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IT'S ABOUT PEOPLE 2023: SOCIAL AND TECHNOLOGICAL DEVELOPMENT IN SERVICE OF SECURITY AND DIGNITY

The 11th Annual Conference of Europe's Sciences and Arts Leaders and Scholars

Proceedings book on scholarly papers
MANAGEMENT AND DIGITAL TECHNOLOGIES

Editors: Mladen Radujković, Matej Mertik

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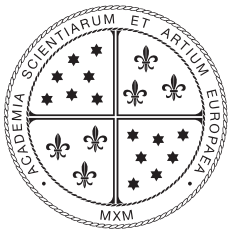

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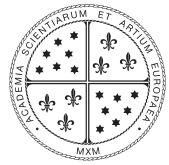

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PROJECT MANAGEMENT

COMMUNICATION SCREEN SHOT IN PROJECTS OF MULTICULTURAL DIVERSITY

Walid SS. Nassar, PhD Candidate
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ABSTRACT

Organizations are turning their projects towards multicultural environment, which adds value to these projects. On the other hand, this diversity may push the project towards the abyss as well. In this essay, I will try to collect the pros and cons of working in a multicultural environment and provide a literature review of the hottest managerial topics related to multiculturalism and diversity through the teamwork, with an intensive focus on the communication tool between management and teams, following its impact on projects and organizations, whether negatively or positively. Then I will provide a roadmap for each manager working in an organization that contains multicultural team projects, to take advantage of this diversity and twist it to an opportunity that can be developed through the evolution of the project towards more success. The competence of project managers in managing communication in a multicultural work environment depends on a set of knowledge skills and tools, the most prominent of which are related to communication in such a situation will be addressed in a progressive and coherent manner.

***Keywords**: communication, multicultural diversity, multicultural team projects, project management*

1. BACKGROUND: PROJECT MANAGEMENT IN MULTICULTURAL ENVIRONMENT

Have you ever thought about the nationalities of the gadgets in your office? Look well, they are multinational, your computer in front of you or your mobile phone, several global teams have produced and delivered it to your desk or hand in the form and efficiency you usually aspire to.

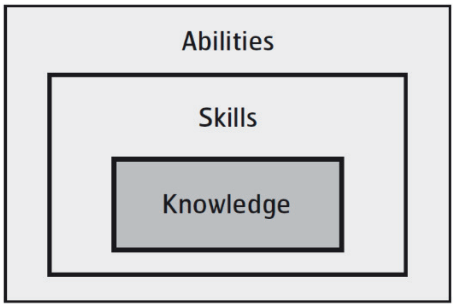
The environments in which multicultural management occurs have grown more complicated . Now, rather than having a single foreign manager act as the international shield for an entire department or even company, employees must deal with global virtual communication, data exchange in shared server environments, or collaboration in multinational and divided up teams. (Romani et al. 2018)

At the beginning of writing this essay, I asked myself several questions: Why are cultural differences important to a project manager? What administrative classifications intersect with multiculturalism? How might project leadership be able to address the cultural differences of teams working on multicultural projects? How they communicate with less conflicts?

Due to the fact that business relationships are ultimately instances of cultural interaction, the future of global business depends on people's capacity to deal with diversity in an honest and transparent manner (Dumbravă 2018).

It is necessary to delve into the managerial competence associated with multicultural projects in which include the "skills and the knowledge needed, together with abilities" (IPMA 2015, 15) to understand the value that this human diversity adds to the project, and to avoid the negatives that may be caused by a decline in the performance of culturally different teams and thus the decline in the opportunities of success for the project as a whole, see figure 1:

Figure 1: individual competence component



Source: IPMA 2015.

In addition to managing time, money, and quality, a project manager is also in charge of managing integration, scope, human resources, communication, risk, and procurement (Radujković and Sjekavica 2017).

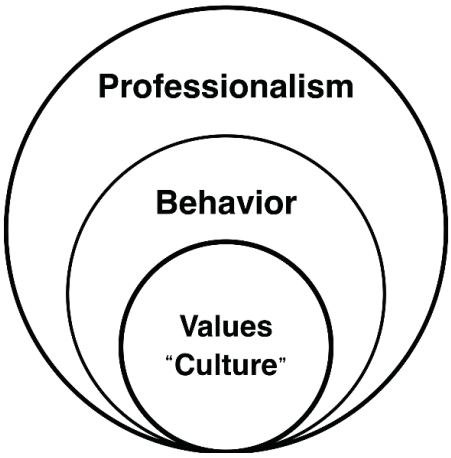
Among the most prominent management activities associated with multicultural projects are communication, evaluation, leadership, decision-making and trust between the team and project stakeholders (Meyer 2016).

Communication is defined by many authors as the exchange of information between recipient and sender by which a message is directed from a point to another point and the communicators are associated all together through communication channels and it is the process by which information is exchanged and understood by two or more people, usually with the intent to influence or motivate behavior .

In this essay I will focus on Multicultural communication which is defined as the exchange of information between individuals with various cultural backgrounds, studying intercultural communication is important to create increased self-awareness (Martin and Nakayama 2010).

Communication is one of the most important activities that shorten the deep scene between the individual personality with its "cultural" values, passing through the individual behavior covered by professionalism (Hofstede et al. 2005), as shown in the figure 2, and when individuals are intertwined in many collective work, the scene becomes more complex.

Figure 2: individual "cultural" values, behavior and professionalism



Source: self – design based on Hofstede et al. 2005.

In order to understand communicative activity in a multicultural environment, it is necessary first to identify the advantages and disadvantages of the any Multicultural workplace, this understanding turns into keys of communication that connect the team of the project (Zita 2020).

2. THE PROS AND CONS OF A MULTICULTURAL PROJECT

The pros and cons of a multicultural project environment can be summed up as they are in the following table from different angles upon to (Gambardella 2021).

Table 1: pros and cons of a multicultural project environment

Disadvantages of Multiculturalism	Advantages of Multiculturalism
COMMUNICATION PROBLEMS In a workplace with a diverse workforce, communication barriers can be the most challenging to overcome. This is caused, for instance, by some team members' limited proficiency in the language spoken most frequently or by the manner in which they communicate in their home nation. **DIFFERENT WORK CULTURES** Indeed, while certain cultures are adapted to hierarchical hierarchies, others are fine with flat organizational systems. A behavior that is perceived as respectful in one culture could not be in another. For instance, team members from hierarchical cultures anticipate varying treatment depending on their position within the company. Workers from egalitarian cultures don't, on the other hand. If some members don't live up to those expectations, they risk being humiliated or losing respect and credibility. **DECISION-MAKING CONFLICTS** Working on a multicultural team also means dealing with differences in decision-making processes and how much forethought is required of teammates. Conflicts arise when some of them act quickly versus slowly or analytically versus instinctively. Someone who enjoys making decisions quickly might become frustrated with those who require more time. For instance, when compared to managers in other nations, American managers are known to prefer making decisions quickly and with little thought. Asian managers, on the other hand, invest more time in analysis.	**PRODUCTIVITY** Different cultural perspectives and backgrounds can inspire creativity and productivity. Every team member brings a unique set of experiences and perspectives, which can enhance the range of services and goods that a company can provide to the wider public. An organization with a global workforce can be more considerate of audiences in other countries by creating, for example, targeted marketing campaigns and materials that meet their needs. **IMPROVE OF CREATIVITY** If someone is only exposed to people from, say, Asia, South America, and Europe, there is a good possibility that the flow of ideas will be unrestricted. Along with sharing their own experiences, colleagues will also instruct others on what is effective in their setting and vice versa. **IMPROVE OF PROBLEM-SOLVING SKILLS** International employees contribute their personal histories and experiences to the team. Due to this, when a solution is required, they are able to think of concepts that a group with a single culture mindset would never have considered. Additionally, teammates are exposed to various points of view and are given the opportunity to learn how to think creatively, which improves their soft skills.

NEGATIVE CULTURAL STEREOTYPES AND PREJUDICES Unconscious cultural beliefs and stereotypes eventually result from interactions between individuals from different countries. They can be particularly challenging to overcome if they make some team members less motivated to collaborate. Negative cultural stereotypes can have a significant negative impact on employee and productivity. **INCREASING OF STRESS AND DIVERGING OF OPINION** There may be too many opinions at work, which can lead to conflicts and added stress. As a result of poorer social integration within the team and a potential slowdown in project speed, complaints do indeed frequently increase when working in a multicultural team.	**PERSONAL GROWTH AND FLEXIBILITY** Being a part of a global team is similar to going to an exchange program every day at work. Members of a multicultural team are exposed to different cultures while working together, and this can easily affect how they think and how they behave. Setting aside expectations and prejudices is necessary for adjusting to new circumstances and challenges. A person can initiate deep personal growth in this way, becoming more adaptable, tolerant, and dedicated to cooperation. They can also develop a more open mind. **THINKING QUICKLY** Being aware of the rules is the best way to increase group agility. Particularly in multicultural teams, where members will be more effective, spontaneous, and quick thinkers the sooner they begin to feel comfortable.

Source: Gambardella 2021.

3. COMMUNICATION WITHIN MULTICULTURAL TEAMS

56 % of your project budget might be at risk due to poor communication (PMI 2013), therefore communication skills within a multicultural workplace or project necessarily need a conscious management of the context range and dimensions of multiculturalism, and how they can transform this diversity into an added value to the project, this can be achieved through conscious communication messages, able to combine the emerging differences in multicultural projects (Bogoeva 2020).

I have an interesting story about miscommunication. After one session that was discussing "radiofrequencies remotely linking" in California 2014, I visited the representatives of the corporate that was liable for the session, to ask about some details, during my conversation with the US man in his forties who was the team manager, I asked him about the difference in electrical environments from one country to a different, and whether his product is compatible with countries which have unstable electrical current, he asked me why this instability happens in some countries? I told him: **Your fingers don't seem to be like mine** (I used my left hand to precise my body language), he surprised me with his response when he asked me: do you mean that you are married? Immediately i noticed that he checked out the ring with my left hand and failed to understand what I meant, actually I meant that individuals are different from one to another, countries are likewise. He took my sentence literally and recognized that I'm a married man. This phrase is commonly utilized by the people of the Middle East to precise attitudes of differences, they assert "**your fingers aren't like mine**". The US man and I totally misunderstood each other.

4. LOW CONTEXT AND HIGH CONTEXT OF COMMUNICATION

Erin Meyer (2016) defined a measure of communication within the project community and made it at two opposite levels, the first he called: low context and the second he called: high context, see figure 3.

Figure 3: low context and high context of communication

Source: Meyer 2016.

Typically, cultures cannot be categorized strictly into high or low context. The majority of civilizations fall somewhere in the middle of the range and can, to varied degrees, exhibit both high context and low context qualities (SHINNERS 2017).

The question of whether a culture has high context or low context can be complicated, yet it can influence many other facets of that culture. For instance, similarity is a key attribute in high-context cultures. This is because people in high context cultures tend to share similar educational levels, as well as a common race, religion, and history (Meyer 2016).

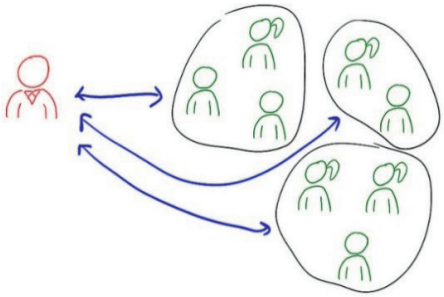
By presuming that the audience will think similarly to the speaker or writer and understand the underlying message latent in their speech or writing, communication can be contextualized through these shared experiences (Alizadeh Afrouzi 2021).

The opposite is accurate in low-context cultures. They typically focus on the person rather than the group and are diverse (Meyer 2016). Communication in a low-context culture must be simple enough for the greatest number of individuals to grasp it because there are so many disparities between people there (Alizadeh Afrouzi 2021).

Scaling communication from low to high, it takes the communication context into account. Low context communicators convey their messages using simple, direct language (Bansal 2021). Background information, past experiences, body language, speech tonality, etc. are largely irrelevant (Lifintsev, and Wellbrock 2019). Say what you think and think what you say with clear, precise terminology, as opposed to high context communication, where the meaning is inferred from the context and what is said is not necessarily as important as what is meant. The two communicators must share a basic knowledge in order to observe the subtleties (Meyer 2016) .

A good comparison would be between a long-married couple who complete each other's sentences and a pair of strangers who can only communicate through language (SHINNERS 2017).

Figure 4: Knowledge sharing



Source: Minnesota 2016.

Reverting to the mentioned story with the US man, I was very "high context", and he was very "low context" while we had our conversation.

5. DEEP IN PROJECT MANAGEMENT COMMUNICATION THROUGH THE DIMENSIONS OF CULTURE

In a recent study was based on a large survey of more than 1100 project managers in 7 countries, Zwikael et al. (2021) discovered that performance-oriented organizations place a greater emphasis on project communication management. Communication is essential since information exchange is a key driver of project performance. They emphasized that communication in a project not only encourages various sorts of information gathering and exchanging, but it also lowers problems caused by misunderstanding and information imbalance.

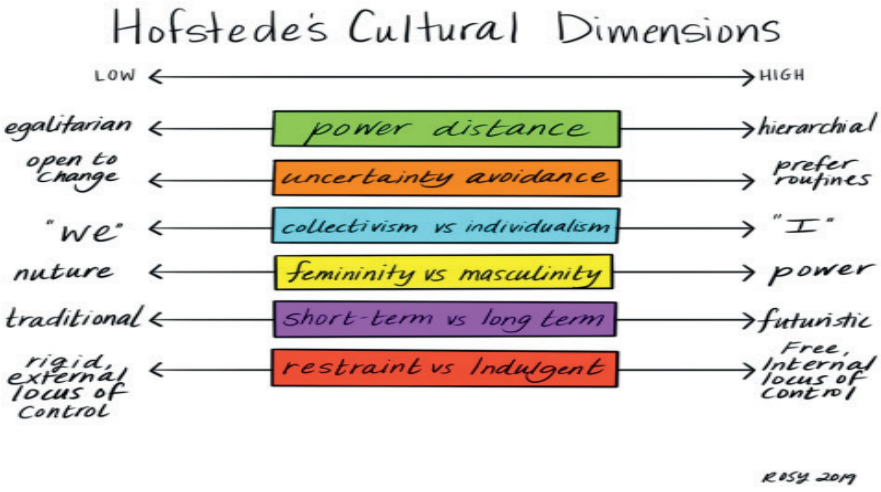
Collaboration with people from many cultures is essential for effective global business strategies. As a result, the challenge for business is to create ways for people who think differently to collaborate in a positive way (Andersen 2016). As a result, it is critical for the organizations to be aware of these differences and to have measures in place to deal with any multicultural communication challenges that may occur.

The main questions in this essay are what are these knowledge and skills that project managers must have to communicate effectively within a multicultural teamwork in order to obtain the advantages of diversity in such an environment? And how he / she can improve his / her knowledge and skills?

Both effective communication methods and communication message can assist leaders in anticipating and responding to possible crises that threaten, disrupt, or imperil a business and the stakeholders it serves (Fortunato et al. 2017). In order to act better in a project of cultural diversity, the project management administrations and teams have to have an enough knowledge of which this diversity can shape the dimensions of the culture embedded in the Organisation (Hofstede et al. 2005).

These dimensions of cultural are summed up briefly in a recent essay for (Kobiruzzaman 2021) based on - Hofstede's 6 Cultural Dimensions theory as shown in figure 4.

Figure 4: Hofstede's 6 Cultural Dimensions theory



Source: Maryland 2019.

Kobiruzzaman (2021) explains that:

1. Power Distance Index (PDI):
   A team's acceptance of an unequal, hierarchical distribution of power is indicated by a high PDI score. Low PDI scores indicate that power is shared and that team members do not accept situations in which power is not distributed fairly.
2. Uncertainty Avoidance Index (UAI)
   People who have a high Uncertainty Avoidance score try to make life as predictable and manageable as they can. People in nations with low UAI scores tend to be more relaxed, inclusive, or open.
3. Individualism Vs Collectivism:
   In places with a high Individualism score, people bear less responsibility for the decisions and actions of others. People are expected to be loyal to the group they belong to, in collectivist teams.
4. Masculinity Vs Femininity:
   Men are expected to act assertively in communities where gender roles are less overlapping. However, there is a lot of crossover between male and female duties in feminine societies, and modesty is viewed as a virtue.
5. Long Vs Short Term Orientation
   Long-term oriented nations typically have a pragmatic, modest, and more self-sufficient outlook. People in short-term oriented nations are typically religious and nationalistic and tend to place more value on principles, consistency, and truth.

6. Indulgence Vs Restraint (IVR):
   High scoring „IVR" nations support relatively unrestricted satisfaction of an individual's inner desires and feelings. People's behavior is more strictly regulated and social norms are more rigid in a nation with a low „IVR" score.

I believe that any project manager who moderates a multicultural team has to understand these six cultural dimensions, in order to create a personal and organizational strategy to communicate with the team, which makes the working atmosphere more suitable for the nature of the team, the project and the organization itself, to takes advantage of the high value of diversity that exists in such circumstances in order to achieve a sufficient level of less conflicts and more efficiency and success.

6. UNDERSTANDING THE PROJECT MANAGER ROLE IN COMMUNICATION

The many task operators in the various activity must be kept up to date on all activities, progress reports, issues, solutions, and other pertinent information. All of them come together thanks to communication, which also enables various units to coordinate their efforts, enable the necessary growth, a communication strategy is needed (Zita 2020).

A project manager is impacted by both his or her own country culture and the multicultural context in which he or she has grown up. His or her individual attitudes and prejudices affect how diversely he or she manages and have a significant impact on how well the team manages cultural diversity (Bogoeva 2020). This is frequently best expressed in how decisions are made at various phases of project management, in how tasks are coordinated, in leadership and authority, as well as in time management, project communication, and project risk.(Alexandrova 2018).

The management style of a project manager in a multicultural setting is distinguished by a higher degree of adaptability, prompt problem-solving, open communication, the pursuit of consensus and compromise, as well as an effort to prevent or lessen confrontation (Bogoeva 2020). One of the variables that, despite bringing value to the projects, may persuade as one of the finest obstacles in the practice of project management in a multicultural setting is cultural diversity (PMI 2021).

Due to the evolution of the global business environment, the introduction of new technologies, and the diversity of cultures, project management has required the fusion of a wide range of talents and individuals. The project manager is in charge of those elements, and it is his or her job to utilize all environmental influences, including cultural variances (Bogoeva 2020). When the development of a strong, inclusive culture and values is promoted, when the project participants are not only participating, but also empowered, which leads to more effective teams and greater performance, there is a strong multicultural team (Alexandrova 2018).

With reference to the abovementioned, a significant step was taken for organizations in terms of project implementation in a global, multicultural setting. And today more than ever, there is a need for a wider and more varied collection of tools, competencies, abilities, and strategies in our unpredictable, contentious, and constantly changing environment (Alexandrova 2018; Fortunato et al. 2017; Kim 2017; Meye, 2016; PMI 2021).

To achieve this, "communication" must be the greatest common denominator of all these knowledge that a successful manager needs in a multicultural project, in the near future, having effective multicultural communication skills will be more and more crucial (Lifintsev and Wellbrock 2019).

There has to be a method that communication are managed in a multicultural organization, what is the mindset in which helps project managers do that in Practical and scalable way?

The fundamental components of effective communication are described by personal communication. Both the message and the medium must be understandable and suitable for the intended audience (IPMA 2015, 76) These components are divided into two levels as listed below in figure 5.

Figure 5: fundamental components of effective communication

A. Fundamental Knowledge related to communication:

Different communication techniques, questioning strategies, feedback guidelines, facilitation techniques, presentation strategies, communication channels and styles, rhetoric, body language attributes, communication technologies.

B. Fundamental Skills and abilities related to communication

To communicate effectively, use a variety of communication techniques; Effective use of body language; active listening; questioning techniques; empathy; presentation and moderation techniques.

Source: IPMA 2015.

7. COMMUNICATION MANAGEMENT IN MULTICULTURAL ENVIRONMENT

Project communication management, at its most basic level, makes ensuring that important information is effectively and purposefully shared among many parties involved in (or influenced by) a project (PMI 2013). Different people use information differently (remember my short story with the US manager), and some people may only need to be aware of it rather than acting in a certain way as a result. The success of a project depends on establishing a plan for information sharing throughout the project's lifecycle (Harrin 2021).

One of the most important lessons learned is that project communication management needs to happen at every early stage of a project's lifecycle, especially when a transition takes place, this can be clearly noticed we understand that the project communication management is a project by itself upon to Harrin (2021), she emphasized that competent project managers must realize the lesson that communication management happens in a well-defined and repeatable cycle as indicated in the figure 6, managers often communicate in one way or another in a cycle of (Plan communication, deliver communication, monitor responses and then learn and adapt).

Figure 6: Project communication process (Plan, deliver, monitor and learn)

Source: Harrin 2021.

I really like this way of thinking, but there is a central question on my mind: What culture must project managers have in order to run a multicultural project?

7.1 Communication culture

Effective communication is crucial to project management because it links together the various stakeholders that are participating in a project and who have varied cultural and organizational backgrounds, degrees of knowledge, perspectives, and interests in how the project is carried out (Zita 2020).

Up until the goal is accomplished, communication is a process that includes numerous additional steps and actions. It's crucial to remember that communication's main goal is to transfer information from a source to a receiver (Llopis-Lorente et al. 2017). The source needs to deliver information to a certain recipient, who may or may not be expecting it. The contact between practitioners at various levels needs to be changed in order to improve the communication culture (Zita 2020).

7.2 Communicate in person or virtually? Or something else?

It is crucial to emphasize that internal communication shouldn't be viewed as a task that is begun at a specific time, completed, and then abandoned. Internal communication is a continuous process that has no beginning or end; this illustrates the complex relationship between internal communication and organizational performance (Ali et al. 2021).

Despite the technological development in the means of communication, face-to-face communication remains one of the most important administrative communication tools because of its emotional and mental dimensions that carry messages and deliver them to the opposite person with the least potential for misunderstanding, considering the culture to which the corresponding person belongs. This claim meets the numbers of a recent report in which was published by (Gallagher 2022) that face to-face communication channels are still considered the most impactful, with more than 90% of respondents rating most of these as 'very' or 'quite' effective, see table 2.

Table 2: Face to face communication effectiveness

	Use	Effectiveness
Team meetings run by people managers	82%	89%
Face-to-face or virtual conferences / Roadshows / Town halls (all employees)	76%	94%
One-to-ones run by people managers	66%	92%
Face-to-face or virtual conferences / Roadshows / Town halls (senior leaders and/or people managers only)	60%	92%
Informal get-togethers and social events (In person or virtual)	57%	91%
Web calls / Conference calls (all employees)	52%	90%
Web calls / Conference calls (senior leaders and/or people managers only)	49%	90%
Knowledge-sharing / Lunch and learn / Brown bag sessions	46%	85%
Employee or staff forum / Work councils	35%	78%
Ambassadors / Communications champions	31%	77%

Source: Gallagher 2022.

On the other hand, managers can use many virtual tools to communicate, such as Text messaging, Instant messaging, Video chat, Voice over internet protocol (VoIP), social media, Email and / or Web conferencing. Upon to (Gallagher 2022), the effectiveness of these channels are generally less than the face – to – face channels but still effective, see table 3.

Table 3: Digital communication tools effectiveness

	Use	Effectiveness
Email announcements	94%	78%
Intranet	83%	60%
Employee portal(s) e.g. for benefits, wellbeing, learning and development	77%	75%
Enterprise chat tools (Microsoft Teams, Cisco Jabber, etc.)	72%	91%
E-newsletters	64%	64%
Enterprise social networks (Workplace from Meta, Yammer, etc.)	39%	59%
Mobile app(s)	31%	70%
Online peer-to-peer recognition platforms	30%	68%
Messaging apps (text, WhatsApp, etc.)	24%	87%
Artificial Intelligence (AI) e.g. chatbots, etc.	10%	52%
Extranet	8%	62%

Source: Gallagher 2022.

We can conclude from the above, that communication using digital means (tools) are effective which save time and effort, in the meanwhile it cannot match face-to-face communication, so the use of hybrid communication means, especially in a multicultural work environment, may be a way to increase productivity and reduce conflicts in the organization.

8. COMMUNICATION SKILLS (COMMUNICATE AS A MANAGER)

The core of everything you do as a manager is communication. Managers communicate for up to 80 % of their working hours (Mazor 2017). You interact with people all day long by talking, listening, presenting, and exchanging knowledge. You will understand your team's needs more and be a more effective manager if you are good at sharing ideas and communicating as a manager (OSU 2022). Table 4 shows 7 communication skills that every manager needs to have specially when acting in a multicultural environment.

Table 4: shows 7 communication skills every manager needs

Be a positive communicator	▪ Discourage complaining and negativity among the employees. ▪ Make personal connections with employees ▪ Be positive in the nonverbal ways you communicate. ▪ Be aware of the messages you send with body language, tone of voice and eye contact. ▪ Create an atmosphere of open communication.
Be a careful communicator	▪ If you don't know the answer to a question, be honest and say so. ▪ Speak simply, clearly and avoid jargon. ▪ Explain your decisions as much as possible. ▪ Never communicate when you are angry or feeling highly emotional. ▪ Don't make promises you can't keep. ▪ Apologize. ▪ Keep people informed.
Actively listen	▪ Practice active listening and make it a habit. ▪ Paraphrase what the other person said using your own words to be sure you understood. ▪ Be curious and ask people what they think. ▪ Listen for the meaning behind the words and make sure you watch the non-verbal's as well.
Meet regularly with each of your direct reports	▪ Take the time to explain and review goals. ▪ Listen and ask questions at your meetings with employees. ▪ Coach your employees to help them reach their full potential.
Powerful Questions - Be Curious	▪ What is your vision for this? ▪ Would you say more about that? ▪ What have you already tried? ▪ What has worked well for you in the past? ▪ Tell me what happened next. ▪ What should be the results? What steps have you taken to get to the results? ▪ What small steps can you take to get you closer to your vision? ▪ What needs to happen next? What needs to happen differently? ▪ How much energy are you willing to put into that?
Give and ask for frequent feedback	▪ Provide specific appreciative feedback on a regular basis. ▪ Provide opportunities for employees to share ideas and concerns. ▪ Ask for feedback from employees. ▪ Follow through both in answering questions and responding to feedback.
Effective Ways to Handle Conflict	▪ Take conflict seriously. ▪ Where there is a conflict, face it directly and promptly. ▪ Help employees understand that resolving conflict requires give and take from everyone.

Source: OSU 2022.

9. DISCUSSION

It is clear that the idea of a management in multicultural environment has been subjected to many scientific discussions, including those who supported dealing with the multicultural reality, and tried to lay the foundations and theories for it as Hofstede and Fink (2007) did, after that they began framing the transactions through understanding the form and content that result from the multiple cultures in an organization as in Hofstede's 6 Cultural Dimensions theory and its development until 2020.

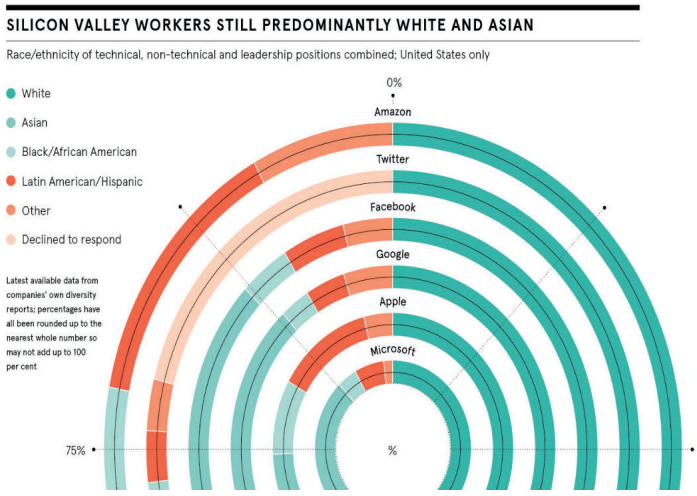
The future of global business depends on people's ability to deal with diversity in an honest and transparent way because business relationships are ultimately instances of cultural interaction (Dumbravă 2018). This balance entails being conscious of one's cultural identity in relation to diversity as a whole, since "It is only when you start to identify what is typical in your culture, but different from others, that you can begin to open a dialogue of sharing, learning, and ultimately understanding" (Meyer 2016, 203). On the other hand, some scholars have tried to interpret their ideas related to multiculturalism based on the results of economic projects, and the extent of profit or loss achieved by an organization, whether it is multicultural or monocultural, and their fears cannot be denied, since a multicultural environment is difficult to manage in a purely local way. This was expressed by Schommer et al. (2019), by highlighting the negatives that may reflected in the projects in which a multicultural teams work together. In the recent study of Schommer et al. (2019), several correlation coefficients emerged that showed a negative relationship between culturally

diverse work teams and the desired results of the work and warned all organizations and managers against taking the step of entering into projects of diverse cultures before seriously considering its dimensions and setting a prior strategy to deal with the caveats. They concluded that this needs time before any desired change.

Despite my understanding of the warnings issued by some scholars regarding the cultural diversity of the work team in an organization or a project, I tend to the idea of considering diversity as an opportunity for development as (Bansal 2021; Bogoeva 2020; Hofstede & Fin, 2007; SHINNERS 2017; Zita 2020) argued, cultural diversity may be a qualitative addition to the project or organization, if there is a strategy in the institution to deal with this diversity, through prior understanding and analysis of the basics of cultural diversity that I have briefly introduced throughout this essay.

Do you remember I invited you to look at the computer in front of you in the office, or your mobile phone in your hand? My invitation was not free, and it took me a one month to write this essay, but the good news is that I got a statistic in the figure 8 below that may make you rethink the topic of diversity, and may change your prejudices in judging others, this is one of the fundamentals that made the giants of Silicon Valley believe in multiculturalism and they take advantage of it to the extent that you can now close this essay with one **click** on a button, someone in the world may have made button for you, you both speak a different languages and live in a completely different place of culture, but finally you communicate each other, albeit indirectly.

Figure 8: Race/ ethnical, non-technical leadership positions combined in USA only (Silicon Valley)



Source: Barton 2019.

This notable success in managing cultural difference and diversity in the work teams of giant hi-tech companies, makes me more inclined to the opinions of scholars who see cultural difference as an opportunity to increase creativity in understanding the other, which can be a new opportunity for a successful project. Enabling project managers to manage multicultural teams has become a duty for heads of companies and organizations seeking to internationalize their projects and expand their profits, and these ideas must be clear before the planning process of any multicultural project. The consequences could be catastrophic if this preamble does not take place.

I believe after this explanation of the processes of communication in cross-cultural work environments, that the culture of difference, and the difference of culture creates new environments of work, not necessarily positive, but at least the negatives must be understood to avoid them as much as possible, here lies the strength of multicultural human teams, they understand their differences and turn it into a new culture that engages their professionalism, to produce the best that can be produced within the framework of human capacity. Professional communication knowledge and skills in which are covered by the ability will be one of the most distinguished milestones of successfully managing a project of a multicultural human environment.

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TRUST AND CONTROL IN HYBRID WORK PROJECT TEAMS

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ABSTRACT

Project teams have increasingly turned to remote work in the past few years and are primarily impacted by the challenges of the latest pandemic. Most practised work arrangement is hybrid. This combines work in the office and from home using virtual communication tools. This organizational change has prompted many researchers to examine factors that drive and affect the dynamics and success of projects. This research paper will examine the relationship between trust and control in virtual project teams. We examine the relationship between trust and control in hybrid project teams. How the relationship between trust and level of control changes in dependence on whether work is done in the office or virtually. The survey is taken among project managers in a leading energy company in Ireland. Data analysis has shown that level of trust is higher and control lower when working in the office, and the opposite is true when working virtually. However, the paper recommends strategies for how that relationship can be best utilized for managing hybrid project teams.

***Keywords**: virtual teams, project management, trust, control, communication*

1. INTRODUCTION

Trust and control are two essential factors in hybrid work project teams. A high level of trust can lead to a reduced need for control and a more autonomous team (Gergle et al. 2016). Conversely, a lack of trust can increase the need for control, leading to a more micromanaged and less efficient team. To balance trust and control, project managers should focus on establishing clear expectations and guidelines while also creating a supportive and collaborative team environment. There has been a growing body of research on the relationship between trust and control in hybrid work project teams, particularly in the context of remote work and the shift towards more flexible work arrangements. As the global marketplace for employing workforce talent has grown, virtual teams have become an increasingly common form of organization. Virtual teams are defined as teams "whose members use technology to varying degrees in working across locational, temporal, and relational boundaries to accomplish interdependent tasks" (Martins, Gilson and Maynard 2004). Today, a significant percentage of the workforce interacts virtually and is led by remote leaders (Newman, Ford and Marshall 2020). This definition of a virtual team needs to be expanded to include teams that work virtually and combine office and virtual working environments. "Hybrid work," where employees spend some of their workdays in the physical office and the rest of their workdays working remotely, is emerging as a novel form of organizing knowledge work globally (McAllister 1995). An estimate is that 20 per cent of full workdays will be supplied from home after the pandemic ends, compared with just 5 per cent before (Barrero, Bloom and Davis 2020).

1.1 Trust and control

It is essential to define control and trust and how they will be used in the scope of this research. The purpose of control is to ensure that the work performed in projects is executed satisfactorily to achieve project goals. Hence, control is an essential managerial task in all projects. Control can be defined as "a process that regulates the behaviour of organizational members in favour of the achievement of organizational goals" (Costa and Bijlsma-Frankema 2007, 396). In the context of projects, control should regulate the behaviour of project team members to achieve project goals. Control is an important management task that includes the means a project manager applies to influence the behaviour and decisions of the project team members. The purpose of exercising control is to achieve predictability and reduce risks, vulnerability and uncertainty in the project to ensure that the project goals are accomplished. There are two main types of control in project management: formal control and informal control (Jørgensen and Åsgård 2019). Formal control is mainly executed by monitoring the behaviour of project team members (behaviour control) or by monitoring the work results (result control). Informal control, however, is based on the social norms of the project team. As a result, informal control is executed through the (often not explicit) threat of sanctions by the team if the norms are violated.

There are two main types of trust; affect- and cognition-based trust (McAllister 1995). Cognitive trust is based on an evaluation of the trustworthiness of the other party. Such an evaluation involves three main components: 1) the evaluation of competence, i.e. the other party's ability to perform a required task; 2) the evaluation of willingness, i.e. the other party's wish to perform the task; and finally 3) integrity, i.e. does the other party show consistent and predictable behaviour over time Affect-based trust is based upon positive emotional connections between people and depends upon confidence in each other's good intentions. It is all about positive expectations towards the other party. (Nikolova, Möllering and Reihlen 2015) In this perspective, trust relies on establishing emotional ties between the parties. In professional relationships, cognitive trust is a requirement for affective trust to develop (Jørgensen and Åsgård 2019). Building trust is a mutual and sometimes time-demanding process. To lose trust, on the other hand, can happen in an instant. The relationship between trust and control is a matter of perspective. Some see them as opposite ends of a spectrum, while others believe they can work together. For trust and control to be mutually supportive, control measures must be seen as helpful and developed through team input. It is a continuous process in all projects to balance trust and control (Jagd 2010). From a subsidiary perspective, when trust is present, it can reduce the need for control and vice versa (Varoutsa and Scapens 2018). Therefore, trust and control can be seen as alternative strategies to ensure project predictability and goal achievement. However, trust and control can also be applied simultaneously and without conflict,

as shown in the complementary perspective. When control is lacking, it is often connected with insecurity and uncertainty.

Thus, control can also contribute to the development of trust in projects. Both control and trust can have unintended consequences in projects. Too much control can lead to goal displacement and an exaggerated focus on rules, which can soon occupy team members more than doing the right things (Martins, Gilson and Maynard 2004). This can also result in an unintended emphasis on quantitative factors in the project, overshadowing quality evaluation. Furthermore, formal control can demotivate team members and result in poorer work performance. This study investigates how trust and control change in different working environments, specifically in hybrid working environments. For that purpose, we will be basing our research on the two hypothesis.

Hypothesis 1: The perceived levels of control projects managers have over the actions of their team members are higher when team members are working from home in a hybrid working environment.

Hypothesis 2: Perceived levels of trust projects managers have with team members are lower when team members are working from home in a hybrid working environment.

Examining the question is vital because control and trust can unintentionally affect projects. Too much control can lead to goal displacement and an exaggerated focus on rules. The team members can soon become more occupied with doing things right than doing the right things (Alsharo, Gregg and Ramirez 2017). It is also a danger that too much control will lead to an unintended emphasis on quantitative factors in the project, i.e., factors that can be counted and measured. Tasks dominated by reporting numbers can overshadow the evaluation of quality. The motivation of the team members can also suffer by being subject to formal control, resulting in poorer work performance and weakening loyalty (Martins, Gilson and Maynard 2004).

1.2 Method

Participants

The survey participants were all managers at an energy company. The size of their teams ranged from two to ten people. Work at the company has changed since the pandemic began. Before the pandemic, all work was done in the office, with only occasional work from home. Since the pandemic began, changes have been introduced where the most common option for surveyed teams is hybrid work, which is a mix of two or three days in the office and the rest of the week working from home. The number of days in the office depends on the job type. Only teams that were practising some form of hybrid work were surveyed; those who were not were excluded from the research. Project managers were the focus of the research, and only they were surveyed. The survey covered 14 Project managers from different departments of the organization.

Procedure

We conducted a survey via an online tool that was available for one month. The organisation has more than 14 managers, but 14 of them responded during the period that the survey was available.

Measures

All survey items use a five-point Likert scale. Responses were anonymous, and no identifiable information was posted in the questions. This was done to ease the corporate peer pressure and was a condition to participate for some participants. Statistical data was processed using JASP statistical tool. Due to the protection of the privacy of each survey respondent, the names were replaced with PM1 to PM14. All participants in the survey were anonymous; the author only knows the set of participants, not the individual names corresponding to answers.

2. RESULTS AND ANALYSIS

The purpose of the study was to investigate how trust and control interact in a hybrid work environment from the perspective of a project manager. Collected data and the survey structure were tested with Cronbach's alpha. A Cronbach's alpha value of 0.823 indicates that the items in the scale or questionnaire have high internal consistency or reliability. In general, a Cronbach's alpha value of 0.7 or higher is considered to indicate acceptable reliability, while a value of 0.8 or higher is considered to indicate good reliability.

Table 1: Survey Scale Reliability Analysis

Frequentist Scale Reliability Statistics	
Estimate	**Cronbach's α**
Point estimate	0.823
95% CI lower bound	0.633
95% CI upper bound	0.926

We also test that the sample data has a normal distribution. The lowest W statistic is 0.688, and the highest p-value is 0.055; it can be concluded that the sample does come from a normally distributed population. The high value of W indicates that the sample is well-modelled by a normal distribution, while the low p-value supports this conclusion by showing that the deviation from normality is not statistically significant.

Table 2: Shapiro–Wilk test of normality

N - 14		Q1	Q2	Q3	Q2	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Shapiro-Wilk		0.878	0.769	0.75	0.769	0.87	0.862	0.835	0.843	0.854	0.868	0.688
P-value		0.055	0.002	0.001	0.002	0.042	0.033	0.014	0.018	0.025	0.039	<.001

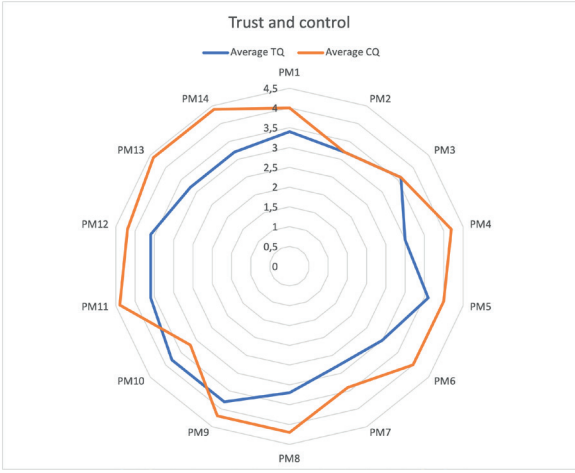
Next, we see the average response for a given scale from 1 to 5. 1 indicates strong disagreement, while 5 indicates strong agreement. The responses to both sets of questions demonstrate a bias in favour of an agreement with the statements. The trust set of questions has less agreement than the control questions. The two sets of questions are scored on the same scale, making it simpler to compare the results. Questions were asked concerning working from home, the opposite of working in the office. The interpretation of trust questions suggests that if the responses are closer to 5 on a 5-point scale, it can be inferred that the project manager has a high level of trust in their team members. A similar inference can be drawn from the control set of questions. The degree of confidence associated with each set of questions provides insights into which aspect is prioritized. As demonstrated in Table 2, the results indicate that managers perceive that they have a higher level of control and should have greater control over their team members when they are working from home. However, they exhibit a lower level of confidence in relation to trust and to work remotely.

Table 3: Mean scores for each respondent

	PM1	PM2	PM3	PM4	PM5	PM6	PM7	PM8	PM9	PM10	PM11	PM12	PM13	PM14	Total AVG
Average TQ	3.4	3.2	3.6	3	3.6	3	2.8	3.2	3.8	3.8	3.6	3.6	3.2	3.2	3.36
Average CQ	4	3.2	3.6	4.2	4	4	3.4	4.2	4.2	3.2	4.4	4.2	4.4	4.4	3.96

TQ – Trust-related set of questions
CQ - Control-related set of questions

Figure 1: Visual representation of mean scores for both sets of questions



The data confirm Hypothesis 1, which posits that project managers perceive more significant control over their team members when working remotely, with the average answer being 3.96. This also means that the opposite is true for office work, as questions are asked, so the opposite must be valid when agreeing or disagreeing with the statement in the questions. This data provides some evidence that project managers perceive more significant control over their team members when working remotely and highlights the importance of considering the role of remote work in project management. Further research is necessary to validate these findings and better understand the complexities of remote work in project management. The data also partially confirm Hypothesis 2 with less confidence than for control, with 0.36 points above the neutral position, which states that perception levels of trust projects managers have with team members are lower when team members work from home in a hybrid working environment. This also means that the opposite is true for office work, as questions are asked, so the opposite must be valid when agreeing or disagreeing with the statement in the questions. Overall, the data suggest that perception levels of trust among project managers are lower when team members work from home in a hybrid working environment. Further research is necessary to validate these findings and better understand the complexities of trust in hybrid work arrangements. Additionally, it is crucial for project managers to consider the impact of hybrid work on trust levels and to implement strategies to build and maintain trust with their team members. Also, meta-analyses by Costa show that collective trust among team members influences the bottom-line outcomes of the team. Echoing calls from past reviews, we note the need for meta-analytical integration of trust research at the team level (Costa, Fulmer and Anderson 2018).

3. DISCUSSION

The results of this study provide valuable insights into the dynamic relationship between trust and control in a hybrid work environment. The findings suggest that the traditional relationship between trust and control, as established in previous research in a non-hybrid setting, may not hold in the same manner in a hybrid work environment. The data indicates a shift in the intensity of this relationship, with an increase in perceived control by project managers and a decrease in perceived trust with team members in a virtual work setting. This shift is also present in a traditional office setting but to a lesser extent. These results highlight the need for further examination of the impact of work arrangements on the trust and control dynamic in organizations. It has been shown that The findings suggest that trust positively influences virtual team collaboration but does not have a direct effect on team effectiveness; instead, the impact of trust on team effectiveness is fully mediated by collaboration (Alsharo, Gregg, and Ramirez 2017). It is imperative for managers to acknowledge that an excessive exercise of control could potentially undermine the efficiency of their teams. It can be inferred that the shift to a hybrid work environment may bring to light disparities in the levels of control exerted by project managers over their team members. This heightened sense of control, particularly when team members are working from home, may result in a decline in team members' trust in the manager. Previous research has established a linear negative relationship between control and trust (Gergle et al. 2016); thus it is recommended that project managers adopt a uniform control policy, regardless of the work location and method, to avoid the erosion of trust within their team.

4. LIMITATIONS

This article presents valuable insights into the interplay between trust and control within the context of hybrid work projects. However, it should be noted that the results are based on a survey conducted within a single organization, which suggests that the findings are influenced by the unique cultural factors present in that specific workplace, as confirmed in previous research (Dani et al. 2006). Furthermore, as the research was not conducted over an extended period of time, the results may be subject to biases of hindsight and may differ if repeated at different points in time.

5. FUTURE RESEARCH

As the trend of remote work continues to grow, it is essential to understand the dynamics of trust and control in hybrid work environments, particularly in project teams. While the present study provides valuable insights into the relationship between trust and control in a single organization, there is room for further exploration of this topic in multiple organizations and industries to build a more comprehensive understanding of trust and control in hybrid work environments. One area for future research could be to conduct a longitudinal study to assess how trust and control evolve in hybrid work project teams. By tracking changes in trust and control over time, researchers could gain a more in-depth understanding of how these variables interact in hybrid work environments and how they may be influenced by factors such as organizational culture, team composition, and work tasks. Additionally, by comparing results across multiple organizations and industries, researchers could determine the extent to which organizational culture and other contextual factors impact trust and control in hybrid work project teams. Another potential area of investigation is the impact of technology on trust and control in hybrid work project teams. With the rise of virtual collaboration tools, remote work has become increasingly reliant on technology to facilitate communication and collaboration. It would be interesting to explore how technology influences the development of trust and control in hybrid work project teams and whether different technologies have different effects on these variables. Finally, it would be valuable to examine the role of leadership in building trust and maintaining control in hybrid work project teams. The literature suggests that effective leadership can foster trust in teams and ensure that work is performed efficiently and effectively. By exploring how leaders can influence trust and control in hybrid work project teams, researchers could provide practical guidance for organizations looking to establish effective hybrid work practices. In conclusion, the present study highlights the importance of exploring trust and control in hybrid work project teams, but there is much more to learn about these complex dynamics. Further research could help organizations to better understand the factors that influence trust and control in hybrid work environments and how to foster these critical components of effective remote work practices.

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INFLUENCE OF TRUST ON PROJECT SUCCESS IN VIRTUAL PROJECT ENVIRONMENT

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ABSTRACT

Nowadays, digital transformation and challenging times due to the COVID-19 restrictions push project managers to work in virtual environment. Project managers and team members have to quickly adapt and replace face-to-face communication with virtual communication, and without direct contact, it is not easy to retain and build trust relationships. Therefore, in virtual environment it is very important to develop trust between project managers and project team members from the first step of a project and keep building trust throughout every phase of the project life cycle. The aim of this paper was to examine trust relationships in virtual project environment and what effect project managers' trust had on project success in virtual environment. The research was conducted on a sample of 50 project managers using LinkedIn and e-mail network, and data were collected with quantitative and qualitative questions. A virtual model of the trust triangle is proposed and tested with correlation analysis, which measured how strong the connection was between the variables. The data analysis revealed that the project trust triangle predicted project success; however, the project management organization had no impact on virtual team and project manager trust. This research provides insight into a better understanding of the importance of trust relationships in virtual environment and contributes to managers who want to increase the level of trust in virtual project environment.

Keywords: *trust, project manager, virtual project environment, project success*

1. INTRODUCTION

COVID-19 (www.euro.who.int) restrictions, digital transformation, and the availability of project management tools improve project managers' approach toward virtual project approach. The COVID-19 pandemic, which affects project task processes, puts pressure on many team members (Koch and Schermuly 2021). Managing employee mental health can be crucial in the face of the present pandemic and upcoming crises. This requires the identification of process variables and potential organizational resources. Project office and fieldwork project environments, which project managers have replaced with working from home offices, have demanded the ability to adapt and be productive in a virtual environment instantly. Virtual project environments are relatively new ways of managing projects, and gaining trust among virtual team members without face-to-face meetings has become the most difficult task for project managers (Zhang and Sun 2022). Trust develops with open communication and honesty. "*Trust is the expectation or belief that one can rely on the words and actions of the leader and that the leader will have good intentions for the team at all times*" (Guinalíu and Jordán 2016, 58–70), and in a virtual project environment, it is harder to gain confidence in someone from an online perspective.

Trust relationships between the project manager and team members can have a positive or negative impact on the success of the project. The project activities through project life cycle brings obstacles and test the trust relationships in team. *"Trust is the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party"* (Mayer et al. 1995, 709-734). Therefore, research about trust in a virtual environment is relevant for project managers in order to ensure the efficient implementation of high levels of trust in project relationships and the successful delivery of the project.

Gibb, J. R. (1962) developed a trust theory based on personal and organizational behavior within a project group. Additionally, Gibb's ten years later presented the TORI Theory (Trust, Openness, Realization, and Interdependence) described ten levels of trust and leadership approaches. The trust in projects with regard to the COVID-19 demands has been studied lately (Schreier et al., 2022; Koch, and Schermuly 2021). Some virtual project management studies in focus on trust building through communication (Zhang and Sun 2022; Cripe and Burleigh 2022), as well as project leadership and project success (Imam and Zaheer 2021; Majeed et al. 2021).

Although the topic of trust in project management has been researched in the literature, the study of trust relationships in virtual environments is still in its infancy. What is unknown is how working from home and in a virtual environment affect trust in project relationships and whether project success is at risk due to a lack of face-to-face interaction. Hence, does or does not trust in a virtual environment make the project successful? We used qualitative and quantitative analyses, as well as the trust theory, to solve this problem.

This paper's main goal is to reveal internal information about trust interactions in a virtual project environment. These insights should highlight the present relationship between trust and virtual relationships as well as what project managers may do to become more comfortable in virtual project environments. In the paper, we make a methodological contribution by using our own, independently constructed Virtual Trust Triangle Model based on the study of Mumbi and McGill (2008) as a starting point. As well, we contribute to the limited theoretical knowledge by considering trust in the virtual environment in the context of virtual project management.

The paper consists of a literature review with a focus on trust in project management and a methodology and methods section with regard to the conducted research. Finally, based on our research, we offer a discussion and a conclusion. The discussion part provides a detailed explanation of the research results, and the conclusion section finalizes the paper and provides implications and recommendations for the next research.

2. LITERATURE REVIEW

In a virtual project environment, trust is the most important key factor for virtual team collaboration and effectiveness (Breuer et al. 2020). Trust is essential because it overcomes the psychological gap

between team members, and it is a bigger challenge to coordinate projects and build trust relationships in the virtual environment. Hacker et al. (2019), with a systematic theoretical review, offers a higher perception of how trust evolves along the team's evolution and a better understanding of how trust might develop differently in a virtual environment. There have been many different definitions regarding trust in project management (Blaze et al. 1999; Karlsen et al. 2008; Mayer et al. 2015). For this paper, we adopted the trust definition from Guinalíu and Jordán (2016, 58–70), who defined trust as *„the expectation or belief that one can rely on the words and actions of the leader and that the leader will have good intentions for the team at all times".*

Project management success depends on the degree of collaboration among team members, which, on the other hand, is influenced by an increase in the level of trust between team members (Bond-Barnard et al. 2018). It can be challenging to establish and maintain trust in a virtual environment. As a result, the study by Zang and Sun (2022) sought to determine which strategies project management office leaders and project team leaders would rely on to form effective virtual project teams. Even though the value of trust and its benefits were widely recognized, this understanding was mostly intuitive rather than intellectual. As a result, the complexities of establishing and sustaining trust in a project context, as well as how to fix it when things went wrong, were largely ignored (Strahorn et al. 2017). The study by de Olivera Dias (2022) looked at how trust loss affected project management negotiations in some way. The findings highlighted severe effects for both the relationship and the substance, including dissatisfaction, lost sales and customers, and a contract that cannot be achieved in the near future.

Different studies have been conducted on the topic of trust in the virtual environment, and it is clear from the studies that an increasing number of project managers are becoming aware of how much a lack of trust in a team may affect the project's delivery. Turesky et al. (2020) investigated the leadership behaviors of virtual team managers, and reached the conclusion that creating a high-trust atmosphere was important for virtual teams' effectiveness. Managers of virtual teams indicated that having good conflict management skills was also crucial.

Cripe and Burleigh (2022) conducted interviews with ten qualified virtual team managers with a minimum of 10 years' experience working in the field of IT to establish the communication strategies and tools that may be simplest for leading and acting with virtual project team members, in addition to outlining and establishing the suitable leadership abilities and behaviors. The study's findings show that in order to successfully manage projects, move projects forward in the direction of achieving sustainable business and ensuring client satisfaction, it may be necessary to continue coaching, mentoring, cooperation, identifying their accomplishments, providing them with technical training, and understanding different cultures and local laws that relate to virtual teams.

Virtual teams were affected by challenges with communication, trust, socialization, cultural diversity, and leadership (Wattanatinnachot 2022). Trust is one of the most crucial elements that determines team performance in a virtual project environment. In addition, the most important aspect influencing team knowledge sharing is trust because it is a defining characteristic of interactions between team members. As team members progress from one stage to another, trust steadily grows, addressing how trust evolves through time in professional relationships. The main concepts of this model are that trust is a dynamic process that emerges through interaction and that it is neither high nor low but rather qualitatively different at each step (Dumitru and Mittelstädt 2020). Davidavičienė et al. (2020) investigated how trust influences the knowledge sharing process in virtual teams, and it has been discovered that when trust improves within an organization, so does knowledge sharing. Trust and communication are critical in virtual project teams for project success (Lukić et al. 2018). According to Sagar's research (2023), the most important criteria in developing trust among virtual team members were a team member's skill, which included integrity, kindness, competency, trustworthiness, and efficiency.

This paper uses the traditional definition of project success (completed on time, under budget, and to specification), and the "iron triangle" is a common phrase for these criteria (Pollack et al. 2018). However, a variety of variables could affect how successful a project is, so there is currently no agreement on what makes a successful project. Other performance measurements, including safety, resource efficiency, effectiveness, stakeholder satisfaction, and reducing conflicts and disagreements, are becoming more crucial (Ogunlana 2010). A project's success is significantly correlated with its

communication, and communication and success are linked via trust (Majeed et al. 2021). Based on both owners and contractors, a study from Jiang et al. (2016) examines how various levels of trust impact project success in the construction business, and the findings demonstrate the reliability of six trust indicators - competence, honesty, communication, reciprocity, and the contract - in establishing a relationship of trust between owners and contractors. Alvarenga et al., (2019) also indicates that communication, commitment, and leadership are considered to be the three most crucial factors in project success by project managers. However, we can presume that without a high level of trust, these three characteristics will not have a strong positive impact on the project's success. Imam and Zaheer (2021) research investigates how shared leadership influences project success. It also looks into the moderating effects of team trust, cohesion, and knowledge sharing. Results showed that shared leadership increases project success both directly and indirectly through knowledge sharing and team cohesion. They also showed that team trust interacts with team cohesion and information sharing to increase project success. There are also more varieties of trust, as the literature review revealed. The study from Jiang et al. (2016) looks at the dynamic interaction between calculative and relational trust and shows how each supports the project's success, although relational trust has a stronger impact on project success than calculative trust.

Moreover, a lack of trust might increase the probability that a project will fail. Distrust in a virtual project environment may result in conflicts, criticism, and apathy, as well as a cessation of communication (Qureshi et al. 2006) and potentially project delays. The function of trust and distrust as two separate organizing principles that influence how organizations evaluate information, choose suitable behaviors, and organize actions in inter organizational relationships (Kostis et al. 2022). Thus, since both trust and distrust are necessary, it is crucial to understand how they interact in a virtual project environment. Findings from Hussein's (2019) study reveal that trust, openness, respect, loyalty, and commitment are significant shared values for project success; however, those success elements are not applicable to all types of projects.

Along with the questionnaire, a defined model for trust in the scope of the virtual project environment was developed for research purposes (Table 1). The term "virtual triangle of trust" refers to the three perspectives through which the virtual project environment is seen. In consideration of a literature review, we hypothesize that:

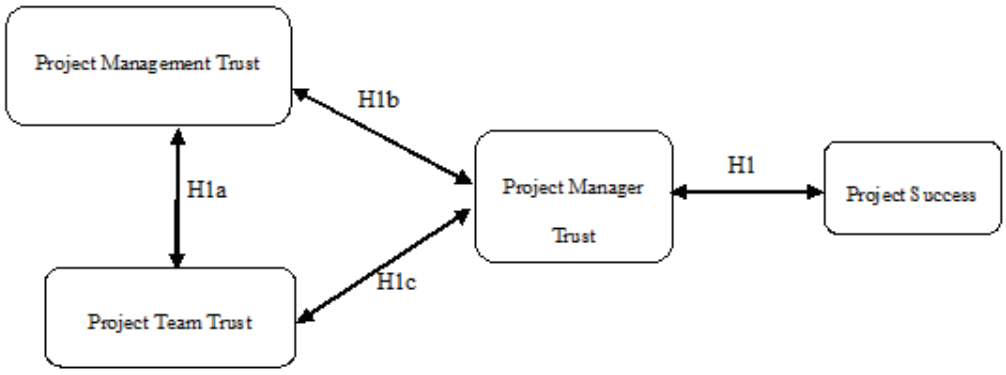
H1: The project's success will be positively influenced by the trust triangle.

H1a: Project management trust intention will positively influence project team trust.

H1b: The project management trust intention will positively influence the project manager's trust.

H1c: Project manager trust support will positively influence the project team trust.

Table 1: Virtual project trust triangle, the model structure (source: author's construction)



3. METHODOLOGY

Data Collection

For this study, project managers were the target population. To discover trust relationships between the project manager and virtual team, we used an online survey. The data was collected in April and May 2022, (period 25.04.2022.-25.05.2022.). The main goal was to learn about project managers leading projects and building trust in the project team without having face-to-face meetings. Working from home in the COVID-19 pandemic period was the "new normal", and project managers did not have time to assimilate.

Regardless of the main limitation of this research, which was the small sample size of participants, the survey was collected two years after the COVID-19 pandemic started, and we were able to get an actual perspective on how leading projects with trust in a virtual environment affected project success.

Research instrument

For investigation of the management and trust relationship between the project manager and the virtual project team, we used demographic questions and quantitative questions. After a literature review with regard to the trust topic, we decided to follow a method developed by Mumbi and McGill (2008) as a starting point to compose our questionnaire. In the first part of the questionnaire with demographic data, we collected information about the project manager's gender and experience in traditional and virtual project environments. In addition, we collected data on project manager experience regarding trust in the project virtual environment.

The second section of the questionnaire consisted of quantitative questions and a Likert 5-point scale for measurement, with two scales: 1 (do not agree)-5 (agree) and 1 (never)-5 (always). The survey was distributed online via LinkedIn and e-mail. The calculation of average values we did with an Excel program, and for analyzing the numeric data, we used the Power BI Desktop Program. With correlation statistics, we determined the direction and strength of the relationships between variables.

4. RESULTS

The first section of the questionnaire was qualitative research, and the sample consisted of 50 project managers (N = 50), 62 % of whom were male and 38 % of whom were female. Analyses of average experience were conducted using Excel calculations, and participants in traditional project management had an average work experience of 12.42 years, whereas participants in the virtual project management environment had an average work experience of 4.72 years. The questionnaire's second section was quantitative research, with questions on a Likert scale. The analyses were performed with the Power BI desktop program, and the correlation coefficient was calculated. With the virtual trust model composed by the author (Table 2), we presented the results of testing the correlation relationship between variables.

According to the correlation data, every variable in the virtual environment was positively associated, meaning that as one variable rises, so do all the others (Table 2).

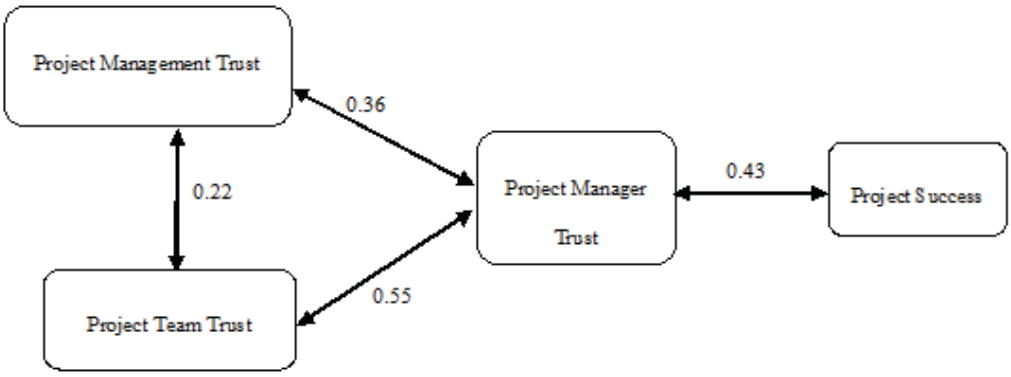
The degree of moderately positive correlation between "project trust triangle and project success" was 0.43. According to the findings, the level of project success would increase with the addition of project trust triangle. Therefore, H1 is supported.

When we look at results between "project management trust" and "project team trust," we see a weak positive correlation with a degree of 0.22. Therefore, Ha is not supported.

The findings showed a 0.36-degree weak positive correlation between "project management trust" and "project manager trust" in the results. The data indicate a positive but weak mutual connection. Thus, Hb is not supported.

However, there was a moderately positive correlation of 0.55 between "project team trust" and "project manager trust." As a result, if the project manager increases trust in the project's virtual environment, the virtual team's degree of trust will also increase. Therefore, Hc is supported.

Table 2: Virtual project trust triangle, the model structure -showing results



5. DISCUSSION

The research findings indicate that there is a significant awareness of the importance of trust within a virtual project environment with regard to project success. According to the hypothesis H1 data, project manager trust has a moderately positive influence on project success in a virtual environment. By creating a high level of trust from the beginning of the project (Cripe and Burleigh 2022), the project manager is able to positively affect project success. This finding is confirmed by a study by Imam and Zaheer (2021), who demonstrated that the success of a project is also influenced by the relationship between team trust, cohesion, and information sharing. In light of the results, it is critical to establish a trusting working environment in which project team members can continuously improve their skills.

The study's results show that the level of trust between the project management and team members was insufficient to support hypothesis Ha. The findings indicate that management has failed to ensure that all employees are treated fairly and equitably in a virtual environment. Furthermore, team members in a virtual environment were unable to rely on one another with confidence and did not demonstrate a willingness to rely on one another. Given that the survey was conducted in May 2022, when the majority of project teams were forcibly transferred to a virtual environment pursuant to COVID-19 demands, the lack of trust between management and team members is not surprising. This finding contradicts the study of Mumbi and McGill (2008). According to their findings, trust-based management plays an important role in trust development. Following the guidelines of Swart et al. (2022) for project management communication, collaboration, and knowledge sharing are more difficult in virtual teams than in traditional face-to-face teams; thus, virtual environments require additional support.

Considering the results of this study, the correlation between project manager and project management is positive, but not enough to support the hypothesis Hb. Such a finding creates new issues, for instance: how much time has the management invested in fostering and sustaining trust in a virtual environment, and what level of confidence did the project manager have in handling this condition? This finding contradicts the findings of Bond-Barnard (2018), who demonstrated the importance of trust in project success. The article from Kostis et al. (2022) has underlined how crucial it is for organizations to be able to manage trust and mistrust in a reflexive manner in order to maintain the dual views necessary for effective project-based relationships. When management emphasizes the value of trust and bases its decisions on it, a project manager increases the value of relationships based on trust in a virtual environment.

The findings of the correlation analysis support the research hypothesis Hc in the context of the relationship of trust between the project team and project manager, and vice versa. It demonstrates that a project manager working in a virtual environment recognizes project team members as trustworthy and honest from the start of the project and that, as a result, trust grows on both sides. Cooperation based on trust and cooperative effort with fairness toward one another emerges when team

members can depend on one another with trust. This discovery is comparable to recent findings from a number of studies (Breuer et al. 2020; Turesly et al. 2020; Swart et al. 2022) proving the positive benefits of trust in project relationships and collaboration in virtual environments. Considering to the importance of trust in a virtual environment, project managers must embrace various methods, communicate frequently and effectively, use new technology with caution, and remember that practice makes perfect (Soga 2022).

6. CONCLUSION

Project managers and team members are constantly adapting to digitalization, technological innovations, and a variety of project management tools. The ability to establish trust in a virtual environment is challenging. The literature review clarified that project relationships and project success are impacted by trust in the virtual environment. The results of this study show that project managers and project teams cannot have a strong influence in a virtual environment without significant management support. A lack of face-to-face interaction resulted in less trust in project management. Accordingly, management must encourage a high level of trust within the organization as well as among project managers and team members.

The study also examined the trust relationship between the project team and the project manager, and it found that the correlation between them increased. This is because all members were able to rely on each other with trust from the beginning of the project, thanks to the project manager's trust-based approach. In addition, the project trust triangle in the virtual environment contributed to the project's success. The ability of a project manager to build trust in a virtual environment strongly relates to the project team's level of trust and reflects the concept that increasing trust will contribute to project success.

This study has limitations; the hypothesis is partially confirmed and requires additional research due to the small sample size and the small region of respondents. There is a potential that the result would have been different if the pattern had been larger. Regardless of the limitations of the data gathering, the results are still useful to academic researchers and project managers and contributes to a better understanding of the trust relationships associated with the project success in virtual environment. Nevertheless, future researchers should aim for more participants and a larger volume of research.

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APPENDIX I - SURVEY QUESTIONS

For qualitative research, we used demographic question.

- Gender (m/f)
- How many years of experience in traditional Project management do you have? (in years)
- How many years of experience in virtual Project management do you have? (in years)

For quantitative questions, we used Likert scale (1-5).

Project management trust (scale, 1-not agree – 5-agree)

- Management organization has processes that provide that all employees will be treated fairly and equitably
- I work in an organization in which good procedures make things fair and equity

Virtual project manager trust (scale, 1-not agree – 5-agree)

- From the beginning of the project the team considered me to be trustworthy
- From the beginning of the project I considered the team members to be trustworthy
- From the beginning of the project, team members felt they could rely on me
- From the beginning of the project I considered the team members to be reliable
- From the beginning of the project team members were positive towards each other

Virtual Project team trust (scale: 1-never - 5 always)

- Team members were able to rely on each other with confidence
- Team members showed a willingness to depend on each other
- Team members acted with fairness towards each other
- Team members were cooperative online

Project success (scale: 1-never - 5 always)

- The project was completed on time
- The project was completed within budget
- The project was completed to specification

CONTRIBUTION OF THE COMMUNICATION IN ADDRESSING THE CULTURAL CHALLENGES IN THE INVESTIGATIVE JOURNALISM PROJECTS

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ABSTRACT

In our days, more and more non-traditional domains, in terms of professional project management approaches, tend to become part of the general projectification trend. The journalism field is a domain where the projects are relatively common, but the project implementation is not enough professionalized yet. This is one of the reasons that managing these projects represent a very challenging endeavor. Another reason relies on the specificity of the journalism projects, especially the investigative journalism ones. They main characteristics of this type of projects are their complex environment, in terms of stakeholders' typology and their multiculturality.

The focus of the paper is two-fold: the first objective is present the main cultural challenges in the investigative journalism projects, as they were identified during the extended literature review performed by the authors. The second objective of the paper is to present how different interventions, especially those for improving communication may contribute in addressing the cultural challenges in the investigative journalism projects. This is the result of the study of current practices in some investigative journalism projects executed in Middle East region. The paper ends with some general recommendations for this type of projects and this specific geographical region.

***Keywords**: investigative journalism projects, multi-cultural project, project management professionalization, projectification, Middle East region.*

1. INTRODUCTION

In our days, more than ever, the organizations are cooperating in their projects with different other public and private organizations, inside and/or outside their geographical surroundings. During projects execution, it is important that the national and organizational cultural differences to be properly managed, to transform them from challenges to opportunities. (Lin et al. 2012; Rodrigues and Sbragia 2013). And the project context seems to be an effective environment for dealing with cultural differences (Muszynska et al. 2015). Several researchers have proposed theoretical frameworks for understanding how individuals think, how they judge situations, and how they interpret events around them, especially if there is contact with a person from a different culture. These concepts allow to understand and deal with challenges arising in multicultural or cross-cultural working environments (Alizadeh Afrouzi 2021; Bogoeva 2020; Hofstede and Fink 2007; Kim 2017; Meyer 2016).

There are many ways in which the challenges of working in a multicultural environment might be overcome. Fostering cultural awareness among employees might help transcend cultural differences and promote a more welcoming and respectful workplace (Harrin 2021, 27 December). This might be a first step, followed by a diagnostic analysis, to identify different categories of challenges. Then, for each potential cultural risk, specific actions may be defined and performed. As one of the most important results are: enhancing the trust between project team members (Sennara and Hartman 2002), that allows everyone to express their opinions freely, promoting values of respect for cultural differences, and developing the competence of understanding the other „and this takes time", and promoting communication methods that are the means for all of the above. (Lifintsev and Wellbrock 2019; SHINNERS 2017)

Communication is one of the most important competence for dealing effectively with the cultural differences (Zita 2020). Through a proper communication, trust is built between team members by representing their points of view within the team in discussions, and communication in this culturally diverse environment creates an increasing atmosphere of harmony and understanding of the different others (Fuccio 2021) Discussing about effective communication, the language proficiency is usually considered. But the communication in multi-cultural environment is more than language proficiency. It is mainly about selecting vocabulary to be used, to deal with language ambiguity, to use the right tone, showing emotions, using properly the humor and breaking ice technique. (Dumbravă 2018; Zita 2020)

Investigative journalism represents a journalism gender that aims to provide news that someone does not want to be shared to the public, because it expose wrongdoing, corruption, or other types of misconduct (Knight 2000). It is about truth-telling, based on team collaboration, high risks and sensationalism (Leigh 2019), being relevant for society (Cordell 2009; Larrondo-Ureta, and Ferreras-Rodríguez 2021). More and more, the investigative journalism is carried out in the form of projects, being an example of projectification in many regions Investigations into human rights violations, business fraud, and government corruption are a few examples of investigative journalism projects (Coelho and Rodrigues 2020; Cordell 2009; Gearing 2014; Majeed 2022; Moreira et al. 2019). The investigative journalism projects frequently involve information sources identification, in-depth interviews, and other information gathering and analysis activities. In investigative journalism projects, the team is usually cross-border, and at the very least it is from one geographic region, but its team is multicultural (Larrondo-Ureta and Ferreras-Rodríguez 2021), since this type of journalism requires time and effort to search for sources that sometimes these sources have international or regional extensions. (Majeed 2022)

Many countries in the Middle East have restrictive laws and government controls on the media, which can make it difficult for journalists to report on sensitive or critical issues (Mutsvairo and Bebawi 2019). Journalists in Middle East may also face obstacles in gaining access to information and sources, as many governments and organizations are reluctant to provide information to the media (Almania 2017; Hamdy 2013). Therefore, many journalists work in investigative reporting from outside their countries and cooperate with local team to accomplish the journalistic story „project", which makes the completion of the project complex, in particular when team members are from a number of countries in the region where cultures differ (Almania 2017; Bebawi 2016).

The paper aims to identify the cultural challenges facing investigative journalism projects, especially those that are implemented in the Middle East region and to propose solutions aligned with the current research results presented in the literature. The paper structure is as follow: At the beginning, the results of the study of scientific literature are presented. The following section is dedicated for describing the most relevant cultural challenges in investigative journalism projects. The case of projects implemented in the Middle East region are analyzed. The paper is ending with the main conclusions and the list of more relevant references.

2. LITERATURE REVIEW

Studying the cultural aspects in multicultural projects allows a proper understanding of cultural challenges and adequate interventions to be considered for addressing them (Lückmann & Färber 2016).

2.1 Relevant cultural challenges in multicultural projects

Reviewing the literature on cultural challenges in projects might be challenging because of the multitude of theoretical approaches and the diversity of project environments. During the literature review, the authors considered that frequency of the cultural challenge identification is a sign its relevance. Based on this hypothesis, table 1 summarizing the main cultural challenges was developed.

Table.1 The main cultural challenges in multicultural projects

Challenges	References
Gaining the awareness about the impact of cultural aspects	(Fuccio 2021; Gallagher 2022; Lückmann and Färber 2016; Rodríguez-Rivero et al. 2022; Rozkwitalska 2011)
Understanding the cultural characteristics in specific project environments	(Carpenter and Dunung 2012; Rodrigues and Sbragia 2013; Sennara and Hartman 2002)
Dealing with a reduced team cohesion, due to the cultural clashes/conflicts and the lack of cultural sensitivity.	(Gibson et al. 2014; Rozkwitalska 2011; Salama 2022; Scott and Wildman 2015; Wang 2018)
Aligning project goals with stakeholders' expectations and measuring project success	(DuBois et al. 2015; Fortunato et al. 2017; Gallagher 2022)
Dealing with the diversity of values, norms, attitudes, and working styles	(Eberlein 2008; Larrondo-Ureta and Ferreras-Rodríguez 2021; Rozkwitalska 2011)
Monitoring the effectiveness of project management processes in relation with the cultural characteristics (for example, monitoring the team effectiveness)	(Galli 2020; Lückmann and Färber 2016; Muszynska et al. 2015; Rodrigues and Sbragia 2013; Sennara and Hartman 2002)
Dealing with the stereotypes, biases, formal and informal power imbalances	(Nienaber et al. 2022; Rozkwitalska 2011; Valdeón 2021; Wildman and Griffith 2015)
Dealing with cultural differences in change management	(DuBois et al. 2015; Gallagher 2022; Rozkwitalska 2011; Scott and Wildman 2015)
Overcoming the communication barriers, due to differences in the vocabulary, specificity of non-verbal communication or body language	(Chang et al, 2011; Larrondo-Ureta and Ferreras-Rodríguez 2021; Muszynska et al. 2015; Rozkwitalska 2011; Valdeón 2021)
Building the trust in multicultural teams	(Galli 2021; Lückmann and Färber 2016; Sennara and Hartman 2002)

Getting cultural awareness, project managers may change their leadership style to better meet the expectations of team members and stakeholders from other cultures. Project managers may lead more productive and efficient teams and ultimately provide better results by being culturally conscious, this can prevent or decrease the occurrence of problems aligned with multicultural environment (Lückmann and Färber 2016; Rozkwitalska 2011). Furthermore, project managers may predict and resolve misunderstandings or conflicts that can result from cultural differences by having a better awareness of cultural characteristics (Rozkwitalska 2011; Scott and Wildman 2015).

It is essential project managers to understand the cultural characteristics of a particular project environment. Communication methods, decision-making procedures, and work habits may all be affected by cultural factors which may have an impact on the direction and conclusion of the project (Carpenter and Dunung 2012; Sennara and Hartman 2002). For instance, if in a project team there is

people with various cultural backgrounds, project managers may be able to change their communication approaches to collaborate more efficiently with the team members. The way that team members react to leadership can largely depend on their different values, norms, attitudes, and working styles. To make sure that every member of the team is properly engaged and motivated, project managers would have to be aware of these distinctions and modify their leadership style accordingly (Larrondo-Ureta and Ferreras-Rodríguez 2021; Rozkwitalska 2011). The cultural perspective of stakeholders must be understood by project managers to customize their approach. Stakeholders' definitions of success, how they view it, and how they wish to communicate and work with the project team can all be impacted by cultural differences (Fortunato et al. 2017).

It is important to keep in mind that effective communication, active listening, and understanding cultural differences are key to successful project management in diverse teams (Gallagher 2022), this leads to monitoring the effectiveness of project management processes in relation to cultural characteristics by evaluating the performance of the team and the project against established metrics and benchmarks in a project of multicultural environment (Sennara and Hartman 2002). Acknowledging and addressing any biases and stereotypes that may exist within the multicultural team can be done through training and awareness programs, as well as actively encouraging open and honest communication about these issues (Rozkwitalska 2011; Valdeón 2021).

To address formal power imbalances such as distribution of authority, and informal power imbalances like unspoken rules, norms, and / or expectations in multicultural projects, it is important to promote diversity and inclusion by creating a safe space for team members to share their cultural perspectives and experiences which may be a tough challenge facing any project of multicultural team (DuBois et al. 2015; Rozkwitalska 2011).

People from different cultures may embrace changes differently, in the manner of working or thinking in the changing conditions, which may affect the quality of the project's expected outputs and the "team functioning" (Scott and Wildman 2015). A scientific approach in project management approach, well managed relationships with the organizational systems and procedures, and a suitable organizational infrastructure, combined with the cultural management might increase the project and organization performance (Eberlein 2008). Discussing about the cultural challenges in multicultural projects, we can conclude that the misunderstanding of cultural aspects, failing in overcoming the communication barriers and in building trust represents the key shortcuts in managing local multicultural projects (Salama 2022).

Communication is a success factor in multi-cultural projects. A study conducted by Project Management Institute reveals that the usage of effective communication methods leads to a 80 % project success rate (DuBois et al.,2015). No matter how successful or cohesive a team is, conflicts might appear only because of the inadequate communication (Galli 2021). Due to different misconceptions of cross-cultural communication methods, geographical distance, and chronological separation, important information may be lost in the communication (Scott, and Wildman 2015). To properly manage multicultural teams, an effective communication is needed to enhance team's viability and performance (Larrondo-Ureta, and Ferreras-Rodríguez 2021). A good cultural fit might be achieved by connecting communication with the leadership style (Al-Lamki 2018).

Analyzing the cultural challenges, we can observe that they are mainly related to the following three reference levels: individuals (for example, dealing with the stereotypes, biases, formal and informal power imbalances, overcoming the communication barriers, due to differences in the vocabulary, specificity of non-verbal communication or body language, dealing with cultural differences in change management etc.), organization level (for example, gaining the awareness about the impact of cultural aspects, understanding the cultural characteristics in the specific project environment etc.) and society/region level (for example, understanding the cultural characteristics in specific project environments). For this reason, when the interventions for addressing the cultural challenges were identified, they were structured inro three groups, based on these levels.

2.2 Interventions for addressing the cultural challenges in multicultural projects

There is not a single model that can be applied to handle the cultural challenges in all circumstances (Wang 2018). But knowing these challenges, this may help to find solutions for addressing these challenges, For example, assuring an effective communication and collaboration with people from

other cultures are critical in the multicultural projects (Muszynska et al. 2015; PMBOK 2021; Rodrigues and Sbragia 2013; Rozkwitalska 2011; Scott and Wildman 2015). Because the cultural challenges are very complex and dynamic, it is crucial that the interventions to be considered at different levels, such as individual, organizational and society levels (Fedorova et al. 2019; Galli 2020, 2021; Vukomanović et al. 2016). Lückmann and Färber (2016) consider that the criterion by which solutions for dealing with cultural challenges might be characterized based on the "trust": the higher is the increase of trust, the more successful are the interventions (Sennara and Hartman 2002).

The interventions identified in the scientific literature, grouped into three different groups, are presented in table 2.

Table 2: Interventions for addressing the cultural challenges

Intervention level	Related initiatives/actions	References
Society/region	Cultural diversity and inclusion initiatives	(Gallagher 2022; Larrondo-Ureta, and Ferreras-Rodríguez 2021; Valdeón 2021)
	Cooperation with relevant institutions at society/regional (professional associations, educational organizations etc.)	(Wagner et al. 2021; Wagner et al. 2022)
Organization	Enhancing the cultural awareness and improving the organizational culture communication	(Gallagher 2022; Galli 2021; Majeed 2022; Rozkwitalska 2011)
	Enhancing collaboration between project and the organizational support structures and functions for bridging different cultures	(IPMA 2015; ISO 2021; PMBOK 2021)
Individual	Developing cross-cultural communication competence of individuals (usage of different styles for effective communication, implying effective use of body language, tone; increasing acceptance and empathy regarding the cultural diversity etc.)	(Fedorova et al. 2019; IPMA 2015; ISO 2021; PMBOK 2021)
	Developing individual competences related to the cross-cultural communication competence (cultural clashes/conflicts management, change management in multicultural teams, increasing trust in multicultural teams etc.)	(IPMA 2015; Larrondo-Ureta, and Ferreras-Rodríguez 2021; PMBOK 2021; Wang 2018)

These interventions are related to project management professionalization and to the projectification of societies/regions. Professionalization of work represents the process of transforming an occupation into a profession with a high degree of integrity and competence (Dascalu et al. 2023). Professionalization requires the existence of professional qualification frameworks, professional associations that define and recommend best practices to members of the represented professional community, a code of professional conduct, and professional certifications to differentiate between competent or less-competent professionals. Projectification means that the number and importance of projects increased significantly, and this has an impact on the organizational structure, culture and teamwork (Wagner et al. 2022).

Personal communication is important in addressing cultural challenges at all three levels. Project managers should take the time to get to know team members on a personal level, and actively encourage open and honest communication (DuBois et al. 2015). The project managers should be aware of their own cultural biases and strive to communicate with team members in a way that is respectful and inclusive of different perspectives and backgrounds (Rozkwitalska 2011; Scott and Wildman 2015). Organizations should define clear communication channels and procedure inside the organization and in the society, the communication between different institution is critical for assuring their collaboration during the projects' execution. Communication is the pillar for building trust and create a more inclusive and effective project environment (Chang et al. 2011).

3. CULTURAL CHALLENGES IN INVESTIGATIVE JOURNALISM PROJECTS. THE CASE OF PROJECTS EXECUTED IN THE MIDDLE EAST REGION

The authors performed in-depth analysis of the cultural challenges for the investigative journalism projects, especially for those executed in the Middle Est region, for doing that, the authors investigate the literature for this specific type of projects.

3.1 General characteristics of the investigative journalism projects

Investigative journalism projects typically involve in-depth research and analysis of a specific topic or issue. These projects often uncover previously unknown or under-reported information, and may reveal corruption, fraud, or other forms of wrongdoing. These projects may take weeks, months, or even years to complete, and may involve the use of public records, interviews, and other sources of information (Almania 2017; Gearing 2014; Larrondo-Ureta and Ferreras-Rodríguez 2021; Majeed 2022; Sambrook 2018). It might be complex challenging to report on investigative journalism initiatives since they often deal with sensitive and debatable subjects. High levels of journalistic competence and skill may also be necessary for this, as well as the capacity to manage ethical and legal considerations. Further complicating the process is the fact that investigative journalists often encounter resistance and pressure from individuals who are the subject of their investigation (Al-Shami 2019; Bebawi 2016; Bisilki and Opoku 2018; Leigh 2019; Moreira et al. 2019).

Project team management is an important aspect of investigative journalism projects, as it allows for the efficient and effective coordination of efforts among team members (Larrondo-Ureta, and Ferreras-Rodríguez 2021). Some key aspects of team management in investigative journalism projects include:

- *Division of labor.* Team members should be assigned tasks that are best suited to their skills and expertise (Larrondo-Ureta and Ferreras-Rodríguez 2021).
- *Flexibility.* Investigative journalism projects are often complex and can be unpredictable, so team members should be prepared to adapt to changing circumstances (Bebawi 2016; Gearing 2014; Majeed 2022).
- *Ethical and legal considerations.* Investigative journalism projects often deal with sensitive topics, so it is important that team members are aware of ethical and legal considerations and how to handle them (Gearing 2014; Larrondo-Ureta and Ferreras-Rodríguez 2021).
- *Collaboration.* Investigative journalism projects often involve multiple teams or organizations working together, effective collaboration is crucial for success (Al-Shami 2019; Sambrook,2018)
- *Communication*. Effective communication is crucial for keeping team members informed and on the same page. This may involve regular meetings, phone calls, or email updates (Gearing 2014).
- *Trust*. Trust is a key component of any team, and investigative journalism projects are no exception. Team members should be able to rely on each other to do their part and to protect sensitive information (Gearing 2014; Larrondo-Ureta and Ferreras-Rodríguez 2021).

3.2 Specific characteristics of the investigative journalism projects executed in the Middle East region

Narrative research was conducted in April – May 2022, with Arab Reporters for Investigative Journalism (ARIJ). ARIJ is an institution based in Amman, Jordan, has been establish since 2005, specialized in producing and training investigative journalism (Armao and Johnson 2014). Participants in a narrative research are asked to consider their experiences as six different managers (10-25 years of experience) from different management / editorial levels base in six countries (Jordan, Egypt, Lebanon, United Arab Emirates and USA), exploring with them the project of making an investigative story as a unique journalism production, followed by focus group of four journalists (5-15 years of experience), from four different countries (Egypt, Lebanon, Sudan and Yemen) who had experience in making investigative stories. All participants publish their investigative stories in Middle East region.

The main findings of the research are the following:

a) *Not getting sufficient information from the sources has a negative impact on the project success.* Four-journalists revealed that the lack of getting information is on the most top challenges in a project of "investigative journalism story".

b) *Institutions do not provide sufficient support to projects.* The coach of the team and almost all other interviewees emphasized that there is a real importance for the support of the journalists during the project, some of them live in another country and they have constant communication related to the topic of the story and the legal environment.

c) *Involved persons must be even more competent in investigative journalism and information gathering.* For this reason, it is important to implement competence development actions such as trainings. All managers and the four-journalist revealed that training is a must before starting the journey of the investigative journalism.

d) *The negative impact of having in project team journalists assigned only part-time to the projects.* The second experienced journalist clearly emphasized that the actual job is essential for her daily life and working on the "project" will be only in the free time during the week.

e) *Frequent meetings are important to assure the project progress.* Three editorials confirmed that meetings are very important to follow up simultaneous projects, but sometimes they are very stressful.

f) *Multi-dimensional impact of working in multicultural environments and from different countries (legal, safety etc.).* Four journalists emphasized that the difference in culture does not contradict the standards of the institution, but from the point of view of the editorial management, the location of the story determines the culture of the project itself, and may create unique legal challenges, and others related to the safety of the journalist.

g) *Delocalization of project team members usually have a negative impact on the project execution.* Two journalists with middle years of experience said that they both face difficulties in distance work mode, especially in the case of correspondence (email and short text), in which there is no contact (face to face).

Considering the findings of the research conducted by ARIJ, a comparison with the interventions included in Table 2 was performed and the following conclusions were drawn out:

- The challenges of multiculturality are clearly identified and characterized based on different dimensions (communication difficulties, lack of personal safety, legal implications etc.).
- The project team members competences, especially personal communication competence one is perceived as being very important.
- The organizational support is important, but the support that professional institutions might offer to projects is not perceived as relevant.

These conclusions allow authors to make the following recommendations for strengthening the success of investigative journalism projects in Middle-Est region:

- On the short term, the adoption of interventions included in Table 2, at individual and organizational levels that were not yet adopted might be considered as very relevant, increasing the professionalization of project management in the region.
- On long term, the adoption of society/regional interventions included in table 2 should be considered, for increasing the projectification degree in the region.

A special attention should be paid to communication, that is relevant in interventions at all three considered levels. Assessing the culture and values of a project team, as well as personal communication, are effective strategies for addressing cultural challenges in project management (Vukomanović et al. 2016). By understanding the team's strengths and weaknesses, building trust and encouraging open communication, and being aware of one's own cultural biases, project managers can create a more inclusive and effective work environment and successfully navigate cultural differences (DuBois et al. 2015; Gallagher 2022).

4. CONCLUSIONS

Based on literature review, the authors discuss the importance of understanding cultural aspects in multicultural projects. They identified the main cultural challenges such as awareness of cultural impact, understanding cultural characteristics, reduced team cohesion, aligning project goals with stakeholders' expectations, diversity of values, norms, attitudes and working styles, monitoring the effectiveness of project management processes in relation to cultural characteristics, stereotypes, biases, formal and informal power imbalances, cultural differences in change management, communication barriers, and building trust in multicultural teams. The review highlights that project

managers must be aware of cultural differences to lead more productive and efficient teams, and ultimately provide better results by being culturally conscious and enhancing .

The authors explored the challenges that arise in multicultural projects and pointed out the main interventions to address them. The interventions are categorized into three levels: individual, organizational and society/regional. At the individual level, interventions include developing cross-cultural communication competence and individual competences related to cross-cultural communication. At the organizational level, interventions include enhancing cultural awareness and improving organizational culture communication and collaboration between the project and organizational support structures. At the society/regional level, interventions include cultural diversity and inclusion initiatives and cooperation with relevant institutions. The article also emphasizes the importance of effective communication and building trust in addressing cultural challenges in project management.

In-depth analysis of the cultural challenges for investigative journalism projects, specifically of those executed in the Middle East region was performed based on literature review, with special focus on the narrative research conducted by the ARIJ institution. This research revealed the relevant cultural challenges, such as: getting sufficient information from sources, lack of institutional support, and lack of some individual competence in investigative journalism projects. The literature review discusses the importance of understanding cultural aspects in multicultural projects. The authors identified main cultural challenges, such as awareness of cultural impact, understanding cultural characteristics, reduced team cohesion, aligning project goals with stakeholders' expectations, diversity of values, norms, attitudes and working styles, monitoring the effectiveness of project management processes in relation to cultural characteristics, stereotypes, biases, formal and informal power imbalances, cultural differences in change management, communication barriers, and building trust in multicultural teams. The review highlights that project managers must be aware of cultural differences to lead more productive and efficient teams, and ultimately provide better results by being culturally conscious. Personal communication was identified as being critical in the successful manage of project culture and values. This includes promoting open communication and recognizing cultural gaps resulting in a more productive and inclusive workplace.

The authors explored interventions to address these challenges, which were categorized into three levels: individual, organizational, and society/regional. These interventions included developing cross-cultural communication, enhancing cultural awareness, and improving organizational culture communication.

As the main research limitations, we can mention the limited number of references and a relatively simple theoretical framework applied in organizing the literature review findings. Despite these limitations, we consider that the study is providing valuable insights especially for the investigative journalism projects executed in the Middle East region.

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CRITICAL SUCCESS FACTORS IN HYBRID PROJECT MANAGEMENT

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ABSTRACT

During the last decades in the project economy the desire of being more flexible and responsive has been increased. This desire paved the way for agile methods and practices to be adopted into environments previously defined as traditional. Thus it has opened the road of combining agile practices with traditional project management methods and plan driven approaches. This combination of methodologies is referred to as Hybrid Project Management (HPM), whose aim is to leverage the benefits from both Agile project management (APM) and traditional project management (TPM). The emergence of HPM is a recent phenomenon in project management examining challenges and benefits of using both agile and traditional project management models towards a hybrid model. Purpose: The study researches the challenges of combining APM and TPM practices providing specific Critical Success Factors (CSF) in IT and non-IT sectors. The challenges of both agile and traditional project management models represents the project management CSF in HPM. While other research has investigated the CSF in traditional and agile project management, this research studies CSF for hybrid project management. This research paper objective is to lay the foundation investigating critical success factors in Hyprid Project Management. Method: This research study has been carried out through semi-structured interviews as a research method, with experienced project managers and pmo leaders around the world within HPM. Inspired by Grounded Theory (GT), this study has employed purposive sampling and analyzed the data through a grounded analysis technique. The semi-structured interviews for the present study were conducted using online virtual tools with the participation of project management professionals from various countries around the world. This research shows that neither traditional project management nor agile project management is wholly similar to hybrid project management. As a further research outcome, the guiding principles have been formulated for showing which situations requires hybrid project management. Contribution: Project management practices can make change possible, therefore simple or complicated or complex types of project management practices are required. Academia benefits from this research through its insight into the increased demand for flexibility in delivering projects. The research will provide a deeper investigation on CSF concerning HPM and also benefits project management practitioners, since it will guide them where to use a certain project management practice. As an outcome, the research implies that project managers could better understand why and in which situation traditional approaches should be chosen, and why and when agile or hybrid project management approaches should be preferred.

***Keywords**: Critical success factors, agile, traditional, hybrid models*

1. INTRODUCTION

This research aims to investigate the trend combining traditional and agile project management practices, so-called 'hybrid project management', and to identify their challenges and benefits. It researches the main differences in Critical Success Factors (CSF) of HPM in addition to the already established factors for TPM and APM.

A key differentiator among others, between TPM and APM is the way in which project management processes are managed. In TPM, project managers have to use defined phases or stages in which each one of them has its own controls. In TPM these controls are known as "phase-gates" and we use them when each project phase delivers an outcome. TPM model, also-called the 'Waterfall model', is based on the notion that a linear or serial process model is organised in successive project phases. What this means is that at each phase the project manager has to obtain permission from a Steering Committee of the project or a Project Board before she/he is allowed to move on to the next project management phase. The scope of the project is defined at its initiation having the advantage of giving large corporations a high level of planning reliability. However it cannot be altered or it is quite complicated to alter once the project has been officially started. In contrast, adopting the agile approach, can altered not only the scope but also the priorities (Ciric et al. 2019) . This results for companies to cultivate the ability to adapt quickly to change and at the same time minimize the risk of developing a product which does not satisfy customer needs. Large corporations and multinational companies in particular, who require planning reliability, however, struggle to balance the need for planning reliability with flexible reactions to a changing environment and therefore fail to develop products whose requirements are not yet fully identified. Thus, during the last five years, project management professionals have begun experimentally to combine the traditional and the agile project management approaches, a combination for which the academia have not so far studied in depth. A study (Kuhrmann Diebold and Jürgen Münch 2017) indicates that there is not an absolute direction to choose a traditional or an agile project management practice. Other studies have revealed that about 77 % of project professionals combine various project management approaches and tools (Kuhrmann, Diebold and Jürgen Münch 2017). This indicates that only a small part of project professionals use a project management model in its pure form and most of them apply changes to existing models. This leads to a combination of use of multiple project management frameworks and their tools which formulates hybrid project management. However academia has not so many studies on this increasing phenomenon and has not yet researched the critical success factors (CSF) of HPM. This article consists of five sections. Section one gives an introduction to the article, providing background information in hybrid project management as the basis of the study and an overview of the research article as a whole. Section two provides background information in hybrid project management making a brief comparison between traditional and agile project management, to clarify the differences between them and gives the scientific basis for Critical Success Factors (CSF) in project management. Section three presents the methodology and the data collection and analysis design. Sec. four presents the results of our qualitative research. In the end, we discuss our findings and conclude.

2. HYBRID PROJECT MANAGEMENT AND CRITICAL SUCCESS FACTORS

2.1 Hybrid project management

An approach, which combines traditional and agile, is emerging and has been reported in various domains of literature by academics and practitioners. This is called hybrid project management approach. At its most general level, a HPM approach combines methodologies and practices from more than one project management approach. The hybrid project management approach is often considered for projects to increase stakeholder feedback and reduce the risk and uncertainties (Archer and Kaufman 2013). In general the aim of a hybrid approaches to take advantage of the benefits of the waterfall, agile and lean approaches and reduce their weaknesses. HPM popularity and the need for its adoption comes from the uncertainty and complexity the increasing integration of AI creates , as also from the higher expectations customers' have and the very demanding markets where the products need to compete.

In the author's former systematic literature review, the combination is considered as combining agile with traditional practices or several agile approaches. We will refer for all these combinations as the hybrid approaches throughout this research paper. To date, the combination of agile and traditional approaches and practices has been discussed in the software engineering, information systems, and practitioner literature (Papadakis and Tsironis 2018), but the effects, of adopting a hybrid approach, on performance have only rarely been explored empirically in the literature (Gemino, Horner Reich and Serrador 2020). The selection of the "right" project management approach may be the first and the most important decision a project manager has to take in order to meet the specific needs of a project and increase the probability of a successful project delivery. On one hand agile methods can add a faster delivery, seek to promote change and boost interaction with the customer (Paolo et al. 2019). On the other hand, TPM or waterfall project management gives you a clear, efficient plan and a structure for project delivery. Combining both approaches may provide an advantage for your project's success.

2.2 Critical Success Factors and project success

It is important to emphasize that the importance of project success criteria extends beyond the final evaluation of the project outcome. The importance of defining project success criteria in the initiation phase to align stakeholders and to establish a common vision about the project's outcome has been addressed from Jugdev and Müller (2005). Although much research has been carried out on project success criteria for projects that mainly follow the traditional waterfall model, it does not take into account the emergent characteristics of agile software projects and their combination with the already popular plan-driven approaches. Traditionally, project management has been associated with the fields of construction and engineering, where the project success criteria are objective, well-accepted, and measurable, usually by the conventional triangle criteria of time, budget, and compliance with the client's terms of reference, or 'quality'. Project management, however, has become very popular nowadays also in the service sector, as well as in areas like social voluntary work projects and capacity building and (Diallo and Thuillier 2005). However, projects according their context presents a complexity that demand a combination of agile and traditional waterfall approaches (Gemino, Horner Reich and Serrador 2020).

A definition for project success is that project success balances the competing demands for project quality, scope, time, and cost, as well as meeting the varying concerns and expectations of the stakeholders (Bannerman, 2008). However, Carlos Antonio et al. (2017) indicates that many other criteria were added recently together with the 'iron triangle' (i.e., cost, time, and quality). These include customer satisfaction, benefit to other stakeholders, benefit to the strategic objectives of the organization, and business success. Though there is no consensus on success criteria in the project management literature, the research study by Khang and Moe (2008) are comprehensive and relevant for development projects. The established criteria by those studies include efficiency, effectiveness, impact, and sustainability.

Methodological support in form of project standards for the successful execution of projects is supported and researched also by project management practice representatives and associations such as the Project Management Institute (PMI), the International Project Management Association (IPMA) or The Office of Government Commerce (Prince2). However, there is still a debate over which criteria are responsible for the successful project delivery. Therefore, the results are still rather heterogeneous. Some are derived from extensive collections of primary data while others rely on existing knowledge.

3. METHODOLOGY

The research was undertaken in two phases, a systematic literature review followed by semi-structured interviews with a range of project management professionals. In the first phase critical success factors which are responsible for the successful achievement of objectives were identified, based on an extensive literature review and on the researchers' professional experience.

In the second phase, an exploratory research was conducted which took the form of face-to-face interview with ten project professionals personnel around the world, four project managers, and six

pmo leaders who were experienced in construction engineering projects, software developement projects and consulting services projects. The purpose of the exploratory interviews was to elicit their views regarding the critical success success factors in hybid project management.

3.1 Data collection and analysis

The data for this research was gathered through semi-structured, individual interviews to obtain the personal perspective of each participant and to receive their opinion from their experience on the critical success factors in HPM. The interviews were conducted virtually during covid-19 pandemic.

As for the experience and expertise of the participants chosen for the research, this was an absolute requirement for the authors, as they needed people who were familiar with project management theories and different approaches, traditional , agile as well as having worked with hybrid approaches. The necessary practical experience was minimum 5 years.

The analysis of the discussions with the interviewers was done using content analysis as the most suitable method for analyzing data collected in the form of a text. The content analysis has been conducted with the help of MAXQDA software application (Maxqa 2009). Codes were classified into categories and subcategories. Definition of categories and the factor grouping was guided by the former systematic literature review and the data collection through the semi-structured interviews.

4. DISCUSSION AND RESULTS

The data results of the coding process were inserted into an excel file and a table has been constructed in order to presented their significance. The results are presented in Table 1.

65 codes were detected in the analyzed content, and they were classified into 5 categories: Organizational, People, practices, and project uncertainties. The classification was established to be in accordance with factor grouping in the former systematic literature review and the input from the interviews with the project professionals.

The most highest significant factors which determined and discussed during the interviews were in the practices/methodologies category.

Table 1: Presentation of results

Theme	Code	Freq per code
Organisational	Culture	3
	Technology	3
	Communication	2
	Values	4
People	Stakeholders	5
	Team	3
	Customer	2
	Leadeship	6
Practices/Methodologies	Traditional	13
	Agile	13
	Combination	8
Triangle	scope/requirements	1
	Time/Cost/Quality	2

5. CONCLUSION

Hybrid project management is a combination of traditional and agile project management approaches that aims to achieve the best of both worlds. It is a flexible and adaptable approach that can be tailored to meet the specific needs of a project and its team.

However, as with any project management approach, there are several critical success factors that need to be in place in order to ensure the project's success.

- Strong team: A strong team is essential for the success of any project. The team should be composed of members with the necessary skills and experience to complete the project, as well as a clear understanding of their roles and responsibilities.
- Effective communication: Effective communication is key to the success of any project. The project team must be able to communicate effectively with each other and with stakeholders, in order to ensure that everyone is on the same page and that issues are identified and resolved quickly.
- Flexibility and adaptability: Hybrid project management requires a high degree of flexibility and adaptability, as the approach is tailored to the specific needs of the project and its team. The team must be able to adapt to changes and challenges as they arise, in order to ensure the project's success.
- Continuous improvement: Continuous improvement is essential for the success of any project. The project team must be willing to review and adapt their approach as needed, in order to optimize the project's performance and deliver the best possible outcomes.
- Values and Culture: Organization needs to cultivate values that enhance inclusion. And a key factor to an inclusive culture is leadership. When people feel included, the more they speak up, go the extra mile, and collaborate, all of which ultimately lifts project performance.

In conclusion, a hybrid project management approach is a flexible and adaptable approach that can be tailored to meet the specific needs of a project and its team. However, the success of any project depends on several critical success factors, such as strong teams, effective communication, flexibility and adaptability, continuous improvement and values and culture. By keeping these factors in mind, organisations can ensure that their projects are completed on time, within budget, and to the benefit of all stakeholders.

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HOW TO CREATE AND MAINTAIN TRUST IN HYBRID PROJECT TEAMS? A CASE STUDY IN IT PROJECTS

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ABSTRACT

In the past two decades, virtual teams have become a natural form of work design, and their importance has increased, especially since the beginning of the 2020s, due to the Covid-19 pandemic. In addition to completely virtual teams, the importance of hybrid teams - that dually exist on a spectrum of virtualness and physical distance and use a combination of face-to-face and online communication - has also increased. Team trust has been widely discussed in academic literature as a fundamental characteristic of any work. It is also one of the most frequently addressed topics in the virtual team literature, which points to fundamental differences between trust in traditional organizations and virtual groups. This paper aims to summarize what was experienced during desk research on hybrid teams and trust in two periods, before covid-19 and since the emergence of covid-19 to the present day. Our hypothesis is that (1) a hybrid team is a tangible, from a research point of view, interpretable phenomenon and that (2) operation of hybrid teams, and the factors affecting their operation and success, will differ after the Covid-19 pandemic from those experienced in the previous period. If the hypothesis is confirmed, we would like to interpret the hybrid team as a unit of analysis and the post-covid-19 era as a context in a future case study research in the field of "Trust and its effects in hybrid project teams." With our current desk research, we also aim to provide a basis for additional hypotheses for our future research.

***Keywords**: hybrid team, virtual team, trust, Covid-19*

1. INTRODUCTION

1.1 Why Hybrid Teams?

With the development of information and communication technologies (ICT) about two decades ago, it became possible for project team members to work at a distance, forming virtual teams. (Drouin et al. 2010, 609).

Virtual teams have been present in our lives since then, and the trend toward virtual teams is visible (Paul et al. 2011, 185):

- Gartner found in 2003 that 60 % of professional employees work in teams (Gibson, and Gibbs 2006, 451; Martins, Gilson, and Maynard 2004, 805; Hacker et al. 2019, 1).
- In 2012, the estimate by Gartner (2012) for 2016 grew to 80 % (Hacker et al. 2019, 1), and the surveys of Virtual Teams in 2016 found that 85 % of the respondents work on Virtual Teams.
- According to the Society for Human Resource Management, in 2012, 46 % of surveyed companies used virtual teams (Minton 2012, 1),
- while a 2018 International Workplace Group Study found that 70 % of American professionals work remotely at least one day a week (Browne 2018).
- A trend report about hybrid work in IT found that 95 % of organizations are continuing some form of hybrid or remote work (Info-Tech Research Group, 2023).
- The so-called gig economy, in which people can work from anywhere as long as they are online, promises to resolve global unemployment by 2025 (McKinsey Global Institute 2015; Handke et al. 2020, 626).

Initially, the organizations using virtual teams aimed to create business value (Chatfield et al. 2014, 271), as well as exploit the opportunities that come from the integration of different knowledge resources, time and cost savings and more affordable opportunities for collaboration (Gibson and Gibbs 2006, 458).

Later, external – also forcing - factors made it necessary to turn to virtual work. From the beginning of the 2020s, the use of VTs increased due to the COVID-19 pandemic (Paul et al. 2021, 185).

The roughly 20-year-old trend of employees moving to an increasingly virtual work environment had grown exponentially due to the COVID-19 pandemic when the entire staff worked from home instead of a certain percentage of virtual working team members. A 2020 survey of 2,865 employees by Global Workplace Analytics found that 67 % of those surveyed in the US were working from home for the first time due to the COVID-19 outbreak (Newman and Ford 2021, 1).

The transition, which was a challenge for many (Newman and Ford 2021, 1), created a new situation: According to the 2023 research of the Finance Online Research Center, 64 % of organizations believe that the shift to virtual teamwork is likely to be permanent and 62 % of employees worldwide think that they would transfer from a co-located organization to a company that offers remote work.

Previously considered an exotic and niche phenomenon, virtual teams have become an established work design in the last two decades (Breuer, Hüffmeier and Hertel 2016, 1151).

1.2 Understanding the importance of Trust

Trust is a fundamental characteristic of any work, one of the most frequently studied constructs in organizational research (DeJong, Dirks and Gillespie 2016, 1134).

The phenomenon is considered essential for effective teamwork (Thomas and Bostrom 2010, 46), collaboration (Zolin et al. 2004, 1), communication, and coordination (Jarvenpaa et al. 1998, 47).

Several studies - conducted in the last 20 years confirm - regardless of whether they were published in the early 2000s or a few years ago - that team trust is positively related to team effectiveness. (Paul et. al 2021, 187; Breuer, Hüffmeier and Hertel 2016, 1155; De Jong et al. 2016, 1141; El- Kassrawy and Yasser 2014, 23; Costa 2003, 616). However, others have found no relationship (e.g., Hertel, Konradt and Orlikowski 2004, 20) or even negative correlations (e.g., Dirks 1999, 445; Langfred 2004, 390) between team trust and team effectiveness (Breuer, Hüffmeier and Hertel 2016, 1151).

Trust is also a frequently addressed topic in the virtual team literature (Drouin et al. 2012, 618). It is also examined as both a requirement and a challenge for team effectiveness, particularly in virtual teams (Breuer, Hüffmeier and Hertel 2016, 1152).

2. METHODS

With this desk research, we aimed to understand the topic of trust and hybrid teams by processing related research in two periods: before Covid-19 and from Covid-19 to the present.

The working method covered the literature review as a proven method for learning about the phenomenon and investigating the current knowledge.

As a first step, the relevant articles in the Google Scholar and Research Gate databases for the search term "virtual team or hybrid team" for the time interval 2000-2023 were examined. After processing these articles' abstracts and key findings, the relevant articles were processed in detail. In addition to interpreting the articles, this processing also meant that the cited references reflecting on our topic were examined: first according to their abstract and key findings, then the relevant ones in detail.

3. KEY FINDINGS

3.1. Key dimensions to understand virtual and hybrid teams

Based on the literature review, the dimensions we found to be crucial for understanding virtual and hybrid teams are the following:

- Virtuality
- Technology
- Management and organizational aspects

3.1.1 Virtuality - Structural properties vs. social construction

Virtuality and Virtual Team's definition is unclear, although a significant amount of research has been devoted to the phenomenon in recent decades (Fiol and O'Connor 2005, 20). It is also said that there has been a proliferation of definitions. (Martins et al. 2004, 806).

Previous definitions of virtuality are based on the one hand,

- on the percentage of time spent on a team task not spent face-to-face (Griffith and Neale 2001, 386),
- on the physical distance of the members (Hinds and Bailey 2003, 616),
- on the level of technological support (Griffith and Neale 2001, 386), and
- on its variety (Griffith and Meader 2004, 386).

On the other hand, virtualness is defined as the degree of face-to-face contact between team members (with attention to both the degree and frequency of contact) and suggests that technological support is more of a trend for virtual teams but does not define Virtual Teams (Fiol and O'Connor 2005, 20).

According to recent publications, virtualness is defined as

- the amount of computer-mediated communication (CMC) the group uses lies on a continuum from face-to-face to fully online groups (Martins, Gilson and Maynard 2004, 808).
- the distance between team members (Foster et al. 2015, 269).
- geographic dispersion and technological dependence in work-related interactions among employees (Foster et al. 2015, 281; Klonek et al. 2022, 186).

Groups can be characterized by varying degrees of virtualness and varying geographical distances, so they are expected to be defined and analyzed along these factors. (Kahlow, Klecka and Ruppel 2020, 54).

Based on "cues-filtered-out" theories, all these definitions focus on structural properties, commonly defined as objective features, such as the distance between team members and communication technologies, which filter out critical social cues that make it difficult to transmit and receive messages in communication. (Handke et al. 2020, 625).

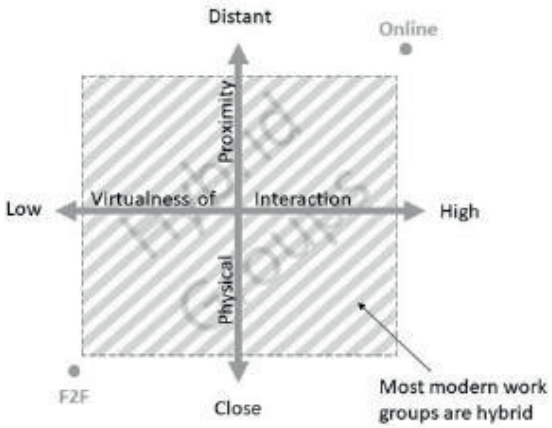
Without disputing the importance of structural properties, another part of the researchers argue that the social construction of a situation is at least as necessary from the point of view of understanding virtual teams. For example, it is more important that team members consider themselves well synchronized than whether they are objectively in the same time zone or communicate face-to-face. In other words, virtuality is dependent on structural properties and on the social-cognitive construction of their shared experience (i.e., Team perceived virtuality) (Handke et al. 2020, 626).

3.1.2 Virtuality as a continuous phenomenon

Not only the earlier but state-of-the-art definitions point out that virtuality is not a discrete category but rather a continuous phenomenon: face-to-face and pure virtual teams differ from the so-called hybrid teams, which do lie on a continuum from more to less virtual (Fiol, and O'Connor 2005, 20; Mitchell, and Brewer 2021, 1; Klonek et al. 2022, 188).

Kahlow, Klecka, and Ruppel state, "most modern work groups should be treated as hybrid groups that dually exist on a spectrum of virtualness and physical distance." They use a combination of face-to-face and online communication, making them hybrid (Kahlow, Klecka, and Ruppel 2020, 52; Griffith, and Neale 2021, 386) and perform their tasks while working from different locations (Klonek et al. 2022, 186; Wiatr, and Skowron-Mielnik 2022, 1).

Figure 1: Definition of Hybrid Groups



Source: Kahlow, Klecka and Ruppel 2020, 55.

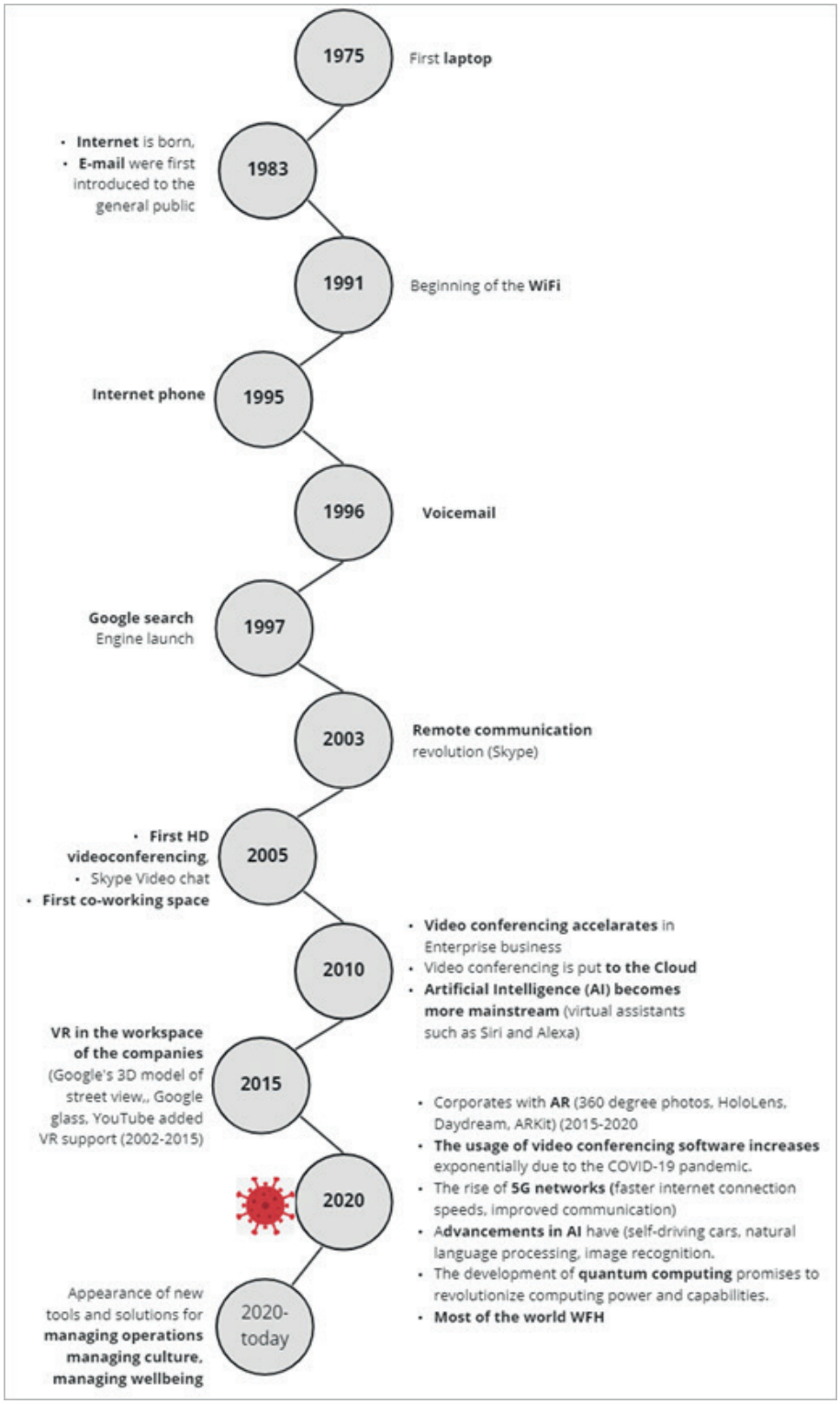
3.1.3 Technology

The role of technology in defining and understanding the functioning of virtual and hybrid teams is indisputable. As Drouin puts it, technologies are and always will be inextricably linked to the virtual team concept (Drouin et al. 2012, 612). This is supported by the fact that – as we presented in chapters 4.1.1 and 4.1.2 - technology and communications technology are also essential elements (structural properties) of the concept of virtuality, and technological support is a trend for virtual teams (Fiol and O'Connor 2005, 20).

Although the previously mentioned cues-filtered-out theories (i.e., media richness theory (MRT)) by Daft and Lengel (1986), Media naturalness theory by Kock (2005), Media Synchronicity Theory (MST), Dennis, Fuller and Valacich (2008) and research based on these examines the extent to which technologies of different richness filter out important social cues from communication and point to the extent to which technology-supported communication distances us from the most natural form of communication, face-to-face communication, it is indisputable that the constantly developing technology is increasingly present and unavoidable in our communication, regardless of the physical distance of the participants in the communication.

The figure (Figure 2) below shows the technological innovation, the results of which we use in virtual and hybrid teams. As we can see in the figure, the development progresses from less rich mediums to richer mediums.

Figure 2: Technology Innovation (own editing based on Internet data)



According to Media richness theory (MRT), task performance, particularly in the case of complex tasks, improves with communication media of higher richness (Aritz et al. 2008, 6). Research also suggests that richer channels lead to higher group effectiveness, and the time to complete tasks is also decreased (Aritz et al. 2008, 6). However, a less rich, "leaner" medium has its place, as it can reduce conflicts (Suvinen and Valo 2006, 65; Drouin et al. 2012, 612).

However, according to the latest research, technology can be seen not only as an enabler, which is less effective than face-to-face communication due to the exclusion of social cues. Technology and infrastructure as a public utility have a significant role in all areas of life and work (Hopkins 2023, 3086). Technology, furthermore, can be seen as a strategic category to re-imagine, re-improve, and re-invent the workplace (Ancillo et al. 2021, 2297).

3.1.4 Management aspects

By management aspects, we mean, in summary, those aspects that enable operation in virtual mode and increase the efficiency of the virtual teams, making them successful (Drouin et al. 2012, 613).

A wide range of studies are focusing on key success factors regarding virtual team performance. These factors include –but are not limited to - communication and information sharing (Vakola and Wilson 2004, 112.), management support, technological support, team members' commitment, and perceived benefits (Bissoonauth 2002, 15–22), good communication processes, availability of adequate technological tools and training to use them, standardized team practices, a common vision and goals, strong and shared leadership, team competence, shared information and know-how, and support from upper management at all locations and trust throughout the project life cycle (Drouin et al. 2012, 613).

The research for the period between 2020-2023 does not refute these factors, but at the same time, clarifies and supplements them and translates them to the new modes of operation.

In connection with good communication processes, it is argued that communication shifts from physical meetings to virtual channels and virtual offices Instead of technology, the digital work environment comes to the fore as a concept (Micic and Mastillo 2022, 5), and it is argued that we live in a digitally connected world (Mitchell and Brewer 2022, 7). Strong and shared leadership is replaced by encouraging shared leadership among team members (Newman and Ford 2021, 8).

3.2 Key dimensions to understand trust

As we discussed earlier, trust as a fundamental characteristic of any work is one of the most frequently studied constructs in organizational research (De Jong, Kroon, and Schilke 2016, 11), and it is also a frequently addressed topic in the virtual team literature (Drouin et al. 2012, 618).

Although scholars have long been interested in the study of trust in organizations, no definition of trust has been universally accepted (Costa 2003, 606).

The definition of trust is approached from two main directions in the trust literature.

According to one approach, trust involves "positive expectations about others" (Costa 2003, 606).

- More recent studies use the definition proposed by Lewicki, McAllister and Bies (1998, 441), according to trust is "Confident, positive expectations about the conduct of another." (Hacker et al. 2019, 3).
- Giddens (1990) defines trust as "confidence in the reality of a person or system, regarding a given set of outcomes or event" (Zidane 2021, 3),
- According to Mayer et al. (1995, 712), trust is the treatment individuals expect they will receive from others which is in line with the definition by Lewicki and Bunker (1996, 116) that argues that trust is expectations about others.
- Smith and Barcley also define trust as individual attributions about other people's intentions and the motives behind their behavior (Smith and Barclay 1997, 3).

According to the other approach, trust can be understood as the "willingness to be vulnerable" (Mayer, Davis and Schoorman 1995, 712) which is the most cited definition of trust (Costa 2003, 606).

- According to Lewis and Weigert, trust would not be needed if actions could be undertaken with complete certainty (Lewis and Weigert 1985, 970).

- Lewicki and Bunker argue that trust involves not only expectations about the motives and intentions of others but also consideration of situations and the risks associated with them (Lewicki and Bunker 1996, 116).
- However, it is essential to understand that "there is no risk taken in the willingness to be vulnerable" (i.e., to trust), but the risk lies in entering into a trusting action, i.e., when the willingness to be vulnerable is manifested (Mayer et al. 1995, 712).

Despite the difference in the definitional background, researchers indeed examine trust as a success factor in the performance of virtual teams (Drouin et al. 2012, 618), as it is essential for collaboration, communication, and coordination. (Jarvanpaa, Knoll and Leidner 1998, 29–64).

4. RESULTS

The main findings of the two periods are collected in the following table along three grouping dimensions (Virtuality, Technology, and Management).

Table 1: Results of literature review – Virtuality dimension

Before 2020	Dimensions	2020-2023
Cues-filtered-out theories in focus: **structural properties** (distance between team members and communication technologies) filter out important social cues that make transmitting and receiving messages in communication difficult.	VIRTUALITY	**Social-construct theory** comes into focus: Virtuality as a collectively constructed, team-level emergent construct ("**Team perceived virtuality**")
Face-to-Face teams vs. **Pure virtual teams**		Virtuality as a **continuous phenomenon**
		Most modern work groups should be treated as **hybrid groups** that dually exist on a spectrum of virtualness and physical distance
Definition based on **physical distance, percentage of time spent not face-to-face**, **level of technological support,** and its variety.		A new **way of diversification of virtuality** (time worked virtuality, member virtuality, distance virtuality)
		Positioning **hybrid work based on the place of work** (office work, working from home, working from anywhere, third places, hybrid work as an intersection of these)

Table 2: Results of literature review – Technology dimension

Before 2020	Dimensions	2020-2023
Technology is linked to the virtual team concept, an **enabler** that is **less effective than face-to- face communication** due to the exclusion of social cues.	TECHNOLOGY	Technology and Infrastructure as a **public utility**, ICT has a significant role in all areas of work and life.
		Technology as a **strategic category** to re-imagine, re-improve, and re-invent the workplace
		Digitally connected world
From **„lean" to „rich"** media		Use of **web-conferencing systems** (e.g., Zoom and Teams), **online messaging platforms** (e.g., Teams, Slack), **online collaboration tools for online ollaboration** (e.g., MIRO, Mural, Zoom), improved VR and Metaverse environments.
		The appearance of new tools and solutions for **managing operations** ("office hoteling apps"), **managing culture**, connection, community, and trust (e.g., Fond, Nectar for acknowledgments, recognition of work, Culture Amp, and Everperform to analyze data and monitor culture), **managing wellbeing**, mental, physical, and social health (e.g., OKPulse for assessing employee wellbeing against benchmarks to detect stress and anxiety.)

Table 3: Results of literature review – Management dimension

Before 2020	Dimensions	2020-2023
Virtual teams to **create business value**	MANAGEMENT	**Digital workplaces**; key to success is business alignment, people alignment, and IT alignment.
		Hybrid workplace as an **employee benefit**
Face-to-Face teams vs. **Pure virtual teams**		Remote working and a new sense of workplace ("fully located," "alternating on-site," "on demand on- site, "remotely connected," and "working from anywhere")
Strong and shared leadership		Encouragement of s**hared leadership among team members**
Good communication practices as a success factor regarding virtual team performance.		**Upgrade communication practices**, fill the gaps in the communication flow.
		Shifting from physical meetings to virtual offices and channels
Building trust as a **relational process that is** essential **for collaboration, communication, coordination, and team performance.**		**Building trust** as a **relational process that is** essential **for collaboration, communication, coordination, and team performance.**
The challenge is to nurture **trust,** connection, and community and **promote a culture of psychological safety when employees are working in virtual/hybrid teams.**		The challenge is to nurture **trust,** connection, and community and **promote a culture of psychological safety when employees are working in virtual/hybrid teams.**

5. DISCUSSION

Research in 2020-2023 and before 2020 does not fundamentally contradict each other regarding virtual/hybrid work and trust.

We found no change in the definitions behind the phenomena and the related theories. Based on the research results, it can be established that the key aspects (dimensions) have not changed; however, the related research results and findings point to a process of change.

It cannot be determined whether these changes would have occurred without COVID-19; research after 2020 confirms that COVID-19 played an accelerating role in these processes and that research after 2020 has given new content to previously examined elements, supplementing them and translated them to the post-covid-19 period.

In terms of *distance*, instead of teams working at "zero distance" (face-to-face teams) and "always at a distance" (pure virtual teams), hybrid teams, which dually exist on a spectrum of virtualness and physical distance, appeared and will remain. They can be "fully located," "alternating on-site," "on-demand on-site, "remotely connected" and "working from anywhere." They may also differ in office frequency and days (office frequency and days are either both fixed or fully flexible, or office frequency is fixed, but attendance is flexible) and in terms of distance virtuality, member virtuality, and team time worked virtuality.

We accept that hybrid teams are a diverse and enduring element of digital workplaces and the digital world as support for our hypothesis.

The continuous development of *ICT* in recent decades is indisputable. Long before the pandemic, digital technologies had developed to such a level that they made it possible to perform tasks regardless of location (see Figure2).

Presumably, the knowledge workers worked full-time in offices because of the workplace norms and regulations established in the previous decades, not because physical presence was necessary to perform the tasks or because technology would not have made it possible to work remotely.

However, using already-known technologies, new ICT solutions appeared that supported work during the pandemic and whose use also remained in the post-pandemic period.

New tools and solutions have emerged for *managing day-to-day operations* ("office hotel apps"), managing *culture*, relationship, community, and trust (e.g., Fond, Nectar for recognition, recognition for work, Culture Amp, and Everperform for data for analysis and monitoring of culture), for managing *wellbeing*, mental, physical, and social health (e.g., OKPulse for assessing employee well-being based on benchmarks for detecting stress and anxiety).

The fact that the ICT solutions designed to deal with the pandemic remained in the post-pandemic period and supported not only work, but also everyday life is accepted as a confirmation of our hypothesis.

As we can see in the result (Table 3.), the diversity of hybrid teams, the new modes of operation, and the ICT solutions to support them, point in the direction that they require a different management approach in the post-covid-19 era.

As a limitation, we identify that in addition to the fact that (1) trust and the creation and maintenance of trust are essential relational processes in both covid-19 and post-covid-19 literature, (2) trust is both an input and an output of the functioning of teams, as well as (3) the perceived impact of the team performance is a research area, we were not able to show meaningful results on the topic of trust based on the processed literature. Another limitation is that the results found along the management aspect are very diverse, and we could not draw any conclusions from them regarding the management of post-covid-19 hybrid teams. However, the limitations only confirm that the planned case-study research can be an interpretable step to getting to know the field better.

6. CONCLUSION

The purpose of this article was to summarize the results of desk research related to hybrid teams and trust in two periods, before covid-19 and since the appearance of covid-19 to the present day, and to provide a basis for confirming or rejecting our hypothesis.

Our hypothesis is that (1) a hybrid team is a tangible, from a research point of view, interpretable phenomenon and that (2) operation of hybrid teams and the factors influencing their operation and success differ after the Covid-19 pandemic from those experienced in the previous period, was confirmed based on the processed literature.

Since our hypothesis has been confirmed, we will interpret the hybrid team as a unit of analysis and the post-Covid-19 era as the context for a future case study research on the topic of "Trust and its effects in hybrid project teams," and we are planning further research on trust and trust-related processes, as well as their potential relation to team performance.

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DIGITAL TECHNOLOGIES

INTEGRATING WEB3D TECHNOLOGIES IN K-12 CURRICULUM AS A POSSIBILITY OF BROADENING SOCIO-ECONOMIC DEVELOPMENT AND CHANGE WITH INNOVATION

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ABSTRACT

Technologies of the cyberspace, such as Web3D-based virtual reality (Web3DVR), information production and visualization (IPV) techniques and spatial computing communication concept and practices, including transdisciplinary scientific knowledge, have been integrated and used by the industry worldwide. So, there has been the challenge of how integrating such technologies and transdisciplinar knowledge on individuals' education trajectories for broadening individuals' participation in the processes of socioeconomic development and change with innovation. This work has contributed for decreasing such challenge. It has inspired lifelong educational practices carried out based on utilizing Web3DVR as IPV technologies. This work outcomes have indicated that such educative computing practices (ECP) have instigated citizens' socioeconomic development and change with support of learning and applying technological innovation at K-12 education levels and beyond. Subjects have direct manipulated Web3D VR technologies, as the Extensible 3D (X3D) language/format and the X3dom platform through integrating real time 3D computer graphics programming, IPV techniques and learning/teaching transdisciplinary scientific concepts. ECP have enhanced individuals' cognitive and technical skills for dealing with computer science principles. Educational adoption and diffusion of Web3DVR has resulted in developing use cases and embracing digital transformation for a sustainable and ethical future. Hence, amplifying individuals' skills for participating, actively, in society changes based on learning to think in multidimensional and complex forms with accuracy, impacting in inspiring ones' lifelong learning and professional achievements.

***Keywords**: coding literacy, lifelong learning, Web3DVR technology, cognitive and technical development*

1. INTRODUCTION

The cyberspace and its immersive[1], emerging technologies, such as Web3D-based virtual reality (Web3D-VR) (Havele 2022) and information production and visualization (IPV) techniques (Chen 2006), including spatial computing communication concept and practices (Diamandis 2019; Spatial Web Foundation 2021), based on utilizing 3D computer graphics programming and visualization for building and visualizing three-dimensional (3D) digital spaces (Cunningham 2007) have been enhanced. These technical processes have happened through research and development, which combines innovative digital techniques and transdisciplinary scientific knowledge. As a result, digital techniques and practices, and scientific knowledge combination has been transformed, ameliorated and adopted in the form of immersive, emerging (IET) referent to extended technologies (XR) (such as virtual reality (VR), augmented reality (AR), and mixed reality (MR)), which have been applied by the industry worldwide (Amon 2023; Havele 2022; Vista Equity Partners 2022).

Innovative XR applications are in the Neurotechnology[2] filed and available in consumer products, which may be used for recreational and mental augmentation purposes. But 'effects of applying neurotechnologies are still unclear and their unregulated use can entail risks for human rights related to freedom of thought, mental integrity and to some of its underlying pre-conditions, as dignity, identity or human agency'. Conversely, neurotechnology applications go far beyond medical sphere. Its applications potential can enhance student's learning and cognition. It facilitates features as 'virtual and augmented reality systems that are supported by brain control and can be used for entertainment' (UNESCO 2023, 6).

These have been some reasons why problems and benefits of utilizing IET and XR involving 3D VR applications should be discussed within a viewpoint of supporting ethical, security and human dignity. So, it is thought that accessing, manipulating and understanding principles, practices and scientific concepts related to IET evolutions and transformations can and should be carried out through learning and teaching processes in all education levels.

Hence, it has been identified lack on individuals' cognitive and technical skills preparation during graduation courses and in-service for dealing with computer science knowledge and practices, as coding abilities, in integrated way with teaching and learning processes (Franco 2020; Reynard 2023; Szabo et al. 2019) involving Sciences, Technology, Engineering, Arts and Mathematics (STEAM) (York 2023). It includes ones' lack of skills for using knowledge and practices related to XR and IET innovations. It is the case of individuals' difficulties for understanding why and how applying 3D computer graphics programming and visualization techniques at K-12 education levels and beyond (Franco 2022; Youngblut 1998).

Conversely, as analysed in (Amon 2010), accessible and cheap Web3D VR-based tools related to using 3D computer graphics programming and visualization techniques for building 3D digital objects and virtual reality (VR) spaces can provide inspirational opportunities for educators in-service and students at k-12 education levels acquiring, comprehending and applying XR, IET and coding knowledge, techniques and practices in an integrated mood.

So, this work use cases of applying Web3D VR-based IET and coding in K-12 curriculum, and describing their impacts on individuals' educational and professional lives can provide adaptable hints related to what for, how to, when and where to utilize IET for enhancing formal and informal educational situations. Hence, the use cases impacts have extended results described in the related work section. These artworks have brought about inspirational examples on how social and techni-

1 Immersive technologies create distinct experiences by merging the physical world with a digital or simulated reality. Augmented reality (AR) and virtual reality (VR) are two principal types of immersive technologies. These technologies share many of the same qualities. However, AR blends computer-generated information onto the user's real environment, while VR uses computer-generated information to provide a full sense of immersion. (Vista Equity Partners 2022)

2 The field of neurotechnology broadly encompasses any electronic device or method that can be used to read or modify the activity of neurons in the nervous system. Its potential to help cure mental illnesses and neurological disorders may amount to one of the most important medical achievements throughout history, opening a highway of hope for people suffering from diseases that go from Parkinson, Alzheimer's, stroke and addiction to hearing loss and blindness. (UNESCO 2023).

cal development based on ethic use of IET have been in service of providing security and dignity to individuals (Alma Mater Europea 2023).

1.1 Web3D Virtual Reality IET in the Inspirational Related Work

Web3D VR IET and scientific knowledge as learning resources have been applied on diverse experimental educational investigation in an integrated mood. For instance, "The Virtual Harlem Project (VHp)" (Virtual Harlem 2023) has formed a collaborative learning network that investigates the Harlem Renaissance and supports Afro-American literature and cultural studies via utilizing 3D VR scenarios, which are used for distance learning, addressing ones' social and educational enhancements needs. But, VHp has not provided an authoring tool interface for ones applying scientific and technical knowledge via creating 3D content.

Another Web3D-VR educative work has focused on producing and providing access to Web3D-VR-based biology, ecology or medicine 3D models for being used in education. It is the 'Bioanim Project' (Amon 2023), which has high level interactive, visual information about cells composition by using accessible IET, 3D VR techniques. Since 1999, this project has applyied Web3D technical innovation in sustainable ways. So, citizens have accessed the 'Bioanim project' (2023) scientific knowledge via ordinary consumer devices, meaning that the researchers have taken care of the ethical side and social significance of this work.

At k-12 education levels, the project 3D Alpha (2022) has provided activities for training individuals via exploring accessible authoring possibilities related to using Web3D-based tools and ready to use open source 3D modelling software, as Blender 3D[3]. The use of Web3D-VR tools, as the Extensible 3D (X3D) language/format, has provided opportunities for educators and students experiencing hands on 3D computer graphics programming techniques through after/before and classroom workshops. However, there has been a lack of information related to long term impacts on individuals' educational and professional lives.

1.2 Purpose and goals

The goal of this work is to share use cases referent to an educational research and reflect about its long term impacts related to integrating Web3D technologies in k-12 curriculum as a possibility of broadening socio-economic development and change with innovation.

This work attempts to answer some research questions. How coding and scientific knowledge integration can be applied and scaled in the everyday learning and teaching proceedings at K-12 Education levels and beyond? What can/will be the impacts of students and educators direct manipulating Web3D and IET languages/formats and techniques while and after acquiring and applying scientific concepts from K-12 curriculum? How hands on coding at k-12 levels can broadening socio-economic development and change with innovation?

There has been comprehension that answering these questions is complex. However, even having as a reference a limited, real world impact which is based on the educational context, as the one described in this article, answer these questions can contribute to reduce a lack of information about how would be middle and long terms impacts, beyond short term human-computer interaction (HCI), of implementing introductory programming activities at K-12 schools (Szabo et al. 2019), through integrating 3D computer graphics programming, Wev3D VR and IET with learning and applying scientific concepts in educational activities in K-12 education settings (Franco 2020; Sharp, Rogers and Preece 2007; Youngblut 1998).

This project long term outcomes, based on the (Computational Action 2023) (CA) concept, which is 'not just about learning about technology - it's also about a framework for learning how to make a lasting impact with a project activities', have been educative computational practices (ECP) (Franco 2020) that have inspired individuals' acquiring and reflecting about why and how enhancing their digital, visual, spatial and conventional literacy skills. Including ones' lifelong learning and professional development based on utilizing Web3D technology and coding knowledge, techniques and practices as companions (Franco 2017; 2022).

3 Blender. https://www.blender.org/ . Available (February 12, 2023).

1.3 Strategies and Instruments

This has been qualitative research, which combines participatory, direct observation in the field (Sharp, Rogers and Preece 2007) literature review and action research techniques (Paiva 2019) based on applying Web3D VR and IET knowledge. Its ECP have inspired individuals' engagement in constructive learning trajectories related to hands on textual 3D computer graphics programming or 'coding', and, real time, visualization of the symbolic representation of the programmed code through 3D objects built or reused for compound Web3D VR spaces.

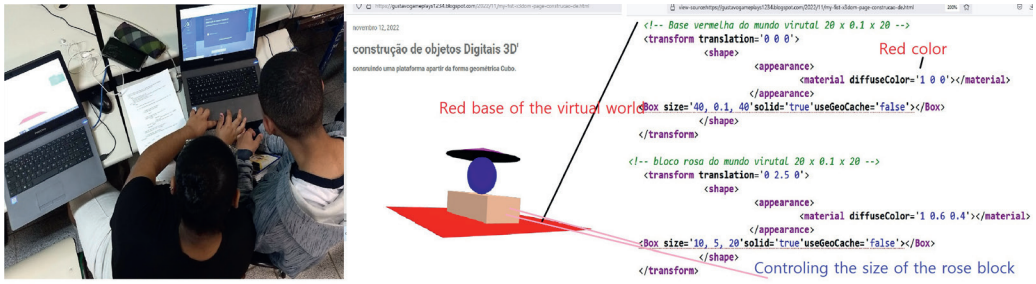
The collaborative and participatory ECP and Web3D tools used for constructing such 3D VR spaces have provided integrated ways for individuals' acquiring and applying transdisciplinar knowledge, for instance, referent to integrating digital and analogue technology, mathematics, geometry, arts and languages scientific concepts and practices studied during K-12 curriculum and beyond (Franco and Lopes 2012; Franco 2020, 2022).

The ECPs have encompassed direct manipulating information production and visualization tools and their evolutions, which have been integrated in web-based browsers, as Firefox™ and Google Chrome™. It includes instigating subjects acquiring conceptual knowledge and technical skills related to coding web-based hypertext languages/formats, such as Hypertext Markup Language (HTML) for producing and visualizing two dimensional (2D) interfaces and Extensible 3D (X3D) for creating and visualizing 3D computational interfaces.

Both, HTML and X3D have been integrated in web-browsers through the implementation of the (X3dom 2023) framework, which have allowed ordinary citizens, even with cheap computing devices, actively, participating, discussing and understanding digital transformation processes through producing their own 3D objects and IET experiences in accessible and sustainable ways. Hence, web-based standard IET instruments, as HTML and X3D and its integration with and for expressing scientific knowledge, have been included in the construction of the cyberspace and metaverse infrastructures (Ball 2023; Havele 2022).

Then, integrating tools like these on citizens' education, even in territories in which ones have been under socioeconomic, cultural and educational disadvantage worth it. Web3D VR tools have brought about opportunities for training and empowering educators in-service, students and surround school community for dealing with advances in IET. It is the case of Ernani Silva Bruno (ESB) Primary School community, located in the suburbs of Sao Paulo city, Brazil. This project has been carried out at ESB and inspired individuals' conscious or well-informed commitment (Freire 2011) with learning how to deal with concepts and innovative tools utilized in the digital transformation[4] processes (Grajek and Reinitz 2018), figure1.

Figure 1: Students from 9th grade using Web3D tools as X3dom for coding and creating a 3DVR sculpture



Source: Author's archives and students' blog https://gustavogameplays1234.blogspot.com/2022/11/ my-fist-x3dom-page-construcao-de.html.

As on figure 1, the data used for describing and analysing this project results have been collected through photos, audio and video, and X3D code and visualization analysis. It includes informa-

4 Digital transformation (Dx) is a series of deep and coordinated culture, workforce, and technology shifts that enable new educational and operating models and transform an institution's operations, strategic directions, and value proposition. (Grajek in Reinitz 2018).

tion gathered via diverse social media, this author's personal e-mail, face to face formal and casual meetings with educators, current and former k-12 students.

2. USE CASES, PROCEEDINGS AND REFLECTIONS

Figure1 shows a trajectory of using Web3D VR tools with students through an ECP at ESB computers lab. ECPs have inspired ones' participation in collaborative and transdisciplinar learning process. For this, individuals have applied Web3D VR standard technologies for creating e-mail (Gmail™) and blog (Blogger™) accounts. After that, ones have utilized the X3dom framework (2023) and its tutorials for learning how to coding through using Blogger HTML code editor for writing/coding and reading HTML/X3D files. Then, citizens have used a web-browser for visualizing, interacting and navigating 3D VR content, as figures 1 and 2.

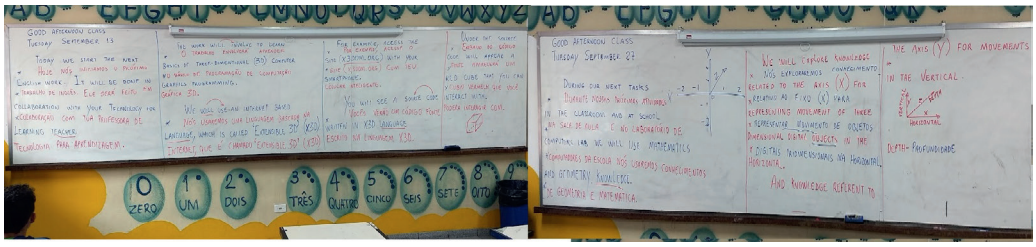
Figure 2: Symbolic representation of a collaborative trajectory of learning and building 3D VR content

Source: Author's archives.

As English teacher at ESB Primary School, in collaboration with 'Technologies for Learning' (TL) educator, this author proposed ECP with 64 students from 9th grade A and B classes, from September to December, 2022, figure 2. For sharing and scaling previous 3D computer graphics coding knowledge learning trajectories with individuals (Franco 2020), English language texts were created on the blackboard and discussed with students in the context of teaching English grammar and cultural uses, including its application in the transdisciplinar composition of artificial computer languages figures 1 and 3.

These teaching actions have been utilized to avoid individuals' distractions observed in past HCI through ECPs inside ESB computers lab, while explaining about the connection among coding 3D VR objects and spaces as opportunity for enhancing spatial, visual, conventional, digital and scientific literacies in transdisciplinar way, figures1and 3, and explained bellow.

Figure 3: The use of English Language for compounding artificial computer languages



Source: Author's archives.

ECPs have stimulated citizens' further comprehension about the use of English language for communicating and building artificial computer languages, as X3D. X3D is compounded by scientific knowledge involving mathematics (**numeracy** as in the (tag) <Box size='**40, 0.1, 40**' solid='true'useGeoCache='false'> </Box>), connecting geometry and arts (colours and shapes composition, red and rose boxes, blue sphere and purple cone for building 3D VR sculpture), and applying languages (English and Portuguese) for programming and producing source code commentaries within the **symbol** (**<!-- - - >**), as in (<!-- **Esfera azul de raio quatro / Blue sphere of ray four**-->) by writing and reading in conventional ways, as on figure 1, on the right. It includes to reflect and learn how algo-

rithms have been combined in a modular form, and for example, made part of developing artificial intelligence (AI) systems, Table 1.

Table1. Algorithms of a shape and light nodes, written and connected in a modular form in X3D language

```
<!-- Esfera azul de raio quatro / Blue sphere of ray four-->
        <transform translation='0 9 0'>
            <shape>
                <appearance>
                    <material diffuseColor='0 0 1'> </material>
                </appearance>
                <Sphere radius="4" > </Sphere>
            </shape>
        </transform>
<!-- Luz do ambiente / Ambient light -->
    <pointLight ambienteintensity="1.0" location="0 40 0" on="true" radius="50"> </pointLight>
```

Source: A former 9th grade student's blog source code: https://gustavogameplays1234.blogspot.com/ 2022/11/my-fist-x3dom-page-construcao-de.html.

ECPs referent to hands on Web3D VR tools and coding, in a modular way, have impacted on ones' grasping that even digital advanced systems, as AI ones and 3D VR interfaces, have used combinations of letters/words and numbers, and transformed our society. Then, Web3D VR ECPs and their real time visualizations outcomes have been powerful arguments for discussing with citizens, since K-12 levels (Franco 2020, Franco 2022), why and how, beyond of being used to push 'ready to use and/or simplified' digital/computational interfaces buttons, human's mind needs to keep reading, writing, researching and articulating diverse concepts and technical processes for keeping its capacity of complex thinking (Nicolelis 2020).

Therefore, ECPs have brought about instigating citizens' comprehending and sharing how social and technical development based on ethic use of advanced technologies can and have been in service of providing security and dignity to individuals in a surrounding community territory, since K-12 school levels. During COVID-19 pandemic period, March to May 2020, this author and the TL educator extended their collaborative teaching, which started in 2017, through supporting TL educator's artwork related to adapting previous ESB Primary School ECPs of 3D VR coding with her high school students, in a State School where she worked. She and her students used advanced three dimensional information production and visualization technology (A3DIPVT), applying the Blogger platform HTML editor, the X3Dom framework and smartphones as tools for coding and visualizing 3D VR objects (Oliveira, 2020). This ECP coordinated by the TL educator can and have been an example of answering related to how scaling technical and cognitive knowledge and broadening socio-economic, cultural, educational development and change with innovation'. The ESB Primary School ECPs use cases outcomes, for instance, as the TL educator and the 9th A and B classes, have extended the 3D Alpha (2022) related to work results, referent to decreasing a lack of information about how educators trained in-service with Web3D VR tools can/would/will use their enhanced technical skills in the future and impact on students' active learning attitudes.

3. CONCLUSION

All the 64 students had access to the initial coding and visualizing trajectory of producing a blog with a 3D red platform, as written on the physical paper, figure 1, on the left, which, for example, together with both students (girl and boy), we used for sustaining participatory HCI with 9th grade A and B. These ECPs have stimulated mental processes beyond visualizing 3D VR produced by third party (Chen 2009). ECPs have brought about learning to research and hands on 3D worlds design and 'processes, production, content generation, concepts, or strategies in 3D imaging', interactivity and engagement with virtual or physical displays (Siggraph Conferences 2023b). Including to access

and explore opportunities to pushing for 'progressive wider representation of marginalized communities both on- and offline without compromise or assimilation' (Siggraph Conferences 2023a).

However, there have been technical accessibilty problems related to a need for a larger and deeper internet infrastructure and maintenance available for all citizens. Even when students bring and use their own devices, for instance, smartphones for coding and visualizing 3D VR content, figure 2 on the right, if the school WI-FI is out of service, it not possible to carry out ECPs in classroom outside the computers lab. This problem has also affected citizens under social and economic disadvantage in marginalized territories. They have not had economic resources for buying smartphone credits and stay on-line all the time.

For decreasing such problem, it should have deeper infrastructure maintenance and up to date of Web3D information visualization software tools, as the FreeWRL™[5], an X3D viewer browser. It is designed for working, off line, with diverse operating systems, allowing the development of standalone 3D VR coding and visualization artwork, which can be inserted in a webpage later through using the X3dom framework. But, FreeWRL has not worked within Android™ 8 operating system and superior versions. An alternative X3D viewer and 3D VR content creator is the Castle Game Engine™[6], which may support X3D within an Android™ system. In previous artworks, as (Franco and Lopes 2012; Franco 2017; Franco 2020), the internet connection available and the X3dom framework was underdevelopment, so this this author and former-students used standalone browsers, as Castle Game Engine and FreeWRL, for keep studying and creating 3DVR worlds.

These adaptive uses of advance XR and IET, including HCI particpatory and collaborative learning processes have impacted in long term outcomes, such as former students graduating in Computer Scince (CS). A former-student who was in a CS graduation course in 2017, (Franco 2017) has worked as Information Technology Analyst in a university and is finishing a post-graduation course in Master Business Administration (MBA) (Docencia Superior / Higher Education Teaching). Another former-student who also studied CS (Franco and Lopes 2012; Franco 2020), has worked as game translator and web developer through coding Java. He has been attempting to learn React, Javascript and PHP, which are web-based languages.

So, based on using the computer fundamental capacity of integrating techniques and scientific knowledge (Santos 2001), these ESB community and subjects outcomes have been evidences of how, in long term results of educational and professional development, ECPs carried out since K-12 education levels can and have inspired citizens engaging in well-informed technical and cognitive knowledge enhancements trajectories, which have brought about broadening socio-economic, cultural, educational development and change with innovation.

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ESTIMATING THE ECONOMIC IMPACT ON THE BUSINESS THROUGH THE INTERNET OF THINGS (IOT)

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ABSTRACT

In this day and age, to grasp the notion of connectivity anytime, anyplace, the Internet of Things (IoT) refers to the global connection between items and associated concepts such as mobile and ubiquitous computing. To ensure that this link is not disrupted. IoT, as well as its proliferation and penetration in organisations, have generated a new competitive economy that motivates the non-digital sector to hold a different view of their business. The analysed business model, which is based on the findings of top IoT Scholars has three major components: Who, Where, and Why. The word "Who" indicates the collaboration of corporate partners that generates a "Value Network." The terms "Where" and "Why" are related to the sources of collaborative value creation that are based on the digital object layer model, and the partners who profit from working in the value network are defined. The suggested framework for strategy, tactics, and value chain components is integrated to explain "How" this model operates.

***Keywords**: competitive economy, organisation, internet of things (IoT), business model, value network*

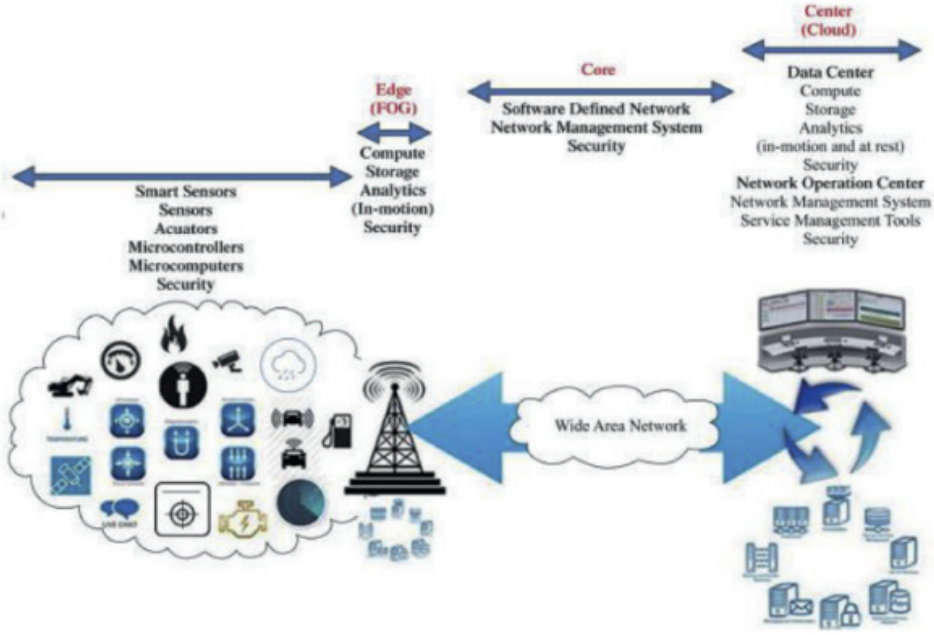
1. INTRODUCTION

In the future, more than 125 million computers are projected to be linked to each other and to cloud infrastructure, generally called the Internet. (Nizeti et al. 2020).

The future of the Internet of Things (IoT) indicates that it can boost sectors and offer improved resources by using it. Nevertheless, as the Internet of Things evolves, so do possibilities and obstacles, such as the opportunity for new opportunities or the absence of a pre-defined process. (Ghanbari et al. 2017).

Providers need the sophistication of IoT technologies to ensure security, scalability, and find compatibility and solve real technological problems with the rise in population and rapid proliferation of IoT technology and its deployment in various fields such as smart homes, transport, climate, and, most importantly, industry. Technologies for the Internet of Things offer applications and resources to ensure synergies between advantageous and productive results in the area of effective smart grids and utilities. (McKinney 2015; Nizeti et al. 2020) Fig 1.

Figure 1: The general structure of the IoT network and connectivity



Source: Nizeti et al. 2020.

Conventionally, each object is associated with another object and interacts with it. This feature becomes possible through many methods and technologies, including radio frequency identification (RFID), near-field communication (NFC), and infrared (IR) sensors.

In this respect, by delivering valuable knowledge to control and improve the tracking of flows and properties, IoT technology can make this possible. This can be achieved by defining (e.g. via RFID or barcode), finding (e.g. via GPS), and tracking asset parameters and status variables (e.g. via Wi-Fi or GPRS / GPR network). The introduction of IoT technology allows remote control processes to be coordinated, automated and managed from any computer connected to the Internet. (Nizeti et al. 2020).

The internet of things (IoT) is the result obtained from the confluence of three main perspectives: Internet orientation (Interface), Object orientation (sensors), and semantic (knowledge). According to Groupe Spécial Mobile Association)GSMA(, although there is not yet a conventional protocol for communicating smart objects, we still know that IoT will change the world. It is expected that, in IoT, "smart objects/things" become active participants of the businesses and connect with the environment by exchanging data and social processes, in which they can communicate with each other

and with the environment, while automatically reacting to the events of the real "real world", and its impact by implementing processes that set up activities and create services with or without direct human intervention (DeMorais, Sadok and Kelner 2019; Hamza, Gharakheili and Sivarman 2020; Lee and Lee 2015).

The services will be able to interact with these "intelligent object/things" using standard interfaces that provide links through the Internet for cases such as query and their status modification, retrieving any related information, attention to user account security, and privacy issues (Hamza, Gharakheili and Sivarman 2020; Vermesan et al. 2015). The definition of IERC is distributed around the world to invent and develop the IoT samples and its concepts through integrating various statements and documents presented as „objects", „Internet", „semantics", and „identification of objects" in terms of IoT by individuals and organizations (Westerlund, Leminen and Rajahonka 2014). In this way, the physical objects became configurable, accessible and reasonable. The integration of digital technology with physical content can provide very different results in the industrial arena. (Dijkman et al. 2015).

The purpose of the present study is to evaluate the business models. Hence, a business model framework is proposed, and more importantly, this model is evaluated by examining the practical examples of this mole's application in the business.

2. ORGANIZATION OVERVIEW

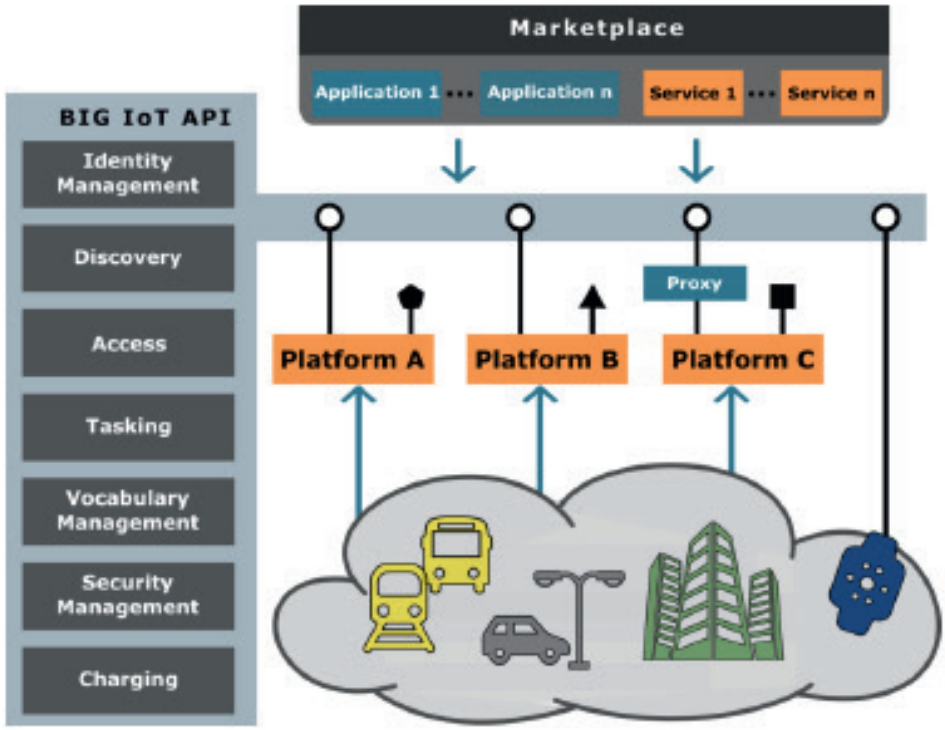
New Arg Telecommunication Services Company was established in 2002. As an operator of telecommunication networks, it has cooperated with major telecommunication operators in the country and various industries such as oil, gas, automobile and railway lines. The company is implementing more than 2 million fixed telephone ports and more than 2000 mobile sites in the country. And put the access layer on the agenda and now has a major market share of this product. The production activities of this group include the production of electronic components in various industries such as the production of ADSL, VDSL, and LTE telecommunication modems or the production of electronic components for domestic automotive companies. With various companies such as Irancell, Mobinnet, etc. He has cooperated.

3. LITERATURE REVIEW

3.1 Examining the business model of IoT

A company implements its revenue and profit generation program in the form of a business model, (Eisert and Gassmann 2012). An easy-to-understand and classified plan to make a business profitable is essential for every successful company traditional business models are designed on a company-oriented basis, nevertheless, considering the principle of interoperability in the IoT ecosystem, we conclude that traditional business models are not efficient today Figure 2. Furthermore, the rapid shift of the market environment in the technology-related industries shows that companies need to move quickly through market challenges to succeed. Companies follow their big production trends by following the big trends, and this leads to progress in production and technological growth.

Figure 2: IoT Ecosystem Overview



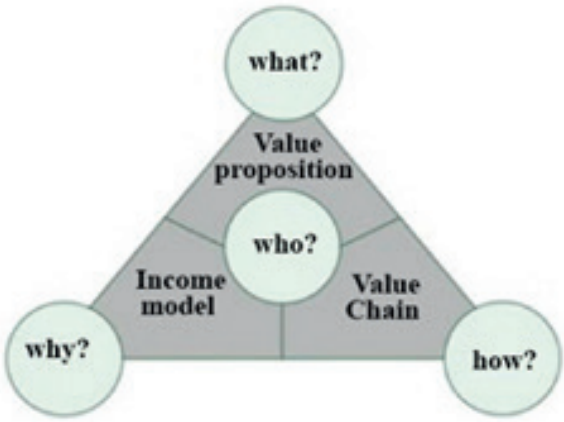
Source: Broring et al. 2017.

Consequently, the business models and innovations presented in it are in the direction of becoming competitive and discovering new paths. When scholars intend to design an IoT business, they usually describe key issues such as "the information between knots, and exchange of useful information for all beneficiaries." Moreover, they identified three contemporary IoT challenges: A variety of objects, Innovation maturity, and unstructured ecosystems. The variety of objects is usually connected with many different kinds of objects and refers to devices that lack generally accepted or emerging standards. The immaturity of these innovations is an implication of today's pure IoT innovation that its services and products have not matured. Unstructured ecosystems refer to issues cases such as the lack of defined structures and management, the role of beneficiaries and the logic of value creation.

Despite these challenges, there are some frameworks for the IoT business model, but there are still Fundamental gaps in the Internet of things that have not yet been addressed. (Chen 2013).

The business model consists of the following basic components:" Who, what, how and why." With environmental changes, the business model is exposed to testing and development. And is able to show potential opportunities. The business model produces value by focusing on the target customers and by measuring the superiority of its services and products over competitors showing how the value chain from the workforce to the design and construction of even the supplier works to present the value proposition to the customer. And states that each service should be provided in such a way as to predict cost structure and revenue flow through payment schedules and pricing strategies. And be able to provide valuable services to future customers in the long run. The four components mentioned in Figure 1 should be considered in a business model in order to achieve good results and make the model operational. This is the basis of the business model. (Lee 2021; Turber et al. 2014).

Figure 3: Business Model Prototype

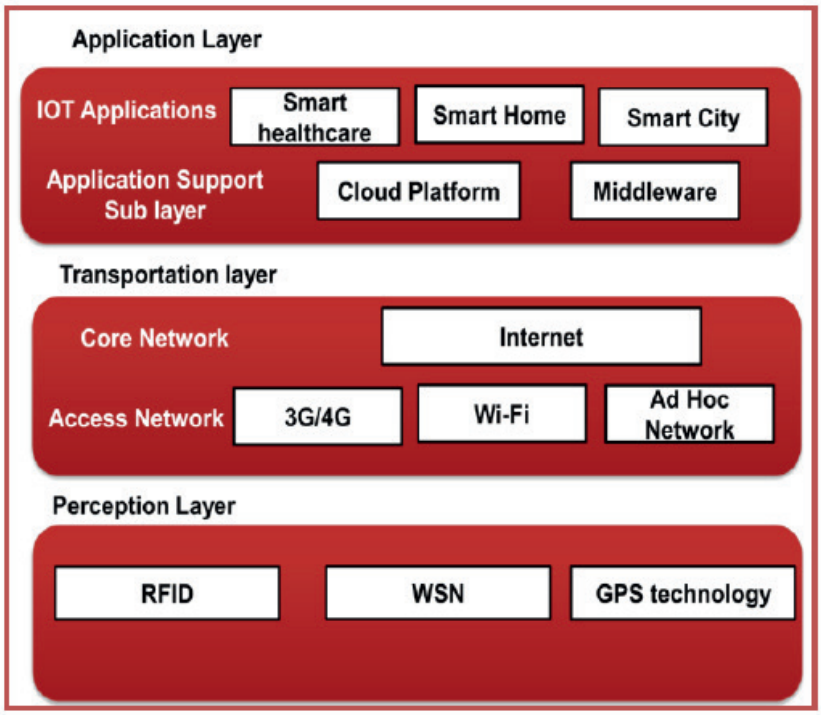


Source: Turber et al. 2014.

The changes that occur in the product line as the result of creating values in the traditional way of thinking are not enough for meeting the existing needs responsively, respond to immediate and emergency needs in a predictable way, and filling out the known established business models and frameworks. IoT valuation is based on three layers of production, Support and value creation. (Holler et al. 2014).

As seen in Figure 4, researchers are providing the IoT three-layer architecture. (Ramalingam and Prasanna, 2019; Ahlawat, Sangwan and Sindhu 2020; Lawal and nabizadeh 2021; Yousefi, Karimipour and Derakhshan 2021).

Figure 4: Architecture of IoT



Source: Ahlawat, Sangwan and Sindhu 2020.

3.1.1 Perception Layer

The first step is to enable smart services and to gather textual information on the environment, „things" and objects of interest. For the provision of information, various wireless technologies such as wireless sensor networks, body area networks (BAMs), WIFI, Bluetooth Zigbee, GPS, GSM, mobile phones, and 3G can be used. This layer's security risks include physical attacks, DOS (Denial of Service), and Routing Attacks.

3.1.2 Transportation Layer

Pervasive and automatic services are delivered by computers everywhere in both programmed and intelligent forms. This layer's security threats include routing attacks, data transit attacks, and DOS attacks.

3.1.3 Intelligent applications and services Layer

In connection with transmission capacity, processing capability, and energy efficiency, heterogeneous network capacity has been enhanced according to the needs of consumers and the configuration of such software. This layer is capable of supplying clients with high-quality services. This layer's security risks include data leakage and the insertion of malicious code.

Each company can present its business in several layers. Some researchers assumed that the main components of the IoT are the "central ecosystem", "core ecosystem" and "business model". They created a framework that was connected to a variety of IoT business models with basic ecosystems. The ecosystem type of framework (private closed or networked open) and the type of customers (business and consumers) are two main subjects. (Morgan and Smith 2012) used so some case studies from the automotive industry, including intelligent procurement of future automotive products and logistics; Current RFIDs in vehicle procurement; Traffic Safety Services; and Tracking car logistics (Kindstrom 2010).

Individual companies should be able to build smart partnerships, such as collaborative forms of basic IoT. If a company is unable or unwilling to cooperate, it will not become competitive. This attention would be transferred to various other parameters, particularly when the content of the services is increased in the IoT market. The business model of IoT has three scopes: who, where, and why. "Who" describes the collaborative partners that build value networks. In addition to all companies that produce IoT products, it also includes customers and beneficiaries in order to reflect the network-driven tendency toward customers being the main builders and manufacturers of value companies. "Where" is rooted in the sources of value creation in the layered model of digital objects. There are four opportunities for values added by colleagues.

These layers include devices, connections, services, and content. The device layer includes hardware and an operating system; the network layer includes transmission, the standard network and physical transportation; the service layer provides direct interaction with users through applications, while hosting the content layer, data, images and information.

"Why" describes the benefits for partners working on a value network that includes both monetary and non-monetary benefits. Three factors needed for designing business ecosystem business models and IoT-based business models are Stimulants, value knots, value exchanges and deductions. Stimulants include both individual and shared stimuli from participants who fulfil a need for value creation, understanding and realizing innovation and creating money in an ecosystem. Value knots are various actors, activities or processes (automatic) that are related to other knots creating value. Value exchanges refer to: the exchange of value with different tools, resources, knowledge and information between/with different value knots. (Fleisch, Weinberger and Wortmann 2015).

3.2 Business Model Patterns in IoT

The purpose-oriented goal of this paper is to examine the feasibility of IoT-based business models and provide a good base for the development of IoT business models. These models should be inspirational and presented at an abstract level so that their application in the industry becomes facilitated. To do this, several business model patterns and many applications have been analyzed concerning the stage at which their value is created. The results of this analysis can be presented as six components for business models and patterns of IoT-independent business models. Based on their strength and dependency (all of which facilitate the process of providing digital product services over physical products.), in a specific pattern, the new business model for the Internet of objects is merged as the designated digital product, as shown in Table 1.

Table 1: Components and Patterns of the IoT Business Model

Components	Business Model pattern
Physical Freemium Digital plugin Digital login Padlock Products as self-service Points of Sale Use and monitor remote conditions	Digital Assigned Products

Source: Fleisch et al. 2014.

In the following, the unique components and patterns of the business model are briefly described:

3.2.1 Physical Freemium

This component is a physical asset sold with a free digital service without adding extra charge (Fleisch, Weinberger, and Wortmann 2015). When customer information and marketing are more important than operating costs.

After a while, a few percent of customers will choose superior services that go beyond those that are released and then factored, such as electronic monitoring or markup across the entire customer base. For example, the canary is a startup in New York City, which is an intelligent home alarm system that includes a variety of temperature sensors and motion sensors to a camera. Functions such as monitoring a space during the absence of its residences and sending a message to a smartphone program during abnormal events are included in the primary function system of this device for free (Rong et al. 2015).

3.2.2 Digital plugin

Digital plugin is a term that is used for a component of a business model in which a very cheap physical asset is sold with a small budget. After a while, the customer is able to activate digital services as desired for a higher fee. (James 2014). When the car's performance can be configured using the software and the car can be considered as a node on the internet, then the customer can purchase a 50-high pressure (HP) surplus for the weekend.

For example, when the plugin service is provided by third parties, the customer can easily purchase an additional premium for entertainment in Italy. (Chen 2013).

3.2.3 Padlock digital

It refers to a sensor-based digital encounter that ensures the limitation of a consistent adaptation, and prevention of fraud and guarantees. The padlock digital-in physical products refer to a sensor-based digital vibration that limits the adaptability and prevents fraud (Westerlund, Leminen, and Rajahonka 2014). Examples of this are smart thermostats that work by sensors rather than using feedback from the atmosphere, such as smart lock control, smart room temperature tracking, path sensors, wind speed sensors, adhesive sensors, or reaction sensors. (De Boer, van Deursen and van Rompay 2018; Bagdadee, Hoque and Zhang 2020).

3.2.4 Products as sale points

Physical products are converted to digital sales and digital service sites. The customer uses the service directly or indirectly through a smartphone and identifying technology. A gum packet-like product turns into an electronic store, and any object can carry digital ads and generate its collections and transfer its loyalty points and capture the digital world around itself through a smartphone.

3.2.5 Self-service objects

Self-service is a component that is able to place commands on the internet separately. In this model, intermediaries, such as the pattern of the direct sale business model, have been distributed. Direction provider business models are determined by automatically ordering the refilling of consumable materials (McKinney 2015).

3.2.6 Using and monitoring remote conditions

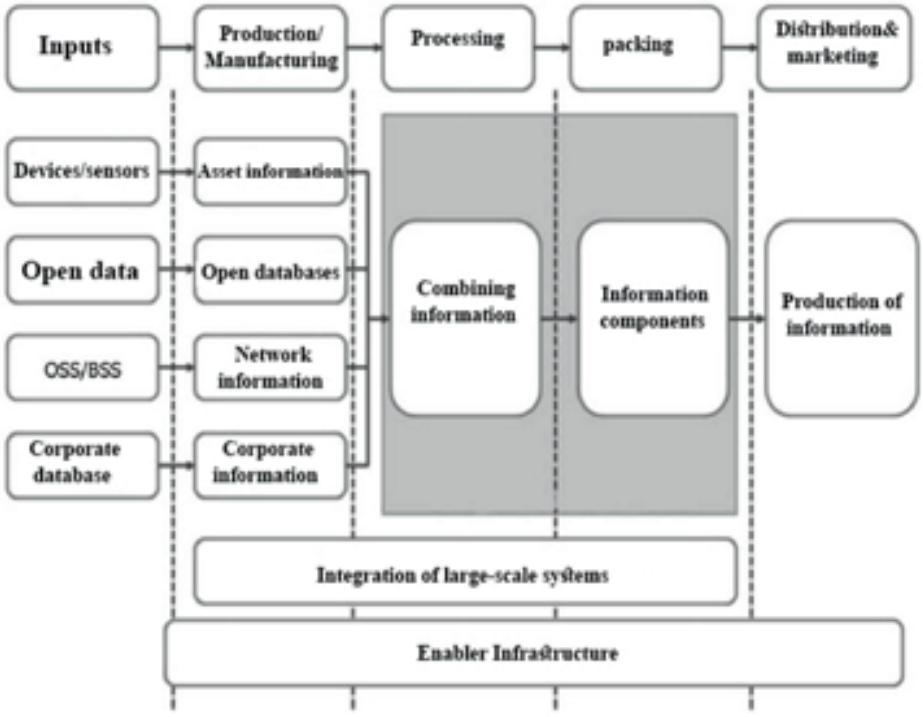
"Intelligent" objects can immediately transfer data about their situation or their environment. This ability helps to prevent mistakes and it is possible to control inventory and consumption. Until now,

the required technology was complicated and relatively expensive, but with the expansion of IoT, costs and expenses are reduced. For example, people can use their smartphones to control the situation (home temperature setting). All of these components are common tactics used by many associates in the IoT ecosystem. (Bunchier, Eisert and Gassmann 2012).

3.3 Value chain

Value chains divide the company's activities into a sequence of value-generation activities, which start with the concept and end with the final use. Value chains for IoT companies are more complex than those that are traditional products; nevertheless, the basic concept remains the same. There are at least 9 products for categories of separate services or products presented in Table 4 along with the value chain in the IoT (Holler et al. 2014; James 2014). However, this report does not classify groups in different layers of architecture. (Holler et al. 2014) proposed a more detailed information-oriented value chain for IoT. As it is shown in Figure. 5, there are four inputs. Each of these four inputs, in addition to indicating their values, is ended as a product through manufacturing /producing, packaging, and then distributing and marketing. The Raw data is collected through a variety of sensors or business systems and corporate databases. processing and categorization can be subdivided into services that also contain product information. The "content" includes all information products. This category contains all the layers proposed in Table 4 (James 2014) and Figure 4 (Ahlawat, Sangwan and Sindhu 2020). Then, the value of each partner along the value chain is then shown in the table. The IoT strategies are identified in a column: a future strategy for the market, a strategy for controlling the market, a future strategy for the technology and a strategy for controlling the technology are added. Moreover, a column shows that the tactics included by Fleisch et al. (2015) and Holler et al. (2014) have been incorporated.

Figure 5: Knowledge-oriented chain for the IoT



Source: Holler et al. 2014.

Their control is one of the most significant problems in the Internet of Things ecosystem due to the non-uniformity and increase of data. In order to deliver customer support, conventional programs are not able to monitor the data collected. (Muthuramalingam et al. 2019).

When data is raw, it is processed and packaged by fixed wireless. Due to the variety of these large data, their speed and volume, infrastructural enablers and integrators of large-scale systems are required.

Nevertheless, different players must overcome the issues of collaborative capability, as was mentioned before, throughout the value chain. Indeed, in the absence of standardization of components and lack of sharing between programs in different markets, players to solve this problem seek to discover software solutions for software and services designed.

3.4. Challenges in IoT Evolution

Objects face problems in both levels, which are summarized in figure 3, based on the architecture seen by the Internet. (Ahlawat, Sangwan and Sindhu 2020; Hossain, Hasan and Skjellum 2017)

3.4.1 Data management challenge

The data output volume in this layer is huge and a small number of companies can store and maintain it.

3.4.2 Privacy challenge

There are questions in this field regarding user protection because of the safety of user information and management control.

3.4.3 Security Challenge

The threat of hackers and attackers is still there with various new devices.

3.4.4 Chaos Challenge

Because of the lack of communication with the IoT sector and network failure, the life of the customer would go into turmoil.

3.5. IoT definition

(Gabi et al. 2013) concluded that today's technologies have a significant impact on businesses. Today, with the help of modern technologies such as connections, wireless communications and sensors it is possible to have connection and communication everywhere. The Internet has crossed the WWW or, in other words, other fixed pages, and the Web, also known as social networks, moves toward the Web, the world of all-places processing. Li et al. (2014) claimed that business owners also distributed many contents and information about IoT and considered it a novel approach to ICT and believe that IoT has good potential for earning money. According to estimations of Gartner IT Institute (published in July 2014), it is expected that the IoT reach maturity in the next 5 to 10 years in the new emerging technologies cycle. Lee et al. (2020) claimed that the use of the internet would compete with efficiency and productivity as well as minimize business losses for businesses (Nizeti et al. 2020). Biresselioglu et al. (2020) claimed that an energy transition was necessary, provided that we are facing a decline in fossil fuels in the future (Nizeti et al. 2020). Lane et al. (2019) introduced the implementation of the IoT Internet as a network infrastructure linking various resource-sharing, research, and management networks (Jurcut, Ranaweera and Le-Khac 2020).

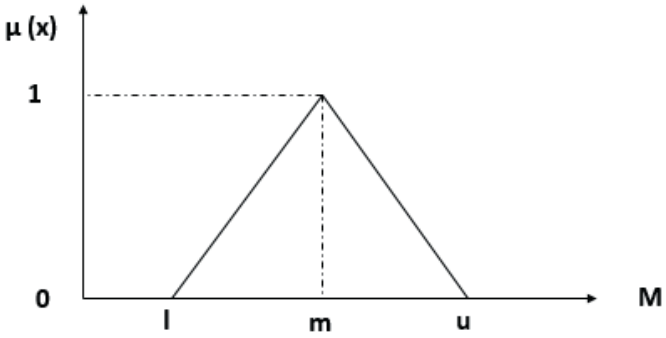
Morrii et al. (2018) explained IoT as a network of devices connected with sensors, electronics, software, and connectivity. Azzurri et al. (2011) concluded in their research that the purpose of the IoT was to empower objects to connect at any time and place with anything and anyone who would ideally use any route or network and service. The IoT is an expanded part of the Internet. The IoT is a new technology that deals whit the environment and the connection of wireless and wired objects to each other.

Vermansen et al. (2011) indicated that these objects work together to create new applications or services and achieve common goals, and in fact, the development challenges are considered in order to create an intelligent and global world. A world that is digital and virtual and directed toward the formation of smart environments. This world also creates smarter areas of energy, transport, health, cities, etc. In 2020, Moniruzzaman et al. suggested that it will boost the quality of living, control time, and save money by using the Internet of Things in smart cities. Nizeti et al. (2020), Carter and Stone (2011) stated that the three-stimulation required for IoT development in countries includes achieving economic success, increasing the quality of life and protecting the environment, which has been addressed in the literature on sustainable development.

4. RESEARCH METHOD

The model of the hierarchical analysis process is a multi-parameter decision-making methodology developed by Saaty in the 1970s (Saaty 1998). In the hierarchical process, the elements of each level are compared in pairs at a higher level than their respective element. In 1996, Chinese scholar Chang designed the fuzzy Analytical hierarchy process based on the analytical development method. The FAHP method was developed based on the AHP method and fuzzy logic. The numbers used in this method are fuzzy triangular numbers. The geometric space of such a set in the fuzzy environment is shown in Fig. 6.

Figure 6: A triangular fuzzy number



Source: Boyokoskan et al. 2011.

Triangular fuzzy numbers are given as (l, m, u). The parameters m, l and u are the smallest possible value, the most probable value expected and the maximum possible value, respectively. Each triangular fuzzy number is represented as a linear representation by Right and left for its membership function can be defined as follows:

$$\mu\left(\frac{x}{M}\right) = \begin{cases} 0 & x < l \\ \dfrac{x-l}{m-l} & l \le x \le m \\ \dfrac{u-x}{u-m} & m \le x \le u \\ 0 & x > u \end{cases}$$

Triangular fuzzy numbers (l, m, u) are used to create a pairwise comparison scale, and a pairwise comparison matrix is constructed for each level in the hierarchy. Then, the subsets of each row in the matrix are calculated to have a new set. The general triangular fuzzy values (li, mi, ui) for the Mi criterion are obtained by calculating Li / li, mi / mi, ui / ui, (i = 1,2,..., n). Membership functions, which means the average weight of the corresponding options in the corresponding matrix, are calculated using these values for each criterion. They are normalized and the final weight of the importance of each criterion is obtained.

In this method, the 5-member membership function and the definition of the fuzzy scale are described in Table 2.

Table 2: Membership function and definition of fuzzy scale

Membership function	Definition	Severity of importance
10.9.8	Infinitely important	8
8.7.6	Very important	7
6.5.3	Important	5
3.3.2	Relatively important	3
2.1.1	Equal Importance	1

Source: Boyokuzkan et al. 2011.

The implementing stages of the AHP methods are as follows:

- Reviewing theoretical literature for determining the indicators of sustainability and IoT applications in the business field;
- Formation of the decision-making team for examining the validity of the questionnaire;
- Distribution of questionnaires and formulation of matched paired comparison matrices with fuzzy vocabulary for each Question sheet;
- Weighing the indexes and Assign points the rating of each option in each of the indicators using the Chang development analysis (FAHP) method;
- Ranking the IoT applications in the business field using the FAHP method.

FAHP method calculations were used in line with Chang's (2011) method to measure the weight of indicators and prioritize IoT applications.

5. RESULTS AND FINDINGS OF THE STUDY

Determining the weight of the indexes and the score of options in each indicator is carried out after the session held for filling out the agreed questionnaire. Four paired comparison questionnaires (a questionnaire for comparing the indicators with each other and three questionnaires for comparing the IoT applications in the business field based on each one of the indices (By fuzzy expressions) were completed using Table 1 and, using the FAHP method. The weight of the indices was obtained from the paired comparison matrices for each index. The incompatibility rate of pairwise comparisons was evaluated and because it is less than 0.1, the pairwise comparison has good stability and compatibility.

5.1. Ranking options using the FAHP method

Finally, with the help of the weights obtained for the sustainable development indicators (Figure 6) and the decision matrix (Table 3), the final points and scores are obtained for each application of IoT technology in the business field through the FAHP method. These points and scores are shown in Table 4.

Table 3: Classifications of IoT Strategy

Market pressure	Industrial Driving Force	Stretching technology
pre-informed Objective Strategy development	A pre-informed strategy in the market such as Haier Strategy development in the market such as Local supermarkets	A pre-informed strategy in technology such as Cinterion Strategy development in technology such as Junmp

Source: Li et el. 2012.

Table 4: Score and priority of each IoT application

Options	Priority	Scores
Processing	1	0.3532
packing	2	0.2529
Network	3	0.1980
Services	4	0.1306
Content	5	0.0553
Advantages	6	0.0100
Strategy	7	0
Tactic	8	0
Product Information	9	0

Source: James 2014.

6. CONCLUSION

The results of this study will raise awareness about IoT technology, introduce the innovative uses of this new technology in the business field to use, emphasize the development of new services using the IoT technology, and encourage the consideration of sustainable development indicators for using modern technologies.

Generally, organizations will be able to grow their business with the help of the Internet of Things. A company implements its revenue and profit generation program in the form of a business model. An easy understanding and classified plan to make a business profitable is essential for every successful company. The purpose of this study is to inspire innovations in business and large communities to develop business models based on the IoT. The overall framework of the IoT business models was analyzed based on available documentation, and a framework was proposed Challenges were identified. In the end, this framework was studied in the market using a practical example that is used in some countries in some countries. These examples can be used in other similar businesses and other countries. It is possible to continue the studies and research of this field to further expand it and operate more business models.

In today's markets where current products rely on current technology, the production process is moving towards digitalization and a greater focus on cloud computing, artificial intelligence, robotics, and so on.

However, this study has some limitations as well. For example, because the IoT technology has not yet matured in our country and much of its applied experience is limited to the business field, it may affect investing motivations that were based on prioritization, which makes it necessary to conduct technical and economic feasibility examinations before implementing the development of these applications. Furthermore, the government still does not support IoT governance, its regulation, or the rights of consumers and producers, so this could be the subject of future research on the use of IoT in the country.

Standards and standards are being established by government policymakers, regulatory agencies, and sector partnerships. This dilemma may be the focus of potential studies into the country's use of the Internet of Things technologies.

On the other hand, by influencing some areas of manufacturing or business, the Internet of Things can minimize labour and direct social connections, which must be taken into consideration. To guarantee them the price they pay for the design, quality and safety of these products, a certain level of reliability and convenience for customers will be necessary.

Protection is extremely important in every human-related category, like IoT-based packaging products, in such a manner that "safety training" is one of the top priorities, and the safety of these devices from manufacturers to retailers to customers to users will be important to all. Consequently, by understanding their IoT-based business model and leveraging effective resources to strengthen their business strategy, the Internet of Things allows enterprises who wish to be part of a business network to revisit their approaches to their business, sector, and marketplace.

AUTHOR'S NOTE

I hereby declare that the given paper is an extension of my previous research work.

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TRANSIENT PATTERN OF INTERSPECIES COMMUNICATION

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ABSTRACT

In the paper is focused on the possibility to record or to visualize pattern of communication of coupled systems human, non-human and more than human, from the view of ArtSci research and practices. If can emerge meaning (or feeling) in the interrelation of communicative pattern of each communicative unit, it is possible to find the principle which can organized understanding and its explanation by the artistic expression. The biosemiotics view of patterned cognition and communication comes from Maturana and Varela's 'Structural coupling' theory, in which the recurrent interaction of unit and medium causes structural coupling, which is reflected in a patterned cognition and communication. Maturana and Varela (1972) and Jakob von Uexküll's umwelt theory. The Interrelation of human- machine – human communication reflected was by Philippe Bootz`s procedural model of communication and the introduction of performative signs. It relates to the unstable form of communicative artwork. The formal principle of how the artwork can be organized is based on the interconnection of agential and intuitive approaches, which are presented by pattern. As a part of the research will be used qualitative methods of analysis data of communicative interaction of water bodies. Collected data will lead to the acknowlegeing the principle of speculative theoretical approach. In the conclusion is described formal principle of a patterned communication which relate to specific hybrid interface.

***Keywords**: pattern of communication, sympoiesis, structural coupling, interface, water bodies*

1. INTRODUCTION

Philippe Bootz in the procedural model of communication described human (author and reader) and machine relation in which is developing a text of programmed e-lit. work Bootz describes all kinds of participation and each state of production and perception of communication by the e-literatury artwork. In the „Cross Reading" method, he uncovers the principles by which the reader can approach more closely the essence of literary artwork Procedural model is a description of extensive parts of artwork, during the contact with subject and most important kind of relation with the artwork. According to Bootz (also other authors), human subject or agent is put in the role of participation with the artwork by his/her activities. Along those activities are constitute extensive parts of artwork. As an author code, author words, reactions of reader...they are in direct connection with those activities and initiates indirect relations with the essence of artwork. They are parts of parergonic artwork body. They are put in countervalue to code source and media artwork result which is represented by „transitoire observable „state (forth T.O.) T.O. is produced by execution of artwork, in very close relation to artwork essence. In the procedural model there is initiated the digital body as material of extensive parts, which relate to the artwork essence by the strong relation.

Katherine N. Hayles defines the manifestation of digital text by the relationship of „pattern and randomness". Hayles calls for specific signification in the digital space because changes of manifestation, 'flickering signifiers'. Katherine N. Hayles and Donna Haraway, both used structuralist tool – "semiotic square" in the context of posthumanistic thinking, which is manifested, or actualized by the digital or hybrid environment. Haraway writes about actualization in the space where *'Boundaries take provisional, never-finished shape in articulatory practices'* (Haraway 2004) and Hayles about manifestation of embodied information, which is related to flickering signifiers, where *'pattern exists in dynamic tension with the random intrusions of noise'* (Hayles 1999). Interconnection of both approaches brought a light into the room of communicative pattern which is related to human-machine -human communication.

The biosemiotics view of patterned cognition and communication comes from Maturana, and Varela's 'Structural coupling' theory, in which the recurrent interaction of unit and medium causes structural coupling, which is reflected in a patterned cognition and communication. (Maturana and Varela 1972) and Jakob von Uexküll's umwelt theory. Communication then depends on intersection of agential cuts of each body agency of communication, which is realized in the interface of communication. Following idea of Structural coupling, the equal medium for all living bodies is water.

Earth is a planet where most processes are based on water. Water regulates climate, morphologically influence a landscape, is a medium of living processes. It is a medium of interaction of organism and mineral parts in microscopic view, between whole organisms and minerals in macroscale on the Earth, and endless interplanetary space. Water topic from the position of artsci research, increasing transferring information of life. In the artsci research was water body figuration related to possibility mediate interspecies communication to better understanding water-based life on the planet. Several authors proposed the importance of water as a medium of interconnectivity between organisms (or minerals) together. Some botanical research describes the potentiality of mutual interspecies communication mediated by water. For example, the hydraulically lifted transfer of mycorrhizal network provides a potential pathway between plants based on water (Egerton-Warburton, Querejeta and Allen 2007). According to planetary science researcher water was always as part of the formation of Earth`s mantle, but also originated from comets and asteroids, that break up into meteorites which fall on the Earth The fact can push the possibility of interspecies communication to the interplanetary space. Water as physical matter is shaped form the solid, liquid and gas materiality. Fluidity is not only one state of water matter, but formal aesthetical principal of artistic, designer, and architectural practises. The fluidity is recognised in the relation to Gilles Deleuze and Bernard Cache theory of Objectile, which based a theoretical background to digital artistic form or artwork body figuration. Then water body figures appear in the differentiations in the repetition processes of multiplicity of water cycles and niches, similarly, as appears meaning of sign (Derrida 1978; Deleuze 1994; Neimanis 2017). According to Astrida Neimanis (2017) in differentiation are continuously unfolding embodiments as an expression of eternal return of the self-same. Water engendering difference 'was' an expression of water that 'is', and its potential 'yet-to-come'. Bodies of water

as figuration was already describe within ecofeminism and anticolonial thinking (Neimanis 2017; Gaard 2003; Armstrong 2006, ...) Lucy Irigaray (1992) relates fluidity to the feminine body. as 'fluid and ever mobile', and 'secreting a flow'. Fluidity is diffuse and multiple, overlapping, and inter-connected, is repetition in hydro/bio cycles and water figures acknowledged in differentiation. The dynamic fluid principle relates to the concept of perpetual intra-action, entanglement, diffraction, and agential cuts which was described by Karin Baradas 'matters agential realism' (Barad 2007).

1.1. Transient pattern as result of pattern - randomness interrelation of each communicative umwelt in the interface of communication

Based on 'Structural coupling' reflection was taken a background of the research. But rather than autopoiesis or self-making, it is related to Donna Haraway's notion of sympoiesis and making-with. (Haraway 2016) as an actualization in the space of never-finished shape of articulatory practices' (Haraway 2004). The idea of dynamic principle is supported by Katharine N. Hayles research of digital manifestation of embodied information, where 'pattern exists in dynamic tension with random intrusions of noise' (Hayles 1999) Also Philippe Bootz reflected Transient state of digital aesthetical form by his 'procedural model of communication' (Bootz 2006).

Pattern and Randomness relation is related to organisation of a text which has an unstable form. The pattern is then reorganized by the internal space of the programmable medium and possibility of mediated the communication by the interface medium. Process of the pattern reorganisation is manifested by pattern - randomness relation and by mutations manifesting in the interface. The result is organization by patternin in the perpetual evoluion. 'Transient Pattern' is the model which operates between arrangement of pattern and randomness. It is caused by interrelation of technical/nonhuman and human actors, who produce data in the feedback loop. In differentiation is appearing meaning, also any act of observation is differencing agency and makes a "cut" between what is included and excluded. Every species has specific 'pattern' of differencing agencies. Transient pattern is intersection of these agencies and relates to the dynamic fluid principle. It is result of perpetual interaction entanglement, diffraction, and agential cuts of communicative units.

1.2 Water as formal approach and essence of artwork

From the position of a posthuman approach, then it is possible to see water as a common equal medium of communication between all bodies of water (human, more-than-human, extra-terrestrial), which can bring equal informational agency.

Water is an essence. **The essence of artwork will be related to the water body essence.** Then the artwork water body is defined as an individual water body. The figure of the individual water body relates to agency of understanding (communication). According to Philippe Bootz`s model of visualization of procedural digital works is work individual body defined by essence, extensive parts and relations linked essence and extensive parts. Extensive parts are composed by physical real parts linked with essence, which are managed by agency. Extensive parts compose wider vision of artwork body[7].(Bootz and Laitano 2013)

The essence of artwork is recognized as individual agent which is related to the soul and the mind. My body (and the other bodies biological and technological) is a sensitive apparatus putting me in principles of global intuition of creating transcorporeal matter in the life of 'water body languages.' **The performative-material practice is based on the gathering and applying data of extensive parts of artwork in the context of emotionally build interactive intermedia artwork. AI (Fluid mechanics) agents are a managing agency that introduce characteristics of the water-based world of artwork.** The process relates to extensive parts of all bodies of water which relates to the manifestation and generate emotional actualization of artwork water body. The reading artwork essence will be put in the middle of analytical - informative and intuitive feeling. Although the deep machine learning - flow dynamics modelling - are used to predict hydrological behaviour, it is not possible to see what will be if human destroys a tiny balance of water flow. **Through the work they are emo-**

7 Understanding to essence is put by Bootz somewhere in the middle of intuition affected by the reading body of work and analytical approach to body of work. If the audience is closer to the analytical reading of work they are farther away from emotional feeling and vice versa (Bootz 2010)

tionally indrawn in the artistic message: 'We, as bodies of water, can interact in the water body holobion, we are all equal in the emotional based communication possibility and understanding our common human and more than human water-based life.

2. METHODS

On described hyphothesis and theoretical bacground basis the project will be following the analytical terein research. The part of research will be based on qualitative methods of analysis data of interaction bodies and will be realized in interdisciplinary collaboration. Here meets ArtSci and technology in the position of biophysics, biology, hydrology fluid dynamic physics programming and art. The data analysis based on the water collection from area of Mira River and Atlantic Ocean. The collectin data will be gained from inner and outer environment of water body holobionts, in interaction of fresh water /underground, rain, brackish, and Atlantic Ocean water to representative and specifically chosen focus group of bodies of water (chosen plants, animals, human- my own body) of organisms (micro and macro scale) and minerals. The data will be corrected by the information gained from second bibliography – articles from Research gate, Academia.edu, University Press Journals, Google scholars and other. It will be realized according to principle of open science and transdisciplinary collaboration with the other specialists of interdisciplinary collaboration. According to data result will be prepared schemes and chards. The main focus will be put in mechanical characteristics of water, as dynamics, biochemistry, biophysics, ionic relation (as hydrogen bonds). Ecological characteristics: such as Ph, salinity, fluid conductivity, amount of $O_{2.}$. and biological interaction will be provided in the second phase. The method of Fluid Mechanics, a mix of canonical Fluid Motion models visualisation (Van Dyke 1982) will be applied in collaboration with programmer.The ArtSci research together with the method of global intuition described by Michael Serres (Watkin 2020). will lead to performative intermedia artwork.

The other theoretical and methodical input is posthuman rethinking of bodies figuration (human, more-than-human), according to the notion: 'we have never been only human' (Braidotti 2013; Haraway 1985, 2008) The posthuman phenomenological approach of body figuration of the project will be followed by the idea of common water space, described by Astida Neimanis in the "Bodies of Water – Posthuman Feminist Phenomenology" (Neimanis 2017). Water relations in her posthuman feministic phenomenology refers to the hybrid assemblage of our living human and more than human equal togetherness. Organisation of matter in the concept of performative-material practice of Karin Barad as 'matters agential realism' (Barad 2007). The level of possibility of emotional interaction relates to the agency of emotional communication that will produce an agency and patterns which relates to the environment and body interaction (Jakob von Uexküll's umwelt theory and Maturana and Varela`s structural coupling).

The project comes from idea of communication which based on equal approach to human (all women, man, transgender, ...) and more than human. Open science practices are implemented as an integral part of the proposed methodology and will follow the FAIR principle.

3. RESULTS

3.1. Transient pattern and interface

According to Deleuze, Haraway, Neimanis, and other authors, the water body figuration is fluid and actual as a characterization of a real; fluidity, both virtual and actual, can be real water-based communication. **Transient pattern** relates to the dynamic fluid principle, for it is result of perpetual interaction entanglement, diffraction, and agential cuts of communicative units. Then in differentiation is appearing meaning, also any act of observation (sensual and intuitive) is differencing agency and makes a "cut" between what is included and excluded.

Water is a medium for bearing the information of life. Water is matter which enables information flow from each water-based body to others alongside the water network. Water is "inform-able interactive matter" From the position of a posthuman approach, then it is possible to see water as a common equal medium of communication between all bodies of water (human, more-than-human, extra-terrestrial), which can bring equal informational agency.

3.2 Art Sci approach to communicate water-based principle of sympoietic principle of life

In the result is able to see possibility how we can communicate water to take interest of audience to be ideologically more connected with water body - as water in the glass, water in the pool, water reservoir, water river, water sea, water ocean...; but also water in the bodies of water, (as water in cells, water in microbiota, water in plants, water in organisms, water in minerals..., Earth water). In this context more connection means more understanding, more caring, and a better environmental approach to water.

Water is an essence and figure of water body relates to individual agency of water figure. The essence of artwork will be related to the water`s essence. The essence, extensive parts and relations linked essence and extensive parts of artwork water body relates, through the agency, to individual agency of water body figuration. Figures of the water body will be related to the agency of communication. The understanding of artwork will relate to the audience reading and will move from an analytical to emotional approach.

Human is part of World cocreators. The interrelation of signs mediates the meaning of living structures. Some models of the World relate to the complex interpretive structure of scientific investigations. A researcher, Victor R. Baker, claims that the interpretation of scientific knowledge signs triggers investigators to new meanings (Baker 2017) The project aims to restore the relationship between humans and water in an aesthetically experimental way and propose posthuman position of ethics to the scientistic and wider audience. Through the work is audience ivited to thinking about sensuality of water bodies togetherness and communication in the equal position of every water-based living and non-living being on planet and space.

4. CONCLUSION

Transient pattern relates to the dynamic fluid principle, for it is result of perpetual interaction entanglement, diffraction, and agential cuts of communicative units. Then in differentiation is appearing meaning, also any act of observation (sensual and intuitive) is differencing agency and makes a "cut" between what is included and excluded.Water is a medium for bearing the information of life. Water is matter which enables information flow from each water-based body to others alongside the water network. Water is "inform-able interactive matter" From the position of a posthuman approach, then it is possible to see water as a common equal medium of communication between all bodies of water (human, more-than-human, extra-terrestrial), which can bring equal informational agency. In the relation to analytical interdisciplinary approach which is based on gaining SciArt data from terrain research will the research improved in the radical way an can bring the other evolution of the project. The research is open and will continue.

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A PILOT OF MACHINE LEARNING METHODS FOR CLINICAL TEXT CLASSIFICATION BASED ON OPEN DATA

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ABSTRACT

This article explores the significance of Natural Language Processing (NLP) in Artificial Intelligence (AI) research and applications, driven by advancements in machine learning and deep learning algorithms for text classification in medicine. The significance of text data, particularly in healthcare domains like Electronic Health Records (EHR), is emphasized due to its crucial role in today various applications. The primary focus of the article is on a pilot research study that compares logistic regression and random forest classifiers for text data classification, utilizing an open-source clinical text dataset. The overarching goal of this paper is then to use the insights gained from the pilot research to show the way for the development of potential new text classification models for medical diagnosis using real-world data. By leveraging experiences and lessons learned from the initial study shown here, this research naemely seeks to contribute to enhanced healthcare practices and improved patient outcomes by further refining and optimizing the text classification models in the medical domain, providing valuable support to medical professionals in their decision-making processes.

1. INTRODUCTION

The Medical Transcriptions dataset avaiable at mtsamples.com (MTsamples 2023) offers a rich and diverse collection of medical transcriptions, making it a valuable resource for Natural Language Processing (NLP) and healthcare research (Demner-Fushman 2009). With a wide range of medical specialties covered, including cardiology, radiology, neurology, and more, each transcription record provides detailed insights into patient conditions, diagnoses, treatments, and medical procedures documented by healthcare professionals. Researchers and practitioners can leverage this dataset to develop and evaluate sophisticated NLP models for different purposes like Named Entity Recognition (NER) to automatically detect and categorize named entities into predefined categories (Au 2022), clinical text classification, sentiment analysis, and medical entity extraction.

In this paper, we leverage open datasets of Medical Transcriptions to compare two distinct text classification algorithms: Logistic Regression and Random Forest. Specifically, our focus lies on segments of the dataset that pertain to cardiovascular and pulmonary diseases, orthopedics, and radiology. The objective is to conduct a comparative analysis of these text classifiers using publicly available data, aiming to discern their performance in handling medical text data from these specialized domains.

2. DATA SET DESCRIPTION AND PREPARATION

The Medical Transcription dataset is a comprehensive repository of text data from diverse medical specialties such as cardiology, radiology, neurology, and more. Each entry in the dataset represents a detailed medical transcription record, offering valuable information on patient conditions, diagnoses, and treatments documented by healthcare professionals. Leveraging this dataset, our study aims to deploy a clinical text classification system specifically tailored to cardiovascular and pulmonary diseases, orthopedics, and radiology, aligning with our research goals. By focusing on these specialized domains, we aim to compare different text classification methods based on their accuracy and efficiency in medical text classification, ultimately contributing to improved patient care.

As of 7th July 2023, the mtsamples dataset comprises 5013 samples, encompassing 40 distinct types of medical transcriptions (MTsamples 2023). In our study, we have concentrated on three specific categories, consisting of a total of 999 samples across the domains of Cardiovascular / Pulmonary (371), Orthopedic (355), and Radiology (273).

For the text classification of this medical data, we adopted a classical data mining process (Olson 2008), encompassing essential steps such as **data preprocessing, feature engineering, model selection, training, and evaluation**. This well-designed machine learning approach allows us to effectively analyze and categorize the textual medical data, contributing to insights and use of these tools in potential further healthcare research and applications.

2.1 Data Preprocessing and Exploration

Each sample in the dataset consists of a text feature comprising a list of sentences, forming the document corpus. The dataset encompasses various types of features, including numeric features like ‚Temperature', categorical features like ‚medical_specialty', and text features like ‚transcription'.

For our text classification purposes, we performed common data preprocessing steps on the ‚transcription' feature. Firstly, we handled missing data by simply dropping the 33 missing entries from the entire dataset, which had a negligible impact on model prediction. Next, we standardized the text by converting it to lowercase and removing punctuation. Tokenization was then applied, treating the text as a sequence of words. This enabled the subsequent activities of removing stopwords, stemming, and lemmatization, effectively reducing the size of the vocabulary for improved text classification outcomes. These preprocessing steps play a crucial role in enhancing the model's ability to understand and categorize the medical text data accurately.

2.2 Feature Engineering

After preprocessing the text feature, each text (document) requires encoding as a vector of numbers, a process known as vectorization, as machine learning models only comprehend numerical data. The choice of encoding method relies on how the text is interpreted. In text classification, a

text string (document) is typically considered either a bag of words or a sequence of words. For our study, we treated the text as a bag of words, and we employed the TF-IDF vectorization (Sammut 2010) method to convert each text into a numerical vector. This approach transforms the text into a single vector of numbers, capturing the importance of individual words in the context of the entire dataset. By using TF-IDF, we enhance the representation of text data, enabling our machine learning models to effectively classify the texts based on their unique word frequencies and weights.

3. DATA MODELING AND TRAINING

3.1 Model Selection

The choice of a machine learning model for text classification depends on how the text is encoded. In our study, we utilized the TF-IDF vectorization method, allowing us to consider various non-sequence classification models such as Logistic Regression, XGBoost, Random Forest, and MLP. For our specific setup, we made the decision to utilize Logistic Regression (Cox 1958) and Random Forest (Ho 1995) as the selected models. These classifiers have proven to be effective in handling TF-IDF encoded text data, enabling us to perform accurate and efficient text classification tasks.

3.2 Model training and evaluation

Before training the model, it was essential to divide the dataset into training, validation, and testing subsets. However, for simplicity, we have decided to split the dataset into only two subsets: one for model training and the other for model testing and evaluation. We used the Random Forest and Logistic Regression algorithms, employing TF-IDF encoding, to showcase non-sequence modeling for text classification. These chosen models, along with the selected encoding method, illustrate the process of effectively classifying text data without considering the sequential nature of the text.

4. OBTAINED RESULTS

The results obtained from our experiments in Scikit-learn (Scikit-learn 2023) are promising; however, it is essential to consider that they depend on the quality of the data. Furthermore, the findings should be evaluated and interpreted by medical experts for potential further direction and validation.

Below are the confusion matrices obtained from both methods:

Figure 1: Logistic Regression Confusion Matrix

	precision	recall	f1-score	support
Cardiovascular / Pulmonary	0.69	0.80	0.74	93
Radiology	0.62	0.56	0.59	68
Orthopedic	0.79	0.72	0.75	89
accuracy			0.70	250
macro avg	0.70	0.69	0.69	250
weighted avg	0.71	0.70	0.70	250

Figure 2: Random Forest Confusion Matrix

	precision	recall	f1-score	support
Cardiovascular / Pulmonary	0.60	0.70	0.64	93
Radiology	0.52	0.46	0.48	68
Orthopedic	0.72	0.65	0.68	89
accuracy			0.62	250
macro avg	0.61	0.60	0.60	250
weighted avg	0.62	0.62	0.61	250

5. CONCLUSION AND DISSCUSION

The confusion matrix serves as a valuable tool for assessing the performance of a classification model. It provides a clear representation of true and predicted classes, enabling us to analyze the model's accuracy and precision.

Logistic Regression achieved a slightly higher overall accuracy (0.70) compared to Random Forest (0.62), indicating that it made more correct predictions for a larger portion of the dataset. In terms of F1-scores, which consider both precision and recall, Logistic Regression outperformed Random Forest in both macro-averaged F1-score (0.69 vs. 0.60) and weighted-averaged F1-score (0.70 vs. 0.61).

Our study reveals that Logistic Regression exhibits better precision and recall for each class, as well as overall accuracy, making it more suitable for this dataset and scenario compared to Random Forest classifier. However, it is essential to note and recognize that the best model choice depends on specific task requirements and data characteristics in the real domain application. Therefore further analysis and experimentation, including tuning and evaluation in real-world scenarios need to be done to determine the most appropriate model for specific classification challenges.

In this article, we delved into the significant role of Natural Language Processing (NLP) and Artificial Intelligence (AI) research in the medical domain, particularly in the context of text classification. We showcased the importance of text data, especially in healthcare domains like Electronic Health Records (EHR), for various applications in the medical field.

Our focus was on designing a pilot experiment where we compared two classifiers, logistic regression, and random forest, for text classification. The experiments conducted on open data from mtsamples demonstrated that both methods performed reasonably well. However, it was evident that Logistic Regression outperformed Random Forest in the evaluation.

This pilot case provided an initial approach to medical text classification using open data. Further investigation and experimentation are necessary, including tuning and evaluation on real-world scenarios and datasets. These efforts will help generate potentially more suitable models for specific text-classification applications in medical domains. The ongoing exploration of NLP and AI in healthcare holds promising potential for advancing medical research, improving patient care, and so enhancing overall healthcare practices in the future.

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