

The Influence of Project Manager's Skills on the Success of Projects – perspectives from the project managers
Rafael Melo Vieira

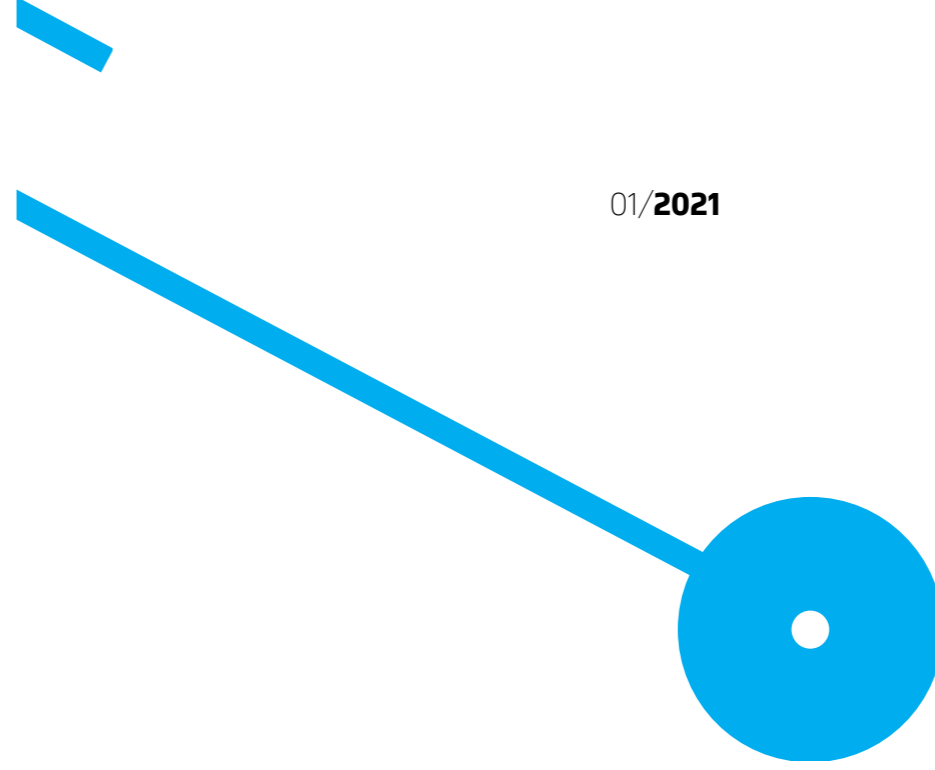
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Goodbye School of Technology and Management and... Thank you

Abstract

Industry 4.0 and digital transformation are not a myth anymore. This new era is changing the market and the way companies act. Digital transformation derives from the application of new tools but also the change of the collaborator's mindset. These changes influence the Project Manager (PM) to improve his skills to face this new digital era.

The purpose of this study is to analyse which new skills should the PM have to meet the new challenges in this new era and how they can influence the success of the projects.

An exploratory analysis is proposed to find which skills are demanded in this context. For this reason, in-depth interviews are developed, and PM's are interviewed. This study aims to find a relation of influence between the project manager's skills and the success of the projects in the 4.0 context.

Keywords: <Project Management, Project Manager, Skills, Digital Skills, Project Success>.

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1 Introduction

At the dawn of the 21st century, the world is witnessing the fourth industrial revolution and the digital transformation of the business world, which is commonly referred as Industry 4.0. The fourth industrial revolution is a hit rather than hype (Ghobakhloo, 2020). The new era 4.0 is here but where is the technology in this big picture?

Nowadays the use of technology is no longer a novelty but a must for any project and the continuous digitisation of processes in the 4.0 era is a natural evolution for any company (Guinan et al., 2019). When influencing the projects, the members of that project have a role in this improvement. The members of any company or project need to keep up with these developments and seek for the critical skills to get the job done (van Liar et al., 2019; Sousa & Rocha, 2019). So, the project manager is no exception, on the contrary, and needs to be constantly updated in terms of digital technologies and tools to play his role more fully and efficiently (Mesaros et al., 2016). These digital skills can be listed in various stages of project management such as team management, project planning, project execution, etc (Napier, Keil, & Tan, 2009). However, in terms of literature, the relation between these skills in a project environment is weakly developed.

Oppositely, the literature on the success of projects and the metrics that can be used to analyse success are quite extensive. Though, a gap is identified in the analysis of the competences that the project manager should have in the era of industry 4.0 in order to obtain successful projects. Therefore, we consider it urgent to define the new competencies demanded to the project managers and relate it with the success of the projects.

In line with this, the main objective of this research is to identify what skills are demanded to the project manager in the industry 4.0 context and to relate them with the success of the projects. For this reason, it is important to relate the skills with the areas of knowledge of Communication Management and Human Resources Management. After reviewing the literature and select the metrics it is our purpose to propose a model and to validate it.

The innovative contributions of this paper are to define the skills demanded to the project manager in a context of the industry 4.0 and to find the relation between them and the success of the projects.

This report is divided in four main topics. The first topic is the literature review - sub-divided in 7 subjects: industry 4.0, general skills and digital skills, the skills of the project manager, project's success, frameworks for digital skills, frameworks for the project success and the bibliometric analysis. The methodology is presented, data is analysed and discussion is developed. Finally, we draw a conclusion on this research.

2 Literature review

The industry 4.0 demands, due to its context demands different competences.

Taking into account that it is our perception that the digital skills have higher relevance in industry 4.0, this topic begins by describing the context of the industry 4.0 and its nine pillars. Next, we address the themes of general and digital skills of the project managers as we intend to relate them with the project's success. After that, we adopt a definition of project and project management. Finally, we analyse various models to develop skills and models to analyse the success of the projects.

2.1 INDUSTRY 4.0

According to Erboz (2017), Industry 4.0 is the current vision shaping the future of many industries by creating new business models through Cyber Physical Systems.

Hermann, Pentek, & Otto (2015) state that Industry 4.0(I4.0) is a collective term for technologies of value chain organizations. I4.0 is divided into 4 categories: Internet of the Things, Cyber Physical Systems, Internet of Services and Smart Factory.

Erboz (2017) and Vaidya, Ambad, & Bhosle (2018) state that the nine pillars of the Industry 4.0 are Big Data and Analytics, Autonomous Robots, Simulation, Horizontal and Vertical System Integration, The Industrial Internet of Things (IIoT), The Cloud, Additive Manufacturing, Augmented Reality (AR) and Cyber Security.

Next, **Table 1** is from Erboz (2017) paper that summarizes some concepts and examples of these nine pillars.

Table 1 - Nine Pillars of the Industry 4.0, Definitions and Examples

The Concepts	The Definitions of the Concepts	The examples of the concepts
<i>Big Data and Analytics</i>	Large, complex datasets that affect the decision making of companies	Big data analytics, algorithms, software programs
<i>Autonomous Robots</i>	Solve complex tasks which cannot be solved by human	Kuka LBR IIWA has the learning ability to achieve some certain tasks
<i>Simulation</i>	Mathematical modelling, algorithms that optimize the process	Software programs
<i>Horizontal and Vertical System Integration</i>	Integration of inside of the factory and SCs	Smart factories, cloud systems
<i>The Industrial Internet of Things (IoT)</i>	Connection of the physical objects and systems	Smart network
<i>The Cloud</i>	Shared platforms that serve to the multiple users	Google Drive, BlueCloud, Windows Azur
<i>Additive Manufacturing</i>	3D printing technology, producing in mass customization	3D printers to produce smartphones
<i>Augmented Reality (AR)</i>	Human-machine interaction on maintenance tasks	Google Glass
<i>Cyber Security</i>	Cyber-attacks to the business environment	National defence systems to prevent attacks

Table caption: Kuka LBR IIWA is a company of robotics technology that is achieving sensitive tasks in working places and collaborates with a human.

Source: **Table 1** adapted from Erboz (2017)

2.2 GENERAL SKILLS AND DIGITAL SKILLS

According to Ghobakhloo (2020), the fourth industrial revolution and the underlying digital transformation, usually known as Industry 4.0, is progressing exponentially. The digital revolution is reshaping the way people live and work. Firms encounter intense competition, market turbulence, and ever-changing technological innovation in a dynamic business environment (Li et al., 2019).

Digital transformation encompasses an organisation's ability to adapt, respond, and position itself for success when facing rapid technology evolution. A critical framework to achieve a successful digital transformation is a digital project team, but there's little research on how they are created and developed (Guinan et al, 2019). Therefore, digital transformation is no longer a myth. It's a reality and the companies whether embrace it and evolve or they will be out of date soon and have to stay away from business.

Bradley & McDonald (2011) state that people are an organisation's greatest asset, and surprisingly or not, they really are! Organisations are formed by people. With empowered people working on the vision, in case of great success, those people are helped to produce short-term wins (Kotter & Cohen, 2012). Aligning talent management to the organisational strategy may create the competitive advantage required to sustain and grow an organisation (Project Management Institute, 2013). But what is talent management?

According to PMI (2014), the talent management process begins with recruiting efforts. Being recognized as an "employer of choice" helps organisations to attract and retain talent. One of the most critical factors mentioned for attracting and retaining talent is having exciting, challenging and engaging programs and projects. Then, organisations need to help develop and support that talent. Training has been the most-established component of development, primarily because it's easy to implement and the number of people trained is easy to track.

In common literature there seems to be some confusion regarding the meanings of skill and competence. Scientific literature has some approaches towards a definition.

A Skill is defined as the learned ability to bring about pre-determined results with maximum certainty; often with the minimum outlay of time or energy or both (Knapp, 1983).

It is important to understand the difference between two close words but different meanings. Competence refers to a behaviour a person should be able to demonstrate while competency is defined as an underlying set of personal characteristics that facilitate superior performance.

According to Rychen & Salganik (2002), "A competence is defined as the ability to meet individual or social demands successfully, or to carry."

Despite the numerous studies on competence, there are many authors who complain about the ambivalence of the concept of competence as Blömeke, Gustafsson, & Shavelson, 2015; Hoffmann, 1999; Jacques, 2016;

Klieme & Hartig, 2008; Short, 1985; Stoof et al., 2002; Velde, 1999; Wilhelm & Nickolaus, 2013). For example, Weinert (1999:) refers “that the many implicit (in word use) and explicit (in theoretical frames of reference) definitions of competence are so heterogeneous that only a small, vague conceptual core re-main”. Or it is for Ashworth and Saxton (1990, p. 3) “... not clear whether a competence is a personal attribute, an act, or an outcome of action...”.

One can also find in the literature, the difference between digital skills and digital competences.

The Select Committee on Digital Skills (2015) defines digital skills as the skills needed to interact with digital technologies.

According to Vieru, Bourdeau, Bernier, & Yapo (2015), digital competence is the ability to use and adopt new or existing information technology to analyse, select and critically evaluate digital information. This should be used in order to solve work-related problems and develop collaborative knowledge and engage organizational practices.

Tidd et al. (2005) claims that Information Systems (IS) innovation is defined as the firm’s ability to be creative and capture the value-creating opportunities presented by the growth of Internet technology and its usage. The authors also state that the mobilization of knowledge, technological skills and experience to create novelty in their offerings and the way in which they create and deliver those offerings.

Swanson (1994) refers that Information Systems (IS) innovation is defined as innovation in the organizational application of digital computer and communications technologies (now commonly known as information technology, or IT) and that, in this revolutionary era, new developments in information technology, innovation in its employment among organizations is increasingly crucial to competitive survival and success. The IS unit within the business is largely responsible for meeting this challenge.

Bresnahan, Brynjolfsson, & Hitt (2002) considered in their study in The United States that the hypothesis that the combination of three related innovations: information technology (IT), complementary workplace reorganization, and new products and services are a significant skill-based technical change affecting labour demand.

In the following topic, we address the skills of the project manager in order to find out what are the most relevant in the literature.

2.3 PROJECT MANAGER'S SKILLS

There are some skillsets proposed by some authors, but none of them is unanimous. The skillsets are improved every year due to market instability and evolution. For Project Management Institute (2016), there is an ideal skillset called "PMI Talent Triangle". According to Project Management Institute (2016, 2013), this Talent Triangle has three critical project management skillsets needed for successful projects:

- Technical project management skills;
- Leadership skills;
- Strategic and business management skills.

Also, other authors like Stevenson & Starkweather (2010) have identified six critical core competences that a project manager should have:

- Leadership, the ability to communicate at multiple level;
- Verbal and written skills;
- Attitude and the ability to deal with ambiguity;
- Change.

Those characteristics were considered important competences to define a successful project manager.

El-Sabaa (2001) considers three main skill areas:

- Human skills: where some characteristics included in this category are mobilization, communication, coping with situations, delegation of authority, political sensitivity, high-self-esteem and enthusiasm;
- Conceptual and organizational skills, including characteristics like planning, organizing, having strong goal orientation, ability to see the project as a whole, ability to visualize the relationship of the individual project to the industry and the community, and strong problem orientation;
- Technical skills, that include characteristics like specialized knowledge in the use of tools and techniques, project knowledge, understanding methods, process and procedures, the technology required, and skill in the use of computer.

It is curious and important to highlight the human skills point referred by El-Sabaa (2001), in such an early year of the digital era. The author also state that a project manager should be sensitive enough to understand the needs and motivations of the project team as well as to have good communication skills.

More recently, PMI (2018) mentioned that the most cited new skills of the project manager for organizations were soft skills at 45%, followed closely by computer/web/IT and management/project management, both at 39%.

The training, the skill improvement and the skillset of the project manager mentioned in the talent management, need constant update due to the instability of the market and specifically, due to this new era of digital transformation. Therefore, one can conclude that the digital skills of the project managers can be improved inside the organizations, under a project context. Kennedy et al (2016) states that HR professionals in organizations that are hiring full-time employees, rated the need for new skills for these positions. The most mentioned new skills for organizations are soft skills like problem-solving, interpersonal, communication, teamwork, leadership at 45%, followed closely by computer/web/IT and management/project management, both at 39%. This shows that organizations are aware of the new skills that the market demands.

In line with this research, we decided to revise the literature looking for what skills should a project manager have in the context of the 4.0 industry. So, we consider that the digital skills are of great importance.

On the report of PMI (2018), the top six digital-age skills for project delivery are Data Science Skills (like Data Management, Analytics and Big Data), Innovative Mindset, Security and Privacy Knowledge, Legal and Regulatory Compliance Knowledge, Ability to Make Data-Driven Decisions and Collaborative Leadership Skills. This combination of the most important skills was defined by Human Resources professionals in innovative organizations when asked which skills are most important in building a truly digital capability for project leaders.

In a context of disruptive business, Maria José Sousa & Rocha (2019), analysed interviews made to IT specialists from different economic sectors. The author found three main categories of skills in order to manage a disruptive digital business: innovation, leadership and management. These categories were measured to specific skills (see Table 1).

Table 2 - Proposed model for the development of skills in order to manage disruptive business. | Source: Maria José Sousa & Rocha (2019)

Categories of Skills	Skills
Innovation Skills	<ul style="list-style-type: none"> - Innovation and creativity - New business opportunities - Project management - Risk management - Efficiency and efficacy – Networking
Leadership Skills	<ul style="list-style-type: none"> - High-performance teams management - Talent management - Motivation and satisfaction - Communication - Careers management - Leadership of multi-cultural employees
Management Skills	<ul style="list-style-type: none"> - New models of work organization - Emergent technologies - Decision making tools - Big data analysis - Organizational change - Strategic management – Social and relational knowledge

An extensive literature review was developed and we found several papers related to the competences and specifically to the digital competences of the project managers (see **Table A1** in the Appendix).

As can be seen in the Appendix - **Table A1**, there are many approaches to define digital skills. There are several studies under different sectors or industries. Some authors like Guinan et al. (2019), use a conceptual study as methodology, but others like van Laar et al. (2019) used Descriptive Analysis and Regression Analysis to prove their fourteen hypothesis, Mesaros, Mandicak, Mesarosova, & Behun (2016), Maria Jose Sousa & Rocha (2019) and PMI (2018).

The mentioned table also shows that most of the studies are developed under quantitative analysis, descriptive analysis, regression and correlation.

As it is our purpose to relate the project manager skills with the success of the projects under a context of the industry 4.0, in the next subtopic we outline some definitions of the project’s success and for that reason we begin by defining the concept of project and the concept of project management.

2.4 PROJECT SUCCESS

As claimed by Project Management Institute (2017), a project is a temporary endeavour undertaken to create a unique product, service, or result. Bannerman (2008) says that to be on time, within budget, to have a specification completion, product produced or to achieve the business objectives of the projects are some of the many ways that project success is referred to. Radujković & Sjekavica (2017) states that usually the project’s success is linked with the result of the evaluation of overall achievement of the project’s goals.

Durmic (2020) highlights the importance of the project's team and the ability to control the project's activities as predictors of successful project outcomes. One of the most common challenges in project management has been determining whether or not a project is successful and what metrics we should use to measure it.

Project Management Institute (2017) state that project management is the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements. The same source refers that it is accomplished through the appropriate application and integration of the project management processes identified for the project. According to the same source, project management enables organizations to execute projects effectively and efficiently.

According to Project Management Institute (2017), one of the most important references in project management, the metrics of scope, time, cost and quality have been traditionally considered the most important factors of project management in defining the success of a project. Despite that, more recently, professionals and academics have determined that project's success should also be measured with consideration toward achievement of the project objectives. Project Management Institute (2018) mentioned that additional has been pursued to determine what factors have more impact on project's success in these disruptive times. Based on a rigorous statistical analysis, three factors emerge:

1. Investing in actively engaged executive sponsors;
2. Avoiding scope creep or uncontrolled changes to a project's scope;
3. Maturing value delivery capabilities.

Still, as referred by Radujković & Sjekavica (2017), there are two main success concepts when talking about projects: project success and project management success. There are similarities, as well as differences, between these two projects success dimensions. The prime difference is related to link project success as result of the evaluation of overall project goals achievement, while project management success relates to traditional measurements of time, cost and quality performance. On the other hand, Procaccino & Verner(2006) study showed that delivering a product or service that meets customer/user requirements, works as intended through performing work that, provides an intrinsic sense of quality and personal achievement, are important factors to consider a project to be a success.

An extensive literature review was developed to find the most prolific approaches regarding the projects' success (see Table A 2 in the Appendix).

Table A2 shows the different approaches to project success and how they can be measured. Bannerman (2008) proposes a framework to define projects' success yet, Cooke-Davies (2002) prefers to define factors that influence the success of the projects. The great majority of these papers use a quantitative methodology after reviewing the literature.

Al-Tmeemy et al (2011) explained that a criterion for building a categorization scheme for success projects should include the categories of project management success, product success, along with market success. According to PMI, the level of talent management alignment to the strategy of the organization also impacts on the success of projects meeting their original goals and business intent (Project Management Institute, 2013).

In short, over the years there hasn't been consensus about how to measure the success of projects, what factors should be considered or what a successful project really is. According to the Project Management Institute (2017), three questions that the key stakeholders and the project manager should answer are:

- What does success look like for this project?
- How will success be measured?
- What factors may impact on success?

The answers to these questions there must be an agreement between the main stakeholders and the project manager.

In order to make sure that all the important references regarding the digital skills were mentioned in this literature review we developed a bibliometric analysis. The results are attached to this thesis in the **Appendix – Table A2**.

Nevertheless, next we present the main conclusions of the mentioned bibliometric analysis.

2.5 BIBLIOMETRIC ANALYSIS

According to Herubel (1999), bibliometrics is a quantitative analysis of publications with the purpose of determine specific kinds of phenomena. The nature and direction of the scientific communication in scientific articles can be statistically modelled based on the citations made to other sources and the bibliography of the work using bibliometric techniques. Bibliometric analysis can be used to map the relationships between the journals and other scientific communication channels among cited articles and determine the flow of the topics between disciplines (Borgman, 1999).

Then, it is possible to determine the cited articles, the researchers who cited them and their disciplines, the journals that are cited more frequently and the impact of certain articles on subsequent researches through citation analysis (Tsay, 2011).

According to Pritchard (1969), bibliometric analysis has been defined as the application of statistical and mathematical methods to the books and other communication tools". In bibliometric analysis, which has been defined by Nederhof, Van Leeuwen, & Tijssen (2004) as quantitative measurement of qualitative characteristics, the number of citations made to an article is accepted as an indicator of the impact of the article on the scientific community.

A search analysis by keywords related to the topics under study was pursued using *Vosviewer* to check what authors refer to the following selected keywords.

2.5.1 Digital Skill(s) or Digital Competence(s) and Project Manager(s)

In the search that was pursued in Web Science, the selected topic was: (digital skill*) OR TOPIC: (digital competence*) AND TOPIC: (project manager*). Then, the filters used were by type of document (article) and the first 500 authors after ordered by “More Citations”. For estimate time it was selected: Every year and as index: *SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI, CCR-EXPANDED, IC*.

Concerning the filters used in *VOSviewer*, the minimum number of documents of an author selected were three and zero as minimum of number of citations of an author. This gave a total of 1605 authors and 18 met the thresholds. The results showed that the authors that were more active discussing the previous mentioned topics were Armand van Deursen, J. Andrew N. Alexander and Eszter Hargittai (see **Figure 2 in Appendix**).

Their papers were analysed but none of them were considered relevant to add any of their ideas to this research.

As an example, in the article from de Boer, van Deursen, & van Rompay (2019), the authors studied specifically the use of IoT from the user’s perspective. In this study, we propose to find the project managers’ skills, so the skills of the users were not taken into account. We must highlight that the bibliometric analysis is based only in the Web of Science source.

2.5.2 Project Success

Regarding the search that was pursued in Web of Science, the selected topic was project success. The filters were selected by a type of document (article) and the first 500 authors after ordered by “More Citations”. For estimate time it was selected: Every year and as index: *SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI, CCR-EXPANDED, IC*.

About the filters used in *VOSviewer*, the minimum number of documents of an author selected were three and zero as minimum of number of citations of an author. This gave a total of 1668 authors and 18 meet the thresholds. The results showed that the authors that were more active discussing the mentioned topics were E.J. Kleinschmidt, J.B. Schmidt, X.M. Song and R.J. Calantone (see **Figure 3 in Appendix**). Their papers were analysed but none of them was considered relevant to add any of their ideas to this research. As example, COOPER & KLEINSCHMIDT (1993) is a research were the authors analyse the success factors for a product in the chemical industry. The paper developed by Calantone, Schmidt, & Song (1996) also looks for product success factors in other contexts. We must highlight that the bibliometric analysis is based only in the Web of Science source.

2.5.3 Merge of the Both Previous Searches

The search that was done in Web Science, the selected topic was: (digital skill* OR digital competence) AND topic: (project manager*) AND topic: (project success). Then, no filters were used this time. For estimate time it was selected: Every year and as index: *SCI-EXPANDED*, *SSCI*, *A&HCI*, *CPCI-S*, *CPCI-SSH*, *ESCI*, *CCR-EXPANDED*, *IC*.

In the filters used in *VOSviewer*, the minimum number of documents of an author selected were one and zero as minimum of number of citations of an author. This gave a total of 24 authors and 24 met the thresholds. The results showed that the authors that discussed the previous mentioned topics were Alena Mesarsova, Marcel Behun, Michael P. Mesaros and Tomáš Mandičák (see **Figure 4 in Appendix**).

With this analysis is concluded that the research about these topics combined is really recent therefore, there are still few authors researching on these topics

In the next topic, frameworks regarding digital skills are presented.

2.6 DIGITAL SKILLS FRAMEWORKS

In the next topic, a bibliometric analysis on the frameworks on digital skills is pursued and analysed.

2.6.1 Bibliometric Analysis

The search that was pursued in Web Science, the selected topic was: Digital Skill* Framework OR Digital Skill* Model OR Digital Competence* Framework OR Digital Competence* Model. Then, the filters used were by type of document (article) and the first 500 authors after ordered by “More Citations”. For estimate time it was selected: Every year and as index: *SCI-EXPANDED*, *SSCI*, *A&HCI*, *CPCI-S*, *CPCI-SSH*, *ESCI*, *CCR-EXPANDED*, *IC*.

In the filters used in *VOSviewer*, the minimum number of documents of an author selected were two and zero as minimum of number of citations of an author. This gave a total of 1555 authors and 51 met the thresholds. The results showed that the authors that discussed the previous mentioned topics were Christine Rhian Thomas, Roger Fenton, Ray Lonsdale, Chris Armstrong, Linda Banwell, Graham Coulson and Jennifer Rowley (see **Figure 5 in Appendix**).

These papers were analysed but were not considered relevant to to this research. As example the research developed by Rowley, Munday, & Polly (2018) aims to explore the critical thinking of students and teachers with the help of digital learning, and this is not the context of this investigation.

Due to the recent analysis of digital skills the literature on this topic is quite scarce and recent specially for project management and the project manager digital skills, as well as the models that can define what are the most important skills to be performed in this digital age.

After the development of the bibliometric analysis (that is based only in the web of science source), some other frameworks from other sources, like *Science Direct* and *B-on*, were analysed due to the specific context and objective of this study (project management and project managers digital skills).

Table 3 - Recent frameworks regarding Digital Skills | Source: Own Elaboration based on literature review

Authors	Model	Number of Citations	Tested? How Many Times?
Maria José Sousa & Rocha (2019)	This research identified three main categories of skills through the content analysis of the interviews made to IT specialists – innovation, leadership and management , and analyse the perception of managers from different economic sectors regarding the level of development needed by managers of disruptive business for those same skills.	81, According to Google Scholar; 20, According to Web of Science	No
Oberländer et al. (2020)	This research defined a model with 25 Dimensions of digital competencies and in which literature and Practice Cluster is each dimension included (see Table A 3).	7, According to Google Scholar; 4, According to Web of Science;	No
Obradović et al (2018)	CHPT concept is used as a base for the following research as four sets of critical skills for project managers. In CHPT, C stands for conceptual skill, H for human skill, P for political skill, and T for technical skill , based on 16 studies and acknowledged research of Sunindijo and Zou (2011).	2, According to Google Scholar	No.

We will use the model proposed by Maria José Sousa & Rocha (2019), due to the number of citations that derive from it and because it was developed for disruptive businesses - a context that we consider closer to the 4.0 industry context.

In the following subtopic we select frameworks to define the Project’s Success.

2.7 PROJECTS SUCCESS FRAMEWORKS

In the next topic, the results of a bibliometric analysis carried about the topic frameworks on projects’ success is resumed.

2.7.1 Bibliometric Analysis

The search that was done in Web Science, the selected topic was Project Success Framework. Then, the filters used were by type of document (article) and the first 500 authors after ordered by “More Citations”. For estimate

time it was selected: Every year and as index: *SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI, CCR-EXPANDED, IC*.

In the filters used in *VOSviewer*, the minimum number of documents of an author selected were two and zero as minimum of number of citations of an author. This gave a total of 1668 authors and 68 met the thresholds. The results showed that the authors that discussed the previous mentioned topics were Manfong Ho, Albert P. C. Chan and Aaron J. Shenhar (see **Figure 6 in Appendix**).

After the bibliometrics analysis, some frameworks were analysed individually and also from other scientific sources.

Table 4 - Projects Success Models Analysis | Source: Own Elaboration based on literature review

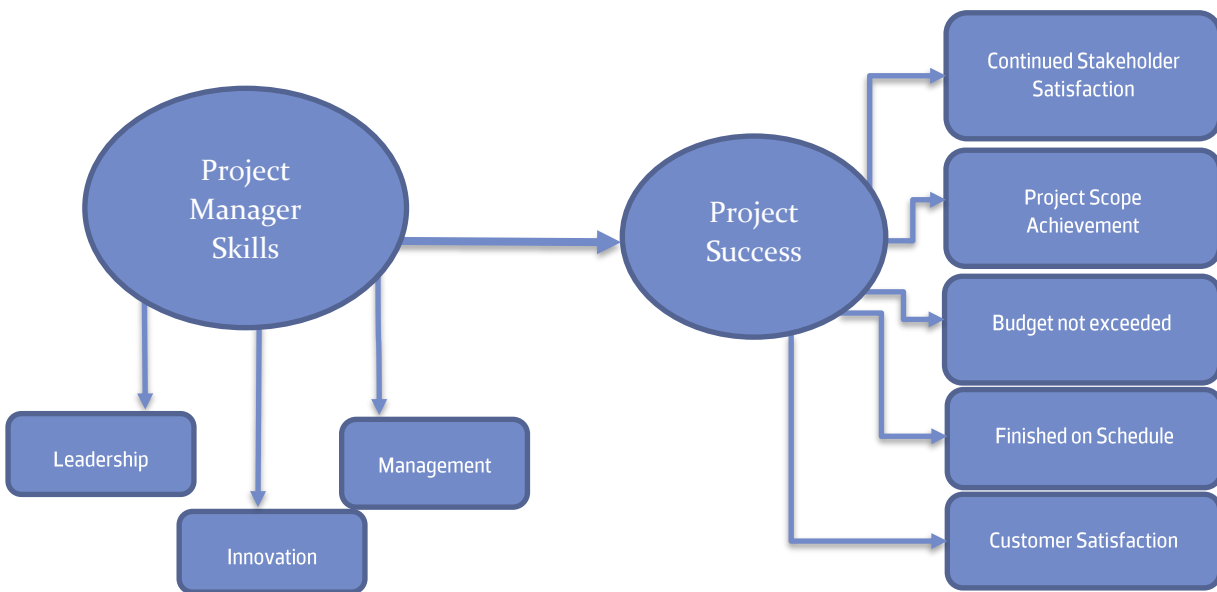
Authors	Model	Number of Citations	Tested? How Many Times?
Bannerman, P. L. (2008)	This paper proposes a framework that comprises five levels of performance criteria. This permit assessment of a project from multiple stakeholder perspectives at different times after project closeout (see Table A 4).	109, According to Google Scholar	Yes, six times in six different projects
Todorovi et al (2015)	The paper presents a project success analysis framework comprised of four key elements: the definition of CSFs, the definition of KPIs, measuring project success according to defined KPIs and documentation of project success measurement according to the KPIs, as well as the creation of final project report.	218, According to Google Scholar; 69, According to Web of Science	No.
Gomes & Romão (2016)	In this paper the project success of the specific project was defined according to customer and stakeholder satisfaction and not according to the “normal” iron triangle.	33, According to Google Scholar; 7, According to Web of Science	One, in a specific project in a small-medium company, leader in the field of geographic engineering, specialized in providing digital geographical products and geo-referenced database.

Considering the number of citations of google scholar and the pertinence of key elements of the framework we consider the Todorović et al (2015) framework the one of the most adequate to use in our research. Gomes & Romão (2016) refer some benefits of this framework where customer and stakeholder’s satisfaction are considered an important contributor to projects` success as they are the final beneficiaries of the result of any project. Another reason is the fact that the framework of Bannerman (2008) considers the stakeholder’s perspective at different times. We consider this very interesting to use because it was already tested in six different projects and gives a continuous perspective of the project’s success (see **appendix Table 3**).

Taking into consideration that these frameworks all have benefits it is our purpose to use a mixed approach where KPI's could be defined also using the iron triangle proposed by PMI (2018). We propose also to use the customer and stakeholder satisfaction perspective. This new approach could give a more abroad and practical perspective to the success of the projects.

In line with what was stated we propose a new theoretical framework.

Figure 1 - Proposed Framework | Own Elaboration based on literature review



In the next topic we present the research methodology selected to answer our research question:

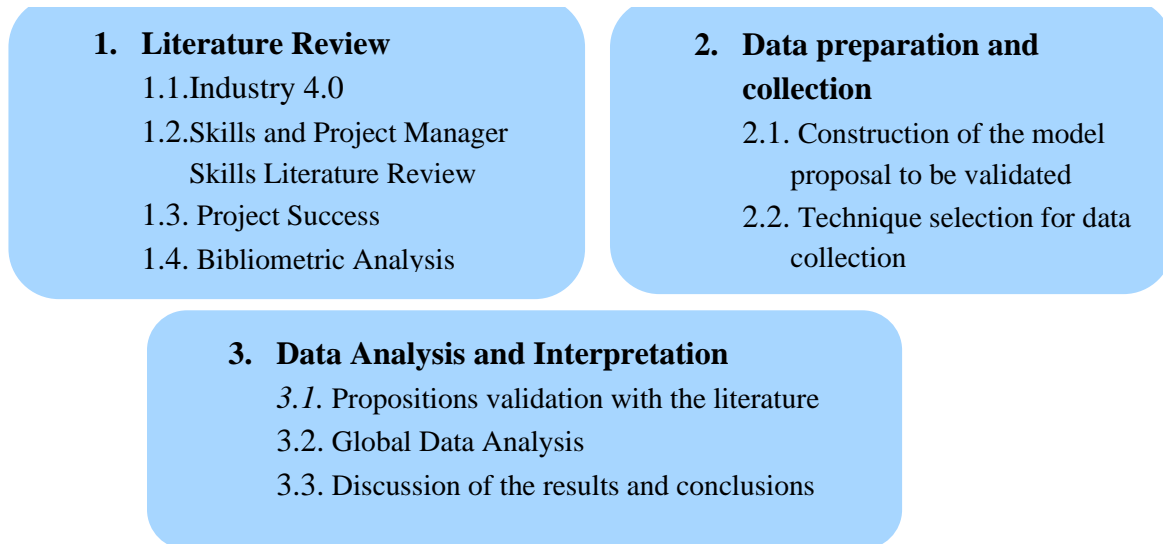
What are the skills demanded to the project manager in the IT sector and in the context of the industry 4.0 and how do they influence the success of the projects?

Particularly we are interested in investigating if the digital skills of the project manager are relevant towards the success of the projects under a context of the industry 4.0. For that purpose, we decided to develop an exploratory research to project managers acting in several sectors regarding the 4.0 context.

3 Research Methodology

In this topic we outline the methodology selected to answer the research question. For that purpose, the following research agenda was developed.

Figure 2 - Research agenda



To answer to the research question, the following propositions were selected.

3.1 PROPOSITIONS

In this subtopic we present the propositions that arise from the literature review.

Regarding the project manager's skills and specifically on the topic of the leadership skills the following proposition is proposed:

P1 – Leadership is one of characteristics of the demanded skills for project managers in the context of the industry 4.0.

Juli (2011) mentioned that the **five leadership principles** (Build Vision, Nurture Collaboration, Promote Performance, Cultivate Learning and Ensure Results) can be applied by a single person, the project leader, or the whole team. In either way they help creating the context for high-performance teams. Involving the complete team when building the project vision, nurturing collaboration, promoting performance, cultivating learning and ensuring results help creating an atmosphere of mutual respect and commitment toward the project vision as well as the other leadership principles. It is team leadership what helps secure project success.

PMI (2013) advocates that organizations are focusing on building a talent triangle of technical, leadership, and, strategic and business management skills. Accordingly, organizations must also ensure that employees have not only the project management and technical prowess, but also the leadership, and, the necessary skills on strategic and business management to get the job done. It states that there are three critical project management skillsets needed for successful projects. They are technical project management skills, leadership skills, and strategic and business management skills.

Further in 2016, Project Management Institute (2016) declares that, in nowadays increasingly complex and competitive global marketplace, technical skills are simply not enough and adds that companies are seeking added skills in leadership and business intelligence to support longer-range strategic objectives that contribute to the bottom line like: benefits management and realization, business models and structures, competitive analysis, customer relationship and satisfaction, industry knowledge and standards, legal and regulatory compliance, market awareness and conditions, operational functions like finance and marketing, strategic planning, analysis and alignment.

According to Project Management Institute (2017), project managers should have the skills of to identify, build, maintain, motivate, lead, and inspire project teams to achieve high team performance and to meet the project's objectives.

Müller & Turner (2007b) stated that team satisfaction impacts on most of the success measures. According to Project Management Institute (2017) as leaders, the project managers are also responsible for proactively develop their team skills and competencies while retaining and improving team motivation and satisfaction.

Recently, Stolzenberger (2019) reported that project managers are taking over the main responsibility for success of multicultural projects. Their study aimed to identify the impact of effective leadership on multicultural project teams and their main findings are that there are seven principles for effective leadership of multicultural teams:

- Technical before personal skills of team member;
- Leading the team with less authority;
- Making experiences to improve cultural awareness;
- Emotional intelligence to reach people;
- Cross-cultural transformational leadership as leadership style;
- Organisational flexibility and top-management awareness;
- Awareness of teamwork significance

These principles are from a broad spectrum but are all part of leadership.

Guzmán, Muschard, Gerolamo, Kohl, & Rozenfeld (2020) state that leadership is essential in organizations to successfully promote a culture of innovation and that leaders assume a crucial role in the new paradigm of the Industry 4.0. The same source added that, the implementation of the called leadership 4.0, requires investment and openness to cultural change.

P2 – Innovation is one of characteristics of the demanded skills for project managers in the industry 4.0 context.

Project Management Institute (2013) states that activities that support organizational success should not be overlooked, especially in a climate of economic uncertainty, growing global priorities and an increasing necessity to enable innovation.

In pursuit, Project Management Institute (2017) declares that project managers may serve as an informal ambassador by educating the organization as to the advantages of project management regarding timeliness, quality, innovation, and resource management.

Also Vladimir Obradović, Alessandra Montenegro (2018) state that digital transformation with new technologies, new business models and integration of virtuality and reality outperform the initial information technology capabilities of the 20th century, and project managers have to respond to this change in order to ensure successful project management in this digital era.

PMI, (2018) argues that when we think of digital skills, we often think of computer-oriented tasks such as coding or using software skills effectively. But building a truly digital skill set that enables success in today's digital environment requires the combination of other skills like data science (data management, analytics, big data), an innovative mindset, security and privacy knowledge, legal and regulatory compliance knowledge, the ability to make data-driven decisions, and collaborative leadership.

Besides, Ritter & Gemünden (2003) argue that the impact of network competence on innovation's success and further in the project's success were also found to be significant.

P3 – Management is one of characteristics of the demanded skills for project managers in the context of the industry 4.0.

Project Management Institute (2013) states that there are three critical project management skillsets needed for successful projects. They are technical project management skills, leadership skills, and strategic and business management skills.

Project management information systems (PMIS) are usually acquired by organizations as software packages. PMIS are meant to provide managers with the decision-making support needed to plan, organize and control projects, that together mean manage projects. In this study, these systems were found to have a direct impact on project success as declares Raymond & Bergeron (2008).

Ali & Chileshe (2009) state that project success can be achieved through the good performance of project managers in the project. Also defines that some characteristics of the successful project manager are committed and decisive. The authors explain that it includes good committed, controlling work and the ability to manage work if anything happened to the main plan, in comparison with the one that was defined in the beginning of the project.

Further, Gomes & Romão (2016) argue that the recognition of the strategic importance of managing projects in the corporate world is rapidly increasing and one important reason for this may arise from the strong belief that the alignment between project management and business strategy can significantly enhance the chances, for organizations, to achieve their strategic objectives as well as improving performance. Likewise, declares that project management is fundamental for attaining the final results of a project, manage the contributors and outcomes, as well as drive and assess the alternatives in order to fulfil the different stakeholders' needs.

Cortellazzo et al (2019) also state that the use of information technology allows the project managers to make more informed decisions and that information systems can provide enormous amounts of real- time data. Therefore, the ability to process high volumes of fast-paced incoming and outgoing data (e.g. big data), in order to analyse it, prioritize and make sense of the relevant information for decision-making, has become and will be even more relevant in the future. We consider this context in line with the context of the industry 4.0. Management skills are needed to manage the enormous amount of data, to analyse it and prioritize it towards decision making.

Crawford et al (2015) state that the results of their research confirm the association between use of all project and change management practices and project success.

P4 – The skills demanded for project managers in the industry 4.0 have a positive influence in the success of projects.

According to Al-Wazzan, H (2019), project managers and teams require higher variant soft skills and hard skills than those needed in the past and a greater degree of autonomy in order to handle industry 4.0 projects. The author also states that many challenges arise to the project managers in the industry 4.0, especially regarding management and technical skills. The project manager must develop soft and hard skills to accomplish the complex and autonomous Industry 4.0 context.

Saraiva, Machado, & Oliveira (2019) conclude that the role of the project manager as a leader influencing the management of the projects of technological innovation in the industry 4.0, should be filled with important knowledge, skills and attitude.

Ali & Chileshe (2009) developed a research that confirmed that the project manager is considered an essential element to the success of projects. They concluded that successful project management depends upon many

factors such as good project managers with high level of skills, strong relationship development, motivation and capability to workforce, selection of the project' steam, high level of communications, great planning and control, and a good selection of the right project manager.

UKEssays (November 2018) claims that project manager's management skills determine the project success or failure.

P5 – The success of projects is measured by the continued stakeholder satisfaction.

Serrador & Rodney Turner (2014) argue that project efficiency is correlated with the stakeholders` satisfaction and overall project success.

Accordingly, the Project Management Institute (2017) states that regular interactions with the community of stakeholders throughout the project mitigate risk, build trust, and support adjustments earlier in the project cycle. This reduces costs and increases the project success rate.

Davis (2014) developed a research regarding the perception of the stakeholders on the success of projects. The author concluded that the projects must satisfy the various groups of stakeholders.

P6 – The success of projects is measured by the project's scope achievement.

PMI (2014) declares that the ability to bring projects on time, in scope and on budget remains critical to the success of projects.

Zwikael (2009) developed a study where declares that the knowledge areas with the greatest impact on project success were Time, Risk, Scope, and Human Resources.

According to the Project Management Institute (2017) to complete the project successfully it is necessary that the project's scope management includes all the processes required to ensure the required work, meaning that the scope is defined in the beginning of the project.

P7 – The success of projects is measured by the accomplishment of the project budget in terms of not exceeding it.

Prabhakar (2009) notes that there is a general agreement that schedule and budget performance alone are considered inadequate to measure the success of projects but that they are still important components of the overall construct.

Along with that, PMI (2014) claims that the ability to bring project on budget is critical for the project's success.

Further, success is measured by product and project quality, timeliness, budget compliance and degree of customer satisfaction as claimed by Project Management Institute (2017).

P8 – The success of projects is measured by the project schedule is accomplished.

Prabhakar (2009) notes that there is a general agreement that schedule and budget performance alone are considered inadequate as measures of project success but that they are still important components of the overall construct.

Also, Davis (2014) refers that four stakeholder groups (project manager, client, sponsor and user) considered setting and meeting a schedule (success factor two) as essential for measuring and understanding project's success.

Furthermore, PMI (2014) affirms that the competence to finish projects on time remains demanding so projects could be successful.

P9 – The success of projects is measured by the customer satisfaction.

Al-Tmeemy et al. (2011) claim that it is incompetent to judge a project's success merely according to the objective criterias like cost, time and quality. For that reason, it is imperative to plan the future, which should include development of strategies and the use of technologies that respond to current and future customer needs.

Dvir et al. (2003) points that there are many cases where projects are executed as planned, on time, on budget and achieve the planned performance goals, but turn out to be complete failures because they don't actual produce benefits to the customer.

The issue of customer satisfaction is also mentioned by Project Management Institute (2017). It states that success is measured by product and project quality, timeliness, budget compliance, and the degree of the customer satisfaction.

Müller & Turner (2007b) analyzed the median level of importance attached to the success criteria and found that customer satisfaction, end-user satisfaction and the respondents self-determined criteria are considered most important for project success.

3.2 EXPLORATORY ANALYSIS

In the first stage, will use an exploratory analysis to explore the most important skills that are required in the context of the Industry 4.0 (where is included the digital transformation), using in-depth individual interviews with a screenplay (see in Appendix in the topic Base Screenplay Questions) to explore what skills the project managers consider to be the most important in this new era.

According to Saunders et al (2009), an exploratory study is a valuable mean to ask open questions to discover what is happening and to gain insights about a topic of interest for which there isn't much research yet. There are several ways to conduct exploratory researches. These include reviewing the literature; interviewing 'experts' in the subject; conducting in-depth individual interviews, conducting focus group interviews...

Hsieh & Shannon (2005) refer that qualitative analysis is one of numerous research methods used to analyse text data that might be in verbal, print, or electronic form and might have been obtained from narrative responses, open-ended survey questions, interviews, focus groups, observations, or print media such as articles, books, or manuals.

Saunders et al (2009) state that exploratory research is flexible and adaptable to change. When conducting exploratory research, the research must be willing to change the direction as a result of new data that appears and new insights that occur.

Specifically, about collecting data through interviews, Hsieh & Shannon (2005) say that open-ended questions will be used. Probes also tends to be open-ended or specific to the participant's comments rather than to a pre-existing theory.

This research is developed by means of in-depth individual interviews.

3.2.1 Interview Objectives

With the interviews we expect to gain new insights about this research and to do a pre-validation of the proposed model:

Specifically, we expect to:

- Validate the variables that have been found in the literature review as well as found new ones;
- Bring real insights to the research about the market and about the project managers.

The interviews followed a confidentiality protocol, authorization to record was agreed. The profile of the interviewee and the base screenplay questions are in Appendix in the topic "Interview Protocol". The studies that are the basis for the predefined questions are summarized in **Table A5**, where we can see that all the constructs, sub-constructs and items were defined base on the literature. We propose to validate the constructs

and items that were previously developed in the literature using quantitative analysis methodologies by means of scale development.

This table has the objective to support the interviews with some literature review.

3.4 DATA ANALYSIS AND DISCUSSION

The interview sample is formed by eight project managers, male and female. The average age of the interviewees is thirty-eight years old. They all manage projects in sectors like services, civil construction, hospitality and event organization. The average years of experience is nine years.

Figure 3 - Interviewees Age

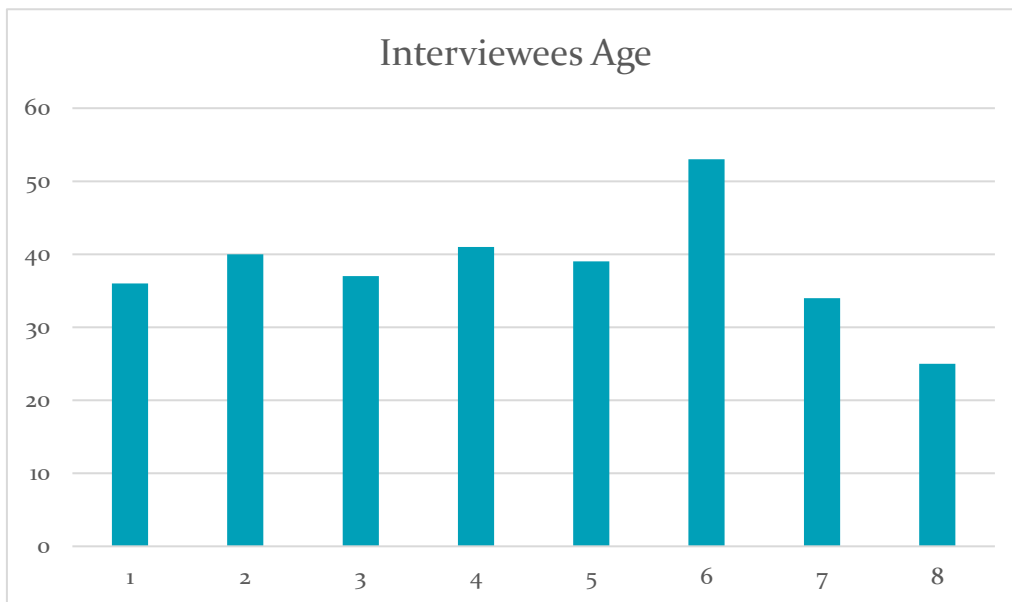


Figure 4 - Interviewees Gender

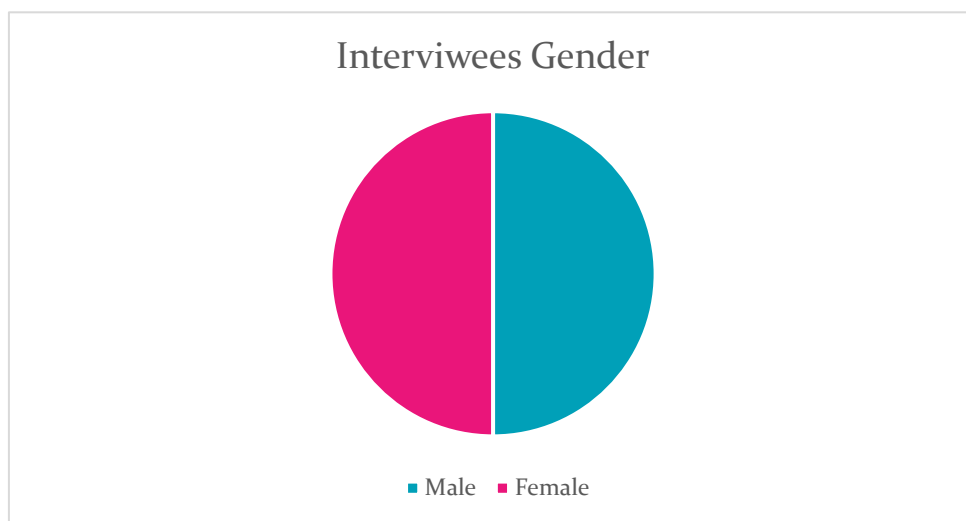
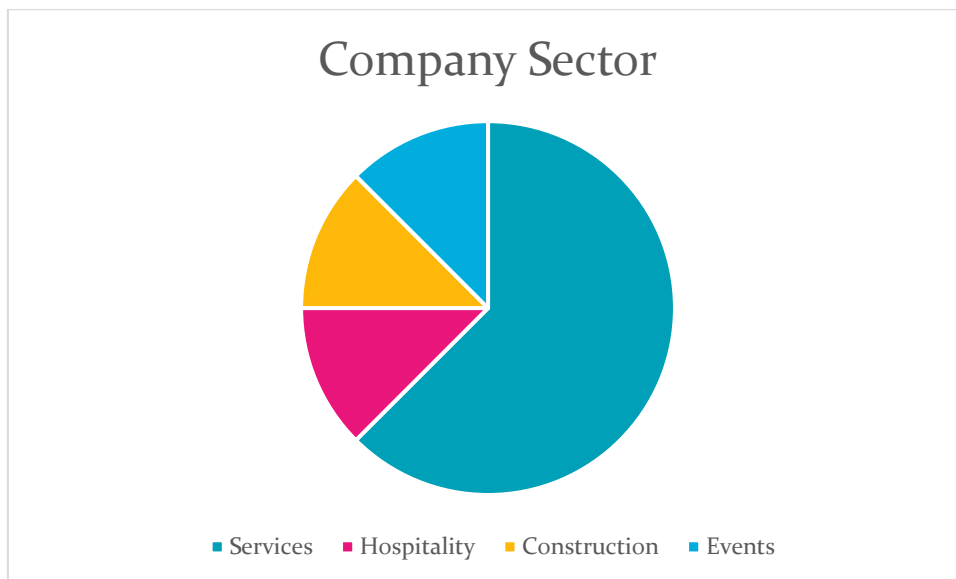


Figure 5 - Interviewees Years of Experience



Figure 6 - Interviewees Company Sector



All interviews were developed between thirty to sixty minutes. All the project managers who were interviewed showed a lot of motivation and interest in contributing to the scientific advancement of project management. They all agreed that the market, the profession and role of the project manager is different in the 4.0 era and that some of the skills needed are different or need to be improved.

The interviews were analysed by means of content analysis. Content analysis is an in-depth reading, determined by the conditions offered by the linguistic system and aims to discover the existing relationships between the

content of the speech and the external aspects. This technique allows the understanding, use and application of a certain content (Bardin, 1991).

According to Vitouladiti (2014), the content analysis method has the following strengths:

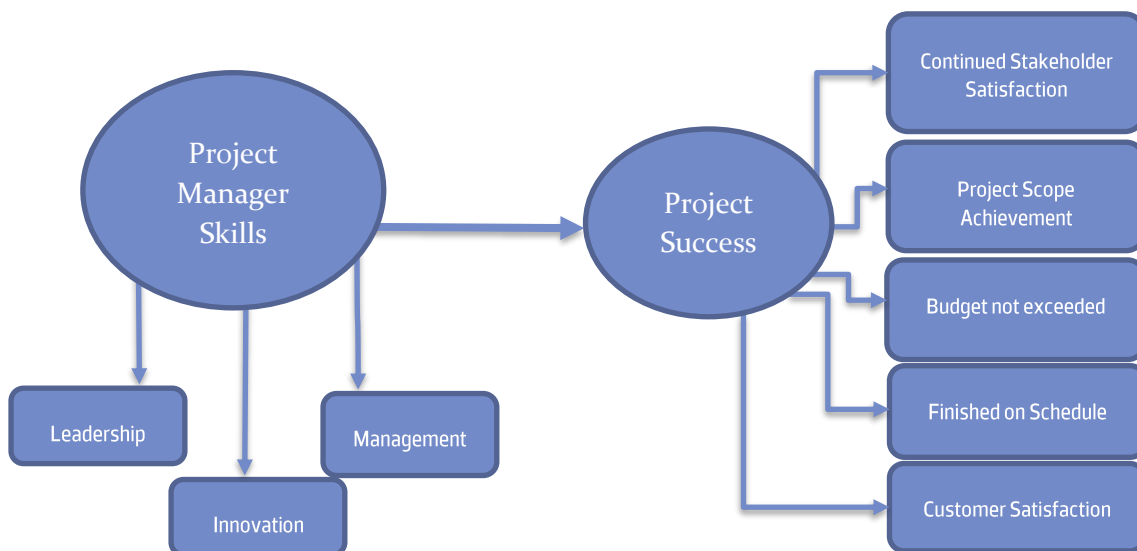
- Can examine any written document, as well as pictures, videos, and situations;
- Widely used and understood;
- Helps decipher trends in groups or individuals;
- It is inexpensive, and can be easily repeated if problems arise;
- It is unobtrusive and does not necessarily requires contact with people;
- Useful for analyzing archival material;
- It is easy and straightforward to establish reliability;
- In comparison with the other research methods, content analysis scores highest with regard to ease of replication. The materials can be made available for others to use.

The same source states that this method also has weaknesses, like:

- Content analysis is a purely descriptive method. It describes what is there but may not reveal the underlying motives for the observed pattern, so do not reveal the why is there.
- The analysis is limited by availability of material

Before analyzing the interviews let´s recall the proposed framework:

Figure 7 - Proposed Framework



OBS: The items that characterize each concept are synthesized in table A5 attached to this thesis.

To understand if the concepts of **leadership, innovation** and **management** are present in the concerns of the project managers in the context of the industry 4.0, the following questions were posed:

As a Project Manager what kind of skills do you think are the most important ones?

and

What are the characteristics that should be considered within the skills that you mentioned before?

P1 – Leadership is one of characteristics of the demanded skills for project managers in the industry 4.0 context.

To obtain answers we had to pose the mentioned questions and to guide the interviews taking into account that, according to the framework of Maria José Sousa & Rocha (2019) the **Leadership** construct is explained by the following six items: **High-Performance Team’s Management, Talent Management, Motivation and Satisfaction, Communication, Careers Management** and **Leadership of Multi-Cultural Employees**.

In terms of the **High-Performance Team’s Management**, the Interviewee 1 told that “*A project manager must have the ability to work with teams under pressure and in an agile format, with good flexibility to manage adversity*”, the Interviewee 2 claims that “*It is very important for the project manager to be able to manage the differences between the team and the client. You need to have that flexibility because the team is under pressure to deliver and the customer always wants more and better*”, the Interviewee 3 said that “*One of the most important skills that a project manager should have is the flexibility to manage all kinds of situations that are happening throughout the project. It is necessary to have a good orientation to the results but to know how to manage the mishaps that are happening*”. In the perspective of the Interviewee 5 “*The first of the main competences of the project manager who would say they are important is the management of resources and knowing how to delegate tasks to those resources.*”. The interviewee 8 agreed “*The project manager must know how to manage time and tasks and how to manage this with the team while maintaining good agility and sensitivity*” and adds that “*Also, a good team organization with people that are used to interact between them is important so the project could have success*”. The literature also validates this sub-item. According to Project Management Institute (2017), project managers require the skills to identify, build, maintain, motivate, lead, and inspire project teams to achieve high team performance and to meet the project’s objectives. Furthermore, Juli (2011) mentioned that the five leadership principles can be applied by a single person, the project leader, or the whole team. In either way they help create the context for high-performance teams. Involving the complete team when building the project vision, nurturing collaboration, promoting performance, cultivating learning and ensuring results help, create an atmosphere of mutual respect and commitment toward the project vision as well as the other leadership principles. It is team leadership which helps secure project success.

Regarding the **Talent Management** the interviewees 6 and 7 said that *“Talent management is essential. Without talent management we will never be able to successfully manage projects. And more than managing we need to maintain and develop it.”* and that *“One of the skills that a project manager must also have is to know how to manage expectations because he cannot create false hopes in the team members because it can affect projects a lot. It will impact the team's commitment. Also, he should have a big involvement in the team's development. He should know the objectives of the team with the project”*. The literature corroborates this sub-item. Project Management Institute (2013) declares that organizations have an average project success rate of 72 percent when talent management is aligned to organizational strategy. Still, PMI (2014) says that NASA sees a direct connection between talent management and project and program success.

The item **Motivation and Satisfaction** seems to be also important for the interviewees. All of them mentioned this sub-item in the interviews. The interviewee 1 claims that *“If the team is lost in motivation or satisfaction, the project manager must insure and reassure the team by compensating when possible. It is very important to have the flexibility and emotional maturity for this”*. Interviewee 2 said that *“It is very important to be able to manage people's motivation and satisfaction, even now with work in the home office, it is very important because we do not all adapt in the same way”* and Interviewee 4 agreed *“The project manager should have the skill of manage and lead people as a facilitator with the objective to direct and forward people so people could be motivated”*. Interviewee 3 mentioned that in his company *“We tried to use other type of tech but the employees weren't satisfied but they couldn't use it well, so we tried to find another one so they understand that tech could help them to do their work and help us to do ours”*. Interviewee 5 and 8 added a good human perspective on this research saying that *“We need to go further than the normal relational and try to have empathy with the other people of the project and take care of their motivation and satisfaction”* and *“The project manager should have the sensitivity with people. He should know how to motivate and take care of the team's satisfaction. Be respected by for the team”*. Interviewee 6 assert that *“The project manager should have the ability to manage people and that includes their motivations and satisfaction on the daily basis”*. The interviewee 7 goes further in this theme and said that *“Teams commitment is very important to the project's success. The project manager should know how to be emphatic with the team and take care of their motivation. A Project manager should lead through the team motivation and satisfaction”*. In terms of literature, Müller & Turner (2007b) expressed that team satisfaction impacts most of the success measures and Project Management Institute (2017) adds that as a leader, the project managers are also responsible for proactively develop their team skills and competencies while retaining and improving team motivation and satisfaction.

Communication is one of the items that were more mentioned by the interviewees. Interviewee 1 stated that *“Communication is very important. Project management is done by people. We cannot discourage communication”* and Interviewee 3 agreed *“The project manager must have excellent communication skills”* as well as Interviewee 6 *“A project manager should have an excellent communication skill”*, Interviewee 7 *“The*

project manager should know how to communicate” and Interviewee 8 *“It’s crucial for a project manager to know how to communicate and know it very well”*. Interviewees 2, 4 and 5, go further and respectively declared that *“With industry 4.0 even more important, communication becomes the competence of the project manager”*, *“A project manager has to communicate well so there’s no misunderstandings”* and *“More than never, now we need to communicate with people. Now we could be everywhere in the world and we need to guarantee that everything is ok with the people of the project and the project itself”*. The literature also validates this sub-item. Müller & Turner (2007a) claims that on all high performing projects conscientiousness, communication and sensitivity are correlated to project success. Likewise, Project Management Institute (2017) declares that communication develops the relationships necessary for successful project.

Concerning the item **Careers’ Management**, Interviewee 7 mentioned that *“The project manager must know how to manage team expectations and team commitment”* and the literature also mentioned the importance of this sub-item. Project Management Institute (2013) reveals that training and career development, recruiting, and hiring contractors all constitute talent management activities that can help organizations increase project management performance. Aligned with that, says that organizations in which talent management is aligned to organizational strategy have an average project success rate of 72 percent.

Along with that, Project Management Institute (2017) says that the project manager, as a leader, is also responsible for proactively developing team skills and competencies while retaining and improving team satisfaction and motivation.

The last item of this construct, **Leadership of multi-cultural employees**, was pointed out by the Interviewee 1 that reported that *“If we have projects with people from other nationalities with various particularities, we have to define a good plan and a well-defined language and these web 2.0 tools also help a lot in this sense of being able to better manage people and projects”*. Regarding the literature of this item, recently Stolzenberger (2019) reported that project managers are taking over the main responsibility for success of multicultural projects. Their study aimed to identify the impact of effective leadership on multicultural project teams and their main findings are that there are seven principles for effective leadership of multicultural teams. These principles are from a broad spectrum but are all part of leadership. They add that if managers can follow and apply them, there will be a higher chance to improve the project performance of multicultural teams. The study has shown that there is a strong relationship between effective leadership and the performance of multicultural project teams. Also, Project Management Institute (2017) states that the qualities and skills of a leader include exhibiting integrity and being culturally sensitive.

Specially, in terms of the **Leadership** as an all, the Interviewee 4 said that *“You really need to know how to manage and lead people, to be a facilitator and not a boss, with the aim of directing and guiding people in a perspective of scrum master to create a well-integrated team”* and, following that, Interviewee 7 points that

“Teams commitment is very important to the project’s success. The project manager should know how to be emphatic with the team and take care of their motivation. A Project manager should lead through the team motivation and satisfaction”. Still in this point of view, the Interviewee 6 claims that *“The basics of project management cannot be overlooked. The project manager should be a leader capable of doing a realistic plan, excellent in work systematization and organization”*. This shows that PM’s really think that leadership is one of the most important characteristics that are demanded for a PM in the industry 4.0 context. Also, in 2013, Project Management Institute (2013) said that there are three critical project management skillsets needed for successful projects. They are technical project management skills, leadership skills, and strategic and business management skills. More recently, Stolzenberger (2019) study has shown that there is a strong relationship between effective leadership and the performance of multicultural project teams.

Taking these arguments into account we may state that there are enough cues to accept this proposition and conclude that Leadership is one of characteristics of the demanded skills for project managers in the context of the industry 4.0.

P2 – Innovation is one of characteristics of the demanded skills for project managers in the industry 4.0 context.

As claimed in the chosen framework of Maria José Sousa & Rocha (2019), the innovation construct is explained by the following six items: Innovation and creativity, new business opportunities, project management, risk management, efficiency and efficacy, and networking.

To understand if innovation is one of characteristics of the demanded skills for project managers in the industry 4.0 context, these questions were asked: **As a Project Manager what kind of skills do you think are most important?** and **What are the characteristics that should be considered within the skills that you mentioned before?**

Regarding **Innovation and Creativity**, Interviewee 1 said that *“Before I was very stuck in the desktop tools that we use on the PC itself as ERP’s that some stakeholders do not use the same ones and it was necessary to import and export the information and now we have these web 2.0 tools that allow us to feed the information directly into the cloud and thus they have access to information in an easy way and help even in time management, cost and remove the rework”*, also the Interviewee 5 points that *“We should always look for better solutions that could improve our daily basis work. The opportunity to have a platform which we can access and manage all tasks and performance and that could be also a repository is very good, for example”*. Still, Interviewee 3 claimed that *“The project manager must also have innovative and creative skills because, in my sector, for example, it is difficult to be able to be everywhere and we had to find solutions to be able to communicate with all workers*, Interviewee 6 agreed saying that *“Project managers must have the skill to adapt to the circumstances through innovation and some creativity.”*, as well as Interviewee 8 that mentioned that *“Project manager should know how to manage time, the tasks and ask for feedback in the team. Always looking*

to maintain a good organization, not the same one". For this item, the literature agreed with the interviewees. Project Management Institute (2013) states that activities that support organizational success should not be overlooked, especially in a climate of economic uncertainty, growing global priorities and an increasing necessity to enable innovation. In pursuit, Project Management Institute (2017) declares that professional project managers may choose to educate and orient other professionals regarding the value of a project management approach to the organization. Also argue that project managers may serve as an informal ambassador by educating the organization as to the advantages of project management regarding timeliness, quality, innovation, and resource management." Likewise, PMI (2014) study says that creativity have become 52% more important than other skills for strategy implementation at project manager's organizations over the past three years. Project Management Institute (2017) also refers that creativity is important in many moments of the project management like knowledge management, conflict management, decision making and others. More recently, PMI, (2018) argues that when we think of digital skills, we often think of computer-oriented tasks such as coding or using software skills effectively. But building a truly digital skill set that enables success in today's digital environment requires the combination of other skills like data science (data management, analytics, big data), an innovative mindset, security and privacy knowledge, legal and regulatory compliance knowledge, the ability to make data-driven decisions, and collaborative leadership.

Concerning **New Business Opportunities**, Interviewee 3 stated that *"We gather a certified supplier so we could win some projects that we couldn't without that certification that we gained to have that supplier"*. In terms of literature, PMI (2013) advocate that organizations are focusing on building a talent triangle of technical, leadership, and strategic and business management skills and that organizations must also ensure that employees have not only the project management and technical prowess, but also the leadership and strategic and business management skills necessary to get the job done. Further in 2016, Project Management Institute (2016) declares that, in nowadays increasingly complex and competitive global marketplace, technical skills are simply not enough and adds that companies are seeking added skills in leadership and business intelligence to support longer-range strategic objectives that contribute to the bottom line like: benefits management and realization, business acumen, business models and structures, competitive analysis, customer relationship and satisfaction, industry knowledge and standards, legal and regulatory compliance, market awareness and conditions, operational functions like finance and marketing, strategic planning, analysis and alignment.

In respect of the item **Project Management**, Interviewee 1 affirmed that *"Project planning is very important. But now also working on the most agile theory is also very important nowadays because we already know that it almost always will go out of planning and that we must have the flexibility to adapt"* and Interviewees 2 and 3 agreed saying, respectively, that *"We must have this ability to adapt and manage projects with the adversities that appear to us. Having the bases and planning well but being able to use the weapons we have to adapt"*, *"This type of tech allows us to manage put our project management bases that we still need, at another level"*,

as well as Interviewee 7 that stated that *“Nowadays we should get as much as we can from the tools to help us improve our project management”*. Interviewee 4 declared that *“The project manager should have the skill to put the real project management in practice with a good organization capability”*, Interviewee 5 concurred *“A project manager should have skills of resource management, schedule management, planning, organization and tasks delegation”*, as well as Interviewee 6 *“The basics of project management cannot be overlooked. The project manager should be a leader capable of doing a realistic plan, excellent in work systematization and organization”*. In the matter of literature, Project Management Institute (2013) states that there are three critical project management skillsets needed for successful projects. They are technical project management skills, leadership skills, and strategic and business management skills. Aligned with that, Ali & Chileshe (2009) says that project success can be achieved through the good performance of project managers in the project and defines one of the ways to succeed as a project manager the know how to use project management tools and methods effectively.

On the subject of the item **Risk Management**, Interviewee 1 said that *“The web 2.0 tools allow us to manage the risk of stakeholders not being so well related to the projects and not being so well informed, which can lead to disagreements”* and Interviewee 3 agreed *“This type of tech allows us to manage risk at another level because we could instantly know about the problem and act quicker”*. Interviewee 2 argued that *“We have to be able to manage possible conflicts with the team and with the client to manage the project risk”* and Interviewee 4 has the same opinion *“The project manager should know how to talk and what to talk with people to avoid conflicts and misunderstandings”*. On the other hand, Interviewee 6 affirmed, simply, that *“A project manager must have the skill for risk management”*. Interviewee 7 declared that *“As project managers we should know how to manage expectations with the team and with the client. It’s risk management”* and Interviewee 8 concurred *“It’s a risk for the project if you can’t manage work organization and the team’s members”*. Regarding the literature, Project Management Institute (2017) refers that the objectives of project risk management are to increase the probability and/or impact of positive risks and to decrease the probability and/or impact of negative risks, in order to optimize the chances of project success. Project Management Institute (2017) also added that the risk management plan provides the approach for identifying, analysing, and monitoring risks. The information included in the risk management plan and quality management plan work together to successfully deliver product with quality and achieve project success. Raz, Shenhar, & Dvir (2002) declared that risk management, when used, practices seem to be working and appear to be related to project success.

About the item **Efficiency and Efficacy**, Interviewee 1 argued that *“Before, I was very stuck in the desktop tools that we use on the PC, such as ERP’s that some stakeholders do not use, and we needed to import and export the information. everyone has easy access to information and helps even in managing time, cost and removing rework. Our customers increasingly want to reduce time and cost”*. Interviewee 2 deposed that *“We use the technologies in the planning and through the project so we could control the time and all the tasks to be*

more efficient” and Interviewee 3, without any hesitation, said that *“Technologies help us to have the data or the information we need at any time and everywhere but we still need to be efficient and discipline so it could actually help us”*. Still, Interviewee 5 declared that *“A project manager should have skills of resource management, schedule management, planning, organization and tasks delegation and always tracking what is done or not”* and Interviewee 6 and 8, agreed saying, in another words, respectively, that *“Project managers should be very good in process organization so they could be efficient in their work and have efficacy in their results”*, *“You should look for new ways of organization so the team could be more efficacy and efficient”*.

In terms of the item **Networking**, nothing was mentioned by the interviewees, but the literature has something to say about networking. Davey (2000) refers that networking is valuable and could be a greater key to project success. Also, Davey (2000) affirms that the results of their study indicate that the true value of networking lies in the efficiency of your network as project manager. Adds that challenges or problems that project managers face will be trivial opposed to having no network at all. Then it should be easier to make decisions to deliver a successful project. Therefore, networking is highly valuable to the project manager. Besides, Ritter & Gemünden (2003) argue that the impact of network competence on innovation success and further in project success were also found to be significant.

Even though, neither of the interviewees seem to validate this proposition, the literature review showed that it could have a positive impact in the success of projects, so it's suggested to still use it in a bigger sample of interviews, focus group or through a questionnaire.

Specifically, about the construct **Innovation**, Interviewee 3 said that *“The project manager must also have innovative and creative skills because, in my sector, for example, it is difficult to be able to be everywhere and we had to find solutions to be able to communicate with all workers”* and Interviewee 6 agrees, saying that *“Project managers must have the skill to adapt to the circumstances through innovation and some creativity”*. With reference to the literature, Project Management Institute (2013) states that activities that support organizational success should not be overlooked, especially in a climate of economic uncertainty, growing global priorities and an increasing necessity to enable innovation. In pursuit, Project Management Institute (2017) declares that professional project managers may choose to educate and orient other professionals regarding the value of a project management approach to the organization. Also argues that project managers may serve as an informal ambassador by educating the organization as to the advantages of project management regarding timeliness, quality, innovation, and resource management.” More recently, PMI, (2018) argue that when we think of digital skills, we often think of computer-oriented tasks such as coding or using software skills effectively. But building a truly digital skill set that enables success in today's digital environment requires the combination of other skills like data science (data management, analytics, big data), an innovative mindset, security and privacy knowledge, legal and regulatory compliance knowledge, the ability to make data-driven decisions, and collaborative leadership.

With all these arguments from the interviewees and from the literature, it could be assessed that this proposition is accepted.

P3 – Management is one of characteristics of the demanded skills for project managers in the industry 4.0 context.

Maria José Sousa & Rocha (2019) states, in the chosen framework, that the management construct is explained by the following seven items: New Models of Work Organization, Emergent Technologies, Decision Making Tools, Big Data Analysis, Organizational Change, Strategic Management and, Social and Relational Knowledge.

To understand if management is one of characteristics of the demanded skills for project managers in the industry 4.0 context, these questions were asked: **As a Project Manager what kind of skills do you think are most important?** and **What are the characteristics that should be considered within the skills that you mentioned before?**

About the item **New Models of Work Organization**, Interviewee 2 clearly affirms that *“With this new reality, we have to adapt and react to adversities and find new ways to manage our work”* and Interviewee 6 agrees *“Project manager should be an excellent at work and process organization and if he has to change it to get through some adversity, he should do it right away”*. Interviewee 3 gives the example of his work saying that *“A project manager has to be an organized but flexible person. Also, in our sector is very important to be effective in the communication to know if everything in the constructions is working as it should and the suppliers are working as they are supposed to, so we need to reinvent ourselves and find some new forms to organize our work flow”* as well as Interviewee 1 *“Before, I was very stuck in the desktop tools that we use on the PC, such as ERP's that some stakeholders do not use, and we needed to import and export the information. everyone has easy access to information and helps even in managing time, cost and removing rework. Our customers increasingly want to reduce time and cost”*. Interviewee 5 and 8 give a different perspective to explain this item, saying respectively that *“Nowadays the project manager is more a bridge between the employees that develop the product or service and the client. Which makes it easier for the employees to focus on the development of the product or service”*, *“Project manager should know how to manage time, the tasks and ask for feedback in the team. Always looking to maintain a good organization, not the same one”*. Interviewee 4 gives an example of the present situation that we live in, declaring that *“Nowadays with the home working or geographically distance, the project manager should find the best option to communicate and has to be sure that the information is everywhere it should always be on the time it should”*. In respect of literature, Project management information systems (PMIS), usually acquired by organizations as software packages, are meant to provide managers with the decision-making support needed to plan, organize and control projects. In this study, these systems were found to have a direct impact on project success as declares Raymond & Bergeron

(2008). Ali & Chileshe (2009) append that project success can be achieved through the good performance of project managers in the project. Also defines that some characteristics of the successful project manager are committed and decisive and explains it saying that it includes good committed, controlling work and the ability to manage work if anything happened to the main plan that was defined in the beginning of the project.

Regarding the item **Emergent Technologies**, Interviewee 1 tell us that *“Today, the level of information acceleration is very high, we need to have the skills of the new tools we call web 2.0, cloud tools that help me a lot in projects today to reduce costs. They are vital tools. Avoid rework”*, Interviewee 2 adds that *“We must be able to use and choose new technologies that allow us to manage projects in a better way, especially now with the home-office”* and Interviewee 4 also agreed with a recent example *“Nowadays with the home working or geographically distance, the project manager should find the best option to communicate and has to be sure that the information is everywhere it should always be on the time it should. So, he should have the tools to facilitate that with new tech”*. Interviewee 3 gives his example *“In our sector is very important to be effective in the communication to know if everything in the constructions is working as it should and the suppliers are working as they are supposed to, so we need to reinvent ourselves and find some new forms to organize our workflow. So, we found some technologies that are easy to use by the employees and that help us as project managers to have instant feedback about how the work is doing”* as well as Interviewee 5 *“The opportunity to have a platform which we can access and manage all tasks and performance and that could be also a repository is very good. We could write there all type of comments, write and save reports. It saves time and gives the opportunity to make better decisions, more informed and quicker”*. Interviewee 6, 7 and 8 affirm, in a more general way, that *“It’s important for the project manager to know how to work with new technologies to help him get the job done”*, *“This easy access to new communication tools allow us to be more agile. Help us in the management”*, *“In this era, it’s important to know how to use the tools that can help us in our work on the daily basis. So, we need to pay attention to new tech”*. In the matter of literature, as Project Management Institute (2017) argues that compared to a few decades ago, there have been many changes in the context in which business and projects take place today. New technologies have been introduced and project managers need to be cognizant of the project context and these new aspects when managing the integration. Then, project managers can decide how to best use these new elements of the environment in their projects to achieve success. Also Vladimir Obradović, Alessandra Montenegro (2018) says that digital transformation with new technologies, new business models and integration of virtuality and reality outperform the initial information technology capabilities of the 20th century, and project managers have to respond to this change in order to ensure successful project management in this digital era.

Relative to **Decision Making Tools**, Interviewee 1, 2, 3 and 5 showed their perspective with practical examples of their reality. Interviewee 1 said that *“Before, I was very stuck in the desktop tools that we use on the PC, such as ERP's that some stakeholders do not use, and we needed to import and export the information. everyone*

has easy access to information and helps even in managing time, cost and removing rework”. Interviewee 2 affirms that “We make weekly reports with daily meetings with the team and we keep the client and stakeholders updated with the project, usually every fifteen days, so we can guarantee their satisfaction. So, we always know how the project is doing and allows us to make better decisions”, Interviewee 3 stated that “We found some technologies that are easy to use by the employees and that help us as project managers to have instant feedback about how the work is doing” and Interviewee 5 mentioned that “The opportunity to have a platform which we can access and manage all tasks and performance and that could also be a repository is very good. We could write there all type of comments, write and save reports. It saves time and gives the opportunity to make better decisions, more informed and quicker”. Also, Interviewee 4 referred that “Nowadays with the home working or geographically distance, the project manager should find the best option to communicate and has to be sure that the information is everywhere it should always be on the time. So, he should have the tools to facilitate that with new tech that could help him and the team to make the best decisions”. Interviewee 6 gives an interesting perspective about this item saying that “Numbers tell us if we are being succeeded. We could see them through the tools that we work on the daily basis where all the data and information should be so we could make better decisions”. Interviewee 8 reported that “In this era, it’s important to know how to use the tools that could help us in our work on the daily basis. So, we need to pay attention to new tech. With them we could manage better and make better decisions”. The literature agreed with the interviewees. Obradović et al. (2018) declares that the digital age causes a changing from technical to soft skills like analytical skills, decision making and working with people and according to Lord Aberdare Earl of Courtown, Baroness Garden of Frogmal, Lord Giddens, Lord Haskel, Lord Holmes of Richmond, Lord Janvrin, Lord Kirkwood of Kirkhope, Lord Lucas, Lord Macdonald of Tradeston, Baroness Morgan of Huyton (Chairman) (2015) findings, manage and store digital information and content, increase independence and confidence by solving problems and finding solutions using digital tools.

Concerning the item **Big Data Analysis**, Interviewee 1 said that “The level of information acceleration today is very high. We need to have the skills of the new tools we call web 2.0, cloud tools that help me a lot in projects today to reduce costs. They are vital tools. Avoid rework”, Interviewee 3 added that “So we found some technologies that are easy to use by the employees and that help us as project managers to have instant feedback about how the work is doing as well as technologies that allow us to have all the data anywhere, anytime we need it”, Interviewee 5 affirmed that “The opportunity to have a platform which we can access and manage all tasks and performance and that could be also a repository is very good. We could write there all type of comments, write and save reports. It saves time and gives the opportunity to make better, more informed and quicker decisions. Having all this information in one place that we could analyse is really great” and Interviewee 6 declared that “Numbers tell us if we are being succeeded. We could see them through the tools that we work on the daily basis where all the data and information should be so we could make better decisions”. About the literature, PMI (2018) refers that when we think of digital skills, we often think of computer-oriented

tasks such as coding or using software skills effectively but building a truly digital skill set that enables success in today's digital environment requires the combination of like data science (data management, analytics, big data), an innovative mindset, the ability to make data-driven decisions, collaborative leadership and others. Cortellazzo et al (2019) also states that the use of information technology allows them to make more informed decisions and that information systems can provide enormous amounts of real-time data. For that, the ability to process high volumes of fast-paced incoming and outgoing data (e.g. Big data), in order to analyse, prioritize and make sense of the relevant information for decision-making, has become and will be even more relevant in the future.

In the matter of the item **Organizational Change**, Interviewee 3 mentioned that *"The organization was not organized like that before, we had to change to get better results and do our job better"* and Interviewee 5 reported that *"Nowadays the project manager is more a bridge between the employees that develop the product or service and the client. Which makes it easier for the employees to focus on the development of the product or service. Also, the decision by the organization to concentrate all project management and organization tools in just one or two made all the difference. Before we used to have five tools to use every day and now with only one or two this time saved for all people that have to use it on the daily basis"*. About literature, Project Management Institute (2018) affirms that organizations with actively engaged executive sponsors report greater collaboration and mutual support, better project success rates and experience less risk. Also refers that effective project sponsors use their influence within an organization to actively overcome challenges by communicating the project's alignment to strategy, removing roadblocks and driving organizational change. Besides, Graham, J. (2005) declares that one of the benefits of organizational change management is a Higher success rate. Also, Crawford et al (2015) affirm that the results of their research confirm the association between use of all project and change management practices and project success. However, those practices identified as critical success factors (CSF) are those drawn from the change implementation toolkit, namely making informed decisions and ensuring business integration.

On the subject of the item **Strategic Management**, Interviewee 3 stated that *"The organization was not organized like that before, we had to change to get better results and do our job better"*, Interviewee 7 declared that *"As project managers we should be agile in our management and we should manage every detail strategically"*. Interviewees 6 and 8 were more accurate when talking about this item. Interviewee 6 affirmed that *"Project manager should always have a strategy in mind and make informed decisions based on that. He must have strategic understanding and materialize it"* and Interviewee 8 agreed *"You should always have a strategic thinking to manage the project well"*. Regarding the literature, Crawford et al (2015) says that some critical success factors are: facilitate business integration by considering business strategy, organization and culture, as well as coping with change and make informed decisions with a holistic vision. Further, Gomes & Romão (2016) argue that the recognition of the strategic importance of managing projects in the corporate world

is rapidly increasing and one important reason for this may arise from the strong belief that the alignment between project management and business strategy can significantly enhance the chances, for organizations, to achieve their strategic objectives as well as improving performance. Likewise, declares that project management is fundamental for attaining the final results of a project, manage the contributors and outcomes, as well as drive and assess the alternatives in order to fulfil the different stakeholders' needs. Still, Al-Tmeemy et al. (2011) claim that it will be incompetent to judge a project's success merely according to the objective criteria like cost, time and quality. For that reason, it is imperative to plan the future, which will include development of strategies and technologies that respond to current and future customer needs.

In terms of **Social and Relational Knowledge**, Interviewee 1 remarked that *"Today, in my view, what most directly impacts a project manager is having interpersonal skills that can be developed over time"*, Interviewee 2 asserted that *"It is very important to have the competence to be sensitive to people. Even more now with the geographical distance"*, Interviewee 3 declared that *"We tried to use other type of tech but the employees weren't satisfied but they couldn't use it well so we tried to find another one so they understand that tech could help them to do their work and help us to do ours. You must listen to people. You don't do anything alone"*, Interviewee 4 stated that *"Project manager should know how to communicate, how and what to say to everyone at any time. He should know how to relate to people"*, Interviewee 5 added that *"The human sensibility is the most important thing. We can't forget that we work with people"*. Also, Interviewee 6 expressed that *"Project managers must be able to communicate, negotiate, explain and show the difference between concepts"*, Interviewee 7 asserted that *"Some of the most important skills that project managers should have are to know how to communicate and to be empathic with their team members"*, Interviewee 8 remarked that *"Having the human sensitivity is so important. You need that human touch to work with people"*. Relating to the literature, Wang et al. (2019) declared that their study confirms that developing good relations between participants can reduce transaction costs and promote project success. Buvik & Rolfsen (2015) and Henderson, Stackman, & Lindekilde (2016) suggest that project team trust and collaboration have a diverse and intertwining relationship with project success.

With all these arguments from the interviewees and from the literature, it could be assessed that this proposition is accepted.

P4 – The skills demanded for project managers in the era 4.0 have a positive influence in the success of projects.

Regarding this specific context of the industry 4.0, all the interviewees agreed that **the market, the profession and role of the project manager is different in this 4.0 era and that some of the skills needed are different or need an improvement**. Interviewee 1 mentioned that *"In industry 4.0, they are still very attached to the project's timeline and budget and to associate this with the success of the projects"*, *"Before I was very stuck in the desktop tools that we use on the PC itself as ERP's that some stakeholders do not use the same ones and*

it was necessary to import and export the information and now we have these web 2.0 tools that allow us to feed the information directly into the cloud and thus they have access to information in an easy way and help even in time management, cost and remove the rework” and concluded with “Project planning is very important. But now also working on the most agile theory is also very important nowadays because we already know that it will almost always go out of planning and that we must have the flexibility to adapt”. Interviewee 2 said that “With industry 4.0, communication became an even more important skill of the project manager”, that “It is very important to be able to manage people’s motivation and satisfaction, even now with work in the home office, it is very important because we do not all adapt in the same way”, also that “We must be able to use and choose new technologies that allow us to manage projects in a better way, especially now with the home-office” and finished saying that “It is very important to have the competence to be sensitive to people. Even more now with the geographical distance”. Interviewee 3 claimed that “This type of tech allows us to manage risk at another level because we could instantly know about the problem and act quicker”. Interviewee 4 stated that “Nowadays with the home working or geographically distance, the project manager should find the best option to communicate and to be sure that the information is everywhere it should always be on the time it should”. Interviewee 5 affirmed that “More than never, now we need to communicate with people. Now we could be everywhere in the world and we need to guarantee that everything is ok with the people of the projects and the project itself” and culminated with “Nowadays the project manager is more a bridge between the employees that develop the product or service and the client. Which makes it easier for the employees to focus on the development of the product or service. Also, the decision by the organization to concentrate all project management and organization tools in just one or two made all the difference. Before we used to have five tools to use every day and now with only one or two this saves time for all people that have to use it on the daily basis”. Interviewee 6 argued that “Project manager should take care of the quality of the product and for that he should validate that with the customer. Sometimes people forget it but 4.0 industry is customer oriented not machine oriented”. Interviewee 7 declared that “Nowadays we should get as much as we can from the tools to help us improve our project management” and that “This easy access to new communication tools allow us to be more agile. Help us in the management”. Finally, Interviewee 8 asserted that “In this era, it’s important to know how to use the tools that could help us in our work on the daily basis. So, we need to pay attention to new tech”.

In terms of literature, Al-Wazzan (2019) argues that having a talented workforce, adaptive project managers and an adaptive company culture can greatly increase a project’s chances of success and ability to manage any risks in its path in the new world of Industry 4.0. According to Cortellazzo et al. (2019), to overcome the challenges derived from the digital transformation, leaders are required to develop a combination of digital and human skills, mainly related to the ability to communicate effectively in a digitalized context, create cohesion between geographically distant followers, foster initiative and change attitudes, and deal with complex and fast problem solving. Saraiva, Machado, & Oliveira (2019) concluded that the project manager as a leader, to

influence the management of technological innovation projects in industry 4.0, should have some important knowledge, skills and attitude.

With all these arguments from the interviewees and from the literature, it could be assessed that this proposition is accepted.

P5 – The success of projects is measured by the continued stakeholder satisfaction.

Regarding the success of projects and as mentioned in the literature review and in the bibliometric analysis, a mixed framework approach was chosen for this topic.

To understand if the success of projects is measured by the continued stakeholder satisfaction, these questions were asked: **What factors are important so a project could be successful?** and **How do you measure those factors that you mentioned before?**

Interviewee 1 gave us an interesting opinion: *“The tools help to keep customers and all stakeholders, like investors, continuously updated and satisfied with the project. Presenting a timeline or schedule and saying that we have met the budget is currently not enough to say that the project was successful. Maintaining an active relationship with stakeholders, keeping him motivated and making him participate and see the difficulties of the project makes them feel effectively satisfied and then it can be said that the project was successful”*. Interviewee 2 talks a little bit about his experience in his company: *“We make weekly reports with daily meetings with the team and we keep the client and stakeholders updated with the project, usually every fifteen days, so we could guarantee their satisfaction”* as well as Interviewee 3: *“I do a lot of residencies so the other stakeholders have to be satisfied with the result because they will use the product for the rest of their lives. Also, if the client and the stakeholders are satisfied, they will give me more projects in the future”*.

On the other hand, Interviewee 4 talks about other perspective but also agreeing with the previous point of other interviewees: *“You always must deliver value to the customer, actually, to all stakeholders. They are all part of the project”*. Further, Interviewee 5 and 6 added, respectively, another perspective: *“It’s important to validate the project per phases with the client and the other stakeholders of the project. This way the final product or service will be closer of what they really want. It will improve the quality of the final product”*, *“Project managers should be able to manage external impacts and manage all stakeholders so he could have the guarantee that they will defend the project and the project manager through all project. Sponsor included with organizational and/or financial support”*. Interviewee 7 told that *“We should always take customer and stakeholders satisfaction into account. We are more dependent of the users than of the client”* and Interviewee 8 added that *“We do regular meetings with the client and other stakeholders to take care of their satisfaction”*. In terms of literature, Serrador & Rodney Turner (2014) argue in this paper that project efficiency is correlated with stakeholder satisfaction and overall project success. Following that, Project Management Institute (2017)

says that regular interactions with the stakeholder community throughout the project mitigate risk, build trust, and support adjustments earlier in the project cycle. This reduces costs and increases the project success rate.

With all these arguments from the interviewees and from the literature, it could be assessed that this proposition is accepted.

P6 – The success of projects is measured by the project scope achievement.

Still regarding the success of projects and as mentioned in the literature review and in the bibliometric analysis, a mixed framework approach was chosen for this topic.

To understand if the success of projects is measured by the project scope achievement, these questions were asked: **What factors are important so a project could be successful?** and **How do you measure those factors that you mentioned before?**

Interviewee 2 said that *"I think the main thing for a successful project is to be able to deliver to the customer what he asked for and within the given time frame. He doesn't always know what he wants, so you have to define the scope well"* and Interviewee 3 added that *"If I gave my word to the client that I would give him this and that in the specific scope and time and then I do it, he's satisfied and that is the most important thing"*. Interviewee 4 – *"After the customer satisfaction, the scope management is the most important aspect related to project success. You must know how to manage customer expectations with the scope defined for the project. It's a critical success factor"*. Interviewee 5 argues that *"Despite the customer satisfaction that we should take care of, we need to take care also of the scope defined in the beginning of the project"* and Interviewee 6 declared that *"A project manager should never forget the basics of project management. A scope declaration and manage it with the customer and sponsor are very important. A project without a clear vision and defined scope, could not be succeeded"*. Interviewee 7 stated that *"We should align the iron triangle (scope, cost and time) with the client and the stakeholders. Manage their expectations and readjust if we all agree to do it"* and Interviewee 8 pointed that *"The project scope is very important and should be always aligned with the client"*. About the literature, PMI (2014) declares that the ability to bring projects in on time, in scope and on budget remains critical to the success of projects. In their study, Zwikael (2009) developed a study where he declares that the knowledge areas with the greatest impact on project success were Time, Risk, Scope, and Human Resources. Project Management Institute (2017) argues that, to complete the project successfully, project scope management should include the processes required to ensure that the project includes all the work required, and only the work required, meaning the scope defined in the beginning of the project.

With all these arguments from the interviewees and from the literature, it could be assessed that this proposition is accepted.

P7 – The success of projects is measured by the project budget not exceeded.

Also, regarding the success of projects and as mentioned in the literature review and in the bibliometric analysis, a mixed framework approach was chosen for this topic.

To understand if the success of projects is measured by the project budget not exceeded, these questions were asked: **What factors are important so a project could be successful?** and **How do you measure those factors that you mentioned before?**

Interviewee 1 gave the current state regarding this item: *“In industry 4.0, they are still very attached to the project's timeline and budget and to associate this with the success of the projects”*. On the other hand, Interviewee 3 added the business perspective: *“The project has to give profit to the company, has to be in the defined budget. That's the first important thing to a project to be really successful”*. Interviewee 4 remembers the basic of Project Management *“Of course you could never forget the basics and the budget and time are also important and are related with the customer satisfaction and with the scope management”* as well as Interviewee 7 *“We should align the iron triangle (scope, cost and time) with the client and the stakeholders. Manage their expectations and readjust if we all agree to do it”*. Interviewee 5 makes a connection between project budget and client satisfaction: *“We should always go through the project with the customer feedback and be transparent with him, because if we defined this budget, it was with a defined scope. If the client wants more than the defined earlier, we will exceed budget and that's not what we want”* as well as Interviewee 8 that still added the connection with stakeholder satisfaction: *“Time and budget are important to project's success and should have a margin to manage it with the client and sponsor”*. Finally, Interviewee 6 argues that *“With unlimited resources we could do everything but that's not possible, so the project manager should always control the budget and manage it with the project sponsor”*. Concerning the literature, Prabhakar (2009) notes that there is a general agreement that schedule and budget performance alone are considered inadequate as measures of project success but that they are still important components of the overall construction. Along with that, PMI (2014) claims that the ability to bring project on budget is still critical so the project could be successful. Further, success is measured by product and project quality, timeliness, budget compliance and degree of customer satisfaction as claimed by Project Management Institute (2017).

With all these arguments from the interviewees and from the literature, it could be assessed that this proposition is accepted.

P8 – The success of projects is measured by the project finished on schedule.

Plus, regarding the success of projects and as mentioned in the literature review and in the bibliometric analysis, a mixed framework approach was chosen for this topic.

To understand if the success of projects is measured by the project finished in schedule, these questions were asked: **What factors are important so a project could be successful?** and **How do you measure those factors that you mentioned before?**

Interviewee 1 declared that *“In industry 4.0, they are still very attached to the project's timeline and budget and to associate this with the success of the projects”* and Interviewee 2 added that *“I think the main thing for a successful project is to be able to deliver to the customer what he asked for and within the given time frame”*. Interviewee 3 stated that *“If I gave my word to the client that I would give him this and that in the specific scope and time and then I do it, he's satisfied and that is the most important thing”* and Interviewee 4 claimed that *“Of course you could never forget the basics and the budget and time are also important and are related with the customer satisfaction and with the scope management”*. Interviewee 5 affirmed that *“We should take care of the schedule with the tools we have that help us through all the project”* and Interviewee 6 added that *“As project manager you should have excellent organization, systematization and management skills so you could have results in the defined schedule”*. Interviewee 7 mentioned that *“We should align the iron triangle (scope, cost and time) with the client and the stakeholders. Manage their expectations and readjust if we all agree to do it”* and Interviewee 8 expressed that *“Time and budget are important to project's success and should have a margin to manage it with the client and sponsor”*. In respect of literature, Prabhakar (2009) notes that there is a general agreement that schedule and budget performance alone are considered inadequate as measures of project success but that they are still important components of the overall construction. Also, Davis (2014) refers on their study that four stakeholder groups (project manager, client, sponsor and user) considered setting and meeting a schedule (success factor two) as essential for measuring and understanding project success. Furthermore, PMI (2014) affirms that the competence to finish projects on time remains demanding so projects could be successful.

With all these arguments from the interviewees and from the literature, it could be assessed that this proposition is accepted.

P9 – The success of projects is measured by the customer satisfaction.

Finally, regarding the success of projects and as mentioned in the literature review and in the bibliometric analysis, a mixed framework approach was chosen for this topic.

To understand if the success of projects is measured by the customer satisfaction, these questions were asked: **What factors are important so a project could be successful?** and **How do you measure those factors that you mentioned before?**

Interviewee 1 expressed that *“The tools help to keep customers and all stakeholders, like investors, continuously updated and satisfied with the project. Presenting a timeline or schedule and saying that we have met the budget*

is currently not enough to say that the project was successful. I have seen clients who in the end with their timeline fulfilled and even with a budget below the forecast, were not really satisfied and never returned to work with us again. On the other hand, I have also seen other clients who, despite not complying with the timeline and budget, were fully satisfied because they participated in the difficulty of the project and felt involved in overcoming them". On the other hand, Interviewee 2 talked about his sector "Currently in the IT area it is important to be able to deliver what the customer wants, on time and with quality. It is a very important differential that will make the customer satisfied, which is very important". Interviewee 3 affirms his perspective also about the ethics of a Project Manager: "If I gave my word to the client that I would give him this and that in the specific scope and time and then I do it, he's satisfied and that is the most important thing. Also, an active client as much more probability to be satisfied. If he participates through all project he will be satisfied in the end of it". Interviewee 4 and 8 agreed saying respectively that "For me, the most important aspect related to project success is the customer satisfaction" and "Customer satisfaction is the most important aspect to project's success". Interviewee 5, 6 and 7 agreed on the need to take care of this customer satisfaction topic. Interviewee 6 said that "We should take care of the customer satisfaction and always with transparent communication. If the client feels involved in the project, he will be more satisfied", Interviewee 6 added that "Project manager should take care of the quality of the product and for that he should validate that with the customer. Sometimes people forget it but 4.0 industry is customer oriented not machine oriented" and Interviewee 7 declared that "We should always take customer and stakeholders satisfaction into account. We should be concerned about the client's operation and guarantee that he's aligned with the project". Relating to the literature, Dvir et al. (2003) point that there are many cases where projects are executed as planned, on time, on budget and achieve the planned performance goals, but turn out to be complete failures because they don't actual produce benefits to the customer. Also, Project Management Institute (2017) states that success is measured by product and project quality, timeliness, budget compliance, and degree of customer satisfaction. Müller & Turner (2007b) analysed the median level of importance attached to the success criteria and found that customer satisfaction, end-user satisfaction and the respondents self-determined criteria are considered most important for project success.

Table 4 summarizes the analysis of the items regarding the constructs under study mentioned in **TableA5** attached. The green spaces mean that the interviewees agreed or seem to agree with the inclusion of the mentioned item and red spaces mean that the interviewees do not agree or do not seem to agree with the inclusion of the item proposed by the literature review.

The majority of the items were consensual among all interviewees. This is a good indicator regarding a future model validity with a greater sample, probably by means of a questionnaire followed by a quantitative analysis with structural equation modelling (SEM).

Table 5 - Propositions Validations

Items vs Interviewees	Int 1	Int 2	Int 3	Int 4	Int 5	Int 6	Int 7	Int 8
Project Manager Digital Skills								
<i>Leadership Skill</i>								
• High Performance Team's Management								
• Talent Management								
• Motivation and Satisfaction								
• Communication								
• Careers Management								
• Leadership of Multi-Cultural Employees								
<i>Innovation Skill</i>								
• Innovation and Creativity								
• New Business Opportunities								
• Project Management								
• Risk Management								
• Efficiency and Efficacy								
• Networking								
<i>Management Skill</i>								
• New Models of Work Organization								
• Emergent Technologies								
• Decision Making Tools								
• Big Data Analysis								
• Organizational Change								
• Strategic Management								
• Social and Relational Knowledge								
Skills demanded for 4.0 have positive influence in project success								
Project Success								
<i>Continued Stakeholder Satisfaction</i>								
<i>Customer Satisfaction</i>								
<i>Project Scope Achievement</i>								
<i>Budget Not Exceed</i>								
<i>Finished on Schedule</i>								

Table caption: Int = Interviewee

In line with the presented results, we may conclude that the proposed framework can be a good starting point to a future validation in a larger scale.

In the next topic a conclusion of this research is drawn.

4 Conclusions

This research started with a literature review on the skills and digital skills demanded to the project managers in the context of the industry 4.0. The literature revision questions the role of the talent management and what are the most important skills that a project manager should have in the mentioned context. Frameworks were selected and analysed to explore the most important skills that the project manager should have in this 4.0 era.

We concluded that the digital skills demanded for project managers on the industry 4.0 are still scarce in the literature. Despite that, we decided to use the framework proposed by Maria José Sousa & Rocha (2019), due to the number of citations of the paper, showing that it has been discussed for many authors and that increases the reliability of the mentioned framework.

Regarding the project's success, there are many frameworks in the literature. Yet, none of them is consensual. It was concluded that this happens because there are too many variables and many perspectives that can be used to measure a successful project. Despite this, we developed a conceptual framework to measure the impact of the project manager's skills in the success of the projects. To measure the success of the projects we use a mixed framework where KPI's can also be defined using the iron triangle proposed by PMI (2018) but also the customer's and the stakeholder's satisfaction. This new framework is expected to give a broader perspective on the success of the projects.

Regarding the methodology a qualitative approach by means of an exploratory analysis is developed. In-depth interviews are developed to eight project managers in order to do a pre-validation. The interviews showed some interesting results where most of the concepts and items of the model were validated by most of the interviewees.

Taking into account the results of this research, we can conclude that the soft skills of the project manager are effectively the most important ones to take into account where it includes, the communication capacity, the management capacity in adversity in the most varied points of higher team performance, risk management, strategic, among others.

In terms of digital skills, the project managers that were interviewed stated that nowadays these skills are crucial in any sector. The project manager must know how to use the new technologies to plan, communicate and work in so many places at the same time as we live nowadays. They also stated that the big data and robotics are no longer the future but the present in the industry 4.0.

Some of the interviewees mentioned the importance of other skills like sensitivity and human touch when managing HR. Also, some contents related to management and also to the necessary technological skills were considered important in this 4.0 era. They stated that nowadays digital skills are very important to support decision making and to help in our daily work in terms of organization and communication.

However, they also state that, despite this, the same communication skills and human conscience should not be discouraged. Oppositely, they must be reinforced, because of the geographical dispersion and remote work.

Regarding the success of the projects, we can say that the continuous and not only final satisfaction of the client and of all stakeholders, is something increasingly relevant for project managers. They never forget the bases of project management and the iron triangle (scope, cost and time) that they refer to as being central, but they also say that it is something that has to be worked out with the client and with the various stakeholders, whether the sponsor or not.

More related to this era of industry 4.0, project managers report that the attention to the customer has doubled. As one of the interviewees said, "People forget that industry 4.0 is customer-oriented, not machine-oriented." This demonstrates that project managers are really alert and proactive to these changes and it also demonstrates that the client is increasingly a key and even more central to the success of any project.

5 Limitations and Future Research

Regarding the bibliometric analysis, one limitation is that the data was exported only from Web of Science that, despite being a good source for good scientific articles, is only one source of scientific material. Many other relevant papers about this topic were found in other sources when searched individually and not as a bibliometric analysis.

The biggest limitation of this paper was the pandemic situation that we still currently live in, that limited this research in many aspects regarding the lockdown that made us all work from home and be concerned about our own and our family safety. It was impossible to interview project managers face to face and that is one of the upgrades that we intend to do in a nearer future. We are also considering developing a quantitative analysis where the proposed model could be improved and confirmed through a questionnaire to a sample of project managers of the industry 4.0. The idea is to validate the proposed framework relating the skills of the project manager with the success of the project by means of a big sample of respondents. The framework could be tested by using structural equation modelling.

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7 Appendix

Table A 1 - Digital Skills Literature Analysis / Source: Own Elaboration based on literature review

Authors	Problem	Goal	Research Question / Hypothesis	Methodology	Conclusions
Guinan et al (2019)	Creating an innovative digital project team: Levers to enable digital transformation.	Describe some findings from a multilevel study of the IT function of 60 companies, including fieldwork at five company sites involving more than 130 semi structured interviews with senior level IT professionals,	How digital leaders are using four essential team-based levers to propel their organizations forward in the journey toward digital transformation?	Conceptual Study from a multilevel study in some interviews	Digital teams need to also have a strategic lens and not be focused solely on tactics and execution to propel business models forward.
van Laar et al (2019)	Determinants of 21st-century digital skills.	Explain differences in the level of various 21st-century digital skills by examining potential personal, motivational, and social determinants at the level of the individual worker.	H1. ICT attitude contributes positively to the level of 21st-century digital skills; H2. Perceived ease of use contributes positively to the level of 21st-century digital skills; H3. ICT self-regulation contributes positively to the level of 21st-century digital skills; H4. Self-directed learning contributes positively to the level of 21st-century digital skills; H5. Learning goal orientation contributes positively to the level of 21st-century digital skills; H6. Performance goal orientation contributes positively to the level of 21st-century digital skills; H7. Avoidance goal orientation contributes negatively to the level of 21st-century digital skills; H8. Personal initiative contributes positively to the level of 21st-century digital skills; H9. Formal social support contributes positively to the level of 21st-century digital skills; H10. Informal social support contributes positively to the level of 21st-century digital skills;	Descriptive Analysis and Regression Analysis	The level of each 21st-century digital skill is explained by a unique set of determinants. Self-directed learning, for instance, contributes to the level of information, collaboration, and problem-solving digital skills, but does not have an impact upon communication, creativity, or critical-thinking digital skills

			<p>H11. Training contributes positively to the level of 21st-century digital skills;</p> <p>H12. Men have higher levels of 21st-century-digital skills than women;</p> <p>H13. Age has a negative influence on the level of 21st-century digital skills;</p> <p>H14. Level of education has a positive influence on the level of 21st-century digital skills.</p>		
Mesaros et al (2016)	Developing Managerial and Digital Competencies Through BIM Technologies in Construction Industry)	Confirm the statement that BIM technology supports better management in construction industry and that BIM technology develops managerial and digital competencies.	<p>Discuss the issue of developing managerial and digital competencies through BIM technologies in construction industry.</p> <p>H1: Construction company size has a significant effect on improving the management process used by BIM technologies, and thereby improving acquisition managerial and digital competences of managers;</p> <p>H2: Use of foreign private equity has an effect on improving the management process used by BIM technologies, and thereby improving acquisition managerial and digital competences of managers;</p> <p>H3: Participant of construction project has an effect on improving the management process used by BIM technologies, and thereby improving acquisition managerial and digital competences of managers.</p>	Descriptive Analysis and ANOVA Analysis	BIM technology as a support tool for developing managerial and digital skills in construction industry and confirmed that company size and use of foreign private equity influence it.
Sousa & Rocha (2019)	Developing skills for digital transformation of organizations	Contribute to the discussion of an effective digital transformation of organizations based on the latest trends of skill and intend to analyse the perceptions of individuals regarding the challenges faced by organizations and opportunities for new disruptive business.	Discuss an effective digital transformation of organizations based on the latest trends of skills and analyse the perceptions of individuals regarding the challenges faced by organizations and opportunities for new disruptive business	Descriptive Analysis and Correlation	The primary impacts expected from the increasingly widespread use of technology in the context of industry 4.0 are: reduced labor costs, greater flexibility and reduced delivery time for products to the market, of dangerous tasks like treating patients or automating manual work, productivity growth, higher quality products; safer surgeries and better quality of life for the elderly and people with disabilities; new challenges in terms of employment and education and the nature of work, manufacturing (notably robotics), analysis of large amounts of data,

					creation of new products and services, and changes in the way companies and other organizations structure themselves.
Ghobakhlo (2020)	Underlying design principles and technology trends of Industry 4.0 can function favourably in support of sustainability.	Discuss the findings and explain how the underlying design principles and technology trends of Industry 4.0 can function favourably in support of sustainability.	Industry 4.0, digitization, and opportunities for sustainability	Literature Review and ISM methodology	The study attempted to provide an interpretive model of Industry 4.0 sustainability function explaining the processes through which the industrial digitization and the underlying technology trends and design principles can contribute to the achievement of economic, environmental, and social sustainability development goals.
PMI (2018)	Project leaders are becoming even more essential as organizations recognize that strategy is implemented through projects and programs, and as disruptive technology frees them from mundane routines, providing more opportunity to innovate.	this research was designed to better understand how organizations are preparing their project talent to manage the impact of disruptive technologies and the role project leaders are playing.	Project Manager of the Future - Developing Digital-Age Project Management Skills to Thrive in Disruptive Times	Descriptive Analysis	The most forward-thinking organizations rely on the power of project leaders to capitalize on all opportunities generated by technological disruption. One big competitive edge: Project leaders are ready, willing, and able to help their organizations not just survive, but truly thrive, in the face of massive change.
Oberländer et al (2020)	In today's organisations and politics, there is a growing awareness of the gap between existing and needed digital competencies of the workforce to master the challenges of the digitalised future at work. Nevertheless, no comprehensive framework or definition of digital competencies at work has been proposed so far.	To offer a holistic view and broaden the scope of the concept of digital competencies, thereby focussing on applications at work.	What is the applicability of professional learning and development of digital competencies at work?	Literature Review and Descriptive Analysis	A thorough analysis of the available literature revealed a lack of scientific research on DC of adults and a neglect of the work context. However, the large variety of terms and proposed frameworks shows the interest in Digital Competencies in many different contexts such as education, politics, or media and communication.
Cortellazzo et al (2019)	Digital technology has changed organizations in an irreversible way. Like the movable type printing accelerated the evolution of our history, digitalization is shaping organizations, work environment and processes, creating new challenges leaders have to face. Social science scholars have been trying to understand this multifaceted phenomenon; however, findings have accumulated in a fragmented and dispersed fashion across	Provide a comprehensive analysis of the contribution of studies on leadership and digitalization, identifying patterns of thought and findings across various social science disciplines, such as management and psychology.	Are there a pattern of thought in the literature about The Role of Leadership in a Digitalized World?	Quantitative research through standard databases and qualitative coding	

	different disciplines, and do not seem to converge within a clear picture.				
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Table A 2 - Project Success Literature Analysis / Source: Own Elaboration based on literature review

Authors	Problem	Goal	Research Question / Hypothesis	Methodology	Conclusions
Radujković & Sjekavica (2017)	Construction projects success is namely fundamental question for most governments, users and communities, so it is very important never to stop looking for new ways of contribution to improvement of construction management success.	This article differs project management from project success, gives definitions of project management success, aims to review different models of project management success, differs success of managing public and private projects and gives a special accent on present situation in context of project management in Croatia.	Project Management Success Factors	Literature Review and Breakdown Structure Methodology	Project management is inevitable in today's world – a place of continuous improvement through different types of various projects. Project management is not only necessity for that improvement but also one field that seeks for improvement itself, through influence on different PM success factors.
Cooke-Davies (2002)	What are the “real” success factors on projects?	To Identify 12 factors that are critical to project success	The “real” success factors on projects	Descriptive Analysis and Correlation	None of 12 critical success factors is directly concerned with “human factors”, although it is fast becoming accepted wisdom that it is people who deliver projects, not processes and systems.
Bannerman, P. L. (2008)	There has been much discussion in the literature on the definition of project success, but no consensus has emerged. A key problem to be overcome is a multiplicity of expectations of projects and perceptions of their performance.	Propose a multilevel framework for defining project success that has wide application in practice	Defining project success: a multilevel framework	Literature-review and Multilevel Framework	Organizations in all disciplines are increasingly finding that project-based work, supported by project management best practice, offer considerable utility over traditional functional designs in managing discrete activities. As the discipline of project management matures, this trend is likely to continue.
PMI (2018)	Organizations face competitive and disruptive times that could reduce the project's success.	Study the key factors that helps organizations facing heightened competition and ongoing disruption.	How is the project's success in these disruptive times?	Descriptive Analysis	No longer is success driven by any one single factor—it requires multiple factors. Smart organizations understand that proven project management practices lead to greater success and less waste.
Todorović et al (2015)	One of the major issues for knowledge management in a project environment is the poor project success analysis and the lack of proper documentation on the results of the previous projects.	To point to steps that would enable efficient and consistent monitoring and evaluation of project success during the entire life cycle and enable systematic analysis of the success of the entire project, aiming to enhance knowledge management in project environment.	H0. The implementation of an adequate project success analysis can contribute to knowledge management in project environment. H1. The definition of CSFs contributes to knowledge management in project environment.	Regression Analysis	If we use a systematic approach when analysing project success, we can contribute to overcoming one of the key problems in knowledge management in project environment – the lack of proper documentation on the results of the previous projects. This systematic approach would include determining the project's CSFs, what are the most important factors used for evaluating project performances, what will be the project's KPIs, in which way we plan to implement

			<p>H2. The definition of KPIs contributes to knowledge management in project environment.</p> <p>H3. The documentation of results relating to project success evaluation according to the defined KPIs contributes to knowledge management in project environment.</p> <p>H4. Reporting on the final, results of project success evaluation contribute to knowledge management in project environment.</p>		<p>success analysis and what is our plan for gathering data on completed project success analysis.</p>
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Table A 3 - Dimensions of digital competencies at work as the result of the clustering process from the literature review and interviews with practitioners / Source: Oberländer et al. (2020)

Dimensions	Literature Cluster	Practice Cluster
1 Handling of hardware	–	Handling hardware
2 Handling of software	–	Handling software/programmes
3 Programming	–	Programming
4 Handling of applications	–	Handling Office, Internet
5 Innovative capability and creativity	Creating content: Creative, innovative	–
6 Information processing: Recognizing one's own knowledge gaps	–	Detecting lack of knowledge
7 Information processing: Search	Information processing: Searching and finding	Search, research
8 Information processing: Data analysis	Information processing: Analysing	–
9 Information processing: Evaluating	Information processing: Evaluating	Data management: filtering
10 Data organisation	Data management	Storing data Organising data
11 Effective usage	Technical know-how: Ability to effectively use ICT	–
12 Communication	Communication	Communication
13 Collaboration	Collaboration	Virtual collaboration
14 Networking	–	Connectivity Networking
15 Netiquette	–	Dealing with each other
16 Sharing data with others	–	Sharing data with others
17 Cultural aspects	Cultural aspects	–
18 Security and law	Security	Security: Awareness of danger, knowledge about security Legal basics/fundamentals Privacy Data security/safety
19 Responsibility	Responsibility	–
20 Goals and motivation	Motivation, goals, self-regulation capabilities, adjust actions to one's own goals	Attitude and motivation
21 Willingness to learn and openness	Learning, adaptability, change	Willingness/readiness to learn Openness Adaptability
22 Ethics and moral	Ethics/moral	–
23 Autonomy and independence	Autonomy/independence	Self-management
24 Problem-solving	Problem-solving	Problem-solving Capability to learn Gather knowledge about problem-solving/solution strategies Precaution Basic knowledge about problem-solving
25 Train/educate others	–	Train/educate others

Table A 4 - A Multilevel Framework of Project Success / Source: Bannerman, P. L. (2008)

Level	Success Criterion	Description	Empirical Indicators
1	Process	Discipline-specific technical and managerial processes, methods, tools, and techniques employed to achieve the project objectives.	Technical and managerial processes were: <ul style="list-style-type: none"> • Appropriately chosen for the purpose • Aligned with the project objectives • Integrated with each other (as appropriate) • Effectively implemented
2	Project Management	The project design parameters or objectives. Here “scope” refers to the intended scope of the project (e.g., to specify, build, test, and implement a new system), not the scope of specifications of the main project deliverable.	<ul style="list-style-type: none"> • Schedule met • Budget not exceeded • Project scope achieved
3	Product	The main deliverable(s) from the project. The nature of the deliverable(s) will be discipline specific. For example, it might be a product, system, building, bridge, airplane, rocket, or a service of some kind.	<ul style="list-style-type: none"> • Specifications met • Requirements met • Client/user expectations met • Client/user acceptance • Product/system used • Client/user satisfied • Client/user benefits realized
4	Business	The business objectives that motivated the investment. That is, what the business wanted to achieve from the investment.	<ul style="list-style-type: none"> • Objectives met • Business case validated • Business benefits realized
5	Strategic	Business expansion or other strategic advantage gained from the project investment, either sought or emergent.	<ul style="list-style-type: none"> • Business development enabled • External stakeholder/competitor recognition • Competitive response generated

Table A 5 - Variables Measurement

Construct	Sub-constructs	Items	Measure	Questions	Literature
Project manager skills	Leadership skill	<ul style="list-style-type: none"> – High-performance teams management – Talent management – Motivation and satisfaction –Communication – Careers management – Leadership of multi-cultural employees 	Development (Likert scale 1-5, where 1 = no development; 2 = weak development; 3 = moderate development; 4 = considerable development; 5 = strong development.)	<p>During the period of 2017 to 2019, what was the degree of development (1- no development; 7- strong development) with each of the following statements:</p> <ul style="list-style-type: none"> 1 - Employees performance 2 – Development opportunities 3 - Motivation of employees 4 - Satisfaction of employee 5 - Communication 6 - Managing expectations 7 - Integrating cultural differences Management 	(Maria José Sousa & Rocha, 2019)
	Innovation skill	<ul style="list-style-type: none"> – Innovation and creativity – New business opportunities – Project management 		<p>During the period of 2017 to 2019, what was the degree of development (1- no development; 7- strong development) with each of the following statements:</p> <ul style="list-style-type: none"> 1 - Capacity to innovate and creativity 	

		<ul style="list-style-type: none"> - Risk management - Efficiency and efficacy - Networking 		<p>2 - Capacity to diversify the business area</p> <p>3 - Capacity to identify and exploit new business opportunities</p> <p>4 - Project management skills to link project goals with business context</p> <p>5 - Capacity and willingness to undertake risk</p> <p>6 - Capacity to organize the necessary resources to respond to the opportunity</p> <p>7 - Capacity to create and develop national and international networks</p> <p>Leadership</p>	
	Management skill	<ul style="list-style-type: none"> - New models of work organization - Emergent technologies - Decision making tools - Big data analysis 		<p>During the period of 2017 to 2019, what was the degree of development (1- no development; 7- strong development) with each of the following statements:</p> <p>1 - New forms and models of work organization</p> <p>2 - New technologies</p>	

		<ul style="list-style-type: none"> – Organizational change – Strategic management – Social and relational knowledge 		<p>3 - Initiative, decision growth-oriented and responsibility</p> <p>4 - Analysis of information</p> <p>5 - Organizational change</p> <p>6 - Capacity to manage strategic deals and alliances</p> <p>7 - Social and relational knowledge</p>	
Project Success	Continued Stakeholder Satisfaction	-	Achieving (Likert scale 1-5, where “1” means “is not achieve at all” and “5” represents “totally achieved”)	In a successful project, do you think you have achieved the satisfaction of your stakeholders?	Adapted from: (Gomes & Romão, 2016)
	Customer Satisfaction			In a successful project do you consider that you have reached the satisfaction of your customer?	
	Project Scope Achievement			In a successful project, do you think you have achieved the scope?	
	Budget not Exceed	Project completed within budget	Agreement (Likert scale 1-5, where “1” means “Disagree” and “5” represents “Agree”)	In a successful project, this project was completed within budget?	

	Finished on Schedule	Project completed on time		In a successful project, this project was completed on time (within schedule)?	
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Figure 8 - Results of the Bibliometric Analysis for Digital Skill(s) or Digital Competence(s) (Print from VOSviewer)

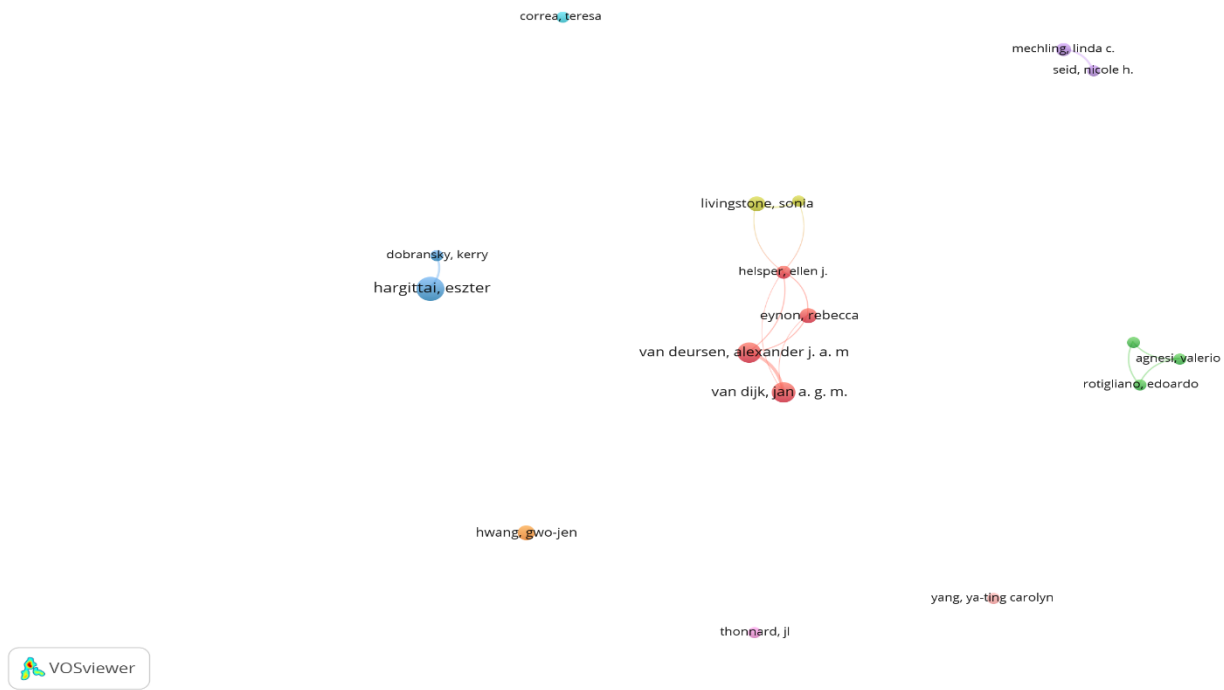


Figure 9 - Results of the Bibliometric Analysis for Project Success (Print from VOSviewer)

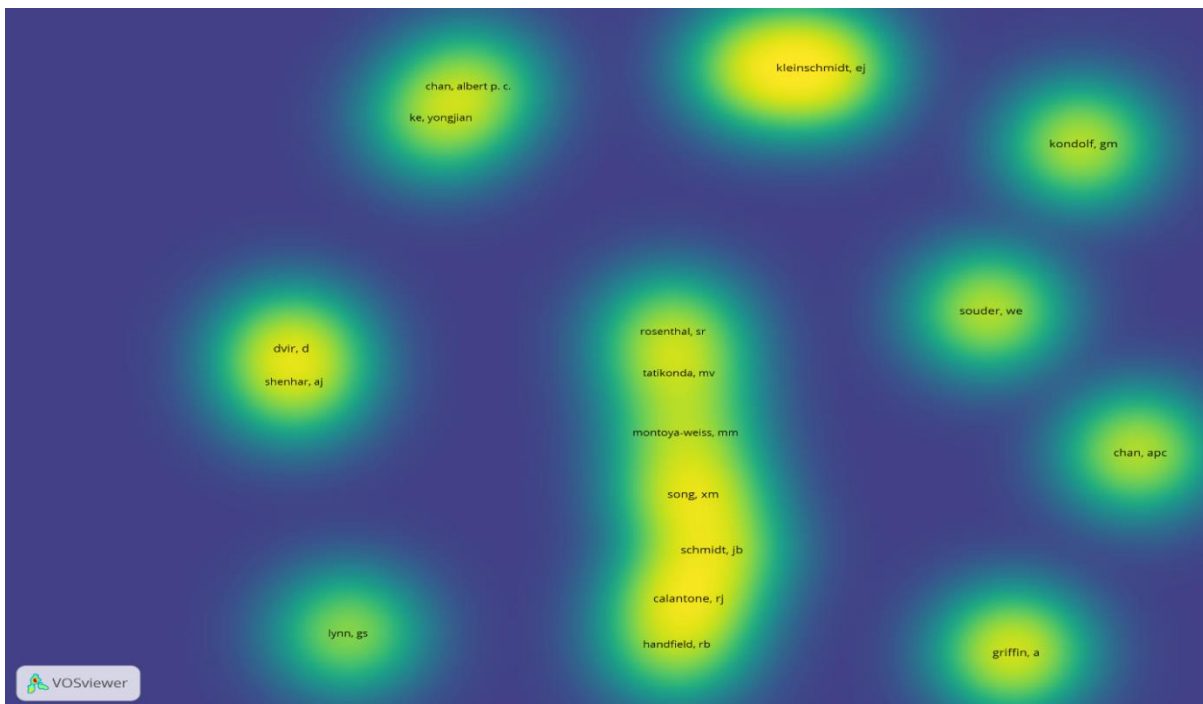


Figure 10 - Results of the Bibliometric Analysis of the Both Previous Searches (Print from VOSviewer)

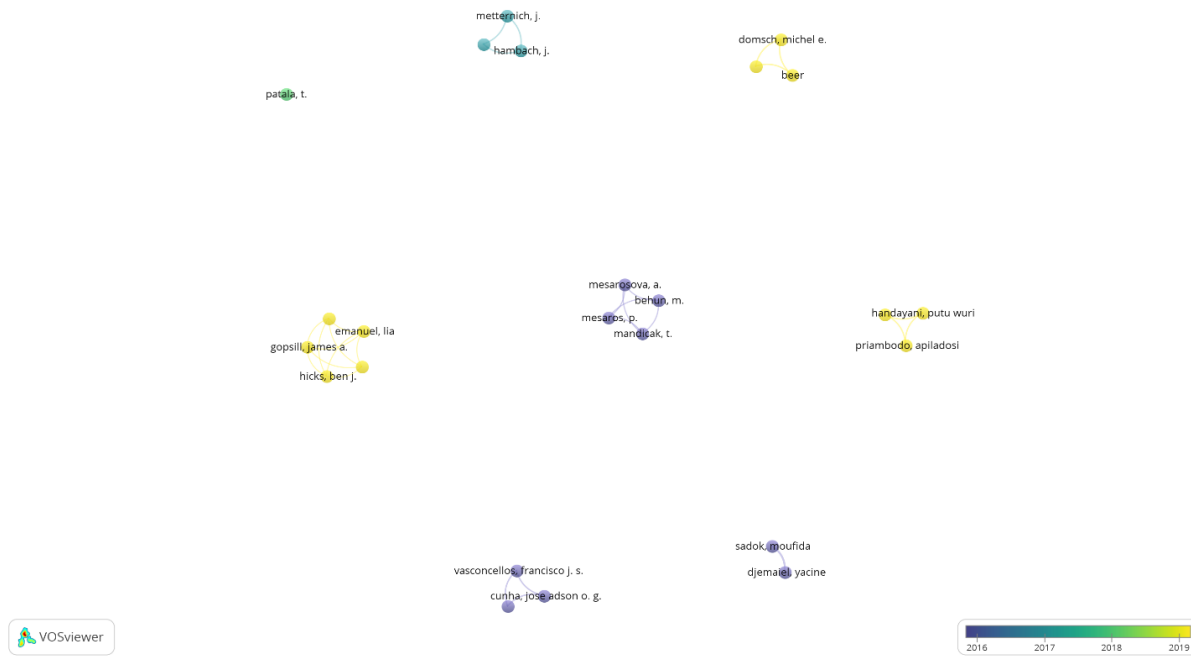


Figure 11 - Results of the Bibliometric Analysis for Digital Skill(s) Framework or Digital Competence(s) Framework (Print from VOSviewer)

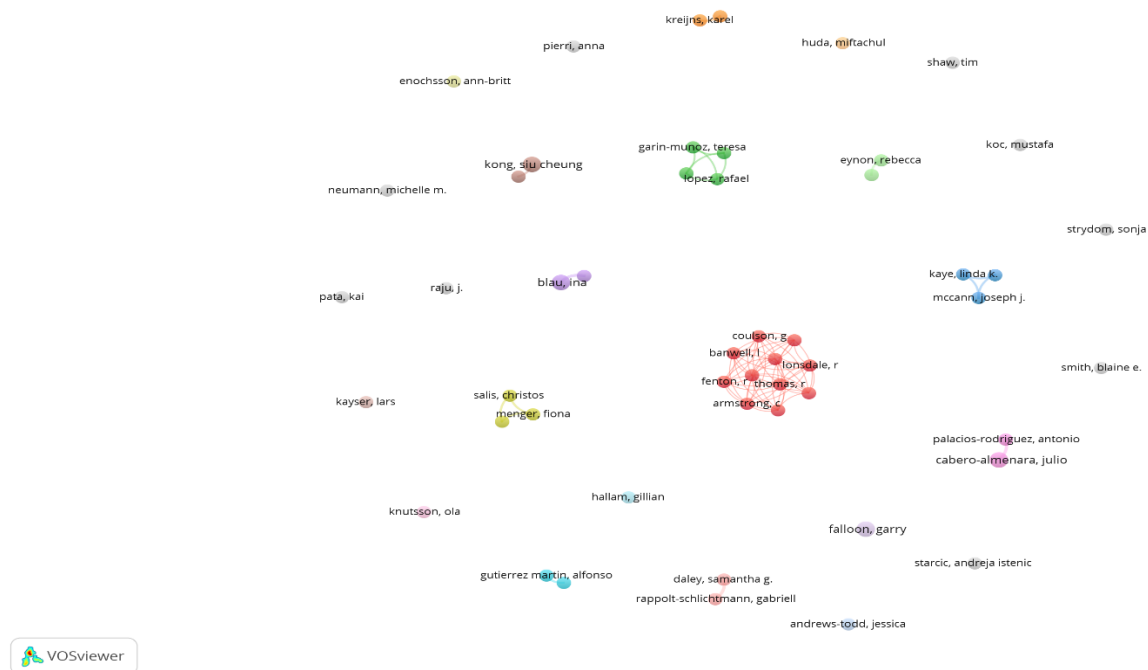
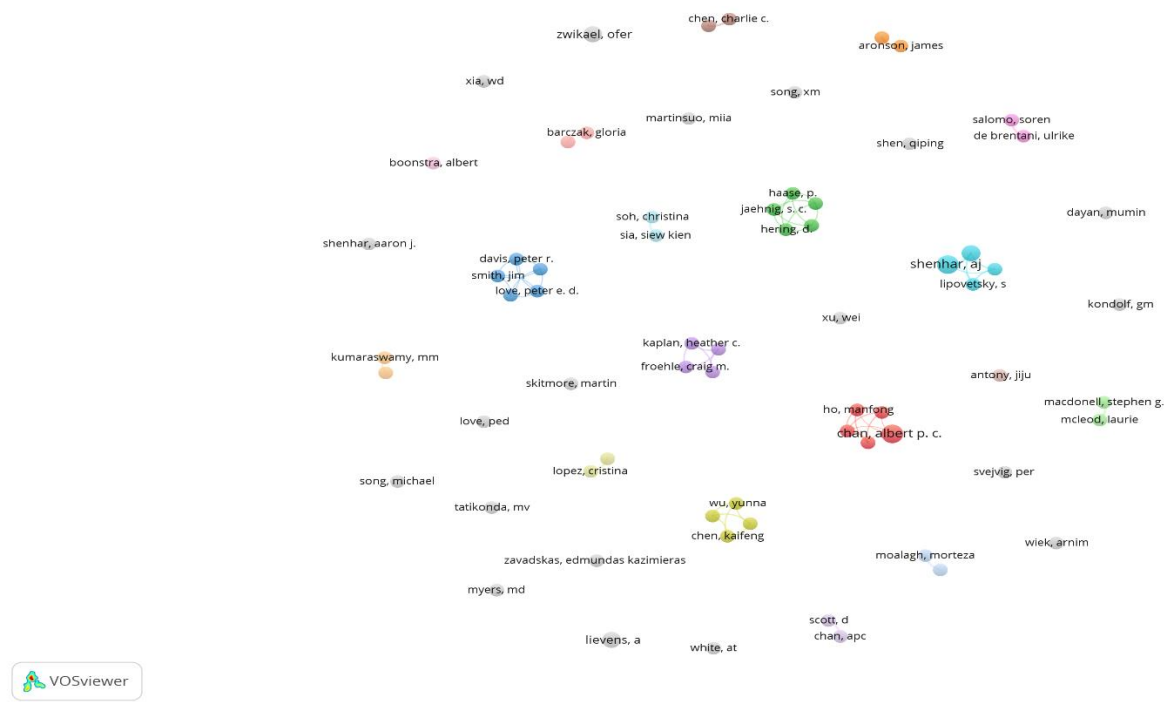


Figure 12 - Results of the Project Success Framework Bibliometric Analysis (Print from VOSviewer)



INTERVIEW PROTOCOL

Confidentiality and authorizations

The interviewee will be informed that all the data that will be gathered is confidential and respects all GDPR (General Data Protection Regulation) as well as that no individual answers will be disclosed.

Interviewee authorization will also be required to record video and audio of the interview. These recordings will be beneficial in order to be able to make an in-depth analysis afterwards of the answers given.

INTERVIEWEE PROFILE

- 1 – How old are you?
- 2 – What is your gender?
- 3 – What is the name of the company you currently work for?
- 4 – What is the sector of this company?
- 5 – How many years of experience do you have as Project Manager?

BASE SCREENPLAY QUESTIONS

1 – As a project manager what kind of skills do you consider the most important ones? Could you explain why and give some practical examples?

2 – Please order them from most important to least important and explain why.

3 – What are the characteristics that should be considered within the skills that you mentioned before and why? Please give some practical examples.

4 – What factors are important in order to consider a project as successful and why?

5 – How do you measure those factors that you've mentioned before and why? Please give some practical examples.



The Influence of Project Manager's Skills on the Success of Projects – perspectives from the project managers

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