: implications for business educators and leaders. *International Journal of E-Collaboration*, *12*(3), 34–50. https://doi.org/10.4018/IJeC.2016070103

Großer, B., & Baumöl, U. (2017). Why virtual teams work - State of the art. *Procedia Computer Science*, *121*, 297–305. https://doi.org/10.1016/j.procs.2017.11.041

Großer, B., & Baumöl, U. (2019). Work processes in virtual teams: A matching algorithm for their technological facilitation. *ICEIS 2019 - Proceedings of the 21st International Conference on Enterprise Information Systems*, *2*(January), 73–83. https://doi.org/10.5220/0007672400730083

Guinalíu, M., & Jordán, P. (2016). Building trust in the leader of virtual work teams. *Spanish Journal of Marketing - ESIC*, *20*(1), 58–70. https://doi.org/10.1016/j.reimke.2016.01.003

Hayat, F., Rehman, A. U., Arif, K. S., Wahab, K., & Abbas, M. (2019, July). The influence of agile methodology (Scrum) on software project management. In 2019 20th IEEE/ACIS International

Henderson, L. S., Stackman, R. W., & Lindekilde, R. (2016). The centrality of communication norm alignment, role clarity, and trust in global project teams. *International Journal of Project Management*, *34*(8), 1717–1730. https://doi.org/10.1016/j.ijproman.2016.09.012

Hoegl, M., & Muethel, M. (2016). Enabling Shared Leadership in Virtual Project Teams: A Practitioners' Guide. *Project Management Journal*, *47*(1), 7–12. https://doi.org/10.1002/pmj.21564

Hosseini, M. R., Chileshe, N., Zuo, J., & Baroudi, B. (2015). Adopting global virtual engineering teams in AEC Projects : A qualitative meta-analysis of innovation diffusion studies. *Construction Innovation*, *15*(2), 151–179. https://doi.org/10.1108/CI-12-2013-0058

Iorio, J., & Taylor, J. E. (2015). Precursors to engaged leaders in virtual project teams. *International Journal of Project Management*, *33*(2), 395–405. https://doi.org/10.1016/j.ijproman.2014.06.007

Jaakson, K., Reino, A., & McClenaghan, P. B. (2019). The space between – linking trust with individual and team performance in virtual teams. *Team Performance Management*, *25*(1–2), 30–46. https://doi.org/10.1108/TPM-03-2018-0024

Kalus G, Kuhrmann M. (2013). Criteria for software process tailoring: a systematic review. In: Proceedings of the 2013 International Conference on Software and System Process. New York: ACM Press; p. 171-180.

Kanagarajoo, M. V., Fulford, R., & Standing, C. (2019). The contribution of social media to project management. *International Journal of Productivity and Performance Management*, *69*(4), 834–872. https://doi.org/10.1108/IJPPM-09-2018-0316

Korhonen, K. (2013). Evaluating the impact of an agile transformation: a longitudinal case study in a distributed context. *Software Quality Journal*. 21, 99–624.

Lumseyfai, J. (2020). A Four-Pillared Holistic Model for Improving Performance in Engineering Virtual Project Teams. *EMJ - Engineering Management Journal*, *32*(2), 107–119. https://doi.org/10.1080/10429247.2019.1672409

Maduka, N. S., Edwards, H., Greenwood, D., Osborne, A., & Babatunde, S. O. (2018). Analysis of competencies for effective virtual team leadership in building successful organisations. *Benchmarking*, *25*(2), 696–712. https://doi.org/10.1108/BIJ-08-2016-0124

Mignone, G., Hosseini, M. R., Chileshe, N., & Arashpour, M. (2016). Enhancing collaboration in BIM-based construction networks through organisational discontinuity theory: a case study of the new Royal Adelaide Hospital. *Architectural Engineering and Design Management*, *12*(5), 333–352. https://doi.org/10.1080/17452007.2016.1169987

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS Medicine*, *6*(7), e1000097. https://doi.org/10.1371/journal.pmed.1000097

Morley, S., Cormican, K., & Folan, P. (2015). An analysis of virtual team characteristics: A model for virtual project managers. *Journal of Technology Management and Innovation*, *10*(1), 188–203. https://doi.org/10.4067/S0718-27242015000100014

Mukherjee, D., & Natrajan, N. S. (2017). Comparative Analysis of Social Media Tool Used in Software Projects Deploying Virtual Teams. *Vision*, *21*(4), 397–409.

https://doi.org/10.1177/0972262917733180

Ng, P. K., & Tung, B. (2018). The importance of reward and recognition system in the leadership of virtual project teams: a qualitative research for the financial services sector. *Journal of Transnational Management*, *23*(4), 198–214. https://doi.org/10.1080/15475778.2018.1512827

Olaisen, J., & Revang, O. (2017). Working smarter and greener: Collaborative knowledge sharing in virtual global project teams. *International Journal of Information Management*, *37*(1), 1441–1448. https://doi.org/10.1016/j.ijinfomgt.2016.10.002

Opdenakker, R. J. G. (Raymond J. G. ., & Cuypers, C. P. M. (Carin P. M. . (2019). *Effective virtual project teams : a design science approach to building a strategic momentum.*

Oraee, M., Hosseini, M. R., Edwards, D. J., Li, H., Papadonikolaki, E., & Cao, D. (2019). Collaboration barriers in BIM-based construction networks: A conceptual model. *International Journal of Project Management*, *37*(6), 839–854. https://doi.org/10.1016/j.ijproman.2019.05.004

Orta-Castañon, P., Urbina-Coronado, P., Ahuett-Garza, H., Hernández-de-Menéndez, M., & Morales-Menendez, R. (2018). Social collaboration software for virtual teams: case studies. *International Journal on Interactive Design and Manufacturing*, *12*(1), 15–24. https://doi.org/10.1007/s12008-017-0372-5

Panteli, N., Yalabik, Z. Y., & Rapti, A. (2019). Fostering work engagement in geographically-dispersed and asynchronous virtual teams. *Information Technology and People*, *32*(1), 2–17. https://doi.org/10.1108/ITP-04-2017-0133

Paul, R., Drake, J. R., & Liang, H. (2016). Global Virtual Team Performance: The Effect of Coordination Effectiveness, Trust, and Team Cohesion. *IEEE Transactions on Professional Communication*, *59*(3), 186–202. https://doi.org/10.1109/TPC.2016.2583319

Plotnick, L., Hiltz, S. R., & Privman, R. (2016). Ingroup Dynamics and Perceived Effectiveness of Partially Distributed Teams. *IEEE Transactions on Professional Communication*, 59(3), 203–229.

PMI. (2014) Implementating Organizational Project Management: A practice guide. PMI.
90

Pozin, M. A. A., Nawi, M. N. M., & Romle, A. R. (2016). Effectiveness of virtual team for improving communication breakdown in IBS project delivery process. *International Journal of Supply Chain Management*, *5*(4), 121–130.

Purvanova, R. K., Charlier, S. D., Reeves, C. J., & Greco, L. M. (2020). Who Emerges into Virtual Team Leadership Roles? The Role of Achievement and Ascription Antecedents for Leadership Emergence Across the Virtuality Spectrum. *Journal of Business and Psychology*. https://doi.org/10.1007/s10869-020-09698-0

Radović-Marković, M., Marković, D., & Radulović, D. (2015). Critical competencies of virtual team members and its managers for business success. *International Review*, *3*(1/2), 17–25.

Ramalingam, S., & Mahalingam, A. (2018). Knowledge coordination in transnational engineering projects:a practice-based study. *Construction Management and Economics*, *36*(12), 700–715. https://doi.org/10.1080/01446193.2018.1498591

Rasnacis, A., & Berzisa, S. (2017). Method for adaptation and implementation of agile project management methodology. Procedia Computer Science, 104, 43-50.

Robert, L. P. (2016). Monitoring and trust in virtual teams. *Proceedings of the ACM Conference on Computer Supported Cooperative Work, CSCW*, *27*, 245–259. https://doi.org/10.1145/2818048.2820076

Rozman, T., Stjepanovic, T. K., & Raspor, A. (2017). An analysis of web-based document management and communication tools usage among project managers. *International Journal of Human Capital and Information Technology Professionals*, *8*(1), 1–24. https://doi.org/10.4018/IJHCITP.2017010101

Schwaber, K. (2015). Nexus is the exoskeleton of SCALED SCRUM [Online]. Available: https://www.scrum.org/Resources/The-Nexus-Guide

Shaik, F. F., & Makhecha, U. P. (2019). Drivers of Employee Engagement in Global Virtual Teams. *Australasian Journal of Information Systems*, *23*(March), 0–45. https://doi.org/10.3127/ajis.v23i0.1770

Stray, V., Moe, N. B., & Noroozi, M. (2019). Slack me if you can! Using Enterprise Social Networking Tools in Virtual Agile Teams. *ACM/IEEE 14th International Conference on Global Software Engineering*, *9*.

Sampaio, S. C., Bastos, T. A., & Marinho, M. L. (2021). Soft skills for newborn software engineers in agile teams. *International Journal of Agile Systems and Management*, *14*(1), 27-52. https://doi.org/10.1504/IJASM.2021.114904

Sweetman, R. & Conboy, K. (2018). Portfolios of Agile Projects: A Complex Adaptive Systems' Agent Perspective. *Project Management Journal*. 49 (6), 1-21.

Suomalainen, T., Kuusela, R., Tihinen, M. (2015). Continuous planning: An important aspect of agile and lean development. International Journal of Agile Systems and Management. Volume: 8(2), pp. 132-162

Taras, V., Baack, D., Caprar, D., Dow, D., Froese, F., Jimenez, A., & Magnusson, P. (2019). Diverse effects of diversity: Disaggregating effects of diversity in global virtual teams. *Journal of International Management*, *25*(4), 100689. https://doi.org/10.1016/j.intman.2019.100689

Tavoletti, E., Stephens, R. D., & Dong, L. (2019). The impact of peer evaluation on team effort, productivity, motivation and performance in global virtual teams. *Team Performance Management*, *25*(5–6), 334–347. https://doi.org/10.1108/TPM-03-2019-0025

Tengshe, A. & Noble, S. (2007). Establishing the Agile PMO - Managing variability across Projects and Portfolios. Conference: Agile 2007

Toro, M. M., Elguezabal, I. Z., & Anacabe, G. G. (2020). Engaging global virtual teams: A theoretical framework proposal on employee engagement predictors in global virtual settings. *International Journal of Networking and Virtual Organisations*, *23*(1), 17–38. https://doi.org/10.1504/IJNVO.2020.107953

Velez-Calle, A., Mariam, M., Gonzalez-Perez, M. A., Jimenez, A., Eisenberg, J., & Santamaria-Alvarez, S. M. (2020). When technological savviness overcomes cultural differences: millennials in global virtual teams. *Critical Perspectives on International Business*, *16*(3), 279–303. https://doi.org/10.1108/cpoib-01-2018-0012

Watfa, M., & Todd, C. (2017). Implications of virtual project management on project management processes. *2016 6th International Conference on Innovative Computing Technology, INTECH 2016*, 58–62. https://doi.org/10.1109/INTECH.2016.7845127

Wickramasinghe, V., & Nandula, S. (2015). Diversity in team composition, relationship conflict and team leader support on globally distributed virtual software development team performance. *Strategic Outsourcing*, *8*(2–3), 138–155. https://doi.org/10.1108/SO-02-2015-0007

Zakaria, N., & Mohd Yusof, S. A. (2020). Crossing Cultural Boundaries Using the Internet: Toward Building a Model of Swift Trust Formation in Global Virtual Teams. *Journal of International Management*, *26*(1), 100654. https://doi.org/10.1016/j.intman.2018.10.004

Appendix

Table 1 – List of papers (Source: Own elaboration)

Citation	Sample	Methodology	Country	Industry
Cheng, Fu & de Vreede (2021)	A team composed of two sub-teams: US and Chinese	Case Study	United States, China	IT
Gallego et al. (2021)	Project managers and project team members	Survey	Spain, Germany	Unknown
Zakaria & Mohd Yusof (2020)	X-Cultural project, more than 100 universities	Experimental	Multiple	Management
Chamakiotis et al. (2020)	Two Industry-Academy collaboration projects	Case Study	Multiple	Engineering
Crowne (2020)	X-Cultural project, more than 100 universities	Experimental	Multiple	Management
Velez-Calle et al. (2020)	University students from multiple universities and countries	Experimental	Multiple	Management
Gibbs et al. (2020)	Two globally distributed teams of students	Experimental	Multiple	Several
Toro et al. (2020)	-	Conceptual Model	-	-
Purvanova et al. (2020)	Sample of college students	Experimental	United States	Psychology and Business
Davidaviciene et al. (2020)	Members of virtual teams in ICT consultancy	Survey	United Arab Emirates	IT
Lumseyfai (2020)	Engineers asked to answer a questionnaire considering the last project performed in a virtual project team	Experiment	Multiple	Engineering
Artem et al. (2019)	-	Conceptual Model	-	Science Research
Oraee et al. (2019)	-	Literature Review	-	Construction
Stray et al. (2019)	Team members for four agile virtual teams	Interviews	Norway and Poland	IT
Taras et al. (2019)	Multiple students from several universities	Experiment	Multiple	Unknown

Panteli et al. (2019)	Multiple projects, some experimental with students and some in the industry	Interviews	Multiple	Engineering
Jaakson et al. (2019)	International virtual student teams from four universities	Experimental	Finland, Estonia, Latvia And Russia	Business
Tavoletti et al. (2019)	X-Cultural project, more than 100 universities	Experimental	Multiple	Management
Kanagarajoo et al. (2019)	-	Survey	Unknown	Several
Dumitraşcu-Băldău et al. (2019)	Professionals from mainly IT, telecom, e-commerce, education, and outsourcing fields	Survey	Multiple	Several
Großer & Baumöl (2019)	Multiple professionals across several industries	Interviews	Unknown	Several
Bjorvatn & Wald (2019)	Project-oriented organizations and governmental agencies funding public and private projects	Survey	Norway And Sweden	Several
Shaik & Makhecha (2019)	Global organisation with head-quarters in India	Interviews	Multiple	Several
Orta-Castañon et al. (2018)	Multiple teams of students	Case Study	Multiple	Engineering
Aritz et al. (2018)	Multiple teams of undergraduated students	Experiment	United States	Business Communication
Maduka et al. (2018)	Company producing plastic with cuting edge technology	Case Study	Nigeria	Manufacturing
Ramalingam & Mahalingam (2018)	Multinational engineering companies with subsidiaries in India	Interviews	Multiple	Engineering
Ng & Tung (2018)	Experienced project team leaders	Interviews	China	Financial
Al Zain et al. (2018)	Tourist workers that have been involved in project virtual teams	Survey	Romania	Tourism
Batarseh et al. (2018)	Teams of design and engineers	Survey	Multiple	IT

	working across Asia, Europe and the United States			
Olaisen & Revang (2017).	Virtual global inter-organisation virtual teams	Case Study	Multiple	Several
Gibbs et al. (2017)	-	Literature Review	-	-
Castellano et al. (2017)	-	Conceptual Model	-	-
Großer & Baumöl (2017)	-	Literature Review	-	-
Rozman et al. (2017)	Project managers or administrators	Interviews	Multiple	Several
Mukherjee & Natrajan (2017)	Members of virtual teams in ICT consultancy	Survey	India	IT
Graham & Daniel (2017)	Undergraduate business students	Experimental	United States	Business
Daniel et al. (2017)	Sophomore students	Experimental	United States	Business
Watfa & Todd (2017)	Project managers and project team members	Interview	Multiple	Several
Blenke et al. (2017)	Employees in an aero-space-defense corporation	Survey	United States	Engineering
Mignone et al. (2016)	New Royal Adelaide Hospital	Case Study	Australia	Construction
Henderson et al.. (2016)	Global team members of a multi-national company	Survey	Multiple	Engineering
Paul et al. (2016)	Business students from universities in two different countries	Survey	United States And India	Business
Hoegl & Muethel (2016)	Virtual software development project teams	Survey	Multiple	IT
Guinalíu & Jordán (2016)	People who regularly work in virtual teams	Survey	Multiple	Several
Eubanks et al. (2016)	Undergraduate students working on virtual project teams	Experimental	United States And United Kingdom	Business
Robert (2016).	Professional full-time employed students	Survey	Unknown	Human Resource Management
Fuller et al. (2016).	undergraduate students working on virtual project teams	Experimental	United States	IT
Gheni et al. (2016)	Team members of IT organisation	Survey	Malaysia	IT
Pozin et al. (2016)	-	Literature Review	-	Engineering

Faegri et al. (2016)	-	Conceptual Model	-	-
Graham et al. (2016)	Sophomore students	Experimental	United States	Business
Plotnick et al. (2016)	Professionals with experience working with virtual teams	Survey	Multiple	Several
De Jong et al. (2016)	-	Literature Review	-	-
Bond-Barnard et al. (2016)	international workers involved in medium-sized projects	Survey	Multiple	Several
Hosseini et al. (2015)	-	Literature Review	-	Construction
Iorio & Taylor (2015)	Graduate students from architecture, construction and engineering	Experimental	United States	Construction
Wickramasinghe & Nandula (2015)	Globally distributed software development project teams	Survey	Sri Lanka	It
Morley et al. (2015)	Workers from a multinational medical device organisation	Case Study	Ireland	Health
Fernandez & Jawadi (2015)	Workers from a car development team	Case Study	France And Germany	Automobile
Gilson et al.. (2015)	-	Literature Review	-	-
Radović-Marković et al. (2015).	-	Literature Review	-	-