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**Globalization and Virtual Teams:
The key role of HRM and ICTs
in enhancing firm performance**

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Introduction

Globalization has enhanced the integration of commodity, labour and capital markets, leading to a new competitive world (Bordo, Taylor and Williamson, 2003). In this scenario, a technological revolution has also been fuelled, enabling the rise of new technologies and ICTs applications. These changes, in turn, have shaped also the labour market and the management of work inside organizations.

Nowadays, national and international firms are placed in an increasingly dynamic environment, where firms can rely on a broader pool of talent and they might face the possibility of managing dispersed and culturally heterogeneous workforce. In this scenario, organizations can exploit different types of communication technologies and collaborative tools, that can enhance their performances in various ways. For example, the correct adoption of these applications might facilitate communication among dispersed workforce and the transportation of data across subsidiaries of a given company.

Firms in this globalized and digitalized business world, with employees that might come from different countries and might be located in different places, can face increasing difficulties in managing and organizing work. Therefore, they might need to adopt new solutions enabled by these technological tools.

In this scenario, a new type of team rises: Virtual Team.

A team that is classified as virtual has three main characteristics: it is a functioning team, made of individuals that work together towards task achievement, interacting and sharing responsibilities, it is a team where members are geographically dispersed, and they interact through technology to perform their tasks (Gibson and Cohen, 2003).

Thus, virtual teams might represent an answer to this competitive and globalized business world, that require firms to increase their flexibility, productivity and dynamism. The adoption of this type of team might provide benefits to firms that are able to correctly manage and exploit them. In fact, they can present a great number of organizational advantages as they might be cost-saving alternatives and they might boost firm's creativity. However, they could also present some drawbacks that need to

be correctly assessed. In fact, since these teams put together people from different backgrounds and cultures, opportunities for non-conformance and dysfunctional activities might arise and tacit knowledge among dispersed workforce could not be easily transferable.

Therefore, it should be considered how these teams can be profoundly different if compared with traditional ones: *<unlike conventional teams, a virtual team works across space, time, and organizational boundaries with links strengthened by webs of communication technologies>* (Lipnack and Stamps, 1997)

In this scenario, the purpose of this research is to correctly define the role of human resource management in assessing some precise competences that team members need to possess, as self-related competences and team context-related competences in order to favour virtual team's efficiency. Another purpose of this research lies on underlining the fact that HRM (human resource management) should contribute to the enhancement of virtual teams by building an appropriate architecture, able to ease the flow of knowledge and communication among dispersed workforce. In this sense, the adoption of the most suitable collaborative tools plays a central role in facilitating communication and activities building among virtual team members.

Therefore, in this dissertation, some of the research papers conducted in the field have been reviewed, questioning the characteristics and competences a virtual team player should own.

Additionally, a further research question this thesis aims to address is understanding the role of ICTs and, in particular, the role that applications that can support virtual team work have in enhancing team's effectiveness. More specifically, this thesis aims at understanding the characteristics current applications might offer and at underling what patterns should be considered by managers that decide to adopt them. In fact, critical factors for the success of virtual teams are, indubitably, human resource policies, that should support working virtually and reward people in a fair way. In this scenario, an important role is carried out by the technical support given by those applications for working remotely.

Therefore, the purpose of this research is to understand the identikit of the ideal virtual team player, trying to assess what personality traits and competences can help in boosting the overall team performance. In addition to this, this thesis aims to analyse the current offer for applications that can support virtual team's functioning, understanding their characteristics and potential patterns in order to provide a clear overview of what is current in the marketplace.

Moreover, this thesis aims to provide a new overview into virtual team's creation and functioning in order to underline possible patterns and key points that managers and organizations need to consider in order to boost virtual team's effectiveness and, consequently, to achieve a superior firm's performance. For this purpose, this thesis proceeds with a review of virtual teams related literature, to assess the themes related to this concept and to gain a comprehensive overview of the topic. In addition to this, a qualitative study is carried out on some of the most popular applications that can support virtual team's remote work in order to understand their characteristics and functionalities.

Therefore, the research questions this dissertation aims to solve are:

- 1. What characteristics an ideal virtual team player should own that should be considered by Human Resources when selecting possible candidates?*
- 2. What are the main features current applications entail? What are the potential relations that might exist between those features?*
- 3. Can the correct adoption of HRM and ICTs, in Virtual teams, boost firm performance?*

The purpose of questioning these aspects is to provide a roadmap to firms, interested in adopting virtual teams, on the most important patterns to put in place in order to make these teams efficient and to boost firm performance, by referring to the selection of the ideal candidates and the selection of the most suitable applications. In doing so, this thesis proceeds with a review of the current literature and a study of some of the most adopted applications that can support virtual team work.

Therefore, this dissertation is organized as follows:

- Chapter I provides an overview of the context in which virtual teams are collocated and the reasons that lead to their foundation. In particular, the rise of globalization and the digitalization process are taken into consideration. In addition to this, the aim of this chapter is to understand, the definitions of virtual teams, the type of virtual teams, and to provide an overview into the organizational advantages this type of structure can bring, and the potential drawbacks it might cause. In this scenario, in order to gain a complete insight into how these teams function, it's important to consider the processes they might entail, their characteristics and their outcomes.
- Chapter II deals with a complete overview of the literature related to the themes that are linked to the virtual team's topic. In particular, some of the key themes connected with this topic are reviewed, that are interrelated among each other, and that are important to consider in order to understand: the functioning, the potential drawbacks and the ways virtual teams behave. Therefore, the communication theme, the trust theme, the identity/personality theme, the creativity theme, the cultural theme, the virtual team's effectiveness theme and the heterogeneity theme are considered. In particular, the aim of this chapter lies on identifying the most important aspects and the most important characteristics organizations should put in place in order to boost virtual team's efficiency and, consequently, firm's performance.
- Chapter III analyses the role of ICTs in enabling remote work and in supporting virtual team's work. In particular, this chapter aims at understanding the current offer for applications that can support virtual teams and the features each application can provide. In this way, it's possible to build a comprehensive matrix of all the features related to the sample of ICTs applications considered. What is more, from the qualitative results gathered, it's possible to proceed with a codification of the results in order to make some statistical computation and to

understand potential relationships among the variables taken into consideration. Consequently, an analysis can be carried out among the different features of the applications considered, questioning the relations that might exist, leading to understanding potential patterns these applications might offer and linkages among the different functionalities.

At the end, given the results gathered through the literature review and through the analysis conducted on the applications, some results linked to the research questions can be provided, that can be considered as important points to make when dealing with virtual team's creation and management.

CHAPTER I: The rise of Globalization and Digitalization and the advent of Virtual Teams

1.1 Globalization and Virtual work

The advent of Globalization in the modern world has undoubtedly changed the way firms do business, sell in markets and behave internationally. Interactions among individuals and workers, both inside and outside firms, have increased and this lead to a new way of approaching business and the working environment worldwide.

Several authors have studied and have attempted to provide definitions to this phenomenon, among these there is the one discussed by Thomas Friedman (2005). According to the author, globalization lead to the condition by which *<the world is flat>*, more specifically, the flat world platform is a consequence of the new digital era, that allows people to connect with each other at long distances, with the use of personal computers and digital tools. Therefore, thanks to the rise of work flow software and internet, individuals and organizations are now enabled to work and collaborate from long distances. Among the changes these virtual technologies allow to happen, there are those related to the way work is performed, according to the author, for example, radiologists are now enabled to outsource the lecture of patient's scans to other doctors placed in different countries, thanks to electronic communication and the advancements in technologies. Therefore, globalization is letting phenomena as outsourcing and offshoring be in place, as it's possible for firms to: move the production abroad more easily, engage foreign workers, move to new environments and become international actors. In this sense it's clear how globalization has enhanced the integration of economies and markets leading to a new competitive world.

In this scenario of change also the world of work has been shaped, ICTs are now easily accessible and can enhance firm's competitive advantage in various way; one way that needs to be considered is the working environment. In fact, these technologies might facilitate communications and the transportation of data across companies, but they also enable firms to exploit globally dispersed knowledge and to integrate it into their businesses.

As a consequence, working practices have evolved and nowadays in firms it's possible to find new patterns, if compared with the past, for example: the "*smart working*" methodology, the usage of videoconferences instead of face-to-face meetings, the possibility of sharing data in real time, using social media, exploiting working platforms and organizing group work in a new way: virtual teams. An example of the adoption of these new working methodologies is represented by Siemens, that in Italy has more than 3000 employees and in 2017 introduced the "smart working methodology", leading to a more flexible way of organizing work inside the company and among workers (Grassia, 2017).

These scenarios prove how working methods are evolving and how enterprises can adopt new ways of managing work across long distances, for example through the adoption of virtual teams, that can provide numerous advantages.

Therefore, along with the integration of economies due to the globalization phenomenon, several ways of organizing work inside companies have arisen worldwide. Nowadays firms can choose among different ways of performing work and these solutions are made possible by the advancements in communication and digital technologies that have enabled cross boundaries communication and a fast and flexible exchange of data.

1.2 Digitalization

When talking about globalization a related world is digitalization, a common definition of is this trend is given by the transformation of services or daily activities from the way they were performed in the past, to new ways thanks to digital technologies. Digitalization is, therefore, linked with an increase in the adoption of digital or computer technologies by individuals and firms (Daidj, 2019).

Thus, it could be said that new technologies and digital applications are impacting everyday life. In fact, they lead to an increase in the usage of internet, computers and digital tools that radically changed the way individuals, but also enterprises, perform their daily activities and working patterns, if compared with the past. The digitalization

process has also allowed several start-ups or small firms to face greater opportunities and place themselves internationally, the World Economic Forum (2016) has defined this process as: <*the rise of unicorns*>.

As a research conducted in 2016 by the McKinsey Global Institute demonstrates, flows of data that are transmitted outside individual's national borders have significantly increased. This led to an increase in information sharing, communications and interactions among enterprises and individuals, outside national boundaries. What is more, data from this research reveal how in 2005 the bandwidth among the main world regions was between 50 and 1000 Gigabits per second (Gbps), depending on the regions, whereas in 2014 the data flowing between Europe and North America travelled at the speed of >20000 Gigabits per second (Gbps). In particular, these data provide an important insight into the advancements of communication technologies and digital usage worldwide. At this increase in the exchange of data flows corresponds a significant change in the way firms do business and manage work inside their own boundaries. In fact, the research proves how 44 million of people around the world are cross borders online workers.

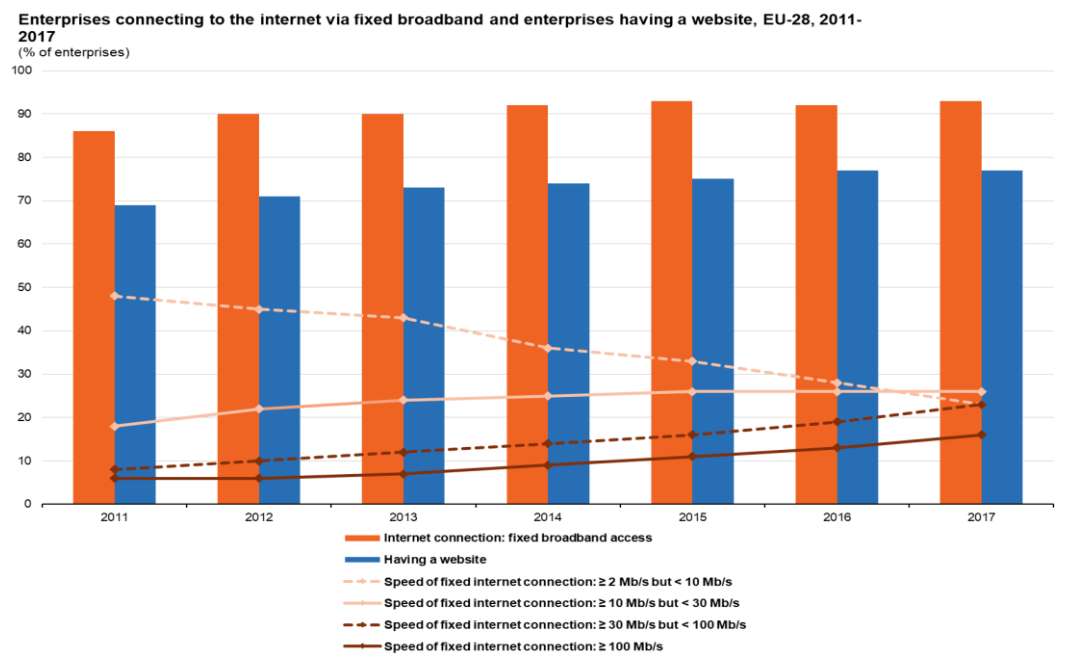
The increasingly dynamic environment in which companies are collocated nowadays, the increase in concurrency from emerging countries that are new in the competitive business world, the exploitation of new ways of doing business (as projecting a product and building a prototype in one site and have it produced in another site), the increase in the usage of video conferences to talk with subsidiaries and the increase in amount of digital interactions among subsidiaries of a globally dispersed company, are all events that are shaping the way organizations work and manage their workforce.

Therefore, knowing what could be the newest trends in this scenario is a critical feature for the contemporary business actor. In this sense several types of working methods, that are made possible thanks to technology, are present, for example, the "*Smart working*" methodology is currently a factor of attractiveness for employees that are enabled to work autonomously from home (or in other places) instead of going to the office, having in this way flexible working hours.

But how much contemporary business actors are keen on digitalization and are ready to embrace new challenges?

In order to provide an answer to this question it's interesting to have an insight into data associated with internet usage, especially related to enterprises that are connected to the internet or that have a website, looking at how they have evolved in the last years. As Figure 1 shows, considering Europe as point of reference, the number of enterprises that are connected to the internet to perform their daily working activities is actually increasing. This graph depicts how in the years between 2011 and 2017 these numbers increased, reaching in 2017 the 90% of the sample considered. What is more, also the number of enterprises that have a website increased, reaching in 2017 almost the 80% of the sample considered. Figure 1, provides also an insight into the advancements that have been made between 2011 and 2017, referring to the speed of internet fixed connection that has seen a decline in slow connection usage, and a rise in fast connections adoptions.

Figure 1: % of Enterprises connected to the internet and having a website (2011-2017)



Source: Eurostat, 18/3/19

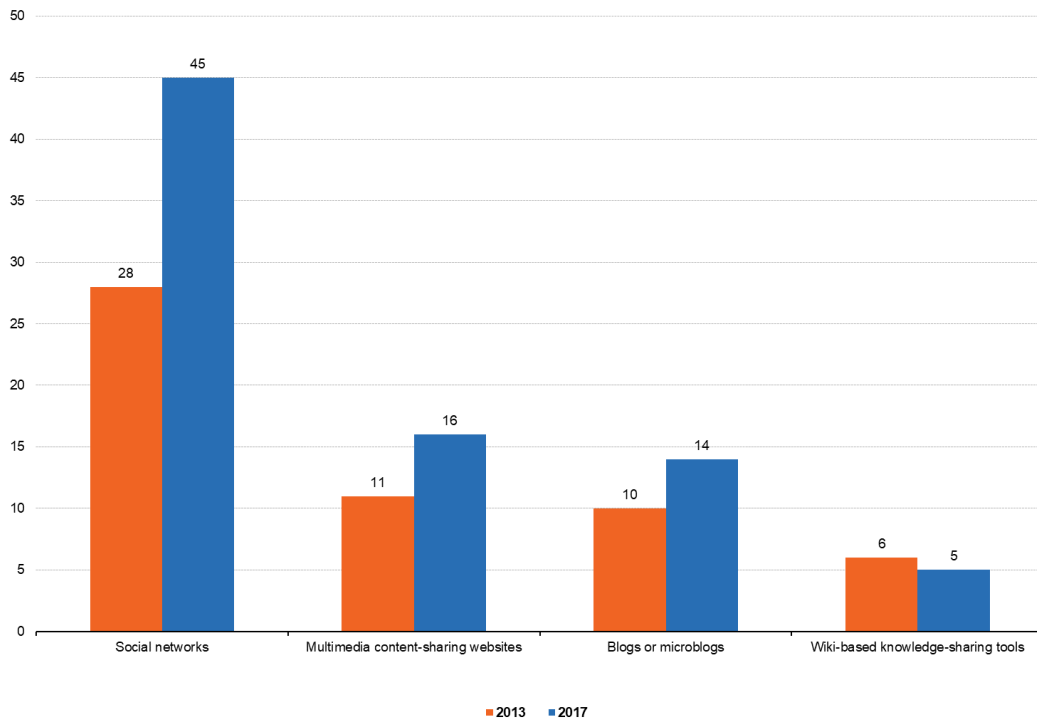
In addition to this, it's also interesting to understand the evolution of the demand for techno-savvy individuals, considering the level of digital skills that contemporary actors are required to own, in order to figure out if it has increased or not. Considering data from Eurostat¹ the percentage of individuals in Europe that owned low overall digital skills in 2015, 2016 and 2017 was between 23% and 26% of the entire population and the percentage of those with basic overall digital skills, instead, was between 26% and 27% of the sample considered. However, if individuals with basic or above basic digital skills are considered the percentage rises significantly as, in the years 2015-2017, was between 55% and 57%. These data provide an insight into the evolution of digital competences that happened in the last few years, as most of the population considered, for the purpose of the research, has proved to own certain levels of digital skills. In addition to this, the white paper on digital transformation issued by the World Economic Forum in 2016, underlines the importance of digital skills owning in the contemporary and future scenario, as global job positions will evolve in this sense and by 2022 they will represent the 22% of the positions available.

From this scenario it is possible to understand the importance that digital skills, digital tools and internet connections have in nowadays business life, in fact, if data from figure 1 are taken into consideration, it appears clear how in today's business world internet connection is essential for enterprises that want to be part of the international business market and, in this scenario, digital skills owning will be increasingly required by enterprises.

In addition to this, data from Eurostat imply also that social media are becoming quite used in enterprises, in fact, the difference between the percentages of enterprises that adopted social media in 2013 and the same data for the year 2017 is significant, as these values almost doubled for the European countries (they increased from 28% to 45%), as it's shown in Figure 2.

¹ Data from Eurostat, extraction dated 16-05-19

Figure 2: Enterprises using social media, by type of social media, EU-28, 2013 and 2017 (% of enterprises)



Source: Eurostat, 18/3/19

In addition to this, the survey conducted by the McKinsey Global Institute (2016) further investigates the concept of globalization and the linkages with digitalization, stating that companies and individuals are increasingly interconnected. For what concerns individuals, for example, they are increasingly interconnected not only inside their national borders, but also at an international level, through the usage of Skype, for having videocalls or by using social media. In particular, they estimate how: *< nearly one billion individuals around the world are direct participants in some form of globalization. MGI analysis of international ties on Facebook, Twitter, LinkedIn, and WeChat shows that some 914 million people have at least one international connection on a social media platform >*.

These data provide an insight into the amount of people that are actually exploiting digital tools to get interconnected and this not only has implications at the individual level but also if we consider enterprises, that can exploit these digital applications and can create virtual teams.

In this scenario of digital adoption, the survey conducted by the McKinsey Global Institute (2016) presents also the example of Unilever that, through these technologies, managed to create: *<global, virtual delivery organizations with team members who meet via video conference>*. In particular, this example demonstrates the potential benefits that can be offered by virtual team's adoption, in fact the organization used to have: *<more than 400 intranets spanning different countries, product groups, and functions—a structure that led to unnecessary expense and misaligned communications>*. Thus, the adoption of these digital working teams might enable organization to have a flexible management of dispersed workforce and efficient communication flows.

Therefore, organizations need to be ready to embrace the opportunities that are given by digitalization in order to improve their business, to exploit the potential opportunities given by these digital means and in order to be the business actors of the future. In fact, as Parviainen, Tihinen, Kääriäinen and Teppola (2017) observe, digitalization can provide several advantages to the organizations that are able to see the opportunities given and that decide to adopt them. According to the authors digitalization can bring three main situations: *<internal efficiency, external opportunities and disruptive change>*. This means that through the adoption of the new technologies enterprises can improve the internal processes by exploiting the right digital tools and technologies, but also, they can exploit new opportunities that can enhance their core business (for example they can provide additional services) and they can dramatically change their business, facing new opportunities. Therefore, companies should consider the new possibilities that are provided by this increasingly digital world that can either help business actors to achieve greater level of internal efficiency and flexibility, or that can present new challenges to embrace.

Along with these new challenges and possibilities, there are also new tools that companies can adopt in order to perform their daily activities. Among these there are *Enterprise Collaboration Systems (ECS)* that, as reported by Greeven and Williams (2017), have seen an increasingly financial investment by companies, such as Microsoft.

Given these new digital supportive tools, enterprises are enabled to consider the adoption of virtual teams, to exploit dispersed workforce. In particular, a survey conducted by the Society for Human resource management, reports how an increasing

number of companies is currently adopting this type of team, as the 66% of multinational corporations interviewed are reported to use virtual teams.

Among the enterprises that have adopted virtual teams there is, for example, IBM where employees are organized in teams that can cooperate at great distances and participants are called “virtual workers” or “remote workers”. In particular, the company recognises the actual benefit that VTs are providing to the working system, as an increase of flexibility, cost savings and also a greater employee motivation². Further multinational companies that have decided to shift to VTs are also General Electrics³, Nokia and Nestle.

1.3 Key Characteristics and types of Virtual Teams

Before providing an insight into the different types of virtual work and virtual teams and the implications they have for firms, it's important to understand the meaning of team working. In this sense, looking at the definition provided by Scarnati (2001), teamwork can be considered as the condition by which individuals can join the forces, sharing knowledge, experiences and tasks and in this way, they are able to accomplish greater results.

From this definition is possible to understand that there are some pre-requisites that the ideal team player should possess and that could substantially benefit group's performances, as being willing to share knowledge and experiences. Therefore, considering the characteristics that also the ideal virtual team member should own is extremely important for firms that are interested in the implementation of this type of working team, that face more complexities if compared with a traditional team.

What it's also interesting is to understand are the different types of virtual work that can be adopted by enterprises that are keen on this phenomenon. Taking as a point of

² Employee Interview, *The Key Benefits of Having a Virtual Team*, IBM, 24/11/17

³ DeRosa D., *3 Companies with High performing Virtual teams*, On point Consulting, 5/10/17

reference the different solutions proposed by Ebrahim, Ahmed and Zahari (2009) there are four possible types of virtual work:

- *Telework*: That is enabled through electronic communication and information systems and that is characterized by the fact that it could take place inside or outside a given organization (ex. Remote work);
- *Virtual groups*: That are made by several workers that communicate through electronic means and information systems (teleworkers) that are combined with each other and report to a superior;
- *Virtual teams*: That is the situation in which a group communicates and interacts through digital tools in order to perform a given task or to reach a common goal;
- *Virtual communities*: That is the broader definition of virtual teams. They are made by several members that interact among each other in order to perform a given task and they are significantly more numerous, if compared with the other alternatives.

In this scenario, the type of virtual work that will be additionally questioned and reviewed in this dissertation is given by virtual teams.

But what can precisely define virtual teams?

A lot of researches have struggled to provide an appropriate definition to this type of working team, following the one of Chudoba and Maznevski (2000), they can be considered as: < (...) *internationally distributed groups of people with an organizational mandate to make or implement decisions with international components and implications* (...)>.

Other definitions imply the strong role that electronic communications and ICTs play to let team members communicate across great distances. In addition to this, another aspect that further characterise these teams is given by the fact that members are located in different places, being geographically dispersed (Gibson and Cohen, 2003).

Besides these definitions, that rely on the number of participants, the means of communication and the location of members, virtual teams can be classified also in relation with the tasks they have to accomplish. Therefore, they can be divided, for

example, into virtual teams that work on a specific project and exist to solve a given task, virtual teams that are responsible for a given task regularly, service teams and teams that can pop out in situation of emergency that require this kind of structure.

After having considered the different characteristics that virtual teams might assume is important to understand where and why they are substantially different from traditional teams.

In this sense, what differentiates virtual teams if compared to traditional face-to-face teams are several characteristics, that have been pointed out by different authors. According to the Ebrahim et al (2009), traditional face-to-face teams are teams in which individuals work in the same location, close to each other and they can schedule regular meetings. These characteristics can provide several advantages, if compared with multicultural dispersed teams, as team members in traditional face-to-face teams can easily create a trustworthy climate by building stronger relationships, thanks also to the adoption of the same communication patterns and to the possibility of meeting in person.

In this scenario, several scholars have attempted to study the differences that virtual teams present, if compared with traditional teams, in order to understand where and if they could be more efficient and perform better. As stated by Connaughton and Shuffler (2007) VTs (virtual teams) can differentiate themselves among several dimensions; they are geographically distributed, they can be permanent or temporary (to solve a particular issue) and they communicate through technological means. These are only some of the characteristics that could differentiate virtual teams if compared to face-to-face teams. In addition to this, virtual teams can be composed of members coming from different cultures, being in this way heterogeneous, they can be geographically dispersed, and they work through digital tools. Therefore, by focusing on teams that are located in different subsidiaries of the same organization or on teams that are composed of people living in different countries, some key characteristics can be underlined.

To summarise, virtual teams, as pointed out by Jimenez, Boehe, Taras and Caprar (2017), can be defined as teams that present three main characteristics, that are given by: *Location, Distance, Time*. Location, that refers to the geographical distance that

might exist among the members of this type of team, distance, that can be referred both to the cultural difference that may characterize the different members of the team, but also economical or educational one, and time that it is mainly referred to the fact that these teams might connect people in different geographical places, belonging to different time zones.

But why should firms prefer virtual teams to traditional face to face teams?

1.4 Organizational Advantages linked to Virtual teams' adoption

When deciding to settle a virtual team, companies should consider both the advantages and the disadvantages that this type of organization can provide to firm's performances and to the management of organizations worldwide. As concerns the advantages, this kind of team presents several pros that are due to its intrinsic and extrinsic characteristics. Among the authors that have studied this topic there are Jimenez, Boehe, Taras and Caprar (2017), that identify some of the major benefits that this type of working structure can provide to firms.

First of all, organizations that decide to adopt virtual teams can exploit the greater degree of *flexibility* that this kind of working group stress out. According to the authors, in fact, flexibility is implied when considering respectively geography and timing. In fact, differently from face-to-face teams, virtual teams can work through the right platforms and digital tools, regardless from the place in which they are located or the different time zones. In this way work can be organized and performed more autonomously, by employees that are located worldwide.

A second significant benefit related to this type of working group is represented by *economic benefits*. Virtual teams, in fact, can provide cost saving solutions to enterprises because they don't require employees to travel and to move, therefore, travel and relocation costs can be avoided. Moreover, they represent also a cost saving alternative for having the best talents worldwide to join the company and for not recurring on the

cost of losing these brilliant minds. Therefore, an additional benefit linked with the cost saving one is the broader pool of talent on which the organization can count.

Moreover, these types of teams can leverage on a larger pool of *cognitive resources*. In fact, as virtual team's members are located in different countries, they might provide new perspectives to organizations, due to the fact that members coming from different cultures can offer different solutions to organizational problems or needs. In fact, members might propose different point of views to organizations and might also suggest adopting new or different technologies. As authors like Gressgård, (2011) observe, diversity could be seen as a benefit for multinational organizations due to the fact that it allows a positive increase of: *<the degree of innovation and creativity in problem solving, and thereby also promote the development of new and radical solutions>*. Therefore, the diversity entailed in these virtual teams might be seen as a positive phenomenon that can provide to organizations, different prospective of the problems and of the possible solutions.

Another benefit that is linked with the previous ones, is given by the fact that this virtual working model inside multinationals allows for a better *circulation of knowledge* among sites. In this way, dispersed workforce, might have some additional chances to receive the tacit knowledge of other colleagues in different parts of the world, members of a given virtual team.

Finally, also the possibility to work autonomously and to self-manage should be considered among the advantages this type of working team can provide. In fact, virtual team's members can be considered as more *independent* if compared to traditional team's members, as they have to complete tasks at a greater distance, mostly individually, and this aspect could boost individuals' competences and can offer to organizations greater degrees of flexibility.

1.5 Potential drawbacks

Along with the consistent advantages that this kind of working solution might provide there are also potential negative consequences that business actors need to take into consideration before settling down this type of working team.

In fact, it should be considered that the existence of virtual teams is dependent towards elements that must be in place to let this kind of team exist. In this scenario, several authors have looked for barriers to the development of this working team and for possible causes of ineffective performances. In particular, Jimenez et al (2017) enumerate among the disadvantages of virtual teams: *time- zone differences*, *coordination issues* and *language difficulties*.

As concerns time zone differences, the dispersion of information and the contact between virtual team members can significantly suffer from this “natural barrier”, even though instant messaging and other digital tools can help members to overcome these difficulties. Therefore, virtual teams might face increasing difficulties in communicating and in sharing knowledge.

Another weak point is represented, according to the authors, by communication, in fact, the difficulties related to information exchanges among members rise as different cultures, different unintended meanings and different technological skills among team members can weaken the communication patterns of this type of organization.

Cultural diversity among team’s members is another point that needs to be taken into consideration, as it could present potential drawbacks that might affect virtual team’s functionality, since culture itself defines part of the individual behaviour and stereotypes of different individuals can follow. As some theories have pointed out (as the *Social Identity Theory*), authors like Vahteraa, Buckleya, Aliyeva, Clegga, Crossb (2017) underline that it’s important to stress out and trying to enhance group’s cohesion, in fact being weak on this point could be detrimental for the success of the group. As a matter of fact, groups located in different places around the world can face grater differences in trying to establish real connections and a sense of belonging among the participants.

Moreover, also language differences might represent a weak point, in fact, as stated by Jimenez et al (2017) they can provoke unintended drawbacks such as: *<social categorization and biases>* and these unintended consequences can lead to conflict among team members or problems of meanings. Moreover, also the adoption of English as common language among team members could be not as problem solving as thought,

in fact, individuals might present differences in the construction of phases that, as a consequence, can provide different meanings for people coming from different cultures.

Furthermore, participants to this kind of group need to own specific technological skills as they have to deal with the digital tools that are used in order to enable virtual team's work. Unfortunately, it could happen that in these organizations some members lack the right skills to perform the given task digitally and this might turn into ineffective performances.

Finally, a consistent disadvantage that virtual teams need to face is given by the substantial difficulties in establishing trust among members. In fact, trust among virtual team members is harder to establish if compared with face-to-face teams, that can rely on constant visual contact and can manage conflict more directly. More specifically, given that these teams are heterogeneous, and members might be highly distant geographically but also culturally, they might face stronger difficulties in creating interpersonal linkages and trust, that are crucial for enabling team development and an efficient communication flow happen (Jarvenpaa et al, 1999).

1.6 Virtual Team's features and processes overview

What appears clear from the previous sections is that taking into consideration the potential benefits and drawbacks, that virtual team's application can provide to organizations, is an important process that needs to be discussed in advance by firms, that are interested in and want to foster this kind of working team. In addition to this a review of the literature and of the research models that have investigated virtual team's characteristics is equally important in order to have a clear overview of the potential applications and of the driver of virtual team's efficiency. Therefore, through an analysis of the researches conducted, that are related to the virtual team's theme, several results came out.

Virtual teams have been studied in different ways due to the fact that in this type of working environment and working structure several cultures and different individuals meet, thanks to electronic and digital communication systems. Among the authors that

have tried to point out all the different themes related to this concept there are Gilson, Maynard, Young, Vartiainen and Hakonen (2015) that provide an overview about all the themes related to the world of virtual teams and its complexities. The authors focus primarily on the following themes: the drivers of virtual team's effectiveness, team virtuality, technology, leadership and trust.

Among the drivers of virtual team effectiveness have been annumerated the differences in group composition, the cultural point, but also the size of the team. Another theme strongly related with the existence of this type of working team is the concept of virtuality, that refers to the fact that team members are geographically dispersed and connect with each other thanks to the technology usage. Therefore, technology permits the existence of these teams, enabling connections and communication among members. As the authors point out, several types of technological tools can serve this purpose, both e-mail, chats and other "traditional" communication methods, as well as other form of digital communication like social networks, platforms and so on. Moreover, Gilson et al (2015) identify other substantial themes that have been touched in literature, the concept of leadership is one of these, as it has been found that the emergence of a leader is positively perceived by team members. Another interesting theme that has been investigated by these studies is the one of trust, in particular the authors point out how trust can influence VT success and communication among team members.

In addition to this, other authors tried to gain an overview of this kind of working teams, that present themselves differently from the traditional ways of creating and managing groups of people and that are the result of the integration between a globalized and virtual world. In this sense Gibson, Huang, Kirkman and Shapiro (2014) provide an overview of the intersection of virtuality and the concept of global in virtual teams. In particular, the authors point out that among the main characteristics of these teams there is the *<degree of electronic communication dependence among team members>*.

More specifically, in this virtual team's scenario, members can rely on two types of communication patterns, asynchronous, that is enabled by digital tools that allow communication through emails or messages for examples, or synchronous, that is given by tools that provide real time means of communication, for example skype and other

videoconference applications. In this scenario, when considering the concept of virtuality in teams Gibson et al (2014) identify important results linked to virtual team's adoption, for example they observe how virtuality is associated with more innovative ideas if compared with the same results of groups that regularly meet face to face. Moreover, according to the authors, team virtuality can increase the circulation of information among team members, but they can also decrease the willingness to share information among members, as members are less confident of each other's if compared with traditional teams.

For what concerns the concept of cultural diversity in virtual teams, instead, Gibson et al (2014) observe that it could be related to different sources, such as: <functional diversity> and <demographic diversity>, but also to <national diversity>, or diversity linked to identity aspect, associated with some personal characteristics, and <different cultural values>. These findings suggest that that diversity among team members needs to be considered in broader terms, as it entails differences in personal values, country values, organizational values and other sense of belonging of the individual. Therefore, studies need to address the phenomenon of VTs in a broader way in order to understand all the possible nuances that different individuals can bring in these types of working structures. According to Jimneza et al (2017) the different cultural orientations of team members can also have substantial effects on the <distributed decision-making process> affecting some different parts of the process such as the identification of the problem, the possible proposals and solutions. Therefore, it could be understood how culture and diversity among team members are a key theme that needs to be further investigated in order to understand the possible drawbacks of making different people, coming from different culture, interact and also the key solutions to overcome these problems and to reach an effective way to manage them.

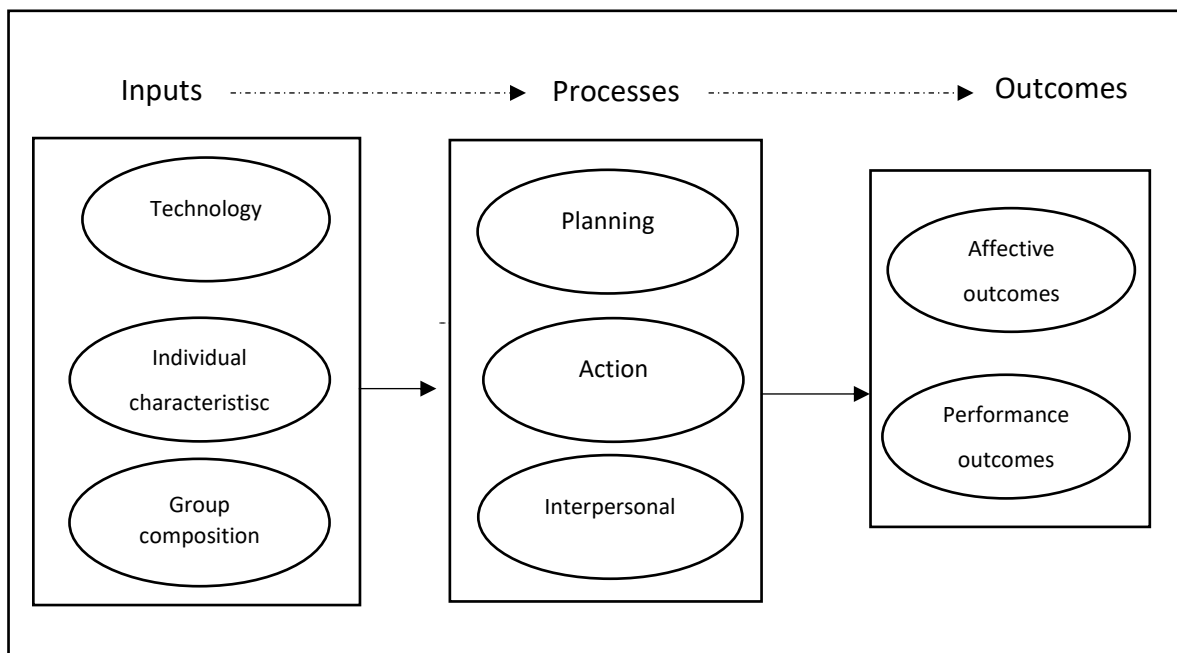
In this scenario, the most widely known technique for studying virtual teams and teams in general is the application of the *Input-Process-Output* model that identifies the key characteristics of this type of work⁴. According to this model, virtual teams are studied

⁴ The first author that theorized this kind of framework back in 1964 was McGrath, who questioned the processes that happen inside a group and the possible patterns that might be depicted. In particular the author focused on the interactions that might be in place among individuals part of a group and he stated that they might be affected by group's inputs, that

referring to the characteristics they present at different levels, as regards: team inputs, team processes and team outcomes. For what concern *team inputs*, they refer to the initial characteristics of the group, that are the resources or the situations through which a group first starts. *Team processes*, instead, are made of all the additional phases that are consequent to the integration among people and the circulation of knowledge, whereas, team's *outcomes* represent the final performance of VTs.

Among the authors that have reviewed the literature through the *IPO model* there are Martins, Gilson and Maynard (2004) that identify the most significant attributes to consider for the three phases.

Figure 3: The IPO model



Source: Martins, Gilson and Maynard (2004)

are made of characteristics of the individuals, of the group structure or of the tasks they are supposed to accomplish. According to the author, thanks to the interactions that happen among individuals part of a group, group outcomes can be achieved (McCrae R. R. e Costa P. T. Jr., 1987).

As figure 3 depicts, the main attributes that characterize a virtual team can be synthesized through this model that enables to link the final performance of the teams with their initial configuration and all the processes that happen in the way.

As regards *team inputs* they have been identified with the intrinsic characteristics of the individuals that are part of the virtual team, in particular Martins et al (2004) cite *<knowledge, skills, abilities (KSAS), group size, tasks, technology>*, all related to the initial status of a group and its characteristics. Therefore, a group can differentiate itself for the skills that the members of the team own and for the type of technology through which they can communicate, that is a critical choice because, as stated by the authors, it could affect the way people communicate, the effectiveness of the group and the interaction among members. Moreover also *<group composition>* is an input that needs to be considered when talking of VTs, in fact, members characteristics such as the country of provenance, the culture and the age can affect the final output of the group, as members with different backgrounds may think and behave in different ways and this could result in a decrease of effectiveness in the long term. However, group composition and the diversity it entails can be also a benefit for the VTs as diversity as it can enhance creativity and the circulation and dispersion of different ideas.

When thinking about *team processes*, instead, Martins et al (2004) address this stage as the moment by which teams strive to achieve the final results, therefore it's the way by which they behave in order to achieve the desired results. Among these team processes can be annumerated *<planning processes, action processes and interpersonal processes>*. Starting from the first one, with planning processes the authors refer to the process by which the final outcome is split into different results that need to be achieved in a given time. This process of goal setting might be positively related with the performance of virtual teams as it can act as a glue among members located in different places that need to work together to achieve the results.

Whereas the action processes refer to those processes that are performed in order to complete virtual team's tasks and to organize the related activities. These processes, in particular, are mostly related with the communication theme. Communication, in fact, is essential in VTs as it's the way by which working procedures, data, information, deadlines and other essential parts are shared among members. The theme of

communication has been largely studied by scholars through the years as it's strongly linked with the creation of trust and, therefore, with the enhancement of team performance. As many authors have noticed communication in virtual teams is strongly related to the performance outcomes of the group, but individuals inside the group coming from a broad diversity of cultures can also differ considering the way they communicate among each other (Zakaria, Amelinckx and Wilemon, 2004). In this scenario, the communication process among team's members can benefit from the adoption of the right communication tools that are provided by communication technologies and media. Thus, regarding the action process Martins et al (2004) point out how the numerous studies conducted among the years related to this topic are mainly connected to: *<team communication and participation>*. In fact, tasks achievement and activities coordination might be best pursued when information is correctly shared among members and when participation is enhanced. Therefore, it appears clear how the study of communication patterns and communication techniques among member coming from different realities is essential in order to exploit virtual teams' potential advantages.

As for *<interpersonal processes>*, according to Martins et al (2004) the major themes related to these concept, are: the dynamics of team conflict, the cohesion among team members, but also the concept of interpersonal trust and informal communication among members. The team conflict theme needs to be considered as in virtual teams the distance and the fact that communication happens only through digital tools can enhance conflict and make conflict resolution practices harder for team members. Another important point related to interpersonal processes is the concept of interpersonal trust in VTs, in fact, it should be considered how it's harder for the members of a team, that is globally dispersed and that is not meeting regularly face-to-face, to establish the right degree of interaction among each other and the right degree of interpersonal trust, that allows a smooth organization of task and inter related processes.

However, the overall interactions among VTs members can be eased thanks to the choice of the right communication tools, that can create patterns that make it simple for members to meet virtually and to share knowledge.

As regards *team outcomes* instead, according to Martins et al (2004) they can be classified into different subcategories such as affective outcomes and performance outcomes. The main difference among these two concepts relies on the fact that affective outcomes are based on members satisfaction within team's dynamics. Therefore, this concept is also dependent from the level of technological dependence of team members, as members satisfaction might be influenced by ineffective communication patterns and by poor levels of information sharing. According to the authors the level of affective satisfaction can also differ if VT and F2F teams are compared, in fact the latter can have further occasions to meet and to share the know-how and create trust worthy relationship among team members.

For what concerns performance outcomes instead, Martins et al (2004) point out how they might be biased by the fact that interactions among VT members, if compared with the ones of traditional teams, take significantly more time due to the fact that connections are created digitally and there is also the factor of location consider, that could lead to delays in communications and the ineffectiveness of instant messaging or emails. In the other hand, the broader pool of talents by which VTs can rely on when selecting members can enhance the performance of the team through an increase in creativity and innovative ideas.

In this scenario it's also interesting to consider what Martins et al (2004) depict as moderators of the virtual team performance. In fact, they represent factors that can influence the final outcomes provided by teams and therefore needs to be considered. Among these the authors cite: *<task type, time spent working in a group, and the team's social context>*. The first one can be represented as a moderator of VT performance due to the fact that, thanks to the greater distance that occurs in this type of team (if compared with traditional teams), members can perform better in a task that implies the sharing of ideas and a moment of brainstorming, as they can speak one at time without interrupting others. If tasks like negotiation are taken into consideration, instead, the scenario is different as traditional teams can perform in a superior way. Considering the second moderating dimension, time, might affect virtual team's outcomes as the difficulties related with the type of communication, implied in this kind of team and other trust issues, according to the authors, decrease with the passing of

time. Finally, also the social context can significantly affect virtual teams as the attitudes of team members towards collaboration can affect the final performance. For example, the authors report how openness to communication and the creation of a positive social environment can be significantly related to an increase in the final performance.

To summarise, in this chapter, in order to provide a broad definition of this type of working solution, have been reviewed: the conditions that might enable the occurrence of virtual teams, their main characteristics and the most adopted methods to address and research their functionalities.

The following chapter, instead, will deal with an in-depth review of the literature and the research conducted, aiming at finding the most important topics related to virtual team's environment.

CHAPTER II: Virtual Teams: a review of the related literature and topics

Virtual teams, their foundation, the conditions under which they operate, and their main characteristics, are topics that have been studied by several scholars. Therefore, in order to have a clear understanding of virtual team's characteristics and their patterns it's useful to have a review of the papers and studies conducted through the years.

In doing so, some common themes can be identified, among them:

- Communication;
- Trust;
- Identity-personality;
- Creativity;
- Culture;
- Heterogeneity;
- Team's Effectiveness;
- Technology.

An in-depth analysis of these themes is necessary to provide a complete overview over these types of working teams and their characteristics, and it's also necessary in order to understand how to exploit the advantages virtual teams might offer. Therefore, through an analysis of the literature linked to these themes is possible to underline several characteristics that define their structure.

Starting from the communication theme, it is related to how teams can manage to communicate effectively and the conditions that enable or not knowledge and information sharing among members. Linked to this theme there is the one of trust, as seen in the previous chapter, trust can influence knowledge exchange, as trustworthy relationships among members can favour a significant flow on information. Therefore, it interesting to understand the conditions that enable the creation of trust among members, essential feature that characterize efficient working relations that take place at substantial distances.

Another theme related to this working method is the one of identity- personality, in fact members that are part of this teams might own different personalities but also different skills, abilities and knowledge and some of these characteristics can positively affect the overall performance of the team.

Moreover, virtual teams might be composed of members that differ for cultural affiliation. In fact, individuals might come from or they might be located in different countries, meaning that virtual teams might be highly heterogeneous. In this scenario it is interesting to investigate whether there could be a link between heterogeneity and team's final performance, in order to understand the possible impacts of integration and cooperation among members, belonging to different countries and cultures, and the way this could affect the overall results.

In addition to this, a theme that is as important to investigate as the others is the one of creativity. In fact, understanding how creativity can be created and exploited in those teams it's essential in order to be the innovative actors of the future and in order to exploit all the potential benefits that this kind of working solution provides, if compared with the traditional working groups.

As for technology, it is a massive theme to investigate as it is the mean by which members can perform their tasks, share data and schedule work. Therefore, it is essential to understand how the different technological and electronic applications can affect the performance of members and of the team as well, and to understand how technological adoption (in those teams) has evolved through the years.

Considering all the themes related to the concept of virtual teams already provides an insight into the number of characteristics and possibilities that this type of team can offer to organizations. Therefore, an accurate analysis of all the data and results that have been studied and collected through the years can provide to organizations, that are interested in and want to implement this way of working, a synthesis of the advantages, disadvantages, positive characteristics and possible outcomes they might face when adopting virtual teams.

By following the order provided at the beginning of this section, this chapter aims at providing an overview of virtual team's related themes through an in-depth analysis of

several studies conducted by many authors. As the following sections will show, the cited themes can be considered interrelated among each other, in fact, for example there is a strong link between communication and trust among virtual teams, but also between trust and team's efficiency and effectiveness and between trust and creativity establishment.

In this work, about 90 studies and research papers have been taken into consideration, in order to provide the most comprehensive overview possible related to this field. Among the researches collected, those that could better meet the purposes of our research have been selected. The working papers considered consist of literature reviews, and also, of case studies and researches.

Therefore, the aim of this chapter is to correctly deal with virtual team's related themes, in order to gather a correct overview of the key characteristics, strengths and advantages that this type of working solution can offer.

2.1 Communication in Virtual Teams:

One of the distinctive characteristics of virtual teams lies on the fact that communication happens through digital and electronic tools and this could significantly influence the way the process takes place, if compared with traditional working teams, where members have the chance to talk in person.

Virtual teams have to face several challenges, in order to successfully share information, data, procedures and knowledge across members and countries, in fact, the communication process and team's performance might be influenced by the way teams are created and by the characteristics of individuals within different habits and cultures. In addition to this, the communication theme is strongly influenced by and linked to the theme of trust, as they are somehow consequent: if there is trust among virtual team's participants, then communication is enhanced and vice versa, if communication is in place than trust among members will follow. Therefore, also the presence of trust among members can significantly condition the communication process.

Among the authors that have investigated this theme there are Killingsworth, Xue and Liu (2016), in their research, in fact, they focus on the knowledge sharing process among virtual team's members and they question the factors that might affect it. The authors underline how a key characteristic of this type of working organization relies on the fact that team members need to share information and knowledge, as the final value virtual teams provide to organizations is dependent from this factor. According to the authors communication among virtual team's members and the knowledge sharing processes depend on two different characteristics that can be identified with: *<team environment and motivation>*.

This means that, in their opinion, communication and knowledge sharing, among people that work remotely, can be influenced both by the environment that is surrounding individuals, that can influence members' attitudes and behaviours, by shaping what they perceive, and also by members' motivation, that is seen as one of the key factors that can influence knowledge sharing and it's related to members overall satisfaction. Therefore, team member's satisfaction, that enhances communication and knowledge

sharing among individuals, and members' motivation can affect the overall attitude of virtual team members and consequently the knowledge sharing process inside teams.

In particular, Killingsworth et al (2016) identify the factors that can substantially influence team environment with: *<affiliation and trust>*. Affiliation is intended as a sense of belonging that members of the same team might feel, it can have substantial positive impacts in the overall team performance as if individuals in virtual teams, that might belong to different cultures and present different patterns, share a sense of affiliation among each other, they could work in a better climate that enables knowledge circulation. As for trust, the authors report that a positive climate of trust among members of a group, especially if they communicate through digital tools, is extremely important as it enables and eases the circulation of information.

In addition to this, communication, as already said, could be influenced also by team motivation. In particular Killingsworth et al (2016) report that motivation could be divided in two macro themes, extrinsic and intrinsic motivation. More specifically, according to the authors, the first one is linked to members' feeling of "satisfaction" towards receiving possible benefits that are reciprocal and that can create a positive climate of interchange, as members might be more willing to share knowledge. The second one, instead, is related to the positive feelings that are in place in some individuals when they decide to help others; these positive feelings also trigger knowledge sharing, as members with intrinsic motivation are considered more willing to share their knowledge.

Thus, the results of this research prove how team environment and team motivation are strongly connected to the development of a positive culture of information and knowledge sharing. In addition to this, knowledge sharing among individuals could also be influenced by further control variables, among these the authors identify: *<age, nationality, computer experience>*. In fact, what is considered important in this scenario is owning digital skills or sharing the same level of digital skills, or computer experience, as in this way members can communicate easily and in a more efficient way. As for the nationality, it should be considered how virtual teams might be composed of members that belong to different cultures. In this sense virtual teams can work smoothly or not depending on the characteristic of the cultures of belonging, individuals with the same

levels of Hofstede dimension, for example, might face fewer difficulties when working, differently from individuals that come from completely distant cultures. What is more, also sharing the same age or close ages can help interactions among individuals as they can develop more easily a sort of shared identity that in turn might boost communication and knowledge sharing.

At this point it could be noticed how virtual teams, in order to successfully interact, should focus on the factors that enable the creation of a good communication and information flow among participants, as in this way an efficient knowledge sharing process could happen, that can in turn boost virtual team's efficiency.

In this scenario, Zakaria, Amelinckx and Wilemon (2004) further investigate this point, and they focus on the communication methods that can be exploited by virtual teams. In particular, the authors underline how thanks to communication technologies is now possible to collaborate among great distances, different cultures and time zones, but what is important in this scenario is to create a knowledge sharing environment that enables members to coordinate and to communicate efficiently. Therefore, in order to build successful virtual team interactions, that enable knowledge and information sharing among participants, individuals should own positive predisposition to share (Zakaria et al, 2004).

At this point it should be considered how communication settings are different in virtual teams, if compared with traditional face-to-face teams. In fact, according to Zakaria et al (2004), communication among traditional teams is eased by face-to-face contacts, visual messages and the ability to decode more effectively hidden information, but in virtual teams the settings are different, as members communicate through electronic or digital means and they face more difficulties in decoding messages. Therefore, understanding the additional challenges that virtual teams face when they set a communication system is crucial, these teams, in fact, cross several boundaries due to the fact that members might come from different culture, they use technology to communicate, and all these elements might consistently affect the communication process.

Thus, after these considerations, it could be assessed the importance of further exploring the theme of communication and knowledge sharing in virtual teams, in order to understand the additional difficulties that virtual team's members are required to face when communicating among each other.

2.1.2 The effects of cultural differences on the communication process

As stated at the beginning of this chapter, the themes that are related to the concept of virtual teams are all correlated among each other. Therefore, understanding how culture affects communication is crucial in order to know how to build effective knowledge sharing environments in heterogeneous virtual teams.

For what concerns the cultural point, Zakaria et al (2004) underline the strong link that is in place between culture and communication patterns, in particular referring to the cultural context in which different countries are placed in.

In this scenario, it's useful to take into consideration the cultural dimensions identified by Hofstede (1980) that might provide several explanations on individual's attitude towards communication. In particular it's important to consider these distinctions:

- *Individualism- Collectivism*: Individualism refers to individuals' personal attitude to look for their own needs or behaviours, collectivism, instead, focuses on being more part of a group and therefore feeling more represented by "we" and not "I". In this scenario, in order to understand the potential differences, among different countries and cultures these dimensions might point out, it's interesting to cite some examples. Therefore, according to data from *Hofstede insights*, countries like Italy (76)⁵ and France (71) present values significantly high in individualism, meaning that they are strongly attached to the "me" objectives and achievements, whereas Japan (46) and China (20) are more collectivistic cultures, thus attention is put on the group and on the cohesion among different ideas and opinions of the individuals.

⁵ Data from *Hofstede Insights*, <https://www.hofstede-insights.com>

- *Power distance*: Refers to the fact that people might accept or not a hierarchical definition of power in which every individual need to stay in the role they are supposed to. In particular, in countries where the power distance is high, individuals stay under a hierarchical order, whereas where it's low individuals feel more equal. In this case countries like Italy (50), Japan (54) and United States (40) don't show high values on this index, if compared with China (80) and Russia (93) where values, instead, are higher.
- *Masculinity- Femininity*: Refers to the difference between a behaviour consistently focused on achievements and rewards (in the case of masculinity), and the opposite behaviour of being more focused on cooperation and being more modest (in the case of femininity). In this case countries like Japan (95) and Italy (70) show considerably high values, meaning that in those countries individuals are more success-oriented, being masculine societies, if compared with Sweden (5) and Denmark (16), that are feminine societies.
- *Uncertainty avoidance*: This dimension refers to the reactions and attitudes that members of a given culture prove when relating to uncertain environments and situations. In this case, to cite some examples, in countries as Italy (75) and Japan (92) the values related to this index are quite high, meaning that individuals belonging to these countries don't feel comfortable in ambiguous situations, whereas in Sweden (29) and Denmark (23) the situation is different, as members of these societies are more relaxed towards ambiguous situations.
- *Long term orientation- Short term orientation*: Refers to the fact that individuals, in the case of short term orientation, are more linked with the past and are closely linked with traditions and norms, instead of those with long term orientation that are more willing to embrace changes and shifts. To cite some examples, Japan (88) shows high levels on this score, meaning that individuals that belong to this country are more projected towards the future, whereas countries like Denmark (35), that present low levels of long term orientation are open to changes and to new patterns.

- *Indulgence- Restraint*: Refers to the degree by which individuals attempt to control what they desire and their impulses, therefore a strong control classifies a culture as restraint, whereas a weaker control can be considered a characteristic of an indulgent culture. Italy (30) in this sense can be classified as a restraint culture as individuals have a strong attention towards rules and the control of their impulses, differently, Sweden (78) that can be classified as indulgent, because people, belonging to this culture, are more willing to spend their time by doing what they really desire.

Considering these differences, that cultures might cause in individuals with different backgrounds, is extremely important as they can reflect different attitudes, or behaviour individuals can have that are due to their mother culture and that can, also, reflect in the communication patterns.

Therefore, by taking into consideration all the factors that can be pointed out when considering establishing a virtual team, it's possible to understand the importance of studying cultural aspects that might eventually cause drawbacks on communication and knowledge sharing.

In this scenario, Zakaria et al (2004) consider some of the dimensions identified by Hofstede (1980), that can be related to communication issues, in particular they focus on the individualism-collectivism dimension. According to the authors, individuals coming from collectivistic culture are more willing to work in groups, if compared with individualistic cultures, but they can feel uncomfortable in that kind of group that is represented by global virtual teams as members cannot communicate face-to-face and can find more difficulties in establishing relationships and trust.

In addition to this, other cultural dimensions, then the ones identified by Hofstede (1980) might influence communication, in fact, authors like Hall (1976) identify other distinctions linked to cultural differences that can be made, in order to understand people behaviours and their consequences on communication flows. In this sense, Hall (1976) provides a key distinction related to the communication patterns that can be in place between individuals coming from different backgrounds. In particular, the author presents the differences between high and low context cultures, stating that high

context cultures are those in which the communication pattern goes as follow: *<most of the information is already in the person, while very little is in the coded, explicit, transmitted part of the message>*, whereas in low context cultures: *< communication is just the opposite; i.e., the mass of the information is vested in the explicit code.>*

Therefore, considering high context cultures, people communicate in routine or daily activities in a way that doesn't need in-depth or background information but just basic data, whereas in low context cultures communication must include several information exchanges and background information. Relationships or meetings between these two different types of cultures can provide several drawbacks, if participants aren't aware of the differences that exist among them. In particular, Hall (1976) provides several examples on how these differences can be found into different cultures, the author states that Germans, for example, need a lot of information exchanges into their working activities, whereas Japanese are more high context cultures and need lesser information background exchanges.

Therefore, considering virtual teams, when cultures that are characterised by these two completely different communication methods meet, participants need to pay attention and to consider the reciprocal differences that might exist, in order to engage in successful communication patterns.

In this scenario the role of technology in helping the communication process and information exchange is crucial, as communication technologies and platforms can be seen as tools that might ease cross cultural communication (Jarvenpaa and Leidner, 1999), for example, they can lessen the cross-cultural effects that members might feel when communicating face-to-face, as communication might be mostly written or asynchronous. Therefore, what is extremely important to consider in this scenario is the fact that virtual teams need to find the most suitable communication tools and patterns in order to foster a successful information and knowledge sharing.

According to these considerations what members need to own, to successfully perform in virtual team's settings and to correctly use the given supportive tools, are digital competences, but also, in addition to this, members should own competences that enable them to correctly behave in multicultural environments (Zakaria et al, 2004).

To summarise what successful virtual team players should own, in order to successfully communicate and share knowledge, are competences that refer to: knowing how to relate with individuals coming from different cultures, but also competences related to information technologies and the related tools.

2.1.3 Factors that can ease efficient communication flows in virtual teams

From the literature reviewed so far, it's clear how organizations and companies, in order to build successful virtual teams, that are able to communicate and share knowledge efficiently and effectively, need to act anticipately, for example organizing some trainings related to the two competences mentioned before, cross cultural ones and technological ones, in order to make individuals successfully interact among each other, through technological means.

In this scenario, firms, interested in fostering virtual team's communication and the knowledge sharing process should look for the right patterns or factors, that might bring to efficient communication flows.

Therefore, further studies should be investigated in order to correctly understand the communication topic in virtual teams, the possible barriers they can face and the strategies to put in place in order to overcome them. Among these, authors like Lowry, Zhang, Zhou and Fu (2010) study the aspects that can affect communication quality and trust establishment among virtual team members. In particular, they investigate over the reliability of their model, which implies that communication quality in global virtual teams is influenceable by social presence. The authors identify social presence with the degree by which interactions and relationships among individuals are enhanced thanks to technological mediums usage. Communication quality, instead, is referred to the degree by which members of a group consider group discussion effective; therefore, a good communication quality can let members express different opinions, having a more complete understanding of the scenario and accessing more interpretations, this could lead to possible improvements or to new ideas to pup out.

In particular, Lowry et al (2010) investigate social presence in different communication scenarios, as: < *FtF groups without collaborative software (CS) support, FtF CS supported groups and virtual CS groups*>, trying to understand possible linkages or patterns.

According to the authors communication quality can be assessed through two different characteristics that are: < *communication openness and task discussion effectiveness*>. In particular, the first one refers to the degree by which individuals are willing to put themselves in place and are ready to share information, knowledge and experiences, whereas the second characteristics is referring to the effectiveness of discussion among members and to the consequent amount of information that is shared. In this scenario, the authors investigate the linkage that exist between social presence and communication quality and, in addition to this, they investigate also over the relationship that exist between interpersonal trust and communication quality. In particular they hypothesize that communication quality, that as stated before, is related to the effectiveness of communication and information exchanges, is positively linked to the formation of interpersonal trust. In this case interpersonal trust is referring to that kind of trust that can be established among team members and individuals within a group and that can be beneficial to the overall group as it can enhance an overall trustworthy climate.

According to the results of the research conducted by Lowry et al (2010) communication quality, represented by communication openness and task discussion effectiveness, is higher in < *FtF non-CS groups than in FtF CS-supported groups and virtual CS-supported groups*>. Therefore, results prove that there is a significantly advantage for traditional face-to-face teams that regularly meet in person as regards communication quality, if compared with virtual teams that communicate through digital means. Moreover, the authors find that interpersonal trust is easier to establish in teams where communication openness and task discussion effectiveness are present. In addition to this, it should be considered, also, how some cultural aspects might influence the process of trust establishment, for example, as demonstrated by Lowry et al (2010), collectivistic cultures might feel higher levels of interpersonal trust if compared with individualistic cultures.

Therefore, this study is able to prove how culture matters as it could influence trust establishment that in turns might benefit communication flows, but it, also, sheds a light into the importance of communication quality, made of task discussion and communication openness, in virtual teams. Thus, it might be important for organizations that want to adopt virtual teams, to establish cross cultural training sessions when several different individuals with different backgrounds meet, but it is also important to choose the right communication media that allow for successful information sharing, through communication openness and task discussion.

Considering the importance of effective communication flows in virtual teams is crucial, in fact, as already considered, communication is the key for providing the final value virtual teams are asked for. Therefore, it's interesting to understand what might be some patterns to follow in order to foster effectiveness in teams.

In this scenario, authors like Walther and Bunz (2005) attempt to provide some basic rules for a smoothly management of communication and information sharing among members. More specifically, they provide a behavioural and organizational guide in order to create the pre-requisites of success among virtual teams, in particular they identify six rules that need to be in place in order to communicate efficiently. According to Walther et al (2005) virtual teams are: *<groups in which interdependent members collaborate from different locations using communication technology.>*, therefore they rely on communication tools, represented by electronic and digital tools, that are essential for let communication flows happen among individuals.

Furthermore, besides a broad definition of this type of team, it should be considered that this type of virtual work faces additional difficulties if compared with traditional ways of working, in fact members by being located in different countries and by communicating not face to face, but digitally, face more troubles when attempting to share knowledge and to create trustworthy relationships. According to Walther and al (2005) relying on some communication rules is crucial for virtual teams that use *CMC (computer-mediated communication)*.

The six rules the authors identify can be synthetized as follow, starting from the beginning Walther et al (2005) understand how it's important for virtual teams, that face

an increasing number of difficulties if compared with traditional face to face teams, to: *<get started right away>*, in fact, traditional teams members tend to procrastinate tasks and the *<production phase>*, but unlikely traditional teams, virtual teams can't afford this behaviour due to the fact that they face additional difficulties in communicating, as they can't be always interconnected, therefore it could be seen as a waste of time waiting to start. A second rule these teams should follow is related to the communication methods, in fact, according to the authors, virtual teams should communicate more frequently and daily if compared with traditional teams as they can face additional difficulties in establishing trust among members (that can help a smooth sharing of information). Therefore, in order to attempt to build interconnections among members a frequent communication is the key to establish better relationships. Moreover, the authors identify as a third rule the one of doing multiple things at once and organizing the work in a way by which there is plenty of simultaneity among team members. In fact, according to Walther et al (2005) in this way, work can be organized more efficiently and more creatively, as individuals can exploit the fact that working in a simultaneous way can create the right environment that let individuals provide different perspectives.

A further rule, virtual team members should follow, instead, is the one of paying attention to the messaging phase, in fact in virtual teams is more difficult to assess if a team member has reached and read a message, because members cannot double check in person. Therefore, a positive rule for the virtual team environment, to avoid mistakes of communication, according to the authors, consist on: *<once a receiver has gotten a message, it requires overt acknowledgement in order for the sender to know>*. In addition to this a further rule, stated by Walther et al (2005), refers to the fact that virtual teams need to put in place additional efforts, if compared with face-to-face teams, as they should pursue explicitness and clarity on their behaviours and actions, this in fact is a key role for making virtual members collaborate among each other's in an effective way and for pursuing efficiency. Therefore, explicitness can help members to understand how other participants in their group behave and what are their common patterns.

Finally, the last rule is referring to deadlines, according to the authors virtual team's members need to respect deadlines, to schedule work and stick to the plans in order to create a trustworthy climate and to enhance the right environment cooperation among members.

Therefore, through the adoption of these rules, connections among members can be enhanced and a positive information sharing environment can be build.

To summarise, through the review of some of the studies that have been conducted in the virtual teams' field, it appears clear how organizations need to consider all the different aspects that might affect efficient communication and information flows, in order to understand the different patterns that they can put in place to foster virtual team's efficiency and the factors that might ease information sharing.

2.2 Trust foundation and its characteristics in Virtual Teams:

Trust, as already seen, is a pivotal point in virtual team's dynamics, in fact several authors attempted to understand its role, the benefit it can bring and its foundation. In particular it has been defined, by Cohen and Gibson (2003), as: *<a shared psychological state characterized by an acceptance of vulnerability based on expectations of intentions of others in the team>*, and in this section it will be further investigated.

As already seen in the sections before, trust in virtual teams might be more difficult to establish, in fact, if compared with traditional teams, they present several characteristics that can be considered as barriers for the development of trust among members. These barriers are represented by: the *geographical dispersion*, as team members face greater amount of difficulties in order to get in touch and to overcome the physical distance, the *electronic communication*, that might not always be able to create the right environment for the development of knowledge sharing and interpersonal relationship and, in addition to this, virtual teams are also facing *cultural* barriers that make establishing relationship among members more difficult to achieve.

Several authors attempted to study trust and the aspects related to virtual team existence and work, among these Sarker, Ahuja, Sarker and Kirkeby (2011) investigate the effects of the influence of communication centrality and trust over the final results of virtual teams. The approach followed by the authors is that of *<networked individualism paradigm>* that states that *<an individual act within the context of a network of other individuals and artifacts, rather than in isolation>*.

Following this approach, the purpose of the authors is that of trying to test the validity of three models identified as: *additive, interaction and mediating*, questioning the role of trust in relation with the final performance. They identify the *additive model* as the one that predicts that both trust and communication can additively affect the performance of individuals. In this sense trust, is assumed to have a positive effect on performance, as well as higher degrees of communication among individuals are assumed to be positively linked to performance, as *<talkative>* individuals are considered more participative to team dynamics and can, consequently, enhance the diffusion of team's objectives and performance. Therefore, the authors state as hypothesis that individuals that present high degrees of *<communication and trust centrality>* can provide a higher performance. The second model that the authors attempt to investigate is the moderation model, or also called interaction model, that states how trust is the enabler of good performances at the group level as it *<it "facilitates" the effect of other variables on performance outcomes>*, in this way a higher performance at group level is more likely to happen, for example trust may be seen as a condition that facilitates the communication patterns among members and this can lead to a better final performance. Finally, the authors consider the mediation model that attempts to test whether trust centrality in an individual, member of a virtual team, can exist as a middle stage that links communication centrality to the increase in value of performance, in this case the hypothesis is that trust centrality in virtual groups has a *<mediating role>* between *<the communication centrality and (..) performance>*.

The three models studied by Sarker et al (2011) attempt to understand the role of trust centrality and the relevance that it can assume if considering the individual and group performance. A summary of the three models can be represented by considering the role of trust and the stage in which it proves its powers over the final result. Therefore,

in the additive model trust centrality and communication centrality are positioned at the same degree as for the effects they can produce over the final performance, in the interaction model instead, trust centrality can influence the relationship between communication centrality and individual's performance, assuming an "external" role, whereas in the mediation model it's a middle stage that is located in between communication centrality and individual performance.

The result of the analysis conducted by the authors prove how the *mediating model* better suits virtual team's settings, therefore according to Sarker et al (2011) the positive effects of communication on individual performance are possible thanks to trust that is the mean by which communication positively affects individual's performance.

These results prove how communication and trust are strongly linked and how a relationship among these two virtual team's "components" can assure a superior performance in virtual team's settings.

Several other authors attempted to study trust in virtual teams, the characteristics under which trust is developed among individuals and the possible linkages with performance increase. Among the authors that tried to provide an overview of the effects of trust over the final team performance there are Brahm and Kunze (2012). In particular, differently from the research conducted by the previous authors, they test the contribution of trust over virtual teams' performance by using a *<moderated-indirect model>*, according to which an antecedent of the positive virtual team performance is given by the creation of clear goals and task that have to be clear in component's mind in order to perform successfully. The authors argue that trust formation is fundamental in order to have a smooth organization, as thanks to the formation of trust among members, the goals that are settled for the team and the tasks that individuals must perform are more clearly communicated to virtual team members and this, in turn, can lead to a better performance alignment. In fact, following this pattern, individuals are moved to make their best in order to reach group's goals, and this can lead to an increase in performance.

Therefore, the *moderated-indirect model* tests the linkages between trust and team performance, by assessing that the planning process assumes a critical role for virtual

teams' performance, because given a clear process of goals and objectives setting, individuals can better understand what they are supposed to do and what actions can lead to goal's achievement. In this sense, according to the authors, the difficulties virtual teams feel are related to setting and clearly stating goals, as individuals barely know each other and don't have established great interconnections among each other. In this scenario, trust plays a critical role, in fact the presence of trust among individuals can help the goal sharing process and can help in establishing a better participation and coordination that can lead to positive achievements. In this way, the model proposed by Brahm et al (2012), if compared with the three tested by Sarker et al (2011), differentiate itself as collocates trust as an accelerator in between the creation of goal, team cohesion and the final performance, in fact, as the authors state that: *<team goal setting is transmitted via team cohesion to team performance, depending on the level of trust among team members>*.

Therefore, through this study it's possible to assess how the goals definition phase is believed to have positive effect among members and teams' cohesion.

In fact, according to Brahm et al (2012) trust existence among virtual team members can have positive effects, on the relationship between the goal setting process and cohesion among members of the team, as virtual teams, that show consistent levels of trust among members, present stronger relationship (if compared with teams with lower levels of trust). In addition to this, according to the authors, higher level of team cohesion can positively affect the performance of virtual teams. Therefore, a positive relationship is in place both between team goal setting and team cohesion, and between team cohesion and team performance.

What can be understood from these analyses lies on the fact that individuals and virtual teams, by stating clearly team's goals in the first place and by establishing a certain degree of trust among members, can develop a team cohesion that can make the goals achievement process clearer. In addition to this, they can consequently achieve a greater performance, in fact in teams with higher level of trust individuals are more willing to establish relationships and communication lines among each other's and they can foster a better team cohesion, reaching team's goals more efficiently.

Therefore, from these studies it's clear how trust has a fundamental role in virtual teams as it can provide substantial benefits in relation with virtual team's performance and the overall successful management of individuals working across long distances.

Other authors that attempted to study the role of trust and the shapes it can assume over the different configuration of virtual groups are Jarvenpaa and Leidner (1999). More specifically, they identify virtual teams as: *<an evolutionary form of network organization enabled by advances in information and communication technology>*.

In particular, in the study conducted by Jarvenpaa et al (1999) several questions related to trust are posed, as: whether trust can exist in virtual teams, how trust could be formed among members and the role of communication in facilitating the development of trust.

In this scenario, what has been observed is that trust foundation can be contingent to several factors that are usually present in traditional teams, in fact individuals in traditional teams might share the same culture or behaviours, might have the same language, and these are all elements that can lead to trust foundation and development. In virtual teams, instead, the situation is different, as individuals can be extremely different as for culture of provenance, language but also behaviours and working methods.

By attempting to understand whether the foundation of trust in this type of team is possible Jarvenpaa et al (1999) analyse several theories that concern the behaviour of groups and the interactions that can happen among members and that might pose some questions regarding trust establishment in virtual teams. Among these theories; the *TIP theory* (time, interaction and performance), identifies successful working groups with those: *<engaged simultaneously and continuously in three functions: (1) production (problem solving and task performance), (2) member support (member inclusion, participation, loyalty, commitment), and (3) group well-being (interaction, member roles, power, politics)>* (Jarvenpaa et al, 1999). In this scenario, virtual teams might be disadvantaged in establishing trust among participants, as they could face additional difficulties in establishing a project, solving eventual problems and conflicts and providing results, as members communicate and work through digital means.

In addition to this, according to the authors, other theories as the *media richness* theory and the *social presence* theory, might question the possibility that members can establish relationships among each other, as they have to communicate and to relate through electronic communication and this can be detrimental for the foundation of trust. On the other hand, the situation might also be different than the one implied by those theories, as electronic communication, might also not constitute a barrier towards information sharing, and instead, can lessen the negative effects of cross-cultural communication.

To synthesize, some aspects are clearly posing questions over the effective creation of trust in virtual teams because, if compared with traditional teams, members are depicted as disadvantaged. Among the disadvantages virtual teams might face, according to Jarvenpaa et al (1999), there are also those related to language differences. In fact, virtual team's members can come from different countries and they might own different languages, in this scenario, even if English is adopted as a common language there could be differences in the way people intend to communicate and in the way they interpret the information. Moreover, differences related to the communication pattern among different cultures are also relative to the Hofstede's dimensions, as Jarvenpaa et al (1999) observe, people coming from individualistic cultures may have to put in place a greater effort in order to share information with virtual team's members, whereas people from collectivistic cultures members are highly focused on group's needs over the individual's ones.

In this scenario, an important theory related to the concept of trust in virtual teams and the aspects it can assume is the one of Meyerson, Weick and Kramer (1996) that it's called *<swift trust>* and looks at the characteristics trust can assume in temporary teams. In particular, this theory explores the way trust is formed in teams that are characterised by the fact of having a limited history together, having members that are different among each other, having to respect deadlines, having to work towards task achievement and being temporal (as members probably won't work again after the tasks are completed). These characteristics might describe virtual team's settings, as these teams might be created for temporary purposes and individuals might be completely strangers among each other. Therefore, in this case the type of trust that can exist

among members is more difficult to establish. In fact, individuals are forced to relate with different setting and different cultures and this could lead to initial difficulties in the establishment of the right pattern of actions. According to the theory of swift trust in these teams *<individuals (..) make initial use of category-driven information processing to form stereotypical impressions of others>* (Jarvenpaa et al, 1999), therefore they initially act on the basis of stereotypes in order to create kind of impressions about the colleagues and the other members and in order to deal with the uncertainty and risk individuals might feel. After this stage, according to the author, trust can be developed and maintained through a consistent level of actions that can fuel trust among people and enhance the integration of members. To synthesize, as many authors have proven, the theory of swift trust, that is at the heart of virtual team's development, focuses on the initial interactions that are created thanks to: *<broad categorical social structures>*⁶, importing trust from the outside. An important role in this scenario is played by the clear statement of roles members have to assume and tasks they are supposed to do.

In addition to this, Jarvenpaa et al (1999) report what might be some characteristics that could enable the formation of trust in virtual team's initial stages and those that let trust happen at the final ones. In particular trust can be enhanced both by communication behaviours and action performed by members of a group, that might ease the process of trust foundation.

For what concerns the communication tips that can provide advantages towards the formation of trust among virtual team members social communication can be cited, that according to the authors, can help in trust establishment at the early stages of a team's life, moreover, also a communication mode focalized on enthusiasm and proactivity is considered crucial in establishing trust initially among participants. As concerns the actions, instead, the authors prove how high levels of trust are present in individuals that can establish a right pattern of actions that allow virtual team's members to overcome the initial uncertain stages that are represented by the virtual team structure. For example, teams that show high initial trust are those in which members can put in

⁶ Jarvenpaa et al (1999)

place some systems that enable them to deal with all the uncertainty that come out in the first phases, as tracking when participants are able to connect and work in order to have a clear and common understanding of each person working hours. In addition to this, other actions that prove to be successful in establishing trust for the first time are related to individual's initiative.

As for the second part of virtual team's life, when individuals start to know each other, further behaviours can be considered when maintaining trust. For example, according to Jarvenpaa et al (1999) establishing a predictable pattern of communication can be a key driver in maintaining trust in these kind of teams, as they operate through long distances, and in this way, there could be more clearness over members commitment and task participation, by establishing a sort of scheduling of communication. Moreover, another important characteristic related to virtual team patterns refers to the fact that members need to show up and prove that messages have been received and that responses can be provided in order to make other team members understand that they are actively participating to the virtual team project and this can enhance the establishment of trust over the long term.

As concerns the actions, instead, Jarvenpaa et al (1999) identify that some key characteristics of members actions can be related to the leadership structure of the team, in fact they observe how in teams where trust is present during the project development, some individuals show up assuming leadership attitudes. Finally, also the attitude over crisis has been studied as a major element that could be seen in highly trustable teams, in fact, in those teams, members are able to organize work in a sustainable way and to commit positively, even in difficult situations.

To summarise, authors like Jarvenpaa et al (1999) prove how the development of trust is possible in virtual teams, even though it might assume the aspect of swift trust. In addition to this, the studies reviewed can provide important insights into the communication methods and actions that can facilitate the formation of trust and its maintenance and they might provide some useful examples of communication patterns and actions that can help the foundation and formation of trust in virtual teams.

Therefore, after having taken into consideration these studies it is clear how trust can assume different shapes in virtual teams and how it is initially, and maybe also during the life of the team, more difficult to establish among members. It's also true that some communication or action patterns, put in place by members, can help to overcome these problems and how the clear statement of roles and tasks early in the team's life can be a key action to take.

Trust has been seen and studied in relation with team working patterns by several authors and in several different ways, so far it can be assumed how a trusting climate can reduce coordination problems among team members, both in the short and in the long term, leading to a decrease in coordination costs and also a decrease in mistakes that derive from a unobtrusive climate that can be identified also with misunderstanding, stereotypes and other unhealthy drawbacks. In this scenario also, the mean of communication can play a substantial role, as it's a way to distinct traditional teams, that use to communicate face-to-face and less often through virtual means, and virtual teams that instead need to rely on electronic communication in order to develop a task or a project and to perform daily operations.

But how could electronic communication influence trust establishment?

2.2.1 What facilitates trust foundation?

In this scenario, the key elements that might facilitate trust foundation should be addressed and should be stressed out by firms interested in adopting virtual teams, as in this way, team's performance could gain.

As it has been already seen in the previous sections, trust in virtual teams is strongly linked with communication among members. In this scenario, a study that has been taken into consideration in order to understand the patterns of trust in virtual teams and the relationship with electronic communication is the one of Henttonen and Blomqvist (2005) that attempt to understand the formation and the development of trust in virtual teams at their initial stages.

More specifically, the authors identify trust as a major element that permits the establishment of a positive working environment within the group, some antecedents of trust are also taken into consideration, as having common goals or having a <social similarity>. In particular, according to the authors, sharing a clear understanding of the goals each member must accomplish and the roles they have to follow, it's important in order to establish trust initially.

Among the factors that can facilitate trust foundation, according to Henttonen et al (2005), there is members goodwill, that is crucial in order to shape individual's expectations and opinions of the other team members. In addition to this, what is considered important in order to establish trust, are: first impressions, individuals' positive attitudes towards tasks, and the advancement of the project and the promptly answer to email and other communications, that can help individuals to achieve a greater coordination. Furthermore, also taking initiative and the overall behaviour of the individuals, when it is open to cooperation, proactive and willing to learn and share information, is considered important to enhance the foundation of trust in virtual team's early stages of life. In addition to this, an important factor that might help in trust foundation, in virtual teams that communicate through electronic means, is given by the importance of visual meetings as, according to Henttonen et al (2005) when this type of communication takes place, members prove to be more cohesive and also communication can gain benefits because of an increase in information sharing.

Therefore, Henttonen et al (2005) observe how, after an initial phase in which trust it is more difficult to establish, the commitment phase happens to be reached when individuals, part of a team, share a common vision and feel comfortable in communicating through electronic means, sharing ideas and information among each other's, proving that trust has been established. Therefore, some characteristics that the digital mean adopted by a virtual team can provide, for example enabling video conferences and visual meetings, could be linked with the creation of trust among members. Thus, organizations that want to adopt virtual teams and want to create the successful conditions that might enable trust foundation should choose among those digital tools that have a "visual meetings" or "video conferencing" feature.

In addition to this, firms should also be aware of the impediments, that might exist, towards trust foundation in virtual teams, in order to be ready to face them correctly. In this case according to Henttonen et al (2005), among the possible barriers to trust foundation there is the fact that, through this type of working solutions (that uses digital and electronic communication), it could happen that members find some difficulties in retaining *<contextual information>*. This could be the consequence of the great distance that there might be between different members and the consequent detachment that members feel when considering the situations other individuals are facing. Along with this, according to the authors, another possible barrier to trust has been identified with the *<failure to provide information evenly>*, meaning that it could happen that information is not shared in the same way through all team members leading to a disadvantage for some individuals over others, that instead possess more data. Moreover, another possible barrier is linked with the difficulties that members have in interpreting the meaning of silence by participants located in other countries, in fact this could lead to a waste of time or to a demotivation of team's members. Finally, also the lack of trustworthiness in maintaining one's promises can affect consistently members behaviours and performance.

At the end it could be said that all these barriers to trust can affect virtual teams' final performance in a negative way, as they don't let the creation of effective working relationships among members and they can also affect information and knowledge sharing.

In order to address this problem, some procedures can be underlined as important points to put in place in virtual teams, in particular some key passages for the creation of trust. In this scenario, among the sources of trust, according to Henttonen et al (2005), as it has been identified by Jarvenpaa et al (1999), a great importance is given to open communication that can enhance trust formation, with timely responses and the creation of feedback to the other members, and also to the situation in which team members try to achieve together a common goal, managing to acquire a greater sense of accomplishment and trust with their colleagues. In addition to this also social similarity has been identified, as a key factor in contributing to the group cohesiveness and the foundation of trust. What is more owing information about an individual's

personal path of growth and life can act as an accelerator in the foundation of trust as it helps individuals to engage among each other.

To conclude, Henttonen et al (2005) assess that establishing some virtual live meetings is helpful for virtual teams because in this way members can break potential walls that are created by distance, different time zones and different cultures. In fact, by organizing a face-to-face meeting early in the life of the team, according to the authors, members might be more cohesive in communicating among each other and in establishing working relations.

In this scenario, in order to correctly assess all the patterns connected with trust, its possible advantages and the drawbacks linked to the absence of this condition, it's important to consider further elements connected with the foundation of trust in virtual teams. In particular, Gibson and Manuel (2003) identify *<risk and interdependence>* as crucial elements that could represent important challenges for trust development. In fact, they represent two elements that are at same time necessary in order to form and develop trust, but also that can constitute a sort of challenge for its development.

For what concerns risk, it could be identified as a crucial condition for the existence of trust in virtual teams, in fact the presence of elements that can be linked to a risky situation or to a feeling of experiencing risk, create the necessity of trust foundation among team's members. Risk is defined, according to Gibson et al (2003), as *<a perceived probability of loss>*, therefore the presence of a certain degree of risk among team members can be beneficial as it enhances the foundation of trust, but in the other hand a too risky situation or environment can be highly detrimental for virtual team's existence because they act as an impediment towards trust foundation. Gibson and Manuel (2003) further investigate the concept of risk, by taking into consideration the behaviours that take place into virtual teams. In fact, individuals in virtual teams tend to get around with people who perceive as similar to them. In this way what happens is the creation of subgroups⁷ inside the main group, composed of different individuals that tend to gather together according with some similarities they have in common, for example the culture of origin. In this scenario, individuals that belong to a subgroup tend

⁷ Social Identification/De-individuation theory (SIDE)

to look at the others in a more suspicious way, therefore in this situation risk might augment as the feeling of uncertainty arise.

The other element that affects both trust creation and maintenance is related to interdependence, defined as the degree by which an individual depends on the information that is provided by another individual. Interdependence is related to trust because when the degree of interdependence is high in virtual teams, individuals need to trust other members in order to try to achieve a greater coordination and information flow, in fact, without the right degree of trust also communication can suffer. According to Gibson and Manuel (2003) interdependence can also be linked to the presence of different cultures in the virtual team, in fact, higher degrees of interdependence can be in place in situations where members of a virtual team belong to the same cultural subgroups and are therefore more willing to share information.

After having considered the characteristics of trust associated with virtual teams, studies have also attempted to assess the connection that might exist between trust and the cultural characteristics of virtual teams, assessing whether virtual team composition can affect trust. The cultural theme will be further investigated in the following sections, but in this section it's interesting to have a review of the literature related to cultural divergences in virtual teams and how they might affect trust foundation.

According to Gibson et al (2003) teams that present a great number of cultural differences show negative perceptions of trust if compared with teams that have members more similar among each other. In fact, in these cases feelings of distrust could arise when virtual team cooperate, as different cultures (that are part of the teams) are characterized by different ways of communicating and expressing. In addition to this, in these teams, members might present dissimilarities also in the choice of words and in meaning of the phrases, leading at difficulties in communicating, and this in turn results in substantial impediments for the foundation of trust. In this scenario, Gibson et al (2003) prove, through they research, that members of virtual teams that are more culturally homogeneous have less problems in developing trust.

Besides these factors that might represent substantial barriers to trust establishment, it should be considered that there are some conditions and some aspects that can be stressed out as they might substantially benefit trust foundation.

Therefore, when considering potential situations and characteristics that might ease trust foundation, communication is a crucial aspect that needs to be reviewed.

In fact, it represents a key process for virtual team members as they need to communicate in order to perform what they are asked to do or what they have planned to do. In this scenario, the presence of trust inside virtual teams can be seen as a condition that enables a positive communication climate and information sharing, but it can also be the vice versa, communication might play an important role in building trust. As Gibson et al (2003) underline, communication has an important role in establishing trust, in fact it permits the correct functioning of relationships among members of the team, plus it can help the team to get along.

In fact, virtual teams that assume an open communication can perceive less difficulties in establishing trustworthy relationships. In addition to this, communication is also the enabler of interactions among individuals and it's the only way virtual team's members have to share clearly information. Therefore, continuous interactions could be helpful in order to build the basis for strong relationship and to create trust among members. Furthermore, the communication process can be also the moment where individuals are able to gather some information about their colleagues, leading to a better understanding of the team members and therefore to a climate that is less hostile.

In this scenario communication might benefit the trust foundation process in virtual teams, but it should also be considered that different aspects might condition efficient communication flows among dispersed members. Therefore, considering the cultural side in the communication pattern it's equally important as it can influence the choice of the language, the intended meaning and the preferred methods, in fact a message that one member wants to send to another colleague could be interpreted differently from its intended meaning because of cultural aspects that are linked to the choice of words or phrases.

At this point, after having taken into consideration several studies, it's possible to have an insight into the possible sources of trust in virtual teams, the possible ways of maintaining that trust during virtual team's life and also into the possible barriers to trust establishment. As already seen, trust foundation proves to be a key element for virtual teams' success and it's also linked to the effective communication methods that can be put in place inside this working teams. Therefore, from all the aspects and theories that have been studied through the years and that can be linked to the concept of trust formation in virtual teams, some implications that can affect the formation of virtual teams can be derived, that can act as a guideline for organizations that are interest in developing this kind of working structure.

To summarize all the theories linked to this topic, it could be said that trust is a pivotal point that needs to be stressed out when considering virtual team foundation, in fact trust plays an important role and has a special and profound link with communication. As the study of Sarker et al (2011) proves, the mediating model better explains this concept as trust centrality is collocated in between communication centrality and individual performance. In addition to this also Brahm and Kunze (2012), through the planning moderating model (that links trust and team performance), prove how the planning process and the clarification of goals can substantially benefit final performance as it is a way to let members understand what they are supposed to do.

What is more, the concept of swift trust and further studies explain how trust can be enhanced in the first place and reinforced later on in team's life and those theories are crucial for the correct assessment of how these teams work and the correct assessment of their structure (Jarvenpaa et al, 1999).

Furthermore, it has been found that electronic communication could be beneficial for virtual teams and trust establishment, as it enables to reduce the detrimental effects that cultural diversity might entails (Jarvenpaa et al, 1999). Also, the adoption of those digital tools that support communication in virtual teams and that allow users to have visual meetings, is considered important in order to reinforce trust among members (Henttonen et al, 2005).

Therefore, when designing virtual teams, organizations should be aware of the fact that a clear communication of tasks and the clear division of team members duties can provide substantial benefits to the team overall performance. What is more, they should consider putting in place favourable conditions that can enhance trust foundation, as the choice of a tool to communicate that permits visual meetings and constant communication. Finally, another aspect that organizations should take into consideration is referred to some individual's characteristics of members of virtual teams. An aspect that will be further developed in the next section.

2.3 Identity and personality characteristics of the Virtual team player:

When considering virtual teams and their potential effectiveness in nowadays business it's important to consider the effects that the different identities and personalities of team members might have towards team's functioning, therefore the aim of this section is to conduct an analysis regarding team's composition.

In particular, the aim of this section is to analyse the following research questions: are individual traits important for virtual team's functionality? Are members' KSAs linked with the final performance?

In order to find the right answers to these questions and to understand what aspects firms need to take into consideration when creating a virtual team (and if so what are the most important characteristics), a review of the literature linked to these themes is necessary.

Starting from the work of Schulze and Krumm (2017) it is possible to understand how a first topic related to this theme is the one of members' *KSAs (Knowledge, skills and abilities)*, that are those individuals' characteristics of virtual team members that are believed to be the drivers of virtual team effectiveness. The most important KSAs that virtual teams must own, according to Schulze et al (2017), can be summarized in 6 areas, in fact they are characteristics associated with: medias, in particular technological communication tools, communication aspects, related to the ability to manage to communicate in an effective way in intercultural and different geographical situations, capabilities linked with trust, acting in order to create trust, intercultural abilities, the ability to manage oneself effectively and to resolve and manage conflict in an effective way. Therefore, linked to these macro areas there are the individual characteristics of virtual team members that could substantially benefit the virtual team final performance. In particular the authors focus on the most important aspects that individuals need to own and that are directly related to virtual team's characteristics, represented by electronic and digital communication, cultural differences and geographical dispersion.

Starting from the electronic and digital communication related competences, individuals, that belong to virtual teams, have to rely on digital tools in to communicate and to share information, this implies that in order to properly use these devices, they must own the proper skills and knowledge. In particular, individuals should know the features and the characteristics of the technological media chosen, meaning that they should, also, own the capability to choose the right technological media, that is able to assure the best performance possible in accordance with what virtual teams are supposed to do. In fact, there are different types of medias among which virtual team members can choose, for example some of them assure synchronicity during communication and other asynchronous communication, but also some are provided with the possibility of having videoconferences and other features. Being knowledgeable on the characteristics associated with a given tool is crucial for virtual team's members, as in this way they can understand the features that are provided by the different tools and they can understand what could be the substantial benefits in choosing an application instead of another one, putting the basis for an effective communication.

In addition to this, the ideal virtual team player should also have the proper digital skills, meaning that individuals that possess the knowledge about the different digital communicative media tools, should also possess the right skills to communicate effectively. In this scenario individuals, according to Schulze et al (2017), need to own the right *<behavioural- oriented skills>* when communicating digitally. In particular, according to the authors, virtual team's players need to own several skills that can enable them to successfully communicate through digital media, these skills are related to four characteristics: attentiveness, coordination, expressiveness and composure. These characteristics correctly describe a virtual team player that: knows how to engage its listeners through alternative means of showing emotions, that in this case can be represented by the use of emoticons during the messaging phase, that is able to coordinate with the other virtual team members, for example he/she replies immediately or in a brief amount of time to messages, that knows how to demonstrate interests to the ones with whom he/she is speaking and knows how to relate with his/hers colleagues.

The same patterns can be found referring to the cultural issues that virtual teams need to face in their daily life experiences, as for this point the same observations carried out for the technological side can be made, in fact also in this scenario individuals need to own the proper skills and knowledge. According to Schulze et al (2017), successful virtual team members have a profound knowledge of the different cultural aspects that can characterize the communication patterns of individuals or the implementation of different activities, in particular they underline how the correct knowledge of the different cultural aspect virtual team members can have is important in order to understand, also, different communication patterns and the media choice. In fact, virtual teams members might have different preferences over the communication media depending on the cultures of provenance, for example the authors report that Chinese people demonstrate a preference for multi communication methods when compared with American people.

These studies are important as they prove how is fundamental for people, that might collaborate across different cultures, to have a clear understanding of all the cultural related patterns that can influence the overall working activity, in order to consider all the differences and in order to enhance a solution that could represent an advantage for all virtual team members, for example a media device that is accepted by all the members.

Therefore, according to Schulze et al (2017) cultural skills refer to the capability of virtual team's members of being able to communicate in an effective way with members coming from different cultures (also for what concerns the correct usage of the digital tools) by taking into consideration the substantial differences that might affect members. Virtual team members, according to the authors should adapt communication behaviours depending on the people they are speaking with, in order to prevent misunderstandings that can take place when communication patterns are different among cultures (it's the case, for example, of members that are keen on communicating by implying several things if compared with members that are keen on communicating every single details). Therefore, attention should be put into the substantial cultural characteristics that can affect communication patterns and behaviours and that virtual team members should be aware of.

Finally, as for the geographic related patterns the authors suggest taking into consideration also the characteristics related to time zone differences that can consistently and negatively affect virtual team's dynamics. In this case, the knowledge and the skills that virtual team members need to possess, according to Schulze et al (2017), are related to all the challenges that working across long distances can pose to managers and employees. Therefore, being aware on how to work with people located in different places and how to boost team efficiency under these conditions, is essential for virtual team's success. According to the studies carried out by Schulze et al (2017), members should possess the right knowledge on the correct way of organizing and carrying out work efficiently, through the choice of the right media, in order to be able to win the geographical distance barrier. For example, knowledgeable virtual team members are able to assess whether it's better to choose for a certain digital tool that provides synchronous or asynchronous communication. Related to the choice of communication alternatives there are also the skills that virtual team players need to possess, such as the capability to work in teams without having frequent follow ups. Virtual team members, in fact, need to carry out the task they have been assigned with, or they have decided to do, by themselves, therefore they need to own the right self-management attitude and skills. In addition to this virtual team's members should also own some skills, according to the authors, that enable them to put in place spontaneous forms of communication, in order to strengthen the group sense of belonging, but also in order to prevent possible conflicts that may arise from miscommunication.

2.3.1 Individual's characteristics and the linkages with Virtual teams' performance

In addition to all the characteristics that virtual team members need to possess, in order to be effective players in these virtual contexts, a growing body of researches is also attempting to understand the linkage between individual's personality traits and team's performance. In defining the key characteristics that successful virtual team members must possess Schulze et al (2017) underline the importance of being open to experience, a characteristic that has a major role both in addressing cultural differences, being open to learn different contexts and way of behaving, and also referring to the technological

use, trying to be ready to adapt to and adopt new ways of communication, being ready and responsive.

From these studies it could be depicted a link between individual's skills and personal traits, and virtual team's successful management and final results. Confirming how owning the right attitudes and skills can substantially benefit the final team performance.

A further study that confirms these trends is the one of Leung and Wang (2015) that attempts to review the linkages that might exist between an individual's *KSAs (knowledge, skills and abilities)* and virtual team effectiveness, stressing out what the authors identify as: *<individual virtual competence (IVC)>*. In particular, focus is put on individual characteristics, as they are believed to be essential for a successful final performance and the correct assessment of these characteristics can provide a consistent advantage to organizations, especially in order to select the most suitable individuals.

Therefore, the authors attempt to understand the correct assessment of individuals KSAs specifically referring to virtual abilities, in fact they believe that IVC substantially influence team's overall performance in a positive way, with individuals that perform higher in IVC showing better overall results referring to virtual team's final performance. In particular this capability has to be studied due to the fact that the ICTs usage in the last decades has seen a great expansion with firms consistently relying on these digital tools that are necessary also in virtual teams' settings.

In this scenario, Leung and Wang (2015) identify individual virtual competences as a construct that is made of different competences related to different dimensions, more specifically there are three constructs that together form the so called IVC, these constructs are: *virtual self-efficacy*, *virtual media skills* and *virtual social skills*. In particular, virtual self-efficacy, refers to the competences related to the individual's ability to correctly behave in virtual team's settings. According to the authors, this competence could be identified with two subgroups called respectively *<computer self-efficacy (CSE)>* and *<remote work self-efficacy (RWSE)>* that refer, for the former, to individual's computer skills and digital related skills, for the latter to individual's

capability to work in virtual environments, characterized by the fact that members are located in different places. As for the *virtual media skill (VMS)*, instead, the authors refer to individual's skills related to the capability of correctly using digital media to perform virtual teams' working activities and related to this concept there is individual's capability to correctly communicate through digital media. Finally, the last part that compose IVC is made of *virtual social skills*, that refer to those skills that are related to the individuals' capabilities to establish and carry out social relationships, with other team's members, that can be created, in this case, only through digital means. Therefore, this competence refers both to the substantial capability of communicating through digital means but also to individual's abilities to correctly choose the right electronic media.

According to Leung and Wang (2015) individuals that own Individual virtual competences (IVC) show a higher performance and are consequently more satisfied with their working activity. This scenario opens a series of questions on the current situation of firms, for what concerns employee's virtual competences, since the presence of these competences has proved to be related to an increase in performance.

These studies further shed a light into the importance of the team composition choices, as virtual team members that are more prepared for working digitally, in a multicultural environment and that are capable to self-manage, might represent an important resource for these kinds of working teams.

At this point it's also interesting to understand whether individual personality traits can also potentially affect virtual team's performance or if it's an effect related to individuals' competences.

Related to team's personality traits there is a growing body of literature that attempts to understand the linkages between individual's characteristics, leadership emergence and other patterns in virtual teams.

In this scenario, the research conducted by Krumm et al (2016) provides an overview on the potential *KSAOs (Knowledge, skills, abilities and other characteristics)*, that are related to a positive team performance and on potential key abilities that individuals need to possess, in order to be effective virtual team players. Therefore, the authors

test the *Eight Competences Model*, that includes eight domains and it is: <seen as a generic competency model>, in the virtual team framework and dynamics. In particular, the eight core competences, specifically refer to:

- *Leading and deciding*
- *Supporting and cooperating*
- *Interacting and Presenting*
- *Analysing and Interpreting*
- *Creating and Conceptualizing*
- *Organizing and Executing*
- *Adapting and Coping*
- *Enterprising and Performing*

The eight domains, conceptualized in the *Eight Competences Model*, can refer to specific characteristics that virtual team's players need to possess. In fact, according to Krumm et al (2016) virtual team's members need to own some specific characteristics and competences due to fact that they operate in international environments, with several different people coming from different cultures that can perform their daily working activities using asynchronous or synchronous digital tools. Therefore, they might possess traits related to the *Leading and Deciding* competence, in fact members are supposed to work autonomously when they are not connecting with the other members, and they need to self-manage their tasks and their work in order to respect the group deadlines. In addition to this, member might also possess competences related to the *Analysing and Interpreting* field, as virtual teams strongly rely on digital media, the virtual competences members need to own have to include also the correct assessment of digital tools and the right skills to be able to efficiently communicate digitally. In addition to this, another competence field that has been considered important by the authors is the one related to *Organizing and Executing*, meaning that individuals in virtual teams need to be skilled in performing autonomous work. Moreover, also competences related to *Creating and Conceptualizing* are considered crucial for the virtual team environment, as members are required to be able to perform efficiently and in an innovative way. In fact, members need to be able to adapt to a fast and always changing digital environment that can offer new digital tools or media.

Therefore, flexibility, digital competences and being able to embrace new experiences are all considered dynamic capabilities that the virtual team player should own.

Given the conceptualization of the Eight Competences Model, Krumm et al (2016) attempt to understand whether virtual team's players own some of these characteristics that can lead to successful outcomes. In particular, the results of the research conducted by the authors demonstrate that, if compared with traditional teams, virtual team's players need to own some particular competences referred to the Eight Competences Model, in particular competences related to *Leading and Deciding* and *Analysing and Interpreting* as they are required to effectively communicate through digital means and setting but also to decide and organize work autonomously.

In this scenario, another aspect that is important to consider in virtual team setting refers to the relationship that might exist between personality traits, leadership emergence and the consequently effects on performance. Therefore, understanding what individual characteristics can lead to leadership emergence is crucial in order to correctly build and manage virtual teams in a way that can substantially lead to a better overall performance. In this sense, the studies conducted by Cogliser, Gardner, Gavin, and Broberg (2012) attempt to understand the relation that exist between the *Big Five personality factors*⁸, leadership emergence and the possible linkages between these conditions and an increase in team performance. At the basis of these theories there is the common belief that leadership emergence, seen as the sense of authority (or recognised authority) that members, belonging to a group, feel in relation with a particular member, is positively related to the overall performance of the group. In particular, the purpose of the authors is to attempt to find a positive relationship between the Big Five personality factors and leadership emergence.

In order to understand the possible linkages that might exist between leadership emergence and the five personality factors is necessary to go into details about the five personality factors that may strongly characterize leaders in virtual teams, and they are: extraversion, agreeableness, conscientiousness, emotional stability and openness to

⁸ The Big Five personality factors, refer to five personality factors identified by McCrae e Costa (1987) that are believed to substantially differentiate individuals.

experience. As for a brief description of the five attributes, an ideal virtual team player, according to the model, should own personality traits related to: extraversion, that can be depicted in individuals that have great skills in socializing, that are able to communicate openly and are proactively, for agreeableness, instead, Cogliser et al (2012) refers to individuals that are cooperative and more willing to help others, and that prove to be trustworthy. For what concerns conscientiousness, instead, the authors refer to the virtual team player that proves to have a great sense of duty and accountability and that is keen on tasks resolutions and deadlines, as for emotional stability, they refer to individuals that prove to have a strong self-esteem and are resistant to feelings such as those of anxiety and anger.

The results of the study conducted by Cogliser et al (2012) prove how the *Big Five Personality factors* are partially linkable with leadership emergence, in fact a positive correlation exist for what concerns agreeableness and conscientiousness, meaning that individuals that are cooperative, willing to help others and have a great sense of duty can emerge as leaders in virtual teams. In addition to this, leadership emergence is proved to be positively related to team performance meaning that that leadership emergence, inside a virtual team, can contribute significantly and positively to task accomplishment. What is more, Cogliser et al (2012) also provide a further contribution to the research field by stating that the *<social-oriented aspect of emergent leadership>* might consistently contribute in establishing a better climate among team members, that can lead to an improvement in trust formation among members.

To summarise, these studies provide important contributions to the individual-personality field within the virtual team research as they help to correctly assess the possible linkages among individual personality traits and further positive conditions for teams' overall performance, as trust foundation, leadership emergence and team performance.

To conclude the research around this topic it's necessary to consider a further aspect taken into consideration by Hoch and Dulebohn (2017), linked to leadership emergence, in particular referring to the role of leadership in relation with team performance, introducing the concept of *emergent* and *shared leadership*. In this sense, emergent leadership is present in those members who have the possibility to influence in a

significant way other member, emerging in an individual and informal way. It's important to consider how in virtual teams, individuals need to self-manage and organize one's task and deadlines in order to correctly perform and meet group's deadlines and goals, differently from the traditional working group where members can easily meet with each other, talk in person, organize work and have regularly discussion in person, as we have previously seen. In this scenario, it should be considered how the emergence of a leader might positively influence one's performance and the overall final group performance. Therefore, emergent leadership can benefit virtual teams and the climate in which members operate, as it could be consequently more positive, cohesive and individuals might be more willing to achieve shared results.

Shared leadership, instead, according to the authors, is a collective process, made of members participating to a virtual team in which they can positively influence each other in a way that the teams' overall tasks and deadlines are respected more efficiently. In this case, leadership is not a characteristic of one individual within a group, but a condition that belongs to several participants as it is spread among them. In this scenario, according to Hoch et al (2017) the linkages between shared leadership and virtual team performance might represent a way to enhance collaboration among members, and collaboration might also be a way to establish trust, that is also crucial for a correct information and knowledge sharing process among members. Therefore, shared leadership is believed to be a precious way for virtual teams to positively affect the final performance and the linkages among members.

To summarise, this section has provided several useful considerations, given by the literature review conducted on some of the most interesting papers and studies that have been carried out related to the identity-personality theme, within the virtual team's field. Therefore, it's important to underline how managers and organizations, need to take into consideration also individual's personality traits when trying to establish new virtual teams. In fact, these studies reveal how some personality factors, as openness to experience and conscientiousness can be sort of predictors of the team success and they can also help in establishing leadership among individual, that can further lead to performance increases.

2.4 Creativity in Virtual Teams:

Considering virtual teams settings, several characteristics have emerged as advantages, that this kind of working solution can provide, but also as barriers that can exist and can represent potential drawbacks for team's working environment. A key characteristic, that can be enhanced in this kind of team, and that can represent a substantial advantage for organizations worldwide, when deciding to adopt this type of working solution, is the possibility of creating a positive environment for team's creativity enhancement. In fact, virtual teams, by being composed of members that might come from different places and cultures and, as previously seen, by owning some personality traits, as being open to experiences and changes, might put in place some conditions that let creativity arise more successfully. Therefore, it's essential for international firms and companies to understand the conditions that enable virtual team's creativity enhancement in order to successfully exploit them and being in this way innovative actors in the business field.

This topic has received great attention from scholars, that attempted to understand team's dynamics toward this phenomenon, starting from Barczak, Lask and Mulki (2010) that focus on the antecedents of team creativity and the condition that might ease its formation. In particular, according to the authors, virtual team's emotional intelligence and team trust are the antecedents of team's creativity creation. More specifically, they identify team emotional intelligence as: *<the ability of a group to develop a set of norms that manage emotional processes>*, in fact, they observe how members' abilities related to the field of: *<'awareness of own emotions, awareness of other's emotions, management of own emotions and management of other's emotions'>* can be considered as crucial in the formation of team cohesiveness and of a better climate that could possibly lead to knowledge sharing and new ideas to pop out.

What is more, also team trust has been identified as a key element in team creativity enhancement. In fact, as already stated when reviewing the trust related field, the concept of trust is strongly linked with the communication theme, therefore in working environments where trust is present, the circulation of knowledge and data is eased, and this increase in information and knowledge sharing might favour creativity

enhancement. Furthermore, according to Barczak et al (2010), trust in virtual teams might assume two main forms: *< affective and cognitive >*, the first one is identified with a type of trust linked with individual's personal feelings towards group's members, whereas cognitive trust is a type of trust that relates to the degree an individual relies on another members' knowledge. In this scenario, the authors hypothesise that the presence of affective and cognitive trust positively affects team's emotional intelligence that in turns fosters team creativity. In particular, a creative group is depicted as one in which there is the presence of a collaborative culture, identified with: *< one that values teamwork, communication, respect and empowerment, and leverages the knowledge of individuals resulting in organizational learning >*. In addition to this, a collaborative culture is also positively related with emotional intelligence presence, as according to the author, team members that own this skill, might foster collaboration that can lead, in turn, to an environment of sharing and of mutual understanding and that is also positively linked with team's affective and cognitive trust, characteristics that can benefit the creativity process.

Thus, the presence of creativity in virtual teams might constitute a strong advantage for organizations as in this way they can collect new ideas and exploit them. Therefore, in order to be innovative actors, firms need to stress out the conditions that can enable creativity development in virtual team settings.

According to Barczak et al (2010), attention must be put on trust, both affective and cognitive, but also on organizational culture and team's emotional stability. In fact, the presence of emotional intelligence in teams can foster trust creation which can contribute to an enhancement of collaboration among members, that in turns leads to a better knowledge and idea sharing that can foster team's creativity.

Therefore, what stands out from these analyses is the importance of understanding team's background in order to create the necessary conditions for team's creativity enhancement. Further studies have addressed this point by taking into consideration the environment that is surrounding the working team as a factor that may enhance the creation of new ideas and innovations.

In this sense, the study of Nemiro (2001) attempts to investigate the working environment's aspects that can be related to the condition of creativity creation in virtual teams. More precisely, the author focuses on the particular conditions that organizations can put in place in order to foster creativity in virtual teams. According to Nemiro (2001) attention should be put on the conditions that identify virtual teams, when compared with traditional teams, and that can consistently influence creativity, as: the different way of communication, the distance among members and the usage of digital tools. According to the author some dimension might help in fostering creativity in virtual teams and they especially refer to trust and role clarity, that are strongly linked with creativity enhancement.

Therefore, in this scenario, important elements that should be in place and that are linked with creativity development are given by: fostering a strong commitment among members towards goals' achievement, stating goals clearly and be aligned towards their achievement.

Moreover, as already observed in relation to other themes, the levels of information sharing and trust in virtual teams might consistently affect a positive environment that can enhance virtual team's creativity. In fact, members that trust each other and that manage to establish an effective communicative background, might share ideas, different point of views and knowledge more frequently, leading to a successful creativity settlement.

2.4.2. Factors that might affect creativity in Virtual teams

The literature reviewed so far has provided a considerable insight into virtual team's dynamics with a particular focus, in this section, towards creativity enhancement. In this context further aspects might be analysed that can considerably affect virtual team's life, member's interactions and also creativity foundation, among these, attention should be put on individual's and team's characteristics.

In this scenario, according to Martins and Shalley (2011), also demographic differences might affect group's dynamics and creativity. In particular, they hypothesize that virtual

team's creativity is positively related with individuals attitude towards sharing different perspective, and important moderators to consider in this relation are linked to: the *<establishment of a rapport>* intended as the boost of interpersonal relationships among members and the consequent increase in trust, and to *<participation equality>*, referred to the amount of engagement of each individual in virtual team's task and dynamics. Therefore, according to the research conducted by Martins and Shalley (2011), demographic differences, as differences in age among virtual team's participants, are positively related to team's creativity, when individuals are able to establish a rapport and when they participate equally to processes.

In this scenario, another factor that might influence the creation of a right environment that can foster team creativity is given by cultural diversity inside the different members that compose the team. Cultural diversity, in fact, might at the same time trigger virtual team's creativity, as it enables the group to acquire different perspectives and ideas, but at the same time might be detrimental as it could be an impediment towards trust creation and knowledge sharing. In this scenario it's interesting to consider the study conducted by Leung and Wang (2015) that attempts to understand the role of cultural diversity in shaping creativity patterns in global virtual teams and the possible moderators to the negative effects this type of diversity may bring, in particular the authors want to assess the role of: *<information and communication technology>* and *<task environment>*, in moderating the role of cultural diversity. According to the authors, the effects that cultural diversity can cause in virtual team's creativity enhancement are caused both by surface-level diversity, intended as the diversity that is related to conditions that are immediately perceivable by virtual team's members, as language differences, and also by deep-level cultural diversity, that refers to deeper differences related to values and norms, for example. In particular, these cultural differences might have a negative impact on team's creativity due to the fact that they can interfere with knowledge circulation. Therefore, Leung and Wang (2015) adopt a *<socio-technical framework>* in order to explain the possible moderators to the negative drawbacks that cultural diversity might bring to virtual team's creativity. In this scenario ICTs are considered as mediators, as they could hinder the effects that cultural diversity might cause, through the degree of communication realism they can provide to

individuals, in particular they identify how digital media that provide low communication realism might be beneficial for lessening *<identity threat>*, that can act as an impediment towards knowledge and information sharing. In addition to this, the other important moderating variable depicted by the authors is given by task environment characteristics, more precisely they theorise how differences in tasks might *<moderate the relationships between group inputs, processes and outputs>*, in particular they point out that in teams with task interdependence, task complexity and task intellectiveness, thus teams in which members rely on other individual's knowledge and competences, the negative effects of cultural diversity on creativity enhancement are reduced.

To summarise, considering the creativity theme in virtual teams is crucial for understanding what could be the potential characteristics and internal or external factors that might enhance and ease its formation. Creative virtual teams are an important resource for organizations that can exploit the different degrees of knowledge and point of views that these types of teams can provide. Therefore, considering the literature and the research related to this aspect of virtual team's life is crucial in order to understand and to exploit the potential condition that might boost creativity foundation.

2.5 Cultural aspects that might characterize Virtual Teams

When considering virtual teams and the characteristics of virtual work an aspect that needs to be taken into consideration relates to the effect that different cultural backgrounds might bring in the working environment. In fact, virtual teams, as already seen in the previous chapters, might be composed of members that are located in the same country, but work at distance, or they might be composed by members located in different countries, belonging to different cultures. Considering the cultural side is extremely important for firms, when deciding to adopt virtual teams, as people might present different attitudes and patterns depending on their culture. In this scenario some the most famous dimensions to consider, closely linked to the concept of culture, are the one theorized by Hofstede (1980).

The dimensions explored by the Hofstede (1980) can considerably affect virtual team's members behaviours, for example Krawczyk-Bryłka (2016) observe that a collectivistic orientation, instead of an individualist one, might favour trust establishment and the attitude of individuals towards knowledge sharing. In addition to this, another dimension, uncertainty avoidance, according to the author, can be a condition that could infer virtual team's attitudes, as low uncertainty avoidance, might be a preferred aspect for a virtual team member. What is more also language barriers, that might arise when virtual team's members come from different cultures and countries, can be detrimental for virtual team's performance.

In this scenario, it should be considered how cultural diversity might bring several benefits to the composition of the team, as an increase in creativity and ideas pop out, as seen in the previous section, but it might also bring some drawbacks to team effectiveness. In particular, it's interesting to understand the possible linkages that might be in place between cultural diversity of virtual team's members and the effects it might have on team's overall performance.

In this sense, the study conducted by Staples and Zhao (2016) questions cultural diversity, that can be national, in the case of surface-level diversity (for example, refers

to differences in languages), or cultural, in the case of deep-level diversity (that might refer to the individualism-collectivism dimensions), and the effects it might provide on the overall team functioning. The authors, in particular, study the linkages between cultural differences, explored in the dimensions of individualism and collectivism, and team performance, in terms of conflict resolutions and communication success. What it's interesting to point out from this research lies on the fact that some communication media in virtual teams were found to reduce the possible drawbacks of surface-level and deep-level diversity, as electronic and digital communication might foster a different type of communication that, differently from the one that takes place in traditional face-to-face teams, has reductive capabilities.

Other authors that attempted to understand the relationship that might exist between the individualism and collectivism dimensions and the contextual effects that they might cause in virtual team's dynamics are Mockaitis, Rose and Zetting (2012). In particular, according to the authors, the collectivistic orientation of individuals inside the group, can lead to positive climate of trust and interdependence. In fact, members, coming from collectivistic cultures, have a positive attitude towards team processes, that can be represented by information sharing, trust foundation and an overall interdependence, and this can turn in a positive overall team environment that might lead to increase in performance.

In this scenario it appears clear how the culture of origin of virtual team's members might consistently influence the team's processes, especially if heterogeneous group are taken into consideration, as they are made of different people coming from different backgrounds. Furthermore, the different cultural values and dimensions, as the one considered by Hofstede (1980), might also have effects on the process of trust foundation among members, that as already seen in the dedicated section, might provide substantial benefits towards the final performance.

On the other hand, what it's also important to underline lies on the fact that the drawbacks caused by cultural diversity, among team members, might be solved through the adoption of some ICTs that can reduce the perceived effects of cultural diversity among the different participants of a given virtual team (Leung and Wang, 2015).

2.5.1. Impacts of cultural diversity in Virtual team's settings

The importance of the different aspect linked with the culture of provenance is crucial when considering virtual teams that are heterogeneous and that present different degrees of diversity, as these aspects might reflect on several processes as trust foundation, communication and also identification among members. In particular, for the latter scholars have provided, during the years, several theories that analyse the identification process that takes place inside teams. Among those theories there is the *Social Identity Theory (SIT)*⁹ that focuses on the level of team identification that members show towards group's or company's belonging, this identification might, in turn, generate feeling of commitment that might influence the overall performance of the group. In addition to this, individuals, also, tend to identify themselves with people that are more similar to them and to their in-groups (Ashforth and Mael, 1989). Therefore, these patterns, but also, the creation of a shared identity among members of an organization might consistently affect the behavioural attitudes of members, that could feel a stronger sense of belonging that might foster satisfaction and workaholic behaviours.

Therefore, studying how cultural diversity might impact identification in virtual teams can provide significant results that can help organizations to correctly define virtual team's compositions. An interesting study that explores this topic is the one of Au and Marks (2012), that proves how identification is considered more difficult to set in virtual teams, due to the fact that these teams are made of people that collaborate across great distances and they can't communicate instantly if a problem occurs. In addition to this, the research demonstrates that individuals tend to identify more with local team members than virtual ones, due to the fact that they had to face additional difficulties when relating to virtual team's colleagues. The most significant barriers to team identification are given, according to Au et al (2012), by differences in languages, that

⁹ According to the *Social Identity Theory*, individuals tend to classify themselves according to some categories, following a social categorization process. In particular, individuals might identify themselves according with some characteristics other members assume, such as sharing the same race or gender, that they might perceive similar to them. (Ashforth and Mael, 1989)

can lead to difficulties in communication, but also by the differences in working attitudes of people coming from different cultures. Moreover, the authors reveal how these barriers could lead to the formation of stereotypes among participants that can further cause impediments in the formation of team identification, as members might not feel any sense of belonging.

Therefore, differences in cultures and nationalities can substantially affect the work of virtual teams, if compared with traditional ones, that have the chance to communicate in person and to avoid tricky situations that might be barriers towards identification processes among members. These aspects should be considered by organizations when studying team's compositions as they could strongly affect the overall performance and results.

In this scenario it appears clear how the effects that cultural diversity might entails need to be further investigated, as they can consistently affect the overall virtual team's performance. In particular, the study conducted by Han and Beyerlein (2016) deals this point, by addressing the impacts that different cultures may cause towards team's overall performance. According to the authors, the effects of team diversity on the final team performance might be studied in relation to *<task processes>*, that refer to those processes that take place when performing activities aimed at achieving goals, and *<socioemotional process>*, referring to the behavioural processes that happen among members, such as trust foundation and cohesion. In this sense, as already seen in the previous sections, socioemotional processes, such as trust foundation, might be consistently affected by cultural diversity.

In particular, cultural diversity, according to Han et al (2016), affects task processes that in turn have effects on team's performance. More specifically, task processes are identified with those processes related to: communication, coordination, knowledge sharing and establishing expectations. Therefore, the goal's achievement process, inside virtual teams, can be influenced by cultural diversity, in particular as regards communication, as seen in the previous sections.

In fact, the communication process might be affected by cultural diversity as different languages can represent potential barriers and source of misunderstandings among

people that collaborate across great distances, with the purpose of achieving a common result. However, communication through electronic and digital media might provide some advantages for virtual team's members as the effects of cultural differences might be reduced (Leung and Wang, 2015).

Moreover, cultural diversity might also cause issues related to the knowledge sharing process, in fact, as already discussed in the communication chapter, when people coming from different backgrounds and cultures attempt to communicate, share knowledge and data, that are crucial for the correct team's functioning, cultural barriers or identification issues might arise. In fact, individuals might feel more comfortable to share information with persons with which they could identify, that belong to their in-groups (as the social identity theory suggests), and, what is more, trust can more easily settled among members that feel comfortable among each other. Furthermore, virtual team members might face difficulties in establishing trust, because of the different behaviours or the different attitudes towards work that members of the same team might present due to different mother cultures.

To conclude, considering these researches can provide an insight into the complexity of the cultural related theme and the drawbacks cultural diversity might cause. Therefore, managers of national and international companies, that want to adopt virtual teams, should take into consideration the differences and the potential negative effects that might be caused by the culture of origin of individuals. In fact, understanding the potential effects that cultural differences might cause inside virtual teams could be an important point to stress out, as it enables companies to find effective ways to foster team efficiency in the long run.

2.5.2 Ways of enhancing cultural patterns in VTs

After having taken into consideration all the effects that cultural diversity and cultural aspects might cause in the virtual team's functioning it's interesting to understand how these cultural differences can be exploited and how they can be turned into benefits for the overall team's functioning.

In fact, there are some elements that might be fostered by organizations when creating virtual teams, that can contribute to lessen these cultural differences and the consequent effects that they might create towards the overall team's functioning. In this sense a research conducted by Changa, Hungb and Hsieha (2014) provides the result that cultural adaptation, among virtual team members, might consistently benefit communication processes among members. Therefore, according to these results, virtual team members should be chosen among those participants that present the capability to adapt and work successfully among different cultures. Moreover, according to the authors, a great sense of understanding of different cultures and a sense of openness towards diversity is a key capability that these members need to own, therefore, *<cultural sensitivity training>* might be essential.

In addition to this, the concept of culture inside virtual teams might be considered also not only when referring to nationality aspects, but also to organizational ones. In fact, when a team culture is present, members can foster a sense of belonging and an increase in alignment towards organizational goals, that might have important effects on the overall team performance. Among the authors that have investigated this topic, there are Earley and Mosakowski (2000) that focus on the emergence of a hybrid culture, within a virtual team, defined as that culture *<emerging from team interaction>*, and they focus on the overall effects it can have towards team's final performance. According to the authors, teams that share an important team culture are those that can perform more successfully as concerns communication and performance patterns. In addition to this, the authors analyse the relationship between team heterogeneity and team effectiveness, identifying teams of three types: homogeneous, those in which members feel close and similar among each other, moderately heterogeneous, those in

which members don't perceive enough similarity among each other cause some sub groups might be in place and highly heterogeneous groups, made of virtual team members who are consistently different among each other. According to Earley et al (2000) the relationship that might exist between the degree of similarity and team culture, and team's overall performance, meaning the relationship that exist between team heterogeneity and team effectiveness, is U-shaped. Therefore, teams that are homogeneous or highly heterogeneous are the ones that demonstrate higher values referring to the final team performance in the long run. These effects are given by the fact that, as concerns homogeneous teams, they face fewer difficulties when relating among each other than heterogeneous teams, as they can communicate more easily, and they don't face the additional difficulties that different cultures might bring. Highly heterogeneous teams instead, according to the authors, face difficulties initially in trying to establish communication patterns or ways of working across cultures, but during the time this condition might be solved as members might find effective ways of communicating, establishing a sort of group identity, and these teams can turn out to be efficient as they are highly creative, providing new solutions and idea.

Therefore, by these analyses it appears clear how taking into consideration the differences related to the cultural side of virtual team's members, both national and organizational, is detrimental because of the strong effects they might cause in relation with virtual team's effectiveness and success.

2.6 Heterogeneity and its effects towards Virtual teams functioning

Heterogeneity is a broad concept that might entails several different aspects related to virtual team's environment, in fact, members can differ for what concerns the culture of belonging, the country of origin but also for the language and other elements.

In particular, virtual teams, that are dispersed globally, can present several different degrees of heterogeneity that can be linked to demographic aspects or to organizational ones. In this sense, according to Maloney and Zellmer-Bruhn (2006), there are two different types of heterogeneity: deliberate and collateral, referring to the reasons that can cause these types of differences. For the former, heterogeneity is a consequence of organizational decisions on which person to hire that need to own a specific expertise, for the latter instead, is the consequence of team's needs. Heterogeneity intended in this sense might be beneficial for team's performance as teams might rely on different degrees of expertise and exploit member's contributions to foster creativity.

On the other hand, there are also negative aspects that need to be taken into consideration, as heterogeneity might lead to an increase in difficulties in communication and information sharing, as well as trust establishment.

A common solution, that can lessen the negative drawbacks that heterogeneity might cause, is the one given by *self-categorization*¹⁰. This theory suggests that virtual teams might benefit from focusing on: *<group identity and minimizing their categorical differences>* (Maloney and Zellmer-Bruhn, 2006), being able in this way to underline shared qualities without focusing on individual or group differences. By stressing out group's identity instead of individual's characteristics and differences, virtual teams can gain in relationship building and trust establishment, on the other hand, as pointed out

¹⁰ The self- categorization theory has been theorized by Turner in 1985 and relates to the behaviour of individuals inside a group. More precisely, according to this theory: *<as people define themselves and others as members of the same category, they would self- stereotype in relation to the category and tend to see themselves as more alike in terms of the defining attributes of the category.>* (Turner and Reynolds, 2011). What is more, individuals can have different degree of self-categorization, depending if they categorize at the interpersonal level, at the intergroup level or at a superordinate group level.

by Maloney and Zellmer-Bruhn (2006) this way of acting might also be ineffective as individual's characteristics and differences in expertise might be the key elements on creativity enhancement.

Therefore, it should be considered that heterogeneity might be an important source of virtual team's value and some ways of enhancing it without recurring to self-categorization need to be found. More precisely, according to Maloney et al (2006) an ideal situation would be the one in which both self-verification and social integration are in place, meaning that individuals should feel free to share their knowledge and information, fighting for obtaining *<verification for their self-views>* and establishing at the same time trust and cohesion with the other members. In order to do this and to successfully exploit the potential advantages that heterogeneity might bring in the virtual team's environment the authors propose some solutions, starting from attempting to reduce "faultlines", intended as potential occasion in which a group could be divided in several subgroups, leading to potential conflicts and misunderstandings. In this scenario a potential way to reduce faultlines related to differences in culture that might arise is considered the one of adopting electronic communication tools that can consistently diminish these issues. A second potential way that might be fostered in order to enhance self-verification and social integration is related to building *<swift norms>*, a sort of roadmap of the rules, experiences and expectations that are shared by virtual team's members and that can consistently help in the attempt of creating a shared identity.

In addition to these solutions, what has been founded as equally important is the establishment of a global mindset that might open individuals to new experiences and foster relationship buildings and also, according to Maloney et al (2006), a *<thought world window>* that enables participants to understand different context and work within international environments.

As already stated, the concept of heterogeneity is broad and can regard several aspects, included the differences that refer to the language of adoption. Investigating this aspect might be crucial as teams, made of individuals of different mother tongues, might suffer from functioning problems and those differences might reflect on virtual team's effectiveness. In this scenario, Klitmøller, Schneider and Jonsen (2015) investigate this

point trying to figure out the relationship that might exist between these language differences, that can foster heterogeneity, and the social categorization process.

As observed by Klitmøller et al (2015), language differences might reflect also on the choice of media that virtual teams need to use to communicate, in fact, individuals who don't master English as a common language or who don't feel proficient with the language of reference might prefer media tools that stress the written communication part, instead of visual meetings or calls. This type of choice according to the results pointed out by the authors, can further benefit the overall virtual team efficiency as members can avoid feeling uncomfortable or uncertain. Thus, the research proves how the choice of the media that is used in virtual teams, in order to communicate among member, the language differences and the possible social categorization process are interrelated, as media choice might lessen language differences effects, and this avoids the social categorization aspects.

Considering those aspects opens a question, also on the right number of individuals who should compose the virtual team. In fact, considering these degrees of heterogeneity and the possibility to create groups with several participants or few one might open different scenarios, therefore for a successful management of these organizations also team size should be considered.

In this sense, an interview issued by the Harvard Business Review to the CEO of Ferrazzi Greenlight, can shed a light into these issues. Talking about her personal experience with virtual team's management the CEO identifies the most efficient virtual teams as the ones made of less of 10 people. According to her experience these types of teams should be composed of the right persons, skilled for that position, able to self-manage and to communicate efficiently through electronic means, in this scenario *<small is beautiful>* as members will feel less coordination issues and social loafing behaviour might be overcome.

Therefore, through the review of these papers and researches, it appears clear how these virtual teams are made of individuals that can present a great amount of differences among each other.

Therefore, organizations that are interested in adopting this type of solution, or firms that want to increase its effectiveness, should consider investigating the aspects related the concept of heterogeneity, and the potential drawbacks they might cause, as if these patterns are not managed in the right way, they might bring to conflicts and ineffectiveness.

2.7 Conditions that can enhance Virtual Team's Effectiveness

Through an in-depth review of the most important themes that characterise virtual team's functioning and environment, is possible to underline the characteristics that can enhance significantly the overall efficiency of the team. Therefore, thanks to the different studies that have been made and that are present in the literature, is possible to extract the most important characteristics that virtual teams should own or that should be in place in order to pursue team's effectiveness.

Starting from the communication side, it has been shown, in the previous sections, that understanding the increasing difficulties and barriers that these types of teams face, when attempting to communicate and share information, is crucial.

When considering communication effectiveness there are several elements that might contribute to its achievement, as already seen, a positive team environment and motivation might foster the right climate that enables information sharing, as well as communication openness and task discussion might foster communication quality (Killingsworth, Xue and Liu, 2016). In this scenario, choosing the right tools that can create the condition that permits knowledge and information sharing is crucial, therefore a great attention should be put on media choice. In addition to this, it should be considered that communication might be affected by several characteristics of virtual team's members as the language, the culture of belonging and the type of communication, if high-context or low-context. Therefore, when considering the communication process and the choice of media and digital tools several patterns need to be taken into consideration.

As the study of Berry (2011) points out, there are different ways of communicating that might be adopted by virtual teams. In particular, according to the author, virtual teams usually adopt <computer mediated asynchronous communication (CMAC)> that allows participants to give their contribution on a topic instantly, expressing their idea and sharing knowledge without suffering from possible interruption that might occur, for example on synchronous communication (due to time zone differences). Furthermore, this type of communication might also bring some potential benefits, as it reduces

communication problems that can arise as consequence of the integration between different cultures.

What it's interesting to understand, at this point, are the contextual factors that are linked with communication, that need to be in place in order to reach an effective team performance. Therefore, it's crucial to underline that the media and communication tools choice has a great importance in virtual teams, as depending on the different preferences individuals have, communicating by emails might be found more efficient than communicating through instant messaging or vice versa. According to Berry (2011), several virtual teams consider an efficient method to communicate using both email and voice mails, as they find that emails can provide the right time to think about an issue or at a concept before providing an answer.

Therefore, what is increasingly important in this scenario is to understand collaboration tool's characteristics and if they can successfully facilitate communication, when considering virtual team's settings.

Further studies confirm these assumptions and the importance that the communication process owns towards the overall success of the virtual team. In this scenario, Horwitz, Bravington and Silvis (2006), attempt to analyse the possible obstacles towards team's effectiveness. According to the research conducted by the authors, facing difficulties in putting in place communication quality is among the greater obstacles that can lead to ineffective virtual teams. However, several efforts might be put in place to contrast this scenario, as increasing the frequency of communication and choosing media that provide the possibility of receiving feedbacks over the effective sending of a message. What it's interesting to point out, according to this research, is the fact that communication quality is considered as the most important contributor towards team's effectiveness.

Besides the communication process, other factors can be underlined as important in boosting virtual teams' effectiveness. Among these, Horwitz et al (2006) point out that the other main factors that might enhance virtual team's effectiveness are given by the clear objectives and goals settlement, team working quality, trust and commitment.

As regards the former, a clear statement of what team members are supposed to do early in the team's life can foster positive performances as members can actually understand in the first place what they are supposed to do, therefore, they can plan in advance their work, engaging with the other members and sharing their advancements. In addition to this, also the level of team working quality might effectively help in the achievement of team's efficiency, as the overall level of team's performance might be consistently high in virtual teams that prove a great level of engagement, enthusiasm and that are open to experiences and to information sharing. As for trust, previous sections have provided important insights towards the process of trust formation among virtual team's member and its effects towards team's performance. In fact, as demonstrated by Sarker et al (2011), trust plays a key role in enabling effective communication and in letting virtual teams to perform in a successful way, as it's the mean through which these conditions are enabled.

Therefore, what appears clear from these considerations is that virtual teams, in order to pursue efficiency and effectiveness, should seek for the right communication and collaboration tools, that can lead to conditions that enable trust foundation and implementation to be in place. More specifically, the given tools should provide users with some key characteristics such as the possibility to communicate frequently and freely, but also the possibility to share one's content and work and to track participants connections and contributions.

Along with the communication process and trust foundation among virtual team members, other characteristics might substantially affect virtual team's effectiveness. In fact, it should also be considered that virtual teams are characterized by the fact that they are geographically dispersed, meaning that members that compose the group might come from different cultures. This aspect might further complicate the process of trust and communication establishment, as different cultures have different habits and ways of expressing. However, studies have proved how some of the characteristics that might disadvantage virtual team when attempting to communicate are lessened by the virtuality and by the different type of communication that electronic tools allow, that might be more restrictive (Leung and Wang, 2005).

In addition to this, a further characteristic that might foster virtual team's effectiveness refers to the degree of social presence of members, in fact communication openness, social communication and the establishment of interpersonal trust can be crucial in allowing for a better performance. A common definition of social presence is referring to: *<degree of awareness of other people in an interaction and the subsequent recognition of interpersonal relationships>* (Kimble, 2011). In this sense social presence can act to stimulate a sort of "co-presence" attempting to stress out the importance of inter relations and trust establishment among participants.

Furthermore, an important aspect to consider, linked to virtual team's effectiveness is given by the successful management of the knowledge sharing process, as virtual teams face a great number of difficulties when attempting to share knowledge and data because participants need to face great distances, differences in communicating and expressing ideas. A concept that has been investigated in this scenario is the one of *transactive memory systems (TMS)*¹¹ that refers to a process that happens inside groups and that leads to a successful understanding of the knowledge and the specific competences that each individual own in the group (Wegner, Raymond and Erber, 1991). More specifically, this process might fuel virtual team's effectiveness as it can act as a database of individual's expertise and competences.

In this scenario Cordery and Soo (2008) investigate on the relationship that might be in place between TMS and virtual team's effectiveness, in particular, according to them, TMS presence within a group can provide a sense of clearness over which person holds a particular expertise and to whom refer to in case of necessity, and this can help the information sharing process, leading to a better coordination and achievement of team's goals. In addition to this, TMS might have beneficial effects also for what concerns innovation processes, as team members can have the chance to rely on different types of knowledge and therefore acquire different point of views.

In this scenario, what needs be pointed out, is the fact that frequent communication and information sharing might be profoundly beneficial for virtual team's members as they

¹¹ Transactive memory system, according to Wegner, Raymond and Erber (1991), refers to: *<a shared system for encoding, storing, and retrieving information>*.

can manage to foster trust establishment, information sharing, and they can also have a better understanding of member's expertise, developing in this way an effective TMS.

Therefore, to summarise, what is important in this scenario of virtual team's adoption is to be aware of the several characteristics and drawbacks that this type of virtual solution can provide. What is clear after this literature review is the fact that virtual team's members must be ready to face additional difficulties that are provided by the aggregation of different cultures, languages and nationalities through digital means. Not everybody is suitable for this type of working solution, as members should own particular characteristics in order to be effective and successful players in this context. Organizations, therefore, should assess whether potential candidates own specific skills that are believed to be essential in those contexts, such as owning a certain degree of digital skills, an appropriate degree of communication skills, as well as appropriate cultural and social skills that allow virtual team's players to behave in multicultural contexts and to give their contribution in a successful way, without recurring in misunderstandings or difficulties in sharing information and knowledge.

In order to foster these characteristics and to build successful virtual team, organizations should put in place training activities aimed at enhancing the competences that the ideal virtual team player should possess, with a particular focus on the choice of the digital collaboration and communication tools. In addition to this, organizations should also assess the degree of cultural diversity that might exist among the different individuals, part of a virtual team, in order to prevent the potential drawbacks this aspect might cause and in order to foster the potential benefits it might bring.

Therefore, a first important process that needs to be stressed, when attempting to build a virtual team, before considering the effective tools or ways to enhancing team's performance, is that of choosing correctly the right participants and attendants. In this way the probability that favourable conditions might happen can increase, and organizations can better pursue virtual team's effectiveness, through the adoption of ad hoc digital tools.

CHAPTER III: The key role of ICTs for Virtual Team's successful management

3.1 The role of technology and ICTs in Virtual Teams

The focus of this section relies on exploring the evolution of the technological media that can be exploited by virtual teams, in order to successfully communicate and pursue goal's achievement.

Collaboration and communication tools have evolved throughout the years, ranging from emails and instant messaging to videocalls and then to programs and applications that allow a more complete information sharing and communication among remote teams. Effective communication is what mostly characterize efficient virtual teams and the organization that decide to adopt them, therefore understanding the evolution of virtual teams' supportive technologies and their characteristics is essential.

Several authors have investigated the different collaborative tools that can support virtual team's operation and their evolution throughout the years, an example is the shift from Collaboration 1.0 and Collaboration 2.0 theorized by Turban, Liang, J.Wu (2011). The former refers to the traditional communication methods and collaborative tools that were used by virtual teams in enterprises worldwide, they were not very flexible, they used traditional ways of communicating such as emails and messages, they were costly, and they provided a low level of interactivity. Thanks to technological evolution, social network rise and the possibility to exploit open source programs, Collaboration 2.0 tools rose. According to the authors, the main differences these tools present, if compared with the previous generation of collaborative tools, is the fact that the latter use *<Web 2.0-based social software tools>*, exploiting internet connection. Differently from the tools that were used in Collaboration 1.0, these social software enable to reach a great amount of flexibility, they aren't costly, and they focus on interactions among participants. Among the benefits that these types of applications can offer to enterprises and virtual teams, according to the authors, there are especially a control over costs and an increase in productivity and efficiency. In addition to this,

these types of collaborative software might have an important role in virtual work referring to different phases, as they enhance: information sharing, idea generating, analysis and project management.

In the last years also, *Team communication platforms* have seen a consistently rise in their adoption among enterprises worldwide; they could be defined as social collaborative software that support communication among enterprise members. In particular, they are: *< social collaboration technology that combine features of multiple enterprise social media including social networking platforms and instant messaging >* (Anders, 2016). These tools have seen a consistent rise in their application due to the fact that they are able to combine several different characteristics that are necessary to support communication and information sharing at long distances, as in the case of virtual teams, in fact they are able to provide instant messaging, along with the possibility to use videocalls, chats and sharing medias. These types of communication services have been studied by Anders (2016), who provides an overview of the most important characteristics and dynamics that these interfaces can offer to end users. One of the most interesting point made by the author is the fact that effective teams are those in which communication and social collaboration can be supported by those technologies that allow four conditions to be in place. The first one, refers to the possibility to share knowledge among participants coming from different sources, the second one to the chance to develop social engagement, as for the third one, to the possibility for all members to be connected and actually contribute and finally the last one to be able to focus on multiple things discussed or pursued in the working activity (tasks, projects and so on).

Another important aspect that has been taken into consideration by the author is the increasing importance that *Enterprise Social Media (ESM)* are gaining in the enterprise environment, intended as those application that can support work in a virtual environment, boosting social interaction and collaboration (including instant messaging applications, social networking platforms). In fact, according to Anders (2016), the usage of these type of enterprise social media can enhance social cohesion among employees, an aspect that is particularly important in virtual team's setting.

In addition to this, another commonly used communication technology is the one made of *Instant Messaging* platform, that can enable individuals to talk privately or to start group conversations where everyone can participate and add contents.

Therefore, by reviewing the possible features that current team collaboration platforms might entail it appears clear how, in order to address and in order to respond to the characteristics that the ideal virtual player should own, they need to comprehend different functionalities that might be represented, for example, both by IM and by ESM. A consistent example of a service that can integrate these characteristics is the one of *Slack*, that enables the end user to use both IM and Social Networking Platforms (SNPs).

According to the research conducted by Anders (2016) there are several reasons that can lead organization to adopt *Team Collaboration Platforms*, in particular, they can be consistently valuable for organization that want to strengthen communication visibility in virtual team's environments, as they can offer a way to strengthen relationship and allow data flow among dispersed employees. In addition to this, if compared with traditional virtual communication ways, such as emails, TCPs are believed to offer a better information sharing process, as differently from email communication, where important messages can be hidden by the numerosity of the emails that one can receive, in those platforms these kinds of problems could be easily overcome.

What is more, these digital solutions can offer several advantages referring to knowledge sharing, social cohesion, collaboration and attention allocation. In fact, according to Anders (2016), these platforms can boost the knowledge sharing process among individuals that work remotely, as user can exploit the different functionalities that these platforms offer, such as the possibility of using chats but also to open dedicated channels in order to share knowledge, documents, files. In addition to this, also social engagement could be strengthened through the use of these platforms as they allow users to have private conversation or off-topic ones, talking about personal aspects with the use of emoji and other elements. This process, in turn, might help in building relationships among individuals that might strengthen trust establishment and group efficiency. What is more, collaboration might benefit from the usage of these tools as for example, by organizing the topic's discussion in different channels, there is a consistent gain in time, and virtual team's members might discuss more openly about

a topic. Furthermore, collaboration is enhanced, according to the author, thanks also to an increase in *<context awareness>* that derives from the fact these platforms enable participants to have a clear look over task discussions, processes and projects that are going on, therefore participants might feel more included in discussion and can have access to an increase number of information. As for attention allocation instead, according to Anders (2016) *<communication visibility, group and channel organization, search function, and streamlined messaging interface all contributed to quicker and more efficient routine communication>*.

In addition to this, thanks to the adoption of these platforms several benefits can be gained by virtual teams that decide to work through these solutions, starting from a decrease in the numerosity of emails and videocalls. Moreover, these tools might provide also a storage of useful information and discussed topics that might be consistently advantageous for all team members. In fact, thanks to the compartmentalization of the topics and of communications settings in those platforms, individuals can be more focused into those information that are referred to their individual tasks or activities, instead of being distracted by several emails.

Even through these media might bring several advantages to enterprises that are willing to adopt them, organizations should also consider the possible disadvantages and challenges that they could pose.

In fact, if it's true that communication and knowledge sharing it's enhanced through these platforms, on the other hand some conditions should be in place in order to successfully adopt them. Starting from the participants choice, they should be chosen among those employees who are willing to adopt and consistently use the platform to communicate and work. In fact, Anders (2016) underline how this type of platform working condition is effective only if it's equally adopted by virtual team's members. In addition to this, also individual's digital skills should be considered, as the successful adoption of these tools inside virtual team's is dependent on whether team's members own the right digital competences.

In this scenario, it's useful to have an insight into the theories related to the media choice and their characteristics, in order to understand the possible characteristics that

different media might offer to organizations. As investigated by Figl and Saunders (2011) the three main theories referring to media choice are: < *social presence, media richness, and media synchronicity*>, the first one refers to the degree by which a given digital tool allows to establish personal and social contacts among individuals using the media, the second one instead refers to the degree a media might assure the correct transmission of a given information the way it's actually sent, an example is given by video calls that offer a greater media richness if compared with emails, through which some gestures and inferences cannot be transmitted. Finally, as for Media synchronicity, is referring to the condition under which virtual team's members that adopt a given media can communicate and work at the same time.

Therefore, collaboration and communication tools can be analysed referring to the characteristics they might assume as for the level of social presence they might offer to users, the level of communication and information transmission and the type of communication they might entail, if asynchronous, synchronous or both.

In this scenario, besides the tools that have been previously cited, it should be considered that technological advancements are leading to new ways of exploiting digital discoveries into virtual teams and their communication settings. Therefore, enterprises should understand what new technological supportive tools they could adopt in order to better and align and exploit their disperse workforce and virtual teams.

Through the years new possibilities have arisen, one of these is represented by *3D Virtual Environments (VE)*, that can be identified with those media that provide users with the possibility to have 3D graphics and simulation of environments to support communication and remote working. Furthermore, VEs offer to participants the chance to use avatars and to personalize their aspects. In this scenario, a research conducted by Bosch-Sijstema and Haapamaki (2014) demonstrates how thanks to the use of these new methods virtual team's collaboration might experience different benefits, such as a consistent increase in the social presence perception, as through these tools there is a clearer perception of other virtual team's members presence, simulating a sort of face-to-face meeting. In addition to this, the usage of 3D Virtual Environments has been found to be beneficial also for what concern engagement and interactivity. In fact, according to the authors, participants might prove a greater sense of interactivity, as

through the use of these media they are able to have an insight of the environment in which they are working at and are also able to foster engagement, as thanks to the use of avatars cultural and social differences might be reduced and people can freely communicate and interact. Moreover, the adoption of these tools can also provide substantial advantages as they can foster relationship building among virtual team's members, as members might face fewer difficulties in trust formation and in communication frequency, leading to a positive working environment.

Considering the technological advancements that happened through the years, and that will continue to happen in the following years, is crucial in order to gain a consistent overview on the potential applications that can serve virtual team's work and, on the characteristics, that future applications might have. This process is fundamental for organizations, as by having a clear overview of the features offered by the different tools, they might be able to select and to train correctly employees who will be asked to use these applications.

In this scenario another technology that is currently starting to be applied by organizations worldwide is that of *Mixed reality*. In this sense, it should be considered how tools that incorporate mixed reality might provide several advantages, that might boost team's efficiency¹². In fact, differently from traditional ways of communicating these tools allow individuals to work virtually in a more realistic way, for example through the usage of video conferencing apps that allow participants to have avatars and see each other through virtual and augmented reality.

To summarise, after having considered the theories related to virtual team's functioning and characteristics, particular attention should be put into the electronic and digital means that allows these interactions to take place.

As already stated at the beginning of this dissertation, the aim of the thesis is to explore virtual team's dynamics and the effects that an effective human resource management and the choice of the correct collaboration and communication tools might bring to

¹² Niersbach P. (2018), *Two ways to improve your team's performance with mixed reality*, Forbes, 28/8/18

organization's performance. For the former aspects, it has been understood, through the review of the different themes, that HRM should act anticipately in the correct assessment and choice of the right virtual team's players, that need to possess the right competences, as digital and cross-cultural ones, and should have the right predisposition to work in groups and to individually manage one's work (Zakaria et al, 2004; Schulze and Krumm, 2017; Leung and Wang, 2015). In addition to this HRM should also put in place the right strategies that enable to strengthen individual's competences, for example through ad hoc trainings, and virtual cohesiveness.

As for the choice of the ad hoc collaboration tools several characteristics need to be considered in this scenario. In fact, collaboration and communication tools should own the right characteristics to help virtual teams to correctly schedule and manage remote work, along with the possibility of having recurrent communication and information sharing. In addition to this, the choice of the correct tools should also fit with the characteristics that virtual team's players possess, and with the characteristics that need to be in place in order to enhance relationships building, trust and a positive working environment among team's members.

Therefore, an analysis of the several different applications that can support virtual team's work, that are currently in the marketplace, can give to organizations an insight into the importance of choosing the most suitable tool, with the right characteristics, that might foster virtual team's efficiency.

3.2 Research

Through a review of the literature and of all the sub themes related to virtual team's concepts and applications some key characteristics have emerged as the one most significantly related to their overall performance increase and success. In this scenario, the aim of this chapter, and of this dissertation, is that of providing an insight into the applications that are available in the marketplace, that can be chosen by firms and multinational enterprises that want to adopt virtual teams and need to correctly assess what could be the most suitable instrument for their purposes.

After having reviewed the literature related to this topic some major themes have emerged as the one most closely linked to the effectiveness and final success of this kind of structure.

In particular, what has emerged as fundamental characteristics that should be in place in order to give virtual teams the best chances to perform efficiently, to achieve a great degree of interactions among members and to correctly pursue tasks, are characteristics related to the type of communication that these instruments might provide, the way of communicating, the level of social engagement they could offer, the possibility of planning, scheduling and share efficiently contents, the degree of connections and the level of digital skills required.

Starting from the communication functionalities and characteristics that these tools can provide, it's interesting to understand both the *type of communication* and the *way of communication* these types of instruments allow. Linked to former aspect there is the theory of *Media synchronicity*, seen in the section before. When studying a given application a key point is understanding whether it allows real time interactions, for example through video conferences, audio calls, if it allows asynchronous communication, meaning that participants can comment on each other's activities and give feed, for example, not in real time, or if the tools analysed could offer both the possibilities. According to Dennis, Fuller and Valacich (2008) Media synchronicity refers to: *<the extent to which the capabilities of a communication medium enable individuals to achieve synchronicity>*, therefore through the usage of communication media that enable video conferences and virtual meetings and through the usage of tools that allow synchronicity among virtual team members, communication can happen in real time. What is more, also transmission velocity has been found to consistently relate to media synchronicity as those media that support a higher transmission of information and messages among users could provide benefits in the coordination and communication side, in fact individuals that work using those media can benefit from the consequent synchronicity they could provide. In addition to this, media that can provide synchronous communication can offer substantial advantages for members that work at long distances as if a message is important and needs to be decoded immediately,

through the usage of synchronicity tools, the given message could be decoded immediately without wasting time.

On the other hand, some applications could support asynchronous communication, that is represented by a type of communication that is not made in real time and through which employees could communicate responding to emails or messages also in a second moment. If it is true that synchronous communication might provide advantages, as a more rapid exchange of important information, on the other hand teams and employees that work remotely could not assure to be constantly available for real time communication. Therefore, asynchronous communication is extremely important and tools that assure that information and knowledge sharing could be actually performed even through members are not online, constitute an important part of remote work, as they allow remote workers to achieve greater levels of flexibility, letting them understand properly what they are asked for before giving an answer (Berry, 2006).

In addition to this, some tools can provide both asynchronous and synchronous communication, giving to end user the possibility to have video conferences, meetings and calls and, at the same time, letting members communicate also through chats, topic discussion and comments. Therefore, understanding what is nowadays offer, for what regards digital applications that support remote working, and the type of communication they might entail is crucial for firms that decide to adopt these tools, as they could choose the right digital media according with the operational purposes they have, for example if they need real time communication or if they need tools that support a more flexible way of communicating.

A second important theme that has been analysed, on the digital applications that have been taken into consideration, is related to the communication and the degree of *media richness*¹³ that these kinds of applications can offer. More specifically, the aim of the research is to understand whether these media can provide users with the possibility of communicating in a rich way. Linked to this topic there is the theory of Media richness

¹³ The media richness theory, as postulated by Daft and Lengel (1986), deals with the degree of information richness a given media can provide. A richer media can be considered as the one that enables to transmit gestures, but also a media that enable frequency in communication and a great degree of information. According to the authors, richer media can enhance performance especially concerning *<equivocal tasks>*.

that postulates the fact that media that enable a richer communication, made of video calls that can support the sharing of hidden meaning through gestures, tone of voice and other characteristics, or that can provide users with additional features (as comments or feedbacks over one's activity), can provide teams with a richer communication that can substantially benefit the overall work. In this sense the degree of communication and media richness that these tools can provide has been studied, for the purpose of the research, related to three considerations: the *way of communicating* that these applications could support, if just through comments or also through chats, messages and feedbacks, the possibility to *integrate chats* and instant messaging tools, that could support communication richness, and the possibility to have *visual meetings*, as it might be a feature that can contribute in boosting trust and communication efficiency among virtual team's members (Henttonen et al, 2005).

Through the review of the literature conducted in the chapters before it has appeared clear how communication owns a great role in providing virtual teams with efficient flows of information. Therefore, a key characteristic these applications should entail is the one of providing communication patterns that could enhance a reach and complete communication that could be both asynchronous, for a flexible management of processes, and synchronous, for communicating in real time important information, and that should also comprehend additional features that could allow users to express their thoughts and share their experiences in the most comprehensive way possible.

What is more, applications should also provide end users with the possibility to express a sort of social presence, as reviewed in Chapter II, that might be identified with the degree by which interactions and relationships among individuals are enhanced thanks to technological mediums usage, and is linked with communication quality (Lowry, Zhang, Zhou and Fu, 2010). More precisely, social presence refers to: *<degree of awareness of other people in an interaction and the subsequent recognition of interpersonal relationships>* (Kimble, 2011). In this sense social presence stresses out the importance of inter relations and trust establishment among participants, which in turns can lead to an increase in virtual team's effectiveness (Figl and Saunders, 2011). Therefore, we question application on the degree of social presence they might offer and, consequently on the level of social engagement they might provide to users. In fact,

trust and social engagement could represent some key important characteristics that could allow virtual teams to perform better and to create a positive working environment that allows members to feel free to share, comment and suggest changes to the tasks or activities they need to accomplish. In addition to this, social engagement might boost trust that, in turns, plays a pivotal role in virtual teams as it could assume a mediating role between communication centrality and team's performance (Sarker et al, 2011).

Therefore, understanding how and if the applications that enterprises could find currently in the marketplace could support social presence and relationship building is an interesting point to stress out, as virtual teams that are able to feel a sense of identification and engagement are proved to be more successful and, additionally, the establishment of a rapport among participants can foster team's creativity leading to a better circulation of information, knowledge and ideas (Martins and Shalley, 2011).

In addition to this, also the "operative" processes that could be allowed through the usage of these tools should be address and studied as the level of *content sharing*, the possibility of *scheduling* activities, the possibility to *track* activities' progresses and the chance to *integrate* these application with other tools, might be extremely important in relation with the applicative and procedural side of remote work. As reviewed in Chapter II, these functionalities might be extremely important in helping virtual teams to achieve superior performance, as for example, an antecedent of the positive virtual team performance is given by the creation of clear goals and task that have to be clear in component's mind in order to perform successfully (Brahm and Kunze, 2012; Horwitz, 2006). Therefore, the scheduling feature and the tracking feature might be extremely important for virtual teams' functioning and they might contribute in enhancing team performance, as through these features, participants can gain a clear understanding of the tasks they are supposed to do and the deadlines. Furthermore, these features might be extremely important in establishing and boosting trust among team's members, as in this way the can have a clear understanding of tasks and goals and they can have access to useful information (Jarvenpaa et al, 1999; Brahm and Kunze, 2012).

For this purpose, the tool's characteristics that have been analysed in the given applications have been four. Starting from the first one that is *content sharing*, refers to

the possibility that users have to share contents with group's members. In fact, what has been pointed out through the literature review is the fact that members, in order to establish trust and run the processes smoothly, need to have the access to information shared (contents and data) in the same way (Henttonen et al, 2005; Gibson and Manuel 2003), for example, reviewing conversations and files shared.

In addition to this, another important dimension is represented by the *Scheduling* option, as observed in the previous chapter in fact, stating goals clearly and planning activities in the first place is beneficial for trust establishment and for having goals and tasks correctly understood by virtual team's members, therefore, this dimension aims at understanding whether these applications allow users to assign tasks and deadlines. A third dimension, instead, is represented by the *Tracking* feature, applications have been analysed on whether they allow users to visualise task progression, having Kanban boards or tracking time, in order to understand the status of given processes, their progression and the overall deadlines. As virtual teams work in a remote way, with members being located in different places among each other, understanding task progression and achievement is an important feature that applications should own, as they can give to users a visual and immediate insight on the current situation, without wasting precious time in email scanning and without recurring in the risk of losing important information. In addition to this, this feature might be important in creating a trustworthy climate and in enhancing the right environment of cooperation among members (Walther and Bunz, 2005), as members can have access to task progression and deadlines and are motivated to respect them.

In addition to this, the analysis that has been carried out in some of the applications that are currently in the marketplace and that can sustain virtual team's work, has also the aim of understanding the degree of connection that these applications can offer to the end user. More specifically, we wanted to understand whether these applications have also a *mobile app* version, that could allow users to be connected also when they don't have a personal computer, they are outside the office and in travel. In fact, it could be understood, through the review of the researches and the case studies conducted through the years, how virtual teams might suffer from time zones differences that could act as a barrier to real time communication. In addition to this, it has been

understood how participants, in virtual teams should communicate more frequently, if compared with traditional teams (Walter et al, 2005) in order to foster trust, flexibility and successful problem management and they should be ready and enabled to reply to messages or questions when necessary. Therefore, applications that allow a mobile version to be installed into the phone or another mobile device could provide end users with greater degrees of flexibility, that in turn might benefit communication and the overall management of the team.

Finally, we wondered about what should be the *level of digital skills required* to be able to correctly use these tools, in fact, as already seen in the previous chapters, successful virtual teams are composed of individuals who have both behavioural competences, referred to the ability of working in group and of being open to individuals coming from different cultures, but also digital skills (Leung and Wang, 2015), as members should be able to understand what should be the most suitable tool for their needs but also they should be able to correctly understand its functionality and options. Therefore, understanding whether a given tool needs higher degree of digital skills if compared with an easier application is necessary for firms that should understand whether the selected participants could be ready or not to work remotely through these applications.

3.2.1 Number and types of applications considered

For the purpose of this research some of the most widely used applications, that can support virtual team's work and remote collaboration, have been taken into consideration. More specifically 45 applications have been analysed, ranging from the most widely used and known (as *Slack*) to solutions that are new in the marketplace (ex. *Spatial*), in order to provide the most comprehensive analysis possible.

The applications have been classified for what concerns the functionalities they might offer, that have been explained in the section before, but also in relation with the type of activity they could support and the type of technology involved.

Therefore, we decided to divide the 45 applications, first of all among those that are *project-oriented*, meaning that they are an essential tool for remote workers that need

to pursue a project dividing it in a set of task and goals, in this case great attention is put on the scheduling and tracking options. A second class of applications has been identified with those tools that are *process-oriented*, meaning that their focus is put majorly on supporting communication and working patterns among divisions and offices that need to run processes smoothly. In particular, a key characteristic that these types of application need to own is the fact that they must enable an efficient communication, knowledge and content sharing among virtual workers.

In addition to this, some applications can be *both process and project-oriented* meaning that they can provide users with the possibility of assigning tasks and tracking working activities, along with a flexible communication and data sharing. Furthermore, considering the type of technology that these applications need to exploit, some of the tools considered are classified in relation with the fact that they use virtual and augmented reality. In these cases, these applications require some additional components in order to be used (ex. Hololens) and can allow participants to feel a stronger sense of engagement as they are immersed in augmented reality, being in this way able to visualize avatars, persons, data in another dimension.

Therefore, for the purpose of this research a matrix has been built around the 45 applications that have been addressed; Table 1 shows the results of the investigation carried out on the key characteristics, seen in the section before, that we believe these applications should own.

Table 1: Virtual team's applications Matrix

Type of tool / Characteristics		Media synchronicity	Communication/ media richness		Social presence		Tools features				Connection	Level of digital skills required		
		Type of comm	Way of comm	Visual meetings	Chat integration	Personal data	Level of social engagement	Content sharing	scheduling	tracking	integration	app	Basic/Above basic	
Type of team	Project oriented	Wrike	mostly asynchronous	Through mentions @, comments and feedbacks over the activities	Possibility to integrate apps that allow video conferencing	Yes	Participants identify themselves with a specific profile	Low	Members can have access to the file that are shared and they can visualise all the changes made by other members.	It has different applications that support the planning phase, as the Gantt Chart. There is the possibility to assign tasks and deadlines	There is the possibility to have a personal dashboard to visualize one's work. Also there is the possibility to create reports	There is the possibility to integrate external files (PDF, Google Drive files), as well as CRM, emails	Yes	Intermediate
		Asana	mostly asynchronous	Through specific conversation, writing some posts and sending notification to other members	Possibility to integrate apps that allow video conferencing	Yes	Participants identify themselves with a specific profile	Low	Members can access to all the files that have been shared in the pages in which they have been invited to collaborate	It's possible to plan in the dedicated section of the Calendar the task that each individual need to complete	It is possible to have an overview of the project process and status	There is the possibility to integrate external files (PDF, Google Drive..)	Yes	Intermediate
		Trello	mostly asynchronous	Through specific topics, through mentions @, or chats	Possibility to integrate apps that allow video conferencing	Yes	Participants identify themselves with a specific profile and can interact	Intermediate	Members can have access to dedicated lists that contain boards, and they can comment or add files	It's possible to plan working activities using the Kanban method, moreover list can be divided into tasks or activities that need to be done	There is the possibility to have status updates on activities that are work in progress or already done. There is also the possibility to see all planned activities in the Calendar	There is the possibility to integrate external files (PDF, Google Drive..) and applications (power ups)	Yes	Intermediate
		Microsoft Teams	asynchronous/synchronous	Participants can create specific channels around some topics where they can start conversations. Communication can happen also privately in chats among selected team members	Team members can communicate also through video calls	not needed	Participants identify themselves with a specific profile and can interact	Intermediate	Members can share files or data in the channels, and they have access to the entire discussion	It's possible to plan team's working activities by exploiting the Planner section, assigning tasks with deadlines	There is the possibility to have status updates on activities that are work in progress or already done in the Progress section	There is the possibility to add external files in the share contents of the channel	Yes	Intermediate
		Confluence	asynchronous/synchronous	Communication happens through chats, or in dedicated channels, also through feedbacks and notes	Participants can implement Hipchart	Yes	Participants identify themselves with a photo and personal data. Feedbacks can be provided by team members.	Intermediate	Members can share contents in dedicated channels, they receive notifications if someone has commented a topic. Plus they can exploit the storage of all useful information and files.	Team members can plan activities and assign specific tasks	Members can review the activities on going in a dedicated section.	There is the possibility to integrate external files (PDF, Google Drive files)	Yes	Intermediate
		Teamwork Projects/Chats	mostly asynchronous	Communication happens through chats (private or group) or in dedicated channels	-	not needed	Participants identify themselves with a specific profile	Low	It's possible to share contents in the channels of the different topics and in the chat. Users can access to all the storage of messages and files sent	Possibility to plan in advance activities, assigning tasks and to use gantt charts.	Users have the chance to have status updates	There is the possibility to integrate external files (PDF, Microsoft office Google Drive files)	Yes	Intermediate
		Redbooth	asynchronous/synchronous	Both in specific channels where the topic is discussed, as well as in chats and in video conferences ,members can have also the chance to start a topic discussion	Team members can communicate also through video calls (up to 25 participants)-Zoom integration	not needed	Participants identify themselves with a specific profile and they can interact	Intermediate	Participants can track conversations over specific topics and access to the storage of all the information and files shared	Members can assign tasks and gain access to Gantt charts and calendars	Members can assign tasks and gain access to Gantt charts and calendars were they can see tasks and projects progression	There is the possibility to integrate external files (PDF, Microsoft office Google Drive files) as well as to integrate external apps (slack, outlook).	Yes	Intermediate

Type of team	Project oriented	ProofHub	mostly asynchronous	Communication happens through group chats or in group's dedicated discussion topics	-	not needed	Participants identify themselves with a specific profile and they can interact	Intermediate	It's possible to share contents in the channels of the different topics. Members can track the conversation in the group page and have freerly access to the entire list of messages	Participants can assign tasks and members can organise their work through the usage of Gantt Charts and timesheets	Members can access to tasks and projects progressions data, gantt charts and can also have a look into the time tracking for each task	There is the possibility to integrate external files (PDF, Microsoft office Google Drive files) as well as to synchronise calendars.	Yes	Intermediate
		Azendoo	asynchronous/synchronous	Both in specific channels where the topic is discussed, as well as in chats members can use mentions @ to talk with other colleagues	Possible through integrations	not needed	Participants identify themselves with a specific profile and they can interact	Intermediate	Members can share files or data in the channels, and they have access to the entire discussion. Plus they can also use the "like function and use polls and comment colleague's activities	Members can assign tasks and gain access to Dashboards and calendars were they can see tasks and projects progression	Members can access to tasks and projects progressions data and can also have a look into the time tracking for each task	There is the possibility to integrate external files (PDF, Google Drive files) and other apps	Yes	Intermediate
		Zoho Projects	asynchronous/synchronous	Communication happens through private or group chats, through posts or feeds, activity stream, forum, and Wiki	Team members can communicate also through video calls	not needed	Participants identify themselves with a specific profile, they can connect easily with other workers and start topics discussion using mentions @	Intermediate	Participants can track conversations over specific topics and access to the storage of all the information and files.	It's possible to plan working activities using the Kanban method, moreover lists can be divided into tasks or activities that need to be done, that are work in progress or already done. There is also the possibility to see all planned activities in the Calendar	Members can assign taks and review their status thanks to Charts and Reports automatically generate	There is the possibility to integrate external files (PDF, Google Drive files) .	Yes	Intermediate
		Monday.com	mostly asynchronous	Communication happens through updates where members can use mentions @	-	Yes	Participants identify themselves with a specific profile	Low	Members can share files in their task description and look for topics in the storage of all the messages send.	It's possible to plan working activities and assign tasks, moreover list can be divided into tasks or activities that need to be done, that are work in progress or already done, adding status updates. There is also the possibility to see all palnned activities in the Calendar and the timeline	There is the possibility to assign tasks and to have status updates over tasks activities.	There is the possibility to integrate external files (computer, gdrive, dropbox)	Yes	Intermediate
		Notion	mostly asynchronous	Communication happens in specific pages where team members can update files, tasks and activities and also through meeting notes	-	No	Participants identify themselves with a specific profile	Low	Participants have access to the notes and files shared	Participants can assign tasks	Participants can have an overview of the the status of assignments and calendar updates	There is the possibility to integrate external files (PDF, Google Drive files) and other apps	Yes	Low
		Apollo	mostly asynchronous	Communication happens through messages that could be linked to the different projects or topics, and through comments to the different tasks	-	No	Participants identify themselves with a specific profile	Low	Members can share files or data in the channels, and they have access to the entire discussion	Participants can assign tasks and keep track of them through status updates and they have access also to the time tracking information.	Participants can see status updates and they have access also to the time tracking information. There is also the possibility to see tasks and deadlines in the calendar and to use whiteboards that could remain private or become public.	There is the possibility to integrate external files (PDF, Google Drive files)	No	Intermediate

Type of team	Project oriented	Jira Software	mostly asynchronous	Communication happens through boards where participants can see tasks and activities descriptions, plus they can comment activities	-	Yes	Participants identify themselves with a specific profile	Low	It's possible to share contents in the channels of the different topics. Participants can also access to all the files attached	Participants can have the chance to access to the roadmap where they can understand projects, they can also understand the specific tasks they are required to perform	Participants can assign tasks and have access to the Scrum board where they can see the overall deadlines and update activity status	There is the possibility to integrate external files (PDF, Google Drive files), different apps	Yes	Intermediate
		Airtable	asynchronous	Communication happens through comments or mentions in the activity pages	-	Yes	Participants identify themselves with a specific profile	Low	Members can attach files when they create tasks or events	Possibility to assign tasks and to visualize the planned activities in the calendar	Members can create timelines in order to track task compliance and assign tasks. The app is also able to provide report about task compliance and a calendar view over processes	There is the possibility to integrate external files (PDF, Google Drive files)	Yes	Intermediate
	Process oriented	Hangouts	mostly synchronous	Communication happens through chats, calls or videoconferences	Team members can communicate also through video calls	Not needed	Participants identify themselves through their google account and they can see in real time if another participants is available (green spot) or not	Intermediate	Participants can have access to the files and documents shared and to the discussions.	-	-	There is the possibility to share the screens while in videoconferencing and to share files through external links	Yes	Low
		Sococo	mostly synchronous	Communication happens in chats or videoconferences that can be switched on in any moments and participants can freely share their screens. Private conversation can take place in specific rooms.	Team members can communicate also through video calls	Not needed	Participants can see in real time other member's avatars and what they are doing	High	Members can share their files and their screen while communicating. Participants can access to the storage of all the information.	-	-	There is the possibility to share the screens while in videoconferencing and to integrate with Slack, Skype, Google Hangouts	Yes	Low
		Slack	asynchronous/synchronous	Both in specific channels where team members can discuss as a group over a specific topic, and both private chats	Possibility to integrate use video calls	Not needed	Participants identify themselves with a photo and some personal data	High	Participants can have access to the storage of all the information and to file shared	-	Participants can track conversations over specific topics	There is the possibility to link Google drive files, PDF, images. (about 1500 Apps can be integrated)	Yes	Intermediate
		Facebook Workplace	asynchronous/synchronous	Communication happens through chats or in group's dedicated page	Team members can communicate also through video calls	Not needed	Participants identify themselves with a specific profile and they can interact	High	Members can track the conversation in the group page and have freely access to the entire list of messages	-	Members can track the conversation in the group page	There is the possibility to integrate external files (PDF, Microsoft office Google Drive files) as well as to synchronise calendars and other applications	Yes	Low
		Flock	mostly synchronous	Communication happens through private or group chats and through video calls	Team members can communicate also through video calls	Not needed	Participants identify themselves with a specific profile and they can interact	High	Members can have freely access to the entire list of messages, files and topics shared	Members can send tasks requests and deadline reminders.	Members can track the conversation in the group page	There is the possibility to integrate external files (PDF, Microsoft office Google Drive files) as well as to synchronise calendars(google chalendar) and to integrate other applications	Yes	Low
		Cisco WebEx	mostly synchronous	Communication happens in private or group chats thanks to instant messaging, video calls and voice messages	Members can communicate also through video calls sharing their screens and using whiteboards	No	Participants identify themselves with a specific profile and they can interact	High	Participants can track conversations over specific topics and access to the storage of all the information and contents shared.	-	Members can have the possibility to register meetings	There is the possibility to integrate external files (PDF, Google Drive files)	Yes	Low
		Wiredrive	asynchronous	Communication happens in dedicated folders through content sharing and comments	-	Not needed	Participants identify themselves with a specific profile and they can interact	Intermediate	The application allows content sharing and file sharing in different topics where members can have access to the entire amount of file uploaded.	-	Members can see new files when they are created or uploaded through the notification system.	There is the possibility to integrate external files (PDF, Google Drive..)	Yes	Low

Type of team	Process oriented	EzTalks Cloud Meeting	mostly synchronous	Communication happens in chat, in video calls, through IM, screen sharing and the usage of whiteboards	Members can communicate also through video calls sharing their screens	Not needed	Participants identify themselves with a specific profile and they can interact	High	Members can share files in their conversation and brainstorm their ideas through the usage of whiteboards. Participants can track conversations over specific topics and access to the storage of all the information	-	Members can register meetings and having webinars	There is the possibility to integrate external files (PDF, Google Drive files)	Yes	Low
		Yammer	asynchronous/synchronous	Communication happens through private or group chats, through posts and through mentions @	Video calls can be made thanks to the integration with Skype	Yes	Participants identify themselves with a specific profile, they can connect easily with other workers and start topics discussion. They can also greet someone for his/her achievements or ask for opinions	High	Members can share files in their conversation and look for topics in the storage of all the messages send. They can also start topics or ask questions	-	Members can track the conversation in the group page	There is the possibility to integrate external files (PDF, Google Drive files) . Possibility to use the app	Yes	Low
		Taskade	asynchronous/synchronous	Communication happens through private or group chats, through posts or video calls and through tasks assignments	Team members can communicate also through video calls	Not needed	Participants identify themselves with a specific profile	High	Participants can track conversations over specific topics and access to the storage of all the information and files.	members can assign tasks	Members can gain access to Dashboards and calendars where they can see tasks and projects progression.	There is the possibility to integrate external files (PDF, Google Drive files) and other apps	Yes	Low
		Miro	mostly synchronous	Communication happens through chats, video calls and activities commenting	Team members can communicate also through video calls	Not needed	Participants identify themselves with a specific profile	High	Participants can track conversations over specific topics and access to the storage of all the information and files.	-	Members can have brainstorming through canvas, robust set of widgets, prebuilt templates, and powerful platform capabilities.	There is the possibility to integrate external files (PDF, Google Drive files) and other apps	Yes	Low
		Zoom	mostly synchronous	Both in private or group chats or in video meetings	Team members can communicate also through video calls	Not needed	Participants identify themselves with a specific profile	High	Members can share files or data in the channels, and they have access to the entire discussion	-	Members can schedule meetings and run videoconferences in full hd where they could discuss and share data	There is the possibility to integrate external files (PDF, Google Drive files)	Yes	Low
		Zoho Cliq	mostly synchronous	Communication happens through private or group chats, through posts or video calls, or through brainstorming sessions	Team members can communicate also through video calls	Not needed	Participants identify themselves with a specific profile	High	The application allows content sharing and file sharing in different chats where members can have access to the entire amount of file uploaded.	-	The application enables team members to have brainstorming and to see when other members are online	There is the possibility to integrate external files (PDF, Google Drive files)	Yes	Low
		Fleep	mostly synchronous	Communication happens through private or group chats, through posts or video calls and through tasks assignments	Team members can communicate also through video calls	Not needed	Participants identify themselves with a specific profile. Members have also the possibility to understand their presence and activity	High	Members can share files or data in the channels, and they have access to the entire discussion	Members can send tasks requests to other group members	Members can access to tasks and to status updates, plus they can see when members where present online and who has seen the messages	There is the possibility to integrate external files (PDF, Google Drive files)	Yes	Low
	Both		Quip	asynchronous/synchronous	Communication happens through private or group chats, and through mentions @ in the document page	-	Not needed	Participants identify themselves with a specific profile	Low	Members can have freely access to the entire list of messages and files shared	Members can insert tasks, deadlines and checklists	Members can track activities and tasks in kanban boards and in the calendar, the conversation in the group page.	There is the possibility to integrate external files (PDF, Google Drive files)	Yes

Type of team Both	Glip	asynchronous/synchronous	Communication happens in chats thanks to instant messaging, video calls and voice messages	Members can communicate also through video calls sharing their screens	Not needed	Participants identify themselves with a specific profile	High	Members can track the conversation in the group page and have freerly access to the entire list of messages and files shared.	Members can insert tasks, deadlines and checklists	Members can create timelines in order to track task compliance	There is the possibility to integrate external files (PDF, Google Drive files)	Yes	Low
	Podio	asynchronous/synchronous	Communication happens through private or group chats, through posts or , and through mentions @ or video calls	Members can communicate also through video calls sharing their screens	Not needed	Participants identify themselves with a specific profile, they can connect easily with other workers and start topics discussion	High	Members can share files in their conversation and look for topics in the storage of all the messages send. They can also start topics or ask questions	Members can assign tasks	Members can create timelines in order to track task compliance. The app is also able to provide report about task compliance	There is the possibility to integrate external files (PDF, Google Drive files) and other apps	Yes	Intermediate
	Project Manger	mostly asynchronous	Communication happens in private or group chats, in topics discussions or in comments to tasks and projects	-	Not needed	Participants identify themselves with a specific profile	Low	Participants can track conversations over specific topics and access to the storage of all the information and files.	Members can assign tasks	Members can assign tasks and gain access to Dashboards, Gantt charts and calendars were they can see tasks and projects progression. In addition to this they can also have a look into the time tracking for each task (real time updates)	There is the possibility to integrate external files (PDF, Google Drive files) and other apps	Yes	Intermediate
	Hive	asynchronous/synchronous	Communication happens through chats, emails, video calls, meeting notes and file sharing	Members can communicate also through video calls, thanks to zoom integration	Not needed	Participants identify themselves with a specific profile	High	Participants can track conversations over specific topics and access to the storage of all the information and files.	Members can assign tasks	Members can assign tasks and gain access to Gantt charts, tables, kanban and calendars were they can see tasks and projects progression. In addition to this they can also have a look into the time tracking for each task and monitor team's activities	There is the possibility to integrate external files (PDF, Google Drive files) and other apps	Yes	Intermediate
	Vabotu	asynchronous/synchronous	Communication happens through private or group chats, through posts or ,and through comments to one's work	-	Not needed	Participants identify themselves with a specific profile and they can interact	Intermediate	Participants can track conversations over specific topics and access to the storage of all the information and files.	members can assign tasks	Members can gain access to Dashboards and calendars where they can see tasks and projects progression. In addition to this they can also have a look into Gantt charts	There is the possibility to integrate external files (PDF, Google Drive files)	Yes	Intermediate
	Wimi	asynchronous/synchronous	Communication happens through private or group chats, through posts or video calls and cooperative writing	Team members can communicate also through video calls	Not needed	Participants identify themselves with a specific profile	High	Members can track the conversation in the group page and have freerly access to the entire list of messages.	members can assign tasks	Members can create timelines in order to track task compliance and they are provided with gantt charts, group calendars and discussion board to encourage more collaboration. Members can also have control over the access to files	There is the possibility to integrate external files (PDF, Google Drive files) and other apps	No	Intermediate
	Collaborate Cloud	mostly asynchronous	Communication happens in chats thanks to instant messaging and in tasks descriptions	-	Not needed	Participants identify themselves with a specific profile	Low	Members can share files or data in the channels, and they have access to the entire discussion	members can assign tasks	Members can track tasks progresses, they can create checklists for routine work and have one dashboard	There is the possibility to integrate external files (PDF, Google Drive files)	No	Intermediate

Type of team	Both	Deskree	mostly asynchronous	Communication happens through private or group chats, through posts or through tasks assignment and comments	-	Not needed	Participants identify themselves with a specific profile	Low	Members can track the conversation in the group page and have free access to the entire list of messages and files.	members can assign tasks	Members can track tasks progress.	There is the possibility to integrate external files (PDF, Google Drive files)	No	Intermediate
		Samepage	asynchronous/synchronous	Communication happens through private or group chats, through posts or video calls, or through brainstorming sessions, and task description	Team members can communicate also through video calls	Not needed	Participants identify themselves with a specific profile and they can interact	High	Members have access to information and the files shared	members can assign tasks	Members can work simultaneously in files that are shared in the topic pages and comment them, in this way every team members is always updated with changes. In addition to this, tasks can be assigned with due dates, priority level, reminders, recurrence, sub-tasks, and description details.	There is the possibility to integrate external files (PDF, Google Drive files)	Yes	Intermediate
		Intraboom	mostly asynchronous	Both in specific channels where the topic is discussed, as well as in chats and in the bulletin page. Members can have also the chance to start a topic discussion and to do brainstorming activities	-	Not needed	Participants identify themselves with a specific profile	Low	Participants can track conversations over specific topics and access to the storage of all the information and files. Plus members can access to the file that are stored in the cloud.	members can assign tasks	Members have the possibility to see tasks and deadlines in the calendar.	There is the possibility to integrate external files (PDF, Google Drive files)	Yes	Intermediate
		ActiveCollab	mostly asynchronous	Communication happens in pages (discussions) where people can mention @others and share files, ideas, feedbacks. Plus they can share comments on tasks.	-	Yes	Participants identify themselves with a specific profile	Low	Participants can track conversations over specific topics and access to the storage of all the information and files.	members can assign tasks	Members have the possibility to see tasks, their status and deadlines in the calendar and have reports.	There is the possibility to integrate external files (PDF, Google Drive files) and the possibility to use the app and to integrate other apps	Yes	Intermediate
		Huddle	mostly asynchronous	Communication happens in pages (discussions) where people can mention @others and share files, ideas, feedbacks. Plus they can share comments on files (Every document in Huddle has its own comment stream) and on tasks.	-	Not needed	Participants identify themselves with a specific profile	Low	Participants can have access to the files and documents shared and to the discussion around a document.	members can assign tasks	Members can create tasks and keep track of them through the dashboard and the activity feed.	There is the possibility to integrate external files (PDF, Google Drive files)	Yes	Intermediate

Type of team	VR / AR	Rumii	synchronous	Communication happens in virtual/augmented reality meetings where participants can talk and share opinions as well as work on prototypes	Team members can communicate through video calls in virtual spaces	No	Participants create their own avatar	High	Participants can share their screens, or files, as well as whiteboards or prototypes. Participants can have access to the files and documents shared .	-	Members can work on prototypes, share their screens and take note in whiteboards in a virtual place.	There is the possibility to integrate external files (PDF, Google Drive files) and the possibility to have some integrations	No	High
		Spatial	synchronous	Communication happens in virtual/augmented reality meetings where participants can talk and share opinions as well as work on prototypes and visualise data	Team members can communicate through video calls in virtual spaces	No	Participants create their own realistic avatar or they can participate through video calls	High	Participants can share their screens, or files, as well as whiteboards or prototypes. Participants can have access to the files and documents shared .	-	Members can visualise all the documents shared and can work in real time and organize 3d models, videos, docs, images, websites. Plus they can share their screens and import files from the phone	There is the possibility to integrate external files (PDF, Google Drive files) from the computer or from the phone	No	High
		MeetingVR	synchronous	Communication happens in virtual/augmented reality meetings where participants can talk and share opinions as well as work on prototypes and visualise data	Team members can communicate through video calls in virtual spaces	No	Participants create their own avatar	High	Participants can share their screens, or files, as well as whiteboards or prototypes. Participants can have access to the files and documents shared .	-	Members can visualise all the documents shared and can present and review products and 3D models, brainstorm, sketch, mind-map, prototype and have team-building activities	There is the possibility to integrate external files (PDF, Google Drive files)	No	High

3.2.2 Codification

The research matrix that has been built on the digital applications that can support virtual team's work and remote work, depicted in table 1, is made of several qualitative information that have been gathered. Therefore, in order to correctly assess the differences and the similarities among the characteristics each application studied entails, it's useful to code the different results for each column in order to have some numerical data that can be further computed.

Starting from the first characteristic that has been studied, the *type of communication*, results can be coded depending on the three most used replies, we adopted a range from 0 up to the number of possible replies that a given characteristic can assume. In the case of the first column the answer "*mostly asynchronous*" has been identified with 0, "*mostly synchronous*" with 1 and "*asynchronous/synchronous*" with 2. The rationale behind this codification is given by the fact that these characteristics are ordered according to their desirability, in fact, as we have seen tools that allow for synchronicity might let communication happen instantly and efficiently (Dennis, Fuller and Valacich, 2008), but in the other hand tools that allow for both asynchronous and synchronous communication might be more flexible and responsive.

For what concerns the second dimension instead, the *way of communication* could assume four different possible answers, depending on the degree of communication richness a given media could provide. Therefore, 0 has been identified with those applications that allow communication to happen "*Through comments or mentions to activities/posts*", being in this way a limited way of communicating, whereas 1 has been identified with the following answer "*Through chats and messages*", meaning that the given media is able to allow a more complete information and knowledge sharing among users. As for number 2, it is referred to the way of communicating "*Through comments or mentions to activities, and through specific topics discussions*", therefore to a type of communication that allows both simple comments over topics or activities and both the possibility of starting a discussion, where members could share opinions, file and contents, leading in this way to a better circulation of information. Instead, 3 has been

associated with that communication that happens “*Through comments or mentions to activities, through specific topics discussions and through chats*”, that combines all the possibilities that have been mentioned before in one tool and could be considered as a comprehensive and rich way of communicating. Finally, number 4 has been identified with those tools that allow communication to happen “*Through virtual and augmented reality*” and it could represent the most comprehensive way of communicating, as through augmented reality individuals could potentially discuss, comment activities, and chat in real time visualising team members and documents in one place.

For what concerns the *Chat integration* feature instead, through the review of information that has been gathered around this characteristic, replies have been classified around three potential alternatives: 0 if the application doesn’t allow a chat integration, limiting in this way the potential discussion among members, 1 in the case that an integration is possible and 2 if the integration is not needed, meaning that those application have already that feature incorporated.

For what concerns the *Visual meetings* feature, instead, in this case the possible answers identified have been two: 0 if the given application doesn’t allow neither video calls or integrations with tools that might provide this feature or, 1 in the case that the application considered allows for the possibility of integrating other tools for this purpose, or if the visual meeting feature is already incorporated in the application, letting members organize virtual face-to-face meetings.

Regarding *Social presence*, instead, the 45 applications have been analysed according with the level of social engagement they could provide to end users. In this case results have been classified around the different degrees of social engagement the applications could entail: 0 when social engagement is low, meaning that members are not provided with additional features that might boost their social presence, they are not enabled to communicate freely among them and they can’t consequently establish consistent levels of interpersonal relationship and trust and 1 when social engagement is intermediate or high, meaning that applications are provided with some features, similar to social networks, that allow members to boost their social presence through personal profiles, sharing personal data and communicating frequently and informally,

through emoji, gif and other features, and these processes could potentially boost communication and levels of trust.

For what regards the *Tools features* part applications have been analysed regarding the features they might provide to end users that support the “operational” process. In this scenario, the *content sharing* characteristic has been codified with two numerical alternatives: 0 if the given application allows to “*Share messages and files*”, letting members to access to the files shared in the given topics or the messages sent in the conversations, and 1, if the application consents to “*Share messages or files and real time prototyping or editing*”, letting users to gain a more comprehensive view on the contents shared, but also on files or models edited and prototyped, enabling members to work together towards a prototype and to see in real time members’ contributions.

As for the *scheduling characteristic*, also in this case the possible answers that have been identified are two, whether the given application doesn’t allow to assign tasks, and in this case the answers corresponds to 0, and whether the application allows to assign tasks, 1, being in this way more complete, as members are enabled to understand more clearly who is supposed to do what and the deadlines associated.

The *tracking feature*, instead, has been analysed regarding three possible scenario that could occur: whether a tracking feature is not provided by the application, 0, whether users can “*review activities and having status updates*”, 1, and whether users can “*review activities, having dashboards, gantt charts and calendar synchronisation*”, that is the most comprehensive alternative, as it allows users to have additional tools to track the overall tasks progressions, and it’s assigned with number 2.

For what concerns the *integration feature*, instead, two alternatives have been identified as possible and they have been consequently codified with: 0, if the given application allows users to integrate external files and 1 if the given application allows to integrate external files and apps, helping users in sharing documents and data more successfully, as they could be better shared across different platforms and applications.

The degree of *connection* the different applications might provide have been analysed regarding whether a given tool allows for a mobile version of the application, or not. In this case, we analysed if applications could provide users with possibility of having a

mobile version (app) in order to enhance their flexibility and to provide a more dynamic working environment. Therefore, in this case 0 has been identified with a negative response, whereas 1 with a positive one.

Finally, we have analysed the *level of digital skills* that users should own, in order to correctly exploit the different tools' functionalities and that are required by the sample of applications considered. In this case we have identified the possible levels with three answers: low, meaning that these applications are similar to other instruments that individuals use in their daily activities and don't require new competences, intermediate if the applications have some additional features that could not be immediately understood by users and therefore need some additional trainings, finally high, that stands for those tools that require a high level of digital competences, as they are made of completely new technologies that need some introductions or trainings in order to be correctly understood by potential users or if are tools that have many features that are not commonly used in one's daily life. For the purpose of our research we decided to code the answers with 0, when the level of digital skills required is basic, meaning that is associated with low level of digital skills required, or 1 if the level could be considered above basic, meaning that is associated with tools that require intermediate or high digital skills.

To summarise, the features that have been identified as the variables of the matrix build on the 45 applications considered, have been coded, for the purpose of this research, following some precise criteria. Therefore, the codification has been carried out according to the level of desirability that some features can entail or according to a natural order that could be depicted. In both cases, the rationale behind the codification has followed some information that have been collected through the literature review and through the research conducted on the applications features. In addition to this, other features instead have been coded around a classification that has been carried out through our considerations in the field.

Therefore, Table 2 shows the results that have been collected during the codification phase and that will be further computed in the next sections.

Table 2: Applications' data

Type of tool / Characteristics		Media synchronicity	Communication/ media richness			Social presence	Tools features				Connection	Level of digital skills	
		Type of comm	Way of comm	Chat integration	Visual meetings	Level of social engagement	Content sharing	scheduling	tracking	integration	app	Basic-Above basic	
Type of team	Project oriented	Wrike	0	0	1	1	0	0	1	2	1	1	1
		Asana	0	0	1	1	0	0	1	1	1	1	1
		Trello	0	0	1	1	1	1	1	1	1	1	1
		Microsoft Teams	2	2	2	1	1	0	1	1	1	1	1
		Confluence	2	0	1	1	1	0	1	1	1	1	1
		Teamwork Projects/Chats	0	2	2	0	0	0	1	1	1	1	1
		Redbooth	2	2	2	1	1	0	1	2	1	1	1
		ProofHub	0	2	2	0	1	0	1	2	1	1	1
		Azendoo	2	2	2	1	1	0	1	1	1	1	1
		Zoho Projects	2	2	2	1	1	0	1	2	1	1	1
		Monday.com	0	0	1	0	0	0	1	1	1	1	1
		Notion	0	1	0	0	0	0	1	1	1	1	0
		Apollo	0	0	0	0	0	0	1	2	1	1	1
		Jira Software	0	0	1	0	0	0	1	2	1	1	1
		Airtable	0	1	1	0	0	0	1	2	1	1	1
	Process oriented	Hangouts	1	1	2	1	1	0	0	0	1	1	0
		Sococo	1	1	2	1	1	0	0	0	1	1	0
		Slack	2	2	2	1	1	0	0	0	1	1	1
Facebook Workplace		2	2	2	1	1	0	0	0	1	1	0	

Type of team	Process oriented	Cisco WebEx	1	1	2	1	1	1	0	0	1	1	0
		Wiredrive	0	0	0	0	1	0	0	0	1	1	0
		EzTalks Cloud Meeting	1	1	2	1	1	1	0	0	0	1	0
		Yammer	2	2	2	1	1	0	0	0	1	1	0
		Miro	1	2	1	1	1	1	0	0	1	1	0
		Zoom	1	1	2	1	1	0	0	0	1	1	0
		Zoho Cliq	1	1	2	1	1	0	0	0	1	1	0
		Flock	1	1	2	1	1	0	1	1	1	1	0
	Both	Taskade	2	1	2	1	1	0	1	2	1	1	0
		Fleep	1	2	2	1	1	0	1	1	1	1	0
		Quip	2	2	2	0	0	1	1	2	1	1	0
		Glip	2	1	2	1	1	1	1	1	1	1	0
		Podio	2	2	2	1	1	0	1	2	1	1	1
		Project Manger	0	2	2	0	0	0	1	2	1	1	1
		Hive	2	2	2	1	1	0	1	2	1	1	1
		Vabotu	2	2	2	0	1	1	1	2	0	1	1
		Wimi	2	2	2	1	1	0	1	2	1	0	1
		Collabrate Cloud	0	1	2	0	0	0	1	2	0	0	1
		Deskree	0	2	2	0	0	0	1	2	0	0	1
		Samepage	2	2	2	1	1	1	1	1	1	1	1
		Intraboom	0	2	2	0	0	0	1	1	0	1	1
		ActiveCollab	0	0	1	0	0	0	1	1	1	1	1
		Huddle	0	2	2	0	0	0	1	1	1	1	1
		VR /AR	Rumii	1	3	0	1	1	1	0	0	1	0
	Spatial		1	3	0	1	1	1	0	0	0	0	1
	MeetingVR		1	3	1	1	1	1	0	0	0	0	1

3.3 Data evaluation

In order to correctly compute and understand the meaning of the collected data, this section proceeds with a descriptive analysis of the results. Information gathered have been analysed through the use of *SPSS* in order to understand important implications and in order to provide an overall overview of the results. The eleven characteristics on which the different applications have been analysed, represent the variables of the matrix built, and they have been analysed regarding to their frequency, the median and the mode.

Therefore, figures from 4 to 15 show the results associated with each variable and table from 3 to 14 the overall frequency of responses that have been given for each characteristic.

Figure 4: Results associated with the “Type of communication” feature

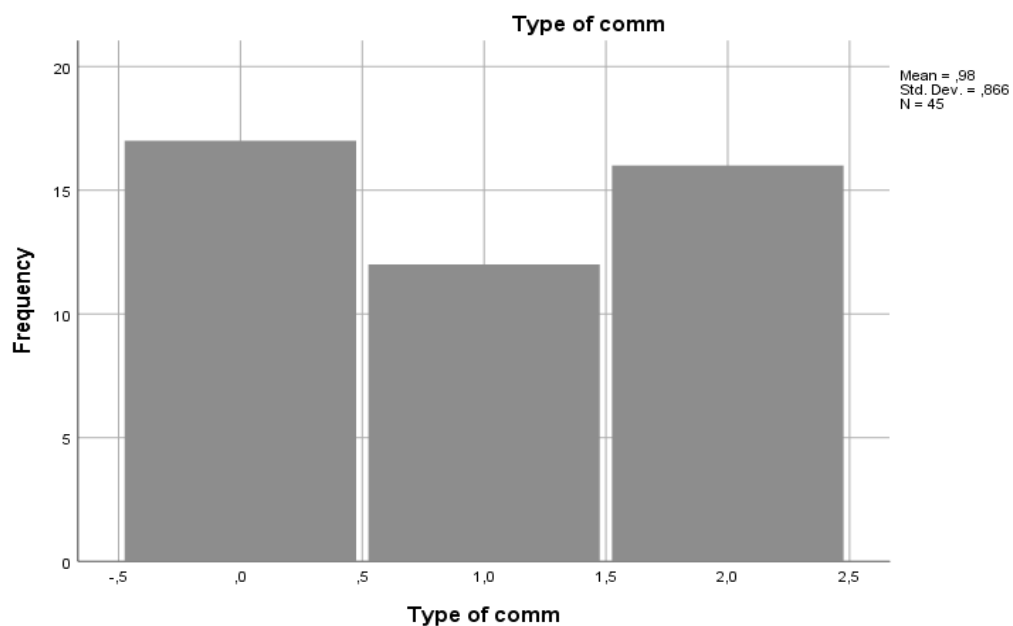


Table 3: Frequencies associated with the “Type of communication” feature

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	mostly asynchronous	17	37.8	37.8	37.8
	mostly synchronous	12	26.7	26.7	64.4
	both	16	35.6	35.6	100.0
	Total	45	100,0	100,0	

Applications have been analysed referring to different dimensions and have been consequently coded around a range of possible answers.

As for the first characteristic, the *type of communication*, data collected through the analysis of the 45 applications and reviewed in Figure 4 and Table 3, show how the type of communication that is most frequently adopted by those tools is primarily asynchronous communication (37.8%) and it's followed by mixed types of communication (both asynchronous and synchronous communication) (35.6%). Whereas tools that allow for mostly synchronous communication are the 26.7% of the sample considered.

Figure 5 and Table 4, instead, provide the results for what concerns the second dimension, the *way of communicating*. In this case, the rationale behind the analysis conducted has been to understand, among the fourth possible options, what is the way of communicating, among those considered, that appears more frequently in the sample of applications analysed.

Figure 5: Results associated with the “Way of communicating” feature

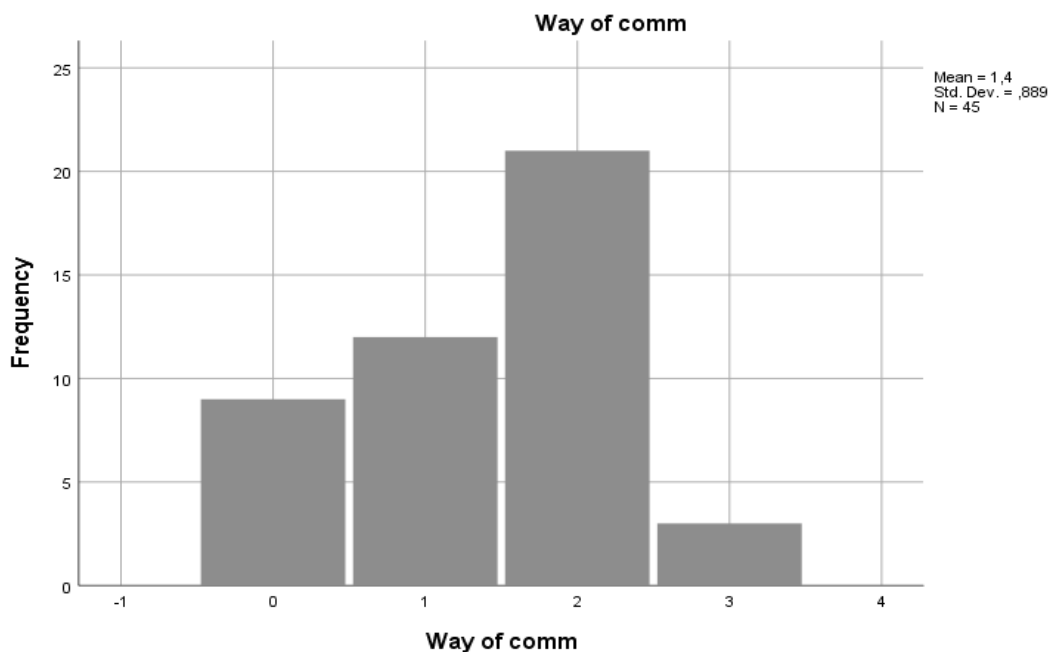


Table 4: Frequencies associated with the “Way of communicating” feature

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	through comments or mentions to activities and through soecific topic discussion	9	20.0	20.0	20.0
	through chats and messages	12	26.7	26.7	46.7
	through comments or mentions to activities, through specific topics discussions and through chats	21	46.7	46.7	93.3
	through virtual and augmented reality	3	6.7	6.7	100.0
	Total	45	100.0	100.0	

Results show how the third option, made of those applications that allow communication to happen “*through comments or mentions to activities, through specific topic discussions and through chats*”, being in this way a quite complete way of sharing information and data, is present on the 46.7% of the applications considered, followed by the second option, “*through chats and messages*”, 26.7%.

Figure 6: Results associated with the “Chat integration” feature

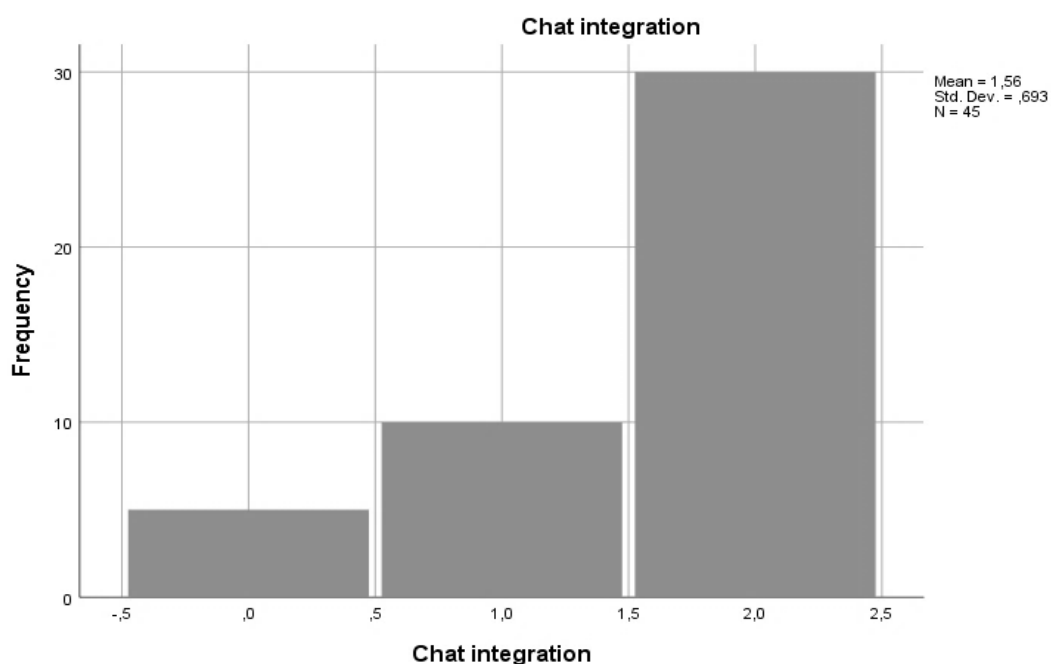


Table 5: Frequencies associated with the “Chat integration” feature

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	5	11.1	11.1	11.1
	yes	10	22.2	22.2	33.3
	Not needed	30	66.7	66.7	100.0
	Total	45	100.0	100.0	

Concerning the *Chat integration* feature, instead, results from figure 6 and table 5 prove how the majority of the applications that have been considered for the purposes of this study don’t necessitate to integrate further tools, as they already have that instant messaging feature incorporated. This result enables us to understand how 40 applications out of 45 prove to have a chat feature, that in the majority of the cases is already incorporated (66.7%), or that could be integrated through other applications (22.2%), allowing in this way to have better communication flows among participants.

Figure 7: Results associated with the “Visual meetings” feature

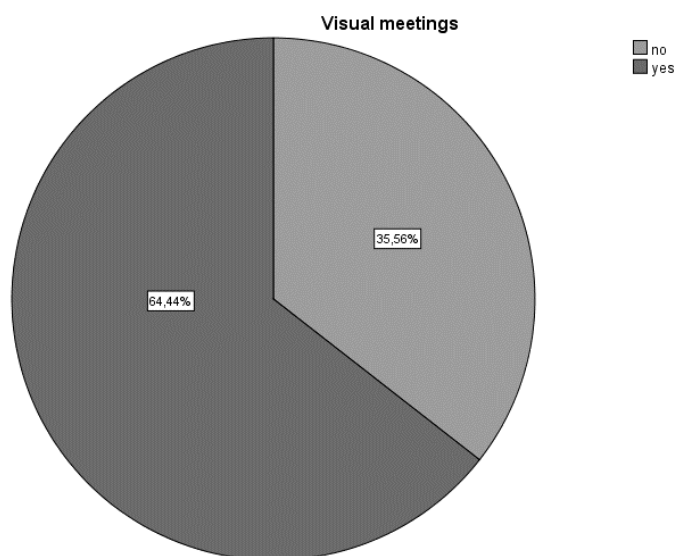


Table 6: Frequencies associated with the “Visual meetings” feature

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	16	35.6	35.6	35.6
	yes	29	64.4	64.4	100.0
	Total	45	100.0	100.0	

Furthermore, also the possibility to allow end users to have video calls and *visual meetings* has been analysed, in order to understand whether the applications considered can support this feature, allowing in this way a richer communication, if compared with those that don’t provide this feature. Therefore, results from figure 7 and table 6 depict how the given applications in the majority of the cases (64.4%) have this feature incorporated or they allow for integrations, allowing users to have visual meetings, while a great part of the applications studied doesn’t provide this feature and doesn’t allow for integrations, (35.6%). These results could provide an interesting insight into the amount of application that could actually support video conferencing and meetings, as they are 29 out of the overall applications taken into consideration for the purpose of the research.

Figure 8: Results associated with the “Levels of Social engagement” feature

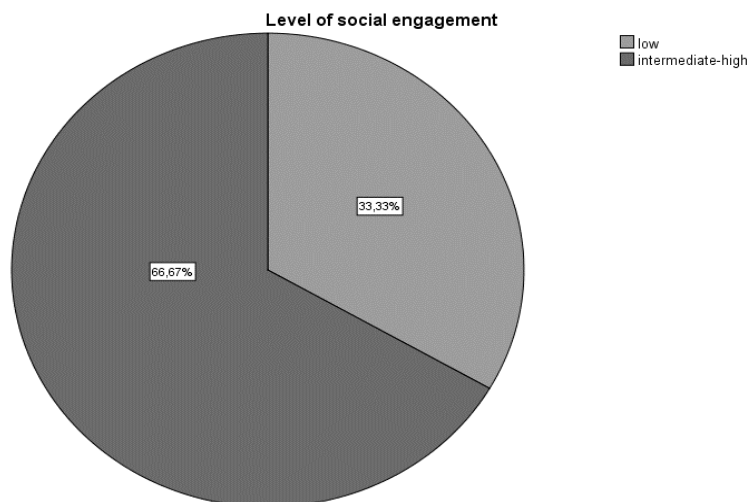


Table 7: Frequencies associated with the “Levels of social engagement” feature

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	low	15	33.3	33.3	33.3
	intermediate-high	30	66.7	66.7	100.0
	Total	45	100.0	100.0	

A further characteristic that has been analysed, as already seen in the previous sections, is the one of *Social engagement*, that has been identified with the possibility that end users, through the usage of these digital applications, have to engage in social relationships. In this sense, we analysed if the applications considered, allow users to have the possibility to share personal experiences, data and information through communications, personal profiles, likes and posts, in order to develop trust and relationships among each other. In this case the information that have been gathered, that are summarised in Figure 8 and Table 7, depict how the 66.75% of the 45 applications studied present a level of social engagement that is intermediate or high.

Figure 9: Results associated with the “Content sharing” feature

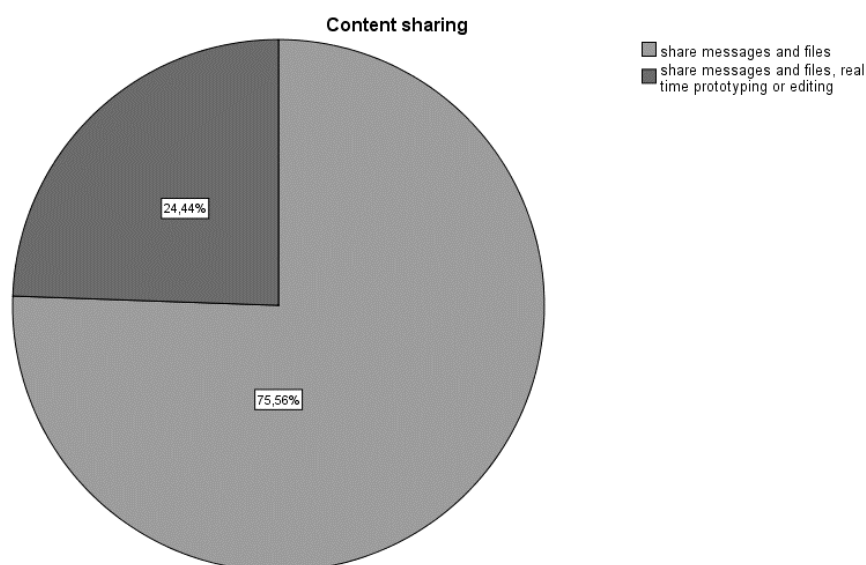


Table 8: Frequencies associated with the “Content sharing” feature

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Share messages and files	34	75.6	75.6	75.6
	Share messages or files and real time prototyping or editing	11	24.4	24.4	100.0
	Total	45	100.0	100.0	

In addition to this, also the tools’ features have been analysed, looking for the characteristics that each application can assume regarding the features of: content sharing, tracking, scheduling and integration.

Starting from the first one, the *content sharing* feature, results, depicted in Figure 9 and Table 8, demonstrate how the vast majority of the digital tools taken into consideration allow end users to “*share messages and files*” while communicating and working (75.6%), instead of providing a more complete way of sharing contents that is represented only by the 24.4% of the applications, that allow users “*to share messages or files and real time prototyping or editing*”.

Figure 10: Results associated with the “Scheduling” feature

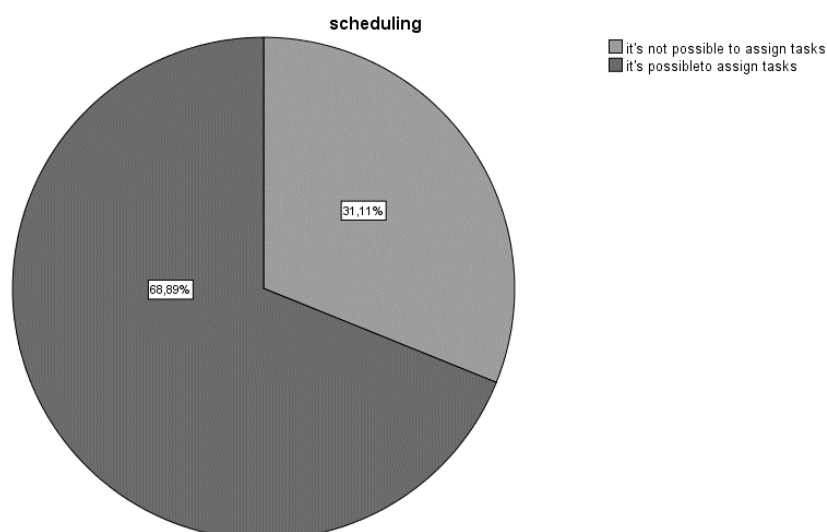


Table 9: Frequencies associated with the “Scheduling” feature

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	It's not possible to assign tasks	14	31.1	31.1	31.1
	it's possible to assign tasks	31	68.9	68.9	100.0
	Total	45	100.0	100.0	

Considering the *scheduling* feature, instead, applications have been questioned on whether they allow end users to assign task, providing, therefore, a clearer overview into who is supposed to do what and over task’s deadlines. Thus, figure 10 and table 9, depict the result associated with this feature, from these data is possible to understand how a great percentage of the applications, taken into consideration in this research, provide end users with the possibility of assigning tasks, 68.9%, whereas the 31.3% don’t have this feature incorporated.

Figure 11: Results associated with the “Tracking” feature

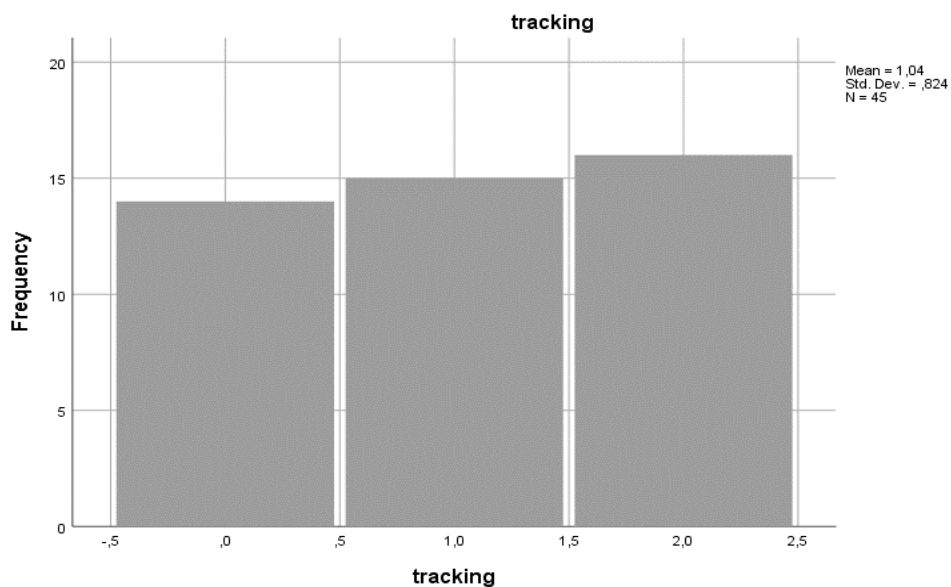


Table 10: Frequencies associated with the “Tracking” feature

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	14	31.1	31.1	31.1
	Reviewing activities and having status updates	15	33.3	33.3	64.4
	Reviewing activities, having status updates, gantt charts and calendar synchronisation	16	35.6	35.6	100.0
	Total	45	100.0	100.0	

As for the *tracking* feature, instead, applications have been analysed to determine whether they could allow users to review activities and having status updates, and whether they could entail additional features, that could provide important information to users over tasks’ deadlines and progression. In this scenario, results depicted in Figure 11 and Table 10 show how the most recurrent characteristic, that has been the possibility of “*reviewing activities, having status updates, gantt charts and calendar synchronisation*”, and that is the most comprehensive one, has achieved the percentage of 35.6% of the sample considered. Furthermore, what is important to understand, is that 31 out of the 45 applications taken into consideration prove to have a tracking feature incorporated.

Figure 12: Results associated with the “Integration” feature

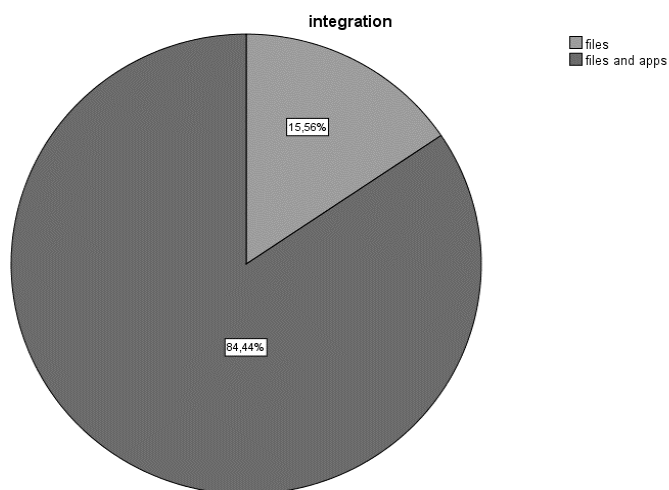


Table 11: Frequencies associated with the “Integration” feature

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	files	7	15.6	15.6	15.6
	files and apps	38	84.4	84.4	100.0
	Total	45	100.0	100.0	

For what concerns the *Integration* feature, instead, applications have been analysed looking at the degree of integration they could allow to end user, in particular, if they enable integrations with external files, or if they could enable users to integrate also other tools, being in this able to import data from multiple sources. Therefore results, depicted in Figure 12 and Table 11, demonstrate how the option of integrating “*files and apps*” is present on the 84.4% of the alternatives. Applications, therefore, prove to be in large part able to allow for file and applications integrations, allowing a smooth management of work and a flexible exchange of data among different platforms.

Figure 13: Results associated with the “App” feature

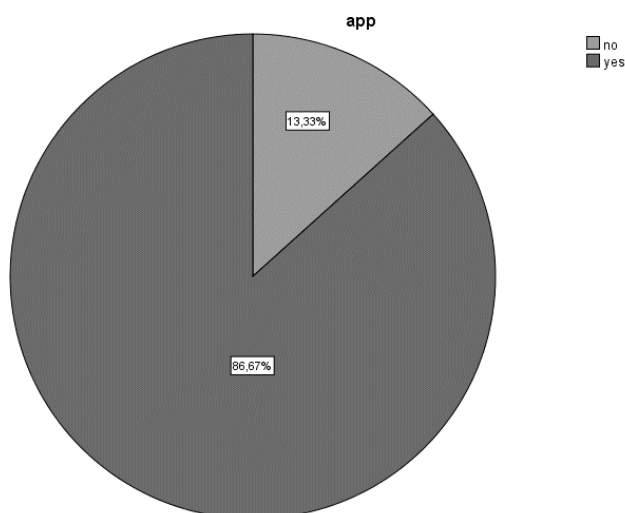


Table 12: Frequencies associated with the “App” feature

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	6	13.3	13.3	13.3
	yes	39	86.7	86.7	100.0
	Total	45	100.0	100.0	

In addition to this, what has also been analysed is the degree of flexibility these applications can offer, in particular, relating to the possibility of using a mobile *app* version, that might enable individuals to be on call also outside the office or outside home, being in this way able to connect whenever a problem occurs. Therefore, the sample considered, depicts interesting results. In fact, results, showed in figure 13 and table 12, depict how the 86.7% of the applications taken into consideration allow for the possibility to have a mobile application installed, whereas just 6 out of 45 applications are not provided with this feature.

Figure 14: Results associated with the “Level of digital skills required” feature

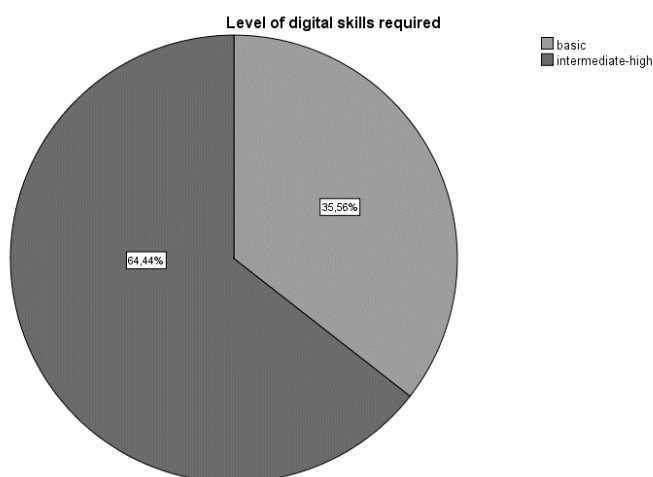


Table 13: Frequencies associated with the “Level of digital skills required” feature

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	basic	16	35.6	35.6	35.6
	intermediate-high	29	64.4	64.4	100.0
	Total	45	100.0	100.0	

Finally, considering the last characteristic that has been taken into consideration, in order to analyse current applications that can support virtual team’s work and remote work, the *level of digital skills required* has been analysed referring to the three possible degrees (low, medium or high), that have been further reclassified under “basic” and “above basic” digital skills. Results, depicted in figure 14 and table 13, prove how the applications considered require above basic digital skills, thus an intermediate or high level, for the 64.4% of the cases, whereas the 35.6% require basic levels of digital skills.

Therefore, through the analysis of the frequencies that turned out in the research carried out on the 45 applications considered, it is possible to have an insight into the data that have been collected and the most common characteristics that those application assume. In order to provide a complete analysis of the given data it’s necessary to consider further dimensions given by: the mode, the median, the mean and the variance for the characteristics that have been taken into consideration.

At this point, before proceeding with additional studies, regarding measures of central tendency and variability, is important to underline the nature of the data taken into consideration. In fact, differently from larger samples of data that are quantitative and on which several computations could be made, data in this case are assumed to be ordinal. In fact, when coding information in numbers, in order to proceed with the research, we have assigned to each quality or to each feature a given number that was ordered according to a desirability level or into a natural order. Therefore, the analysis that can be carried out with this sample of qualitative data concerns the mode and the median, for what regards measures of central tendency.

Therefore, table 14 provides a review of the most important values that need to be computed and taken into consideration in order to correctly analyse the results that have been collected through the matrix. The eleven characteristics that have been identified, also through the studies of the literature related to virtual team's topics, have been further analysed referring to additional measure that can provide important information about the position of the results and their possible measures. From the result depicted in table 14 what could be understood, looking at the mode the different variables have assumed, are the most frequently chosen alternatives for the different variables taken into consideration in the virtual team's supportive tools analysis.

Therefore, the characteristics that the majority of the tools have proved to own (based on the value of the mode each variable assume) depict a tool that allows, for what concerns the communication side: mostly asynchronous communication, that allows communication to happen through comments or mentions to activities, through specific topics discussions and through chats. Furthermore, most of the applications considered have already the chat feature integrated and they can allow users to have visual meetings and conferences, providing an intermediate or high level of social integration.

As for the tool's characteristics instead, results demonstrate how the most frequent patterns that could be found in the sample considered are those that describe a tool that: enables participants to share messages and files, that provides the task assignment feature, that offers members the possibility to review activities, having dashboards, gantt charts and calendar synchronisation and enables users to integrate external files or apps. The final two characteristics that the majority of the applications, that have been considered for the purpose of this analysis, present, regard the possibility of connecting and working also through mobile devices and the level of digital skills required. In this sense the majority of the applications allow for an app to be installed in mobile devices and require above basic levels of digital skills.

Table 14: Data

Statistics

		Type of comm	Way of comm	Chat integration	Visual meetings	Level of social engagement	Content sharing	scheduling	tracking	integration	app	Level of digital skills required
N	Valid	45	45	45	45	45	45	45	45	45	45	45
	Missing	0	0	0	0	0	0	0	0	0	0	0
Median		1,00	2,00	2,00	1,00	1,00	,00	1,00	1,00	1,00	1,00	1,00
Mode		0	2	2	1	1	0	1	2	1	1	1
Percentiles	25	,00	1,00	1,00	,00	,00	,00	,00	,00	1,00	1,00	,00
	50	1,00	2,00	2,00	1,00	1,00	,00	1,00	1,00	1,00	1,00	1,00
	75	2,00	2,00	2,00	1,00	1,00	,50	1,00	2,00	1,00	1,00	1,00
Interquartile range		2	1	1	1	1	1	1	2	0	0	1

Thus, reviewing the collected data through the use of elements belonging to descriptive statistics enables us to understand what are the shapes that the different characteristics assume in the 45 tools that have been analysed and it also enables us to understand important patterns that may arise from these data. Results provide an insight into the possible distribution of the different variables, that as was expected from the fact that the variables taken into consideration are not quantitative but qualitative and follow an ordinal scale of measurement, aren't distributed normally.

Therefore, from these results it could be understood how, among the 45 applications considered, the characteristics that are most frequently observed are those associated with an application that can be both *project and process-oriented*. In fact, the majority of the tools considered prove to have both features associated with communication richness and both with characteristics that might enable users to correctly schedule work and respect deadlines.

3.4 Analysis

After having considered the results depicted by the matrix of research (built with the purpose of analysing the 45 applications that support virtual team's work and remote work) and after having questioned data through the use of the methods given by the descriptive statistic, it's possible to continue the research trying to figure out possible patterns that could exist among variables.

For this purpose, the chosen method is the one given by the *Cross-tabulation analysis*, that permits to test and verify whether two variables can be related among each other. In order to pursue a correct interpretation of the data that have been collected in the matrix it's interesting to understand if patterns among variables occur, through the use of the statistical software *SPSS*. In particular, we are interested in understanding whether the given variables are related in order to assess if the characteristics that have been analysed in the matrix are dependent among each other's.

In this scenario, the correct way to compute these correlations is by using the *Cross-tabulation analysis*, a statistical method that enables to understand the relationship that can exist among two variables and to verify the given null hypothesis (that states that the two variables are independent) through the use of the Chi square test χ^2 (*Pearson Chi square test*).

Before adopting this non-parametric test for assessing the degree of significance of the relationship between the two variables data have been checked in order to understand if the assumptions where met.

In particular, according to scholars, these two requirements need to be met in order to proceed with such analysis:

- The observations need to be independent among each other;
- *<No more than 20% of the expected counts are less than 5 and all individual expected counts are 1 or greater>*, meaning that expected frequencies should be greater than 5 for the 80% of the cases. (Yates, Moore & McCabe, 1999)

After having assessed the adequacy of our data, according with the principles mentioned above, it's possible to proceed with the analysis. Therefore, through the use of the Chi square test χ^2 (*Pearson Chi square test*), the significance of results could be assessed; results with a p value above 0.05 are considered significant, in that cases the null hypothesis (that states that the two variables are independent) is accepted, whereas with values below the 0.05 level of significance the null hypothesis is rejected, meaning that the two variables are correlated.

The aim of this research is to analyse some of the most widely known and used applications that support virtual team work and to analyse, also, whether some of the characteristics, on which the applications have been questioned, are somehow related among each other.

In particular, the attention has been put in understanding how social engagement can be related to different communication dimension that have been labelled under the *"type of communication"*, *"way of communication"* and the *"visual meeting"* features. For example, we wanted to assess if there is a relation between the type of communication that a given application provide, that could be asynchronous,

synchronous or both, and the level of social engagement that can be consequent to its usage. In fact, through the literature review conducted in Chapter II, several elements have been underlined as important features to be considered to build and manage effectively virtual teams. In this scenario, social engagement is considered as one of the most important feature that a given application should allow, in particular, we consider social engagement as the feeling of engagement that members of a given group can feel thanks to frequently and personal interactions that happen through the digital mean, that can be linked to trust foundation. Therefore, it's crucial to understand the linkages and the possible relation that might exist between a given level of social engagement and the type of communication that might allow for it, inside these tools.

Therefore, a first relationship that has been investigated is the one that can possibly exist between the *"Type of communication"* variable, that is an expression of the degree of media synchronicity that a given application can allow, and the *"Level of social engagement"* that the same application provide.

Table 15: Cross Tabulation analysis between "Level of Social engagement" feature and "Type of communication" feature

Level of social engagement * Type of comm Crosstabulation

		Type of comm			Total
		mostly asynchronous	mostly synchronous	both	
Level of social engagement low	Count	14	0	1	15
	% within Level of social engagement	93.3%	0.0%	6.7%	100.0%
	% within Type of comm	82.4%	0,0%	6.3%	33.3%
intermediate-high	Count	3	12	15	30
	% within Level of social engagement	10.0%	40.0%	50.0%	100.0%
	% within Type of comm	17.6%	100,0%	93.8%	66.7%
Total	Count	17	12	16	45
	% within Level of social engagement	37.8%	26,7%	35.6%	100.0%
	% within Type of comm	100.0%	100.0%	100.0%	100.0%

Thus, table 16 provides the result of the *Cross-tabulation analysis* conducted between the two variables and results displayed provide an overview into the relationship among the two variables. In particular, low levels of social engagement have been found in applications that provide users with a mostly asynchronous communication (93.3%), that take place through messages, comments or posts not in real time, whereas intermediate or high levels have been identified mostly with a mixed type of communication (50%), both synchronous and asynchronous. In addition to this, interesting data are the one provided by intermediate-high levels of social engagement that turned also to be substantially related with synchronous communication (40%), that is made of real time communications that allow members to have virtual meetings and in the most technologically advanced applications, meetings in augmented reality. Looking at results of Table 16, it's possible to observe how the level of social engagement at intermediate and high levels seems to increase when passing from an asynchronous way of communicating to mixed way of communicating, while the opposite can be said for low levels of social engagement, that is mostly associated with asynchronous communication. Therefore, thanks to the cross-tabulation analysis carried out among these two variables an interesting data come out, that is the importance of stressing both mixed types of communication (asynchronous and synchronous) and features that allow members to have real time meetings (synchronous communication) as these two characteristics are mostly related to higher levels of social engagement.

In addition to this, the relationship has been tested through the Pearson Chi square test and the results could be considered significant ($\chi^2=29,664$, $df=2$, $p=.000$), therefore the null hypothesis is rejected, as a relation is in place between the two variables. Furthermore, we wanted also to assess the degree of strength that this relationship assumes, therefore we used further measures in order to assess the strength of the relationship.

In this case, given the fact that the variables are assumed to be ordinal, as they have been classified and coded according to a principle that assumes that the most attractive characteristics are associated with higher values, and there is a natural order (low-high) we need to find suitable measures of correlations in order to further address the relation between the two variables. Therefore, in order to measure the association that could

exist among the two variables we decided to run *Kendall's tau-b*, that is a non-parametric measure that assess the correlation among ordinal variables. In particular, results can assume values between -1 and 1 depending on the direction of the relationship and its strength (Kendall, 1938).

Table 16: Symmetric measures referred to the cross-tabulation analysis carried out between the "Level of social engagement" feature and the "Type of communication" feature

		Value	Asymptotic Standard Error ^a	Approximate T ^b	Approximate Significance
Ordinal by Ordinal	Kendall's tau-b	,662	,094	5,976	,000
N of Valid Cases		45			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

Therefore, table 17 depicts the results of this additional computation that proves a quite strong positive level of relation between the two variables.

In addition to this, a further possible relationship that has been questioned and that is important to verify for the purpose of this research, is the one that could possibly occur between the way of communicating that different applications might assume and the relative social engagement they might provide to users. Unfortunately, the two variables don't meet the assumptions needed in order to assess the degree and the level of relation that might exist among them, therefore we didn't proceed with this computation.

Besides this, we were also interested in understanding whether applications that allow for the integration of tools that provide the visual meetings and video conferencing feature, or that have already this feature incorporated, could provide higher level of social engagement among participants. In fact, during the literature review conducted in the previous chapters, the possible differences that might exist between virtual teams and teams that are traditional and have face-to-face meetings, have been analysed. In particular, researches proved how a consistent disadvantage that virtual teams present is given by the fact that they might lack with the possibility of communicating primarily

face-to-face, as members don't have the chance to communicate freely also with gestures or other physical and behavioural aspects that might affect the overall quality of communication. Therefore, it's interesting to understand whether the possibility to have virtual face-to-face meetings can actually benefit social engagement among members and consequently communication quality among dispersed workforce.

Table 17: Cross-tabulation analysis between the "Visual meetings" feature and the "Social engagement feature"

Visual meetings * Level of social engagement Crosstabulation

			Level of social engagement		Total
			low	intermediate-high	
Visual meetings	no	Count	13	3	16
		% within Visual meetings	81.3%	18.8%	100.0%
		% within Level of social engagement	86.7%	10.0%	35.6%
	yes	Count	2	27	29
		% within Visual meetings	6.9%	93.1%	100.0%
		% within Level of social engagement	13.3%	90.0%	64.4%
Total	Count	15	30	45	
	% within Visual meetings	33.3%	66.7%	100.0%	
	% within Level of social engagement	100.0%	10.0%	100.0%	

Therefore, table 18 depicts the results of the cross-tabulation analysis conducted among the two variables. What stands out from the table is the fact that intermediate and high levels of social engagement are given almost entirely (90%) when the visual meetings feature is provided by applications, whereas low levels of social engagement are mostly associated with those applications that don't provide this feature (86.7%).

This means that the possibility of achieving high levels of social engagement among individuals, who work through the usage of the applications that have been taken into

consideration, might depend in great part by the fact of adopting a tool that allows for a visual meeting feature. What is more, data enables us also to understand how intermediate/high levels of social engagement increase when passing from not having the visual meeting feature to having it, whereas low levels of social engagement increase when passing from having the feature incorporated to not having it, therefore, it could be assumed that a relation might exist among the variables. Also, in this case the relation has been tested using the Pearson Chi-square test and results allow us to reject the null hypothesis, meaning that a relationship is actually in place between the two variables ($\chi^2=25,652$, $df=1$, $p=.000$).

What is more, the strength of the relation among the variables can be computed using the Kendall's tau-b method and results, shown in table 19, prove that a positive high correlation exists among the two variables.

Table 18: Symmetric measures referred to the cross-tabulation analysis conducted between the "Visual meetings" feature and the "Level of social engagement" feature

		Value	Asymptotic Standard Error ^a	Approximate T ^b	Approximate Significance
Ordinal by Ordinal	Kendall's tau-b	,755	,103	5,840	,000
N of Valid Cases		45			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

In addition to this, the aim of this research is also to understand whether some of the “operational” features, that these applications can provide to end users, can affect the overall level of digital skills that is required from the given applications.

In particular, we are interested in understanding the relationship that might exist between the “scheduling” and “tracking” feature and the level of digital skills required.

Therefore, regarding the possible linkages that might exist between the level of digital skills required, in order to correctly use a given application, and the possible

“scheduling” feature that might be incorporated in the application, table 20 shows the result of the cross-tabulation analysis conducted among the two variables.

Table 19: Cross-tabulation analysis between the "Scheduling" feature and the "Level of digital skills required" feature

scheduling * Level of digital skills required Crosstabulation

			Level of digital skills required		Total
			basic	intermediate-high	
scheduling	it's not possible to assign tasks	Count	10	4	14
		% within scheduling	71.4%	28.6%	100.0%
		% within Level of digital skills required	62.5%	13.8%	31.1%
	it's possible to assign tasks	Count	6	25	31
		% within scheduling	19.4%	80.6%	100.0%
		% within Level of digital skills required	37.5%	86.2%	68.9%
Total	Count	16	29	45	
	% within scheduling	35.6%	64.4%	100.0%	
	% within Level of digital skills required	100.0%	100.0%	100.0%	

Data show how applications that provide a scheduling feature, that can be that of assigning tasks to other members and planning the activities, require mostly above basic level of digital skills (associated with intermediate or high levels) (86.2%), whereas basic levels of digital competences are mostly associated with other tools that are not provided with that feature (62.5%). Furthermore, it’s possible to observe how the percentages associated with above basic levels of digital skills required prove to increase when passing from “it’s not possible to assign tasks” to “it’s possible to assign tasks”, whereas the opposite could be said for the percentages associated with basic level of digital skills required.

Therefore, what could be assumed by these results is the fact that application that allow for scheduling activities and tasks among participants are identified with those that require more than basic digital competences, meaning that individuals might need some trainings in order to manage to use them successfully.

The relationship between the two variables has been tested with the Pearson Chi square tests and results reject the null hypothesis, therefore a relation is in place between the two variables ($\chi^2=11,414$, $df=1$, $p=.001$). Furthermore, also in this case symmetric measurement have been carried out and Table 21 depicts the results, data provide an insight into the shape the relation can assume that in this case appear to be moderately positively correlated.

Table 20: Symmetric measures referred to the cross-tabulation conducted between the “Scheduling” feature and the “Level of digital skills required” feature

Symmetric Measures

		Value	Asymptotic Standard Error ^a	Approximate T ^b	Approximate Significance
Ordinal by Ordinal	Kendall's tau-b	,504	,136	3,388	,001
N of Valid Cases		45			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

In addition to this, the same research has been conducted for what concerns the possible relation between the “level of digital competences” a given application requires and the “tracking” feature provided by applications. More specifically, the relationship has been tested in order to understand whether applications that allow for a tracking feature require individuals to own above basic digital competences.

Table 21: Cross-tabulation analysis conducted between the "Tracking feature and the "Level of digital skills required" feature

tracking * Level of digital skills required Crosstabulation

		Level of digital skills required		
		basic	intermediate-high	Total
tracking no	Count	10	4	14
	% within tracking	71.4%	28.6%	100.0%
	% within Level of digital skills required	62.5%	13.8%	31.1%
review activities and having status updates	Count	4	11	15
	% within tracking	26.7%	73.3%	100.0%
	% within Level of digital skills required	25.0%	37.9%	33.3%
review activities, having status updates, gantt charts, calendar synchronisation	Count	2	14	16
	% within tracking	12.5%	87.5%	100.0%
	% within Level of digital skills required	12.5%	48.3%	35.6%
Total	Count	16	29	45
	% within tracking	35.6%	64.4%	100.0%
	% within Level of digital skills required	100.0%	100.0%	100.0%

Therefore, through the observation of table 22, which provides the results of the cross-tabulation analysis conducted between the "Tracking" variable and the "level of digital skills required" variable, some assumptions could be made. As noted also in the previous analysis, the Tracking feature that some applications might entail, requires individuals to own above basic digital skills, identified with intermediate or high levels of digital skills. In fact, above levels of digital skills are mostly associated with the option "review activities and having status updates", 37.9% and with "review activities, having status updates, gantt charts, calendar synchronisation", 48.3%.

Moreover, it could be observed how the percentages associated with levels of digital skills required considered "above basic", therefore intermediate or high, increase as the tracking feature is present and more articulated, whereas the percentages associated with basic level of digital skills required, go in the opposite sense, in particular are higher

when the tracking feature is not present. Also, in this case the relationship among the two variables have been tested through the Pearson Chi-square test and the null hypothesis have been rejected ($\chi^2=12,092$, $df=2$, $p=.002$), meaning that the two variables are related.

In addition to this, the relation has been tested also through the use of the Kendall's tau-b method in order to compute the strength of the relation among the two variables. In this case, results from table 23, allow us to understand how the two variables are moderately positively correlated.

Table 22: Symmetric measures referred to the cross-tabulation analysis conducted between the "Tracking" feature and the "Level of digital skills required" feature

Symmetric Measures

		Value	Asymptotic Standard Error ^a	Approximate T ^b	Approximate Significance
Ordinal by Ordinal	Kendall's tau-b	,465	,117	3,799	,000
N of Valid Cases		45			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

To conclude, a further cross-tabulation analysis conducted has been that between the “level of digital skills required” variable and the “level of social engagement” variable. In fact, our research interest lies also in understanding the possible relation between the level of digital skills that individuals should own, in order to correctly perform activities with a given tool, and the level of social engagement that tool can provide to users. This relation, in fact, might provide interesting results as it might allow firms to understand the effect that owning a certain degree of digital competences can have on the level of social engagement that individuals might prove in a virtual team, by using digital tools. Furthermore, the results of this analysis might also allow organizations to understand whether tools that don’t require particular digital competences can provide substantial results towards employees’ social engagement, or if tools with additional feature might be preferred.

Table 23: Cross-tabulation analysis conducted between the "Level of digital skills required" feature and the "Level of Social engagement" feature

Level of digital skills required * Level of social engagement Crosstabulation

		Level of social engagement		Total
		low	intermediate-high	
Level of digital basic skills required	Count	2	14	16
	% within Level of digital skills required	12.5%	87.5%	100.0%
	% within Level of social engagement	13.3%	46.7%	35.6%
intermediate-high	Count	13	16	29
	% within Level of digital skills required	44.8%	55.2%	100.0%
	% within Level of social engagement	86.7%	53.3%	64.4%
Total	Count	15	30	45
	% within Level of digital skills required	33.3%	66.7%	100.0%
	% within Level of social engagement	100.0%	100.0%	100.0%

Therefore, table 24 shows the results of the given analysis, in particular, the most important characteristics that can be depicted are represented by the fact that within the level of social engagement, low levels of social engagement are mostly associated with those tools that require higher level of digital skills in order to be performed (86.7%), whereas higher levels of social engagement are more equally distributed among a basic level of digital skills required (46.7%) and higher levels of digital skills required (53.3%). Therefore, these results enable us to understand how it's not true that the most complex applications can mostly engage final users, but instead that simplicity might count.

These assumptions have been tested through the Pearson Chi-square test and the null hypothesis is rejected ($\chi^2=4,849$, $df=1$, $p=.028$), meaning that the two variables are related. What it is interesting to understand at this point is the degree of the relation

among the two variables, through the Kendall's tau-b. Table 25 depicts the results, showing that the two variables are substantially weakly negatively related.

Table 24: Symmetric measures referred to the cross-tabulation analysis conducted between the "Level of digital skills required" feature and the "Level of Social engagement" feature

		Value	Asymptotic Standard Error ^a	Approximate T ^b	Approximate Significance
Ordinal by Ordinal	Kendall's tau-b	-,328	,122	-2,539	,011
N of Valid Cases		45			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

Therefore, from the results collected through these analyses it could be assumed how some of the tool's characteristics that have been considered as the most important ones (tracking and scheduling features), when collecting information over applications functionality, can require, in large part, above basic levels of digital skills (intermediate or high) by end users.

From these results it could be depicted how the sample of applications considered could be accessible both by individuals who own basic digital skills and both by those that have above basic digital skills. More specifically, from the analyses carried out, it could be understood that, enterprises that are interested in adopting tools that allow for some specific functionalities (as scheduling and tracking work), could require individuals with above basic digital skills. Whereas, individuals with basic digital skills might need to attend some trainings in order to understand how to correctly use those tools. Those tools that lack of these functionalities, instead, can be easily adopted by individuals with basic levels of digital skills.

3.5 Results

The cross-tabulation analyses conducted on some of the eleven characteristics that have been taken into consideration in order to study applications' features, enables us to reach some important conclusion that can help firms, enterprises or individuals that want to adopt these applications, to choose the most suitable one, according to their needs. The information gathered on the 45 applications have been tested in order to look for important implications that some features could have in relation with the level of social engagement they might provide and the level of digital skills they might require.

In particular, the final aim of this research is to understand in detail the functionalities and characteristics that these applications can provide to end users, but also to discover whether some conditions might influence the degree of social engagement the applications can provide and the level of digital skills that are required.

For these purposes, firstly a deep analysis of the results has been carried out in order to understand the most frequent characteristics the given tools can provide to users. In this scenario it has been discovered how most of the applications that have been considered in this research allow for a certain type of communication, that is represented by asynchronous communication, through different ways of communicating such as *“through comments or mentions to activities, through specific topics discussions and through chats”*. Furthermore, we have also analysed whether applications can allow for the possibility to have a chat integration feature, that can be both a group chat or a private chat, and that could have great importance in letting members have efficient flows of communication and to engage them in topics discussion. Results have proved how in the majority of those applications this feature is already incorporated, meaning that these tools don't need further integrations. In addition to this, in order to correctly explore the degree of media richness that the 45 applications could provide, we also wanted to understand whether visual meetings and video conferencing can be performed by the tools considered, by having this feature incorporated or by having integrations. In this case, most of the applications considered

have been found to allow members to have visual meetings, having in this way a communication that could be asynchronous, but can have also some features of synchronicity, as in visual meetings.

Moreover, the features that these applications can provide have been further explored, in particular, related to the level of social presence individuals can feel while using these tools and while communicating through these tools. In particular, we have assumed that the level of social engagement provided could be consequent of the fact of having a social profile with personal information, of having the possibility to engage in private conversations and of having additional features, such as “emoji” or sharing photos and other contents that might help individuals to engage with each other. In this sense, applications have been divided among those that provide low levels of social engagement, meaning that they are more focused on processes and outcomes, being more “operational”, those application that are somehow mixed, meaning that they can be at the same time operational and provide great levels of social engagement, and the applications that are similar to social networks, that can provide great levels of social engagement. In this scenario, most of the tools that have been analysed are referring to application that allow for intermediate or high levels of social engagement.

In addition to this, we have also analysed additional features that refer to further characteristics the applications can provide. In particular, it has been looked at whether applications allow for a content sharing feature and it has been discovered that the vast majority of the digital tools taken into consideration in this research, prove to let users sharing contents while working, while fewer applications allow also for real time prototyping or editing. Furthermore, applications have been analysed on whether they allow for “scheduling” work features and “tracking” work features. In this case, for the former, applications have been discovered to let members assigning tasks to other users and having a clear sight into who is supposed to do what. Moreover, the vast majority of these applications allow users to track work updates, having dashboards, calendar synchronisation and having in this way the possibility to access to important information about deadlines and activities in the same way for all the members of a given team.

In addition to this, we wanted to discover if these tools allow for integrations with external files and applications that can be extremely important in order to run processes smoothly and to gain access to different sources of information. In this scenario, thanks

to the analysis that has been carried out in the collected data, it has been discovered how a great amount of the applications considered allow to integrate external files. Another important point that has been investigated, refers on whether the applications considered can offer to end users the possibility to have a mobile version on their tablet or phone, in order to be connected in a more flexible way and to answer or contribute to working activities whenever is possible. Results prove how most of these tools allow for a mobile version, that can enable, therefore, a greater connectivity.

Finally, we decided to assess also whether these applications require basic or above basic digital skills, depending on the level of different features that are incorporated in these tools and on the complexity that these applications can provide at a first sight. In this scenario, it has been assumed, for example, that applications that are similar to other social networks that are used daily by workers, or applications that have intuitive commands, require individuals to own basic levels of digital skills. Whereas above basic levels digital skills, have been associated with those tools that entail new technologies or additional features that require a certain level of trainings before being completely understood. In this sense, through the analysis conducted it could be considered, looking at the data, how the majority of the applications studied require individuals to own above basic digital skills, meaning that users could necessitate some trainings.

After having assessed the characteristics that these tools present, and after having considered the most frequent patterns, we wanted to understand whether some relation among the given characteristics could actually be in place. Therefore, cross-tabulation analyses have been conducted, in order to understand the substantial relation that could be in place among different characteristics and features that the applications could present.

Therefore, through the data that have been analysed, it's possible to understand where individuals or firms should focus when deciding to adopt an application that can support virtual work. In fact, starting from the first relation that have been questioned, we can understand the great importance that some types of communication have in relation with the level of social engagement they could provide. In fact, data depict how

intermediate or high levels of social engagement, that should be a factor of attractiveness for virtual teams, are mostly associated with tools that provide asynchronous or mixed types of communication (both asynchronous and synchronous). Therefore, when choosing applications, enterprises or managers that are focused in having great levels of social engagement should look for those tools that allow for asynchronous or both asynchronous and synchronous communication. Furthermore, we also questioned the relationship that the visual meeting feature can have in relation with the social engagement characteristic and also in this case, applications that provide this feature are associated with higher levels of social engagement, if compared with those applications that don't provide this feature.

Therefore, it could be understood how successful applications, that can allow users to engage among each other, even though they aren't located in the same place and they work remotely, are the one that are provided with asynchronous or mixed type of communication and with a visual meeting feature.

Moreover, another purpose of the analyses conducted was to assess the association that might be in place among some tool's characteristics, as the scheduling feature and the tracking feature, and the level of digital skills that are required.

The research question, in particular, was: Do applications that allow for tracking and scheduling features require above basic digital skills?

In order to answer to this question, additional cross tabulation analyses have been carried out. In this scenario we can discover how above basic levels of digital skills are associated with tools that allow for the scheduling feature, whereas basic levels of digital skills are mostly associated with tools that don't allow for this feature. In addition to this, the same analysis has been carried out for the tracking feature and results prove how also in this case, above basic levels of digital skills are associated with applications that provide tracking features.

Finally, we were interested in understanding the potential relation among the level of social engagement provided by the applications questioned and the level of digital skills that these applications require. In particular, it has been pointed out how the level of social engagement given by these applications is positively related with the type of

communication, and with some communication features, while the level of digital skills required has been analysed referring to tool's feature. Therefore, it's interesting to understand whether a relation could exist among the level of digital skills required and the level of social engagement provided. Results from the analysis conducted depict how there is a relation in place between these two variables, but these two variables are negatively and weakly correlated, in fact at basic levels of digital skills are mostly associated tools that offer intermediate or high levels of social engagement and at tools that require above basic levels of digital skills are mostly associated low levels of social engagement.

Therefore, from these results it could be assumed how, among the tools that provide high levels of social engagement we can find those that don't require high levels of digital skills, as they might be similar to social networks or other tools that provide similar communication features, that individuals already know how to use. Whereas tools that are more "operational", and might require higher levels of digital skills, as they might provide additional features, could be mostly related to lower levels of social engagement.

To summarise, we can theorise, from the results collected through the analyses, how enterprises could actually choose among different types of applications that can support virtual team's work. In particular, among these we can identify those that might be more communicative and that allow more communication features and higher levels of social engagement (*process-oriented*), and might not require above basic digital skills, and other applications that are more *project-oriented* and that are made for operational purposes, that are provided with additional tool's characteristics, but might not provide high levels of social engagement.

However, as the results collected don't provide perfect associations among the different variables we can't assume just this classification among the applications considered, instead, some applications might allow for both communicative purposes and operative purposes, being able to provide high level of social engagement among end users and requiring at the same time above basic levels of digital skills.

Conclusions, Limitations and Future research

Nowadays national and international companies are placed in an increasingly competitive environment as a result of a globalized and digitalized business world. Companies are evolving, adopting new technologies and new systems in order to perform their daily activities and to deliver a final value. In this scenario, also the world of work has evolved. Companies can rely, consequently from the globalization process, on a larger pool of talents (Sims, 2019), made of individuals coming from different countries that might offer new perspectives, but they can also rely on digital workers that work remotely from different places thanks to technological advancements.

In this scenario, new opportunities to manage work inside organizations might arise. In fact, ICTs might enable organizations to adopt new ways of working using digital means, boosting their flexibility, innovation and dynamism. Some of the new patterns that are enabled by ICTs adoption, for example, are represented by the adoption of enterprise social networks, that might increase employee's engagement, and by the use of remote working methodologies, that allow employees to work at great distances.

In addition to this, a further element that might be exploited by organizations is given by the adoption of Virtual teams. These types of working teams might provide several benefits to organizations, as they can be the most suitable solution for a business world that is asking firms to be flexible and adaptive to changes. Enterprises can acquire dispersed talents, leveraging on the adoption of virtual teams, as they represent cost saving alternatives, due to the fact they can avoid employees travelling around places and they can avoid relocation costs. In addition to the economic advantages, there are also further reasons that make virtual team's adoption an important alternative for enterprises. In fact, as it has been reviewed in Chapter I, these teams can fuel creativity, as they can manage to exploit different perspectives, accessing to underserved knowledge that might be provided by employees located in different countries, and might offer firms new opportunities. Furthermore, the adoption of this kind of working team might constitute the right solution for national or international firms that need to increase dynamism and flexibility and need to coordinate worldwide dispersed workforce (Jimenez et al, 2017; Gressgård, 2011).

In this dissertation, the main characteristics of virtual teams, and the related themes that could be additionally questioned, have been explored in order to provide a comprehensive overview of the field. In particular, we reviewed how virtual teams might essentially be described by the fact that members can be geographically dispersed, both in the same country or region or in completely different countries, and by the fact that they need to communicate through electronic means (Gibson & Cohen, 2003).

Managing these types of teams present additional degrees of complexity if compared with traditional teams that are adopted by organizations, as virtual teams might be composed of different people with completely different backgrounds and cultures, that might don't know each other and that are forced to relate and to communicate electronically and digitally. Thus, Human Resources inside organizations need to face some challenges when adopting these type of teams, as they need to deal with different realities given by: digital employees, digital word and digital employee management.

Therefore, HRM needs to consider not only the advantages this type of working teams might provide, but also to assess the potential drawbacks they might cause, in order to understand whether to adopt this kind of working solutions and what are the important conditions to put in place, in order to be able to foster their efficiency.

In fact, virtual teams might provide more disadvantages than advantages to organizations, if some prerequisites are not in place. Due to the complexities they might face, not every individual can be part of a Virtual team as employees in these contexts might be forced to relate with: technological means of communication, cross-cultural environments and a self-management of work. In Chapter II, some of the papers and researches conducted related to this theme have been reviewed, in order to better understand what characterizes virtual teams and what are the most important points organizations should pay attention to when attempting to put in place this working condition.

Therefore, the first contribution this thesis aims to provide, in the virtual teams related field, regards an assessment of the characteristics and competences individuals, joining virtual teams, should own, in order to help firms select the most suitable employees that might successfully perform and adapt in these types of working teams.

In this scenario, a key role that organizations should underline and stress out is related to the HRM function inside an organization. In fact, by putting in place an effective human resource management, firms can better select the ideal candidates to join virtual teams and better manage them with the adoption of the most suitable applications.

Therefore, a first step to consider is the one of correctly selecting virtual team players, in order to create a team that might face fewer difficulties in virtually developing daily activities and tasks. Through the literature review conducted in the second chapter, some of the most important characteristics the ideal candidate should own have been identified.

In particular, an ideal virtual team player should possess both individual characteristics that make him/her more willing and open to join this type of team, but also particular competences related to the technological side they need to perform in order to communicate and share data, and also to behavioural competencies, in order to correctly behave in a complex and multicultural environment.

Starting from the individual's characteristics that most suit an ideal virtual team player, individuals should first of all own positive attitudes in order to better perform in a flexible and dynamic environment, that is the one represented by dispersed virtual teams. In fact, individual positive predisposition to share and individual openness to communication and to new experiences are key characteristics that can positively influence individuals and processes in virtual teams (Zakaria, Amelinckx, Wileman 2014; Henttonen and Blomqvist 2005). As it has been pointed out, these teams are collocated in a complex environment, made of different individuals that might be completely distant among each other and might not have a common history together. Therefore, if individuals own positive attitudes, are enthusiastic and proactive and are ready and open to experience, communication might certainly benefit, and consequently, also trust establishment and virtual team efficiency (Jarvenpaa and Leidner, 1999). What is more, individuals can better perform in these teams if they are able to correctly organize and self-manage, due to the fact that work might be carried out at long distances and might require individual contributions without having a constant support, as they need to self-manage their tasks and their work in order to respect group's deadlines (Krum, Kanthak, Hartmann & Hertel, 2016). In addition to this, also owning a correct degree of

emotional intelligence might further benefit virtual teams, as in those teams where is present, cohesiveness among participants can be enhanced (Barczak, Lassk and Mulki, 2010).

Besides the individual's behaviours an ideal virtual team player should own, organizations should also assess whether the selected employees own a certain degree of skills, in order to perform in virtual teams. In this scenario, the most important competences a virtual individual should own are related to: digital competences and cross-cultural competences (Zakaria, Amelinck and Wileman, 2004; Schulze and Krumm, 2017; Leung and Wang, 2015). In particular, the former refers to those competences related to the knowledge and the correct assessment of the tools that can support virtual team's work. Individuals need to have some digital competences, or Individual virtual competences (Leung and Wang, 2015), as these types of working teams rely entirely on communicating and working through digital means. What is more, individuals should also be aware of the given functionalities and characteristics of further tools in order to correctly adopt the most suitable solution among those in the marketplace. Instead, as for cross-cultural competences, the ideal virtual team player should know how to relate and behave in a context where participants might come from different countries and different cultures. Therefore, we believe that it is important that the selected virtual team players know what are the substantial differences that might exist among some cultures, for example, relating to the Hofstede or Hall dimensions, and what behaviours they should adopt in order to successfully collaborate.

These considerations can additionally stress the key role of HRM in understanding what should be the more suitable candidates to join a Virtual team and whether some individuals can perform in this type of working team. In fact, before analysing which type of application can better sustain virtual work and the role of ICTs in letting members efficiently perform the working activities, it is important to underline that not every individual can join this type of team. In fact, owning a certain level of competence and owning certain characteristics can better enhance team's performance. Therefore, in order to put in place the most suitable conditions that might enhance virtual team's efficiency and effectiveness, enterprises should carefully select the participants, and in

the case the required competences are lacking, should put in place some useful training session.

A further point this thesis aims at analysing refers to attempt to understand the key role ICTs and applications that can support virtual team work might have in providing the right conditions that can enhance firm's performance. In particular, we decided to carry out a qualitative study on some of the most important applications that are currently in the marketplace in order to understand the characteristics and features they can provide to organizations that decide to adopt them. Following the results of the literature review conducted in Chapter II, some important characteristics can be depicted as the ones these tools need to assume in order to provide an instrument that better fosters virtual team's efficiency. In particular, we focused on investigating the type and way of communication these tools might provide, as communication assumes a key role in virtual teams and it's the means through which information and knowledge is shared in order to provide the final value. Furthermore, we questioned applications on the degree they allow for a chat integration feature and a visual meeting feature, but also on others tool's characteristics such as the tracking feature, the scheduling feature, the content sharing feature and the mobile app feature. In addition to this, we were also interested in understanding the level of social engagement different application can provide and the level of digital skills they require. The results collected through the matrix of virtual teams' applications characteristics can provide interesting insights into the features these tools can provide.

In particular, data collected depict how the majority of the applications considered enable participants to have mostly asynchronous communication, that happens *"through comments or mentions to activities, through specific topics discussions and through chats"*. What is more, the majority of the tools demonstrate to have already a chat feature integrated and also permit members to have visual meetings and conferences. In addition to this, the majority of the applications considered, given these characteristics, provide end users with an intermediate or high level of social engagement. Regarding the tool's functionalities, instead, most of the applications enable participants to *"share messages and files"*, but also provide users with the possibility of *"assigning tasks and tracking activities, having dashboards, gantt chats and*

calendar synchronisation” and enable users to *“integrate external files or apps”*. Additionally, the majority of the applications considered present the possibility of connecting and working also through mobile devices, thanks to a mobile app version, and require users to have an intermediate/high level of digital skills, meaning that these tools have some functionalities that might be different from the one offered by other applications used daily by employees, or they might entail new technologies.

Therefore, through the collection of these information, it is possible to have an insight into the characteristics most of the tools that support virtual teams might entail. Moreover, through a subsequent codification, some analyses have been carried out that can lead to interesting results.

In particular, the cross-tabulation analyses conducted, reveal how there is a positive relation between some media richness features, as the way of communicating and the visual meeting feature, and the overall level of social engagement, but also that a positive relation is in place between some tools feature, such as the tracking feature and the scheduling feature and the level of digital skills required. These results give an interesting insight into the functionalities that different tools might provide, in fact, depending on the purposes that organizations and HRM have, towards virtual teams, they might prefer to foster high level of social engagement in virtual teams, therefore looking for those applications that allow for a mixed type of communication (both synchronous and asynchronous), and that provide a visual meeting feature, or they could be interested in assessing which application requires higher level of digital skills (mostly associated with the presence of the tracking and the scheduling feature). But also, they could assess whether a given tool that allow for intermediate or high level of social engagement, requires certain levels of digital skills.

Therefore, through the analyses conducted some interesting results have been collected that can be an important roadmap for organizations or HRM that want to understand what type of application, currently in the marketplace, could better suit their needs, if more *project-oriented*, *process-oriented* or *both*. In addition to this, the survey conducted on the 45 applications that can support virtual team’s work can provide to organizations an insight on what are the main characteristics of the different types of

tools might entail, but also, it might provide a useful insight on the given capabilities and competences a chosen tool requires.

To conclude, the studies carried out in this dissertation enable us to answer to the initial research questions on the importance of HRM and of ICTs in the virtual context to enhance firm performance. In this scenario, we can understand how HRM has an important role in selecting and correctly managing the ideal virtual team players, but also in choosing the most suitable applications that can support this type of work.

Information collected through the literature review can provide us a sort of identikit of the ideal virtual player, whereas the research conducted on the applications can provide an insight into the instruments currently available, their characteristics, functionalities and possible advantages they might provide.

Therefore, the importance that is given both to ICTs and HRM could be understood, as the former identifies the technologies of which these applications are made and that can efficiently support virtual teams, and the latter enables the correct assessment and selection of the participants and the choice of the most suitable application. Both these two functions are essential, as they help to constitute and correctly manage virtual teams that can represent an important way of organizing work at long distance and that can provide to organizations that decide to adopt them, important benefits, helping to achieve a superior performance.

Limitations of the research

The analysis conducted on the 45 applications that can sustain virtual and remote work has provided important results that can be considered by managers and organizations when choosing applications that can best support their virtual teams. However, this study has its limitations.

Starting from the sample considered, we analysed 45 applications that are present in the marketplace, trying to explore the different features and the different technologies these tools might provide. Even though some important results can be acknowledged, that can allow organizations and individuals to have important insights into the field, the sample considered is limited. In fact, new applications are always popping out as well as advancements in the technological field can let new applications to rise. Therefore, it should be considered that the tools that have been analysed in this study, even though we tried to consider a broader range of applications and technologies possible, are not comprehensive of all the applications that are in the marketplace.

What is more, when we identified the 45 applications to focus we relied on to the most commonly used among firms and individuals that work remotely, but these results might be biased considering the fact that application's preference might also vary depending on the country of reference (to cite an example, while in Italy is commonly used WhatsApp as instant messaging application, in China it's more adopted WeChat), therefore some additional cultural studies should be carried out.

In addition to this, the classification that has been carried out in order to compute relations among the different variables, follows a codification that relies both on the results provided by the literature reviewed, but also on some assumptions that have been made for the purpose of this study. For example, the variable "level of digital skills required" have been coded with 0, if individuals require basic level of digital skills in order to correctly use a given application, or 1 if they require additional training in order to understand all the functionalities, therefore the tool requires above basic digital skills. In this scenario, we have considered those tools that require basic digital skills as the ones that are similar to other applications that are used daily by individuals (for example

social networks) and therefore don't ask for additional training. But we haven't considered the fact that not every individual in every country might have access to the same types of applications, therefore the level of digital skills required might be more difficult to establish when virtual teams are highly heterogeneous.

Future research

Although the study conducted might present some limitations, the results depicted in the previous sections might provide an interesting overview of the current applications that are present in the marketplace, that can be used by managers or by organizations when deciding which tools to adopt and what tool might provide the right characteristics they are looking for.

In this scenario, given the fact this research considers 45 applications, ranging from process-oriented tools or project-oriented ones, to tools that might serve both purposes, or tools that can apply new technologies, it might be interesting to further develop this analysis including a larger sample of tools and instruments that are present in the marketplace, or that can be further developed in the following years. Therefore, this research field, given its continuous evolution, should be further addressed in order to understand whether the same patterns might be found in the new applications and if the conclusion of this research could be further confirmed.

Thus, by considering a larger sample, made of new and already existing instrument, the result of this research could be taken as a basis in order to further develop a more comprehensive analysis in order to provide a sort of guide of the applications that can support virtual teams and remote work.

What is more, as previously underlined, some limitations of this study are given by the fact that the choice of the applications considered, and the characteristics studied might not consider the different shapes that could be given by the cultural of origin of different individuals. In fact, some individuals might have different preferences depending on the country and culture they might be placed in. Therefore, it would be interesting to further expand the research field doing an analysis on what are the current preferences of

individuals, that work remotely and that are globally dispersed, and it would be also interesting to make a comparison of the adoption of these applications in different countries. In this way, some interesting conclusions can be reached and can complete the study carried out in this thesis.

What is more, future research in the field, might also expand the characteristics that have been considered in analysing the sample of applications that support virtual team's work. In fact, we decided to focus on the eleven characteristics mentioned as we have noticed, through the review of the literature and the review of the applications, that are some of the most important ones to depict. Even through this classification can provide interesting results that enable us to understand what are the characteristics of the applications that individuals and virtual groups might use nowadays in order to collaborate, some further characteristics might be questioned in order to provide a broader scenario of these applications.

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