POLITECNICO DI TORINO

Master of Science in ENGINEERING AND MANAGEMENT

Master's Degree Thesis

A correlation between perceived usage of project management methodologies and project success in Horizon 2020 projects.

Supervisor

Prof. Alberto DE MARCO

Prof. Giulio MANGANO

Candidate

Lara Victoria FORNERO

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Abstract

Project management methodologies' popularity has increased throughout the passage of time and is being more and more spread and used in many projects in different sectors. The last research and innovation programme funded by the European Union named "Horizon 2020" has implemented these methodologies as a requirement to grant funds to the consortiums that participate on the different call for proposals. The aim of the investigation is to find empirical evidence to find and establish whether there exists a correlation between the perceived usage of project management methodologies and project success in these projects and establish which is that correlation.

For that purpose, a questionnaire based on Project Management Methodology PM² Guidebook which is the manual chosen by the European Commission for this programme was properly developed and validated, to be used as the data collection tool to gain additional insights into these projects and draw conclusions regarding the study concern. This questionnaire created, enabled the researchers to gather data from a wide range of respondents. More than 100 projects funded by Horizon 2020 were taken as cases and data was collected. The results showed that, despite it not being as strong as expected due to subjective answers from respondents, there is a positive correlation between the perceived usage of project management methodologies and project success in Horizon 2020 projects. The overall application of project management tools and techniques have a great impact on project success and its utilization should be encouraged in future research programmes since there is a great opportunity to improve their project performance and success.

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Chapter 1: Introduction

1.1 Initial Statements and Background

Through the passage of time project management (PM) methodologies' popularity has been increasing which is evidenced by the increasing number of organisations that are using it as a tool to improve their productivity (Frame, 1995). A wide assortment of authors remark that project management has a favourable impact on several aspects of an organization's success. Pollack, J. & Adler, D., in their study confirmed the premise that adopting project management to undertake key business operations has a significant influence on business productivity (Pollack, J. & Adler, D., 2014), Farzana Asad Mir and Ashly H. Pinnington in their research provide empirical evidence of the relationship between PM Performance and Project Success and explains how factors of PM performance can enhance the project success rate (Farzana Asad Mir & Ashly H. Pinnington, 2014, #).

Nonetheless, the relationship between Project Success and PM Performance has shown to be mainly dependent on the subjective nature of the goals and the objective nature of the project. Terence J. Cooke-Davies & Andrew Arzymanow conducted an investigation into the nature and extent of differences in project management techniques across six industries and the findings reveal a perception into how project management has evolved differently depending on the context in which it is fostered and established (Terence J. Cooke-Davies & Andrew Arzymanow, 2003, #). Furthermore, project management research tends to focus on large-scale projects (e.g., Flyvbjerg, 2014; Brady & Davies, 2014),

Therefore, this study aims to find empirical evidence to understand and establish the relationship between the perceived usage of project management methodologies and project success in projects funded by the European Union's research program, "Horizon 2020".

"Horizon 2020 is the financial instrument implementing the Innovation Union, a Europe 2020 flagship initiative aimed at securing Europe's global competitiveness". Is the EU's largest research and innovation programme ever, in which about €80 billion of funding has been available since 2014 and over 7 years. The main objective of the funding is to attract researchers from all over the world to find solutions and contribute with innovations to improve lives, protect the environment, and make European industry more sustainable and competitive.

To abroad the work made on the research, a systematic literature review (SRL) was conducted in order to benchmark and compare how other types of projects and industries in different contexts had measured the impact of project methodologies on project success. Also, some research was done to better understand the previously stated research programme (Horizon 2020), the project methodology imposed by the European Union for this kind of projects, the definition and measure of project success as well as project definition, and its different areas of knowledge and processes.

The next section provides a short explanation of each of the topics previously mentioned, which will be taken into consideration as principals for the analysis and will be integrated on the course of action of this investigation that will lead us to a conclusion for the issue exposed.

1.2   EU Horizon 2020 Research Programme

"Horizon 2020 is the biggest European Union research and innovation programme ever which was created to lead to more breakthroughs, discoveries and word-firsts by taking great ideas from the lab to the market" (https://ec.europa.eu/programmes/horizon2020/) are the words we find in the official European Union website when we look for a definition for this programme. The main objective of this programme is to guarantee Europe produces high-quality science, as well as to eliminate barriers to development and innovation, and make it easier for public and private sectors to cooperate and work together in order to provide innovation and advances.

All the investment in research and innovation is aimed to obtain smart, sustainable, and inclusive growth. Almost €80 billion of funding will be allocated in different projects in which researchers from all over the world will participate. Horizon 2020 focuses on three key areas: excellent science, industrial leadership, and societal challenges. Each section of the programme has different subdivisions which gather activities and projects with similar objectives.

1.2.1 Excellent Science

Activities beneath this pillar aim to strengthen, build up and broaden the Union's science basis and technology, and to consolidate the European Research Area with the purpose of making the Union's research and innovation system more globally competitive to bolster its position as a world leader in science.

Horizon 2020 pretends to reinforce the EU's situation as a global leader in science, to draw in the best minds and to assist researchers with teaming up and sharing thoughts across Europe.

The main four specific objectives of this pillar are:

A.   The European Research Council (ERC) which offers investment to allow individual researchers and their groups to seek after promising paths on the frontier of science, on the premise of Union-wide competition.
B.   Future and emerging technologies help collaborative investigations in order to enlarge and broaden Europe's potential for superior and paradigm-changing innovation. They foster radical and high-risk ideas on promising areas of technology and science.
C.   Marie Skłodowska-Curie Actions provide stunning and innovative research training in addition to Career exchange opportunities across different borders and through different sectors   to put them together to better face future societal challenges.
D.   Research infrastructure builds European research infrastructure for 2020 and beyond, cultivates their innovation capacity and human resources and supplement this with the related Union policy and worldwide cooperation.

Total funding for 2014-2020	€ million
European Research Council (ERC) Frontier research by the best individual teams	13 095
Future & emerging technologies Collaborative research to open new fields of innovation	2 696

Marie Skłodowska-Curie actions (MSCA) Opportunities for training and career development	6 162
Research infrastructures (including e-infrastructure) Ensuring access to world-class facilities	2 488

Table 1: Total funding for Excellent Science projects

1.2.2 Industrial Leadership

This pillar intends to accelerate the development of strategic technologies and ideas that will support upcoming business, organizations, and enterprises, as well as to assist innovative European SMEs in becoming global leaders and more innovative, efficient, and competitive.

It consists of three specific objectives:

A.   "Leadership in enabling and industrial technologies" provides specific assistance for information and communications technology (ICT), nanotechnology, advanced materials, biotechnology, advanced manufacturing and processing, and space research, development, and demonstration, as well as, where appropriate, standardisation and certification.

B.   "Access to risk finance" aims to address shortfalls in loan and equity financing for R&D and innovation-driven businesses and projects at all stages of development. It assists the development of Union-level venture capital.

C.   "Innovation in SMEs" offers SME-specific assistance to encourage all types of innovation in SMEs, with a focus on those with the ability to expand and internationalize across the single market and beyond.

Total funding for 2014-2020	€ million
Leadership in enabling & industrial technologies (LEITs) (ICT, nanotechnologies, materials, biotechnology, manufacturing, space)	13 557
Access to risk finance Leveraging private finance & venture capital	2 842
Innovation in SMEs Fostering all forms of innovation in all types of SMEs	616

Table 2: Total funding for Industrial Leadership projects

1.2.3 Societal Challenges

This pillar reflects the priority of the European Union to address major concerns that affect all citizens in Europe and world-wide. This investment in research and innovation can have a real impact benefitting the citizen by bringing together all types of resources, knowledge from different areas, technologies, and disciplines.

The investment has identified and focuses on the following seven priority challenges:

- Health, demographic change, and wellbeing.
- Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the Bioeconomy.

- Secure, clean, and efficient energy.
- Smart, green, and integrated transport.
- Climate action, environment, resource efficiency and raw materials.
- Europe in a changing world - inclusive, innovative, and reflective societies.
- Secure societies - protecting freedom and security of Europe and its citizens.

Total funding for 2014-2020	€ million
Health, demographic change & wellbeing	7 472
Food security, sustainable agriculture, and forestry, marine/maritime/inland water research and the bioeconomy	3 851
Secure, clean & efficient energy	5 931
Smart, green & integrated transport	6 339
Climate action, environment, resource efficiency & raw materials	3 081
Inclusive, innovative & reflective societies	1 310
Secure societies	1 695

Table 3: Total funding for Societal Challenges projects

1.2.4 Specific objectives

Even though Horizon 2020 focuses on the previously stated pillars, it also provides another type of source of investment through partnerships, to develop closer synergies with national and regional programmes and to encourage greater private investment. The main purpose of programme co-fund actions is to supplement individual calls or programmes and, in this way, being able to tackle bigger challenges.

These two specific objectives are "Spreading Excellence and Widening Participation", and "Science with and for Society". But there are also some other collaboration funds such as "Enhanced European Innovation Council (EIC) pilot", "European Institute of innovation and Technology (EIT)", and "Euratom".

Total funding for 2014-2020	€ million
Spreading excellence & widening participation	816
Science with and for society	462

Table 4: Total funding for Specific objectives projects

1.2.5 How to get funding

So as to be granted funds to carry on a project, participants must fulfil a set of certain requirements or simple rules and follow some specific steps and procedures.

The most important requirement to apply and being selected are the following (additional conditions may apply according to the work programme):

- For standard research projects - a Consortium of at least three legal entities which must be established in an EU Member State or an Associated Country.
- For other programmes, the minimum condition is one legal entity established in a Member State or an Associated Country.

Once the specific research and innovation area is announced, the applicants for funding should address them in their proposals. From this point the steps are simple to follow:

- Submitting a proposal: they must be submitted online and before the deadline of the call.
- Finding partners
- Evaluation by experts: All proposals are evaluated by a panel of independent specialists in the field and are in charge of checking each proposal against criteria to determine if they are receiving funding or not.
- Grant agreement: If a proposal passes the evaluation, applicants are informed about it and the European commission draws up a grant agreement with each participant.

1.2.6 Project Management in Horizon 2020 projects

The project consortium is responsible for carrying out the action. Therefore, good, and adequate project management is therefore for advantageous, smooth, and successful implementation.

Writing proposals for EU projects is a difficult and time-consuming task. It takes a lot of time, a critical eye, and, of course, knowledge of the subject at hand. But, most crucially, it necessitates a strong, if not perfect, project management plan. Also, managing a Horizon 2020 implementing project is not an easy task.

There are some important tasks and documents that need to be done such as agreements, reporting on finance and research, audits, communication, among others and those are required to be granted for funds but more importantly for successful implementation of the project.

The Horizon 2020 programme suggests that 7% of the total project budget should be dedicated to project management, and the resources allocated for this task should not be compromised by other responsibilities, but fully dedicated to its own.

Some of the principal activities that should be carried out by a project manager are:

- Drafting a sound consortium agreement and handling intellectual property rights (IPR) issues; In addition to the Grant Agreement (GA), which outlines the EU Commission's and the project consortium's mutual rights and responsibilities, the project partners/beneficiaries must also sign a Consortium Agreement (CA). The Consortium Agreement usually governs the consortium's payment and decision-making processes.
- Promoting the project and visibility of EU funding and putting together periodic and final reports; *"To make sure your project is carried out according to agreed standards and deadlines, there are a few steps to take into account:*
  - o *reporting - you must submit regular technical and financial reports to the Commission or contracting authority.*
  - o *deliverables – depending on the project, you may have to submit specific deliverables such as general information, a special report, a technical diagram brochure, lists, software milestones, etc.), which have been identified in the grant agreement.*
  - o *communicate about your project results - effective communication is also an essential component of successful EU-financed cooperation projects and programmes. You must plan communication activities from the start of your EU-funded actions"* (European Commission)

- Getting prepared for technical checks, reviews and European Commission audits; *"The Commission will monitor the implementation of your project (during or afterwards) to ensure its compliance with the grant agreement. The grant agreement defines what activities will be undertaken, the project duration, overall budget, rates and costs, the EU budget's contribution, all rights and obligations and more."* (European Commission)

This and some other important tips such as good internal communication, meeting project milestones and quality control, need to be included in the project management of Horizon 2020 projects, in accordance with the funders' instructions, to ensure a smooth and sound technical implementation of the project.

It is critical and highly recommended to seek assistance from an expert in the field of project management, who can assume the responsibility of these tasks and avoid errors that could cost money, time, resources and even the possibility of being granted with funds.

1.3 Project Management (PM)

Before we deepen into the concepts of project methodologies and project success which are the essential points of this dissertation it is necessary that we first analyse and understand what Project Management is and its purpose.

According to Project Management Institute (PMI), to better understand and define Project Management it is necessary to start explaining what a project is and what it involves. Therefore, a project could be defined as "a temporary endeavour undertaken to create a unique product, service or result". A project is also defined as a sequence of associated tasks typically focused on some key output/deliverable and demanding substantial time to complete (Jacobs & Chase, 2011:373). It has some particular characteristics; it is temporary which means that it has a specific start and end time, and therefore its scope is clearly defined and the necessary resources. It is also possible to point that is unique, meaning that it is not a routine operation, but a specific set of activities planned to accomplish a singular objective. So, a project team includes people that do not necessarily work together but they are gathered with a specific goal and in order to achieve it, all the features and activities must be managed properly to deliver the on-time, on-budget results.

Then, "project management is the application of knowledge, skills, tools and techniques in project activities to meet requirements" (Project Management Institute, 2013). In their book, Jacobs and Chase point that PM can also be defined as planning, guiding and governing resources (people, equipment, material) to meet the technical, cost and time constraints of the project (Jacobs & Chase, 2011: 373).

Delving a bit more into it, it is possible to point out that "A Guide to the Project Management Body of Knowledge" (PMBOK® Guide) as the world-wide project management standards or, at least one of the most recognized as so.

This guide identifies different processes on the practice of project management that can be classified on:

- Initiating,
- Planning,
- Executing,
- Monitoring and controlling,

- Closing

Besides, it also recognizes ten areas of knowledge, which are:

- Integration
- Scope
- Time
- Cost
- Quality
- Procurement
- Human resources
- Communications
- Risk management
- Stakeholder management

All management is concerned with these so in the next section these concepts will be further developed and explained.

1.3.1 Project Management Areas of Knowledge

1.3.1.1 Project Integration Management

Project Integration Management is the process that guarantees that the different components of the project are appropriately identified, defined, combined, and coordinated. "Integration includes characteristics of unification, consolidation, communication, and integrative actions that are crucial to controlled project execution through completion, successfully managing stakeholder expectations, and meeting requirements." (Project Management Institute, 2013:5).

1.3.1.2 Project Scope Management

Project scope management is the process that guarantees that all the components and variables necessary for defining and controlling the project are included. (Kwak & Ibbs, 2002, 152) This means that all the work required to complete a project successfully is clearly defined and its boundaries.

1.3.1.3 Project Time Management

Project time management is the process that guarantees completion of a project on time which is one of the most challenging factors in almost every project. (Kwak & Ibbs, 2002, 152) It includes activities such as defining and sequencing activities, estimating duration and resources, schedule development and schedule control.

1.3.1.4 Project Cost Management

Project Cost management is the process that guarantees the project is completed within the approved budget. (Kwak & Ibbs, 2002, 152) It includes activities such as planning and estimating cost, determining budget and control of costs.

1.3.1.5 Project Quality Management

Project quality management is the process that guarantees the project will satisfy the needs for which it was undertaken, and the project requirements will be met or exceeded. It includes activities such as planning and performing quality assurance and controlling quality.

1.3.1.6 Project Procurement Management

Project Frontier management is the process that guarantees that goods and services from outside the project and the performers organizations are purchased. It includes activities such as canning the acquisition, conducting the process of contract negotiation and termination.

1.3.1.7 Project Human Resource Management

Project human resource management is the process that guarantees an effective use of every team member or staff, which is the people who were assigned with roles and responsibilities for completing the project. The core is to manage, motivate and lead the project team effectively. It includes activities such as defining and assigning project roles and responsibilities, obtaining human resources, team development, leadership, conflict resolution, among others.

1.3.1.8 Project Communication Management

Project communication management is the process that guarantees that project information is generated, collected, disseminated, stored, and disposed of in a timely and suitable manner. Effective communication is a key factor for project access. It includes activities such as developing a communication plan, information creation, distribution and storage and monitoring, controlling, and meeting information needs of every stakeholder.

1.3.1.9 Project Risk Management

Project risk management is the process that guarantees the identification, analysis, and response planning to project risk. It includes activities such as defining, identifying, and analysing risks, developing plan risk responses and strategies and control processes.

1.3.1.10 Project Stakeholder Management

Project Stakeholder Management is the process that guarantees the identification of people and organizations that are involved in a project or could be impacted by it, analysing their expectations and requirements, and developing the appropriate strategies for effectively managing them.

1.3.2 Project Management Processes

1.3.2.1 Initiating Process

The project initiating process understands that a project or phase should get started, and the PM team is dedicated to making it happen. It includes creating a proposal for a proposed project, as well as analysing and validating the idea's feasibility to obtain authorization to start the project.

1.3.2.2 Planning Process

The project planning process results in the creation and maintenance of a workable scheme to meet the project's business requirements and objectives. It includes defining the general scope, determining the planning strategy, building the cost and schedule work breakdown structure, revising estimates, and analysing commitments, optimizing the project plan, building risk management plans, and organizing the project staff.

1.3.2.3 Executing Process

The project execution process brings together an organization and other resources, to execute the tasks outlined in the project management plan, to ensure that the project is completed successfully, and the project requirements are met.

1.3.2.4 Monitoring and Controlling Process

The project controlling process guarantees that project objectives are accomplished by tracking, reviewing, and measuring progress and performance and identifying any areas where adjustments to the plan are required and implementing those adjustments. It includes gathering project status information, assessing variations, and providing project updates.

1.3.2.5 Closing Process

The project closing procedure guarantees that all activities across the project are completed and are officially accepted and that it comes to a formal close of the project. It involves contract termination, recording of lessons learned, and administrative closure.

1.4   Project Methodologies

A methodology is a system of methods used in a particular area of study or activity. (Pearsall, Soanes, & Stevenson, 2011).

Referring specifically to the project management discipline, methodology is defined as:

- A system of practices, techniques, procedures, and rules used by those who work in a discipline (PMI Publishing Division, 2013).
- "Project Management Methodology is a strictly defined combination of logically related practices, methods and processes that determine how best to plan, develop, control and deliver a project throughout the continuous implementation process until successful completion and termination. It is a scientifically-proven, systematic and disciplined approach to project design, execution and completion." (McConnell, 2010).

A methodology typically serves as a skeleton for explaining each stage in detail so that a project manager knows what to do to deliver and perform the job according to the timeline, budget, and stakeholder requirements and specifications.   The project management methodology's purpose is to help all project managers in an organization implement the project management plan accurately.

The goal of project methodology is to ensure the success of specific procedures, approaches, techniques, methodologies, and technologies by allowing for effective decision-making and problem-solving throughout the project management process.

In the project management field, there are a range of approaches and strategies that may be used to handle various types of projects. To categorize all sorts of project methodologies, we can divide them in traditional and modern approaches.

On the first hand, traditional approaches entail a series of consecutive stages. It is a method for designing, developing, and delivering a product or service that follows a step-by-step process. It provides the advantages of milestone-based planning and team building.

On the other hand, modern methodologies do not focus on a sequential and linear process, but they provide an alternative approach.

1.5   PM2 Project Management Methodology

It is important to highlight that this investigation is about measuring the correlation between the perceived usage of project management methodologies and project success in projects funded by the programme Horizon 2020. That is why, even though the PMBOK is the globally recognized standard for project management, the manual chosen, used, and imposed by the European Commission for the Horizon 2020 project is the Project Management Methodology PM² Guidebook.

"PM² is a Project Management Methodology developed by the European Commission. Its purpose is to enable Project Managers (PMs) to deliver solutions and benefits to their organisations by effectively managing the entire lifecycle of their project. PM² has been created with the needs of European Union Institutions and projects in mind" (European Commission, 2021, 1)

This methodology can be classified as a traditional approach methodology, which presents a combination of logically related practices, methods and processes that determine how best to plan, develop, control, and deliver a project throughout the continuous implementation process until successful completion and termination. Therefore, its content is organized and presented by processes instead of areas of knowledge. In this way, every project manager could find in it a guide, to better carry on their projects and all activities related to it.

In the following paragraphs, some principal aspects related to this methodology will be introduced and to further understand how projects should be managed in this framework.

1.5.1 The house of PM2

The PM² Methodology is built on Project Management best practices and is supported by four pillars:

1. a project governance model (i.e., Roles & Responsibilities)

2. a project lifecycle (i.e., Project Phases)

3. a set of processes (i.e., project management activities)

4. a set of project Artefacts (i.e., documentation templates and guidelines).
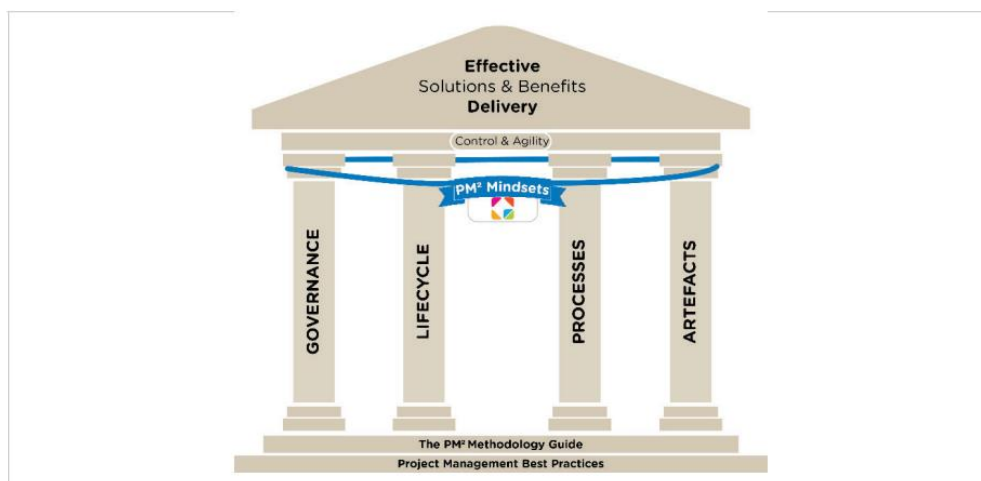
Figure 1: The house of PM2

The heart of this methodology is defined but its mindset, which provides a common spirit and holds together the PM2 practices and sets common beliefs and values for every project team.

1.5.2 The PM2 Lifecycle

As pointed out above, this methodology can be classified as "traditional", which means that linear processes and phases are executed to achieve the goal.

"The PM² project life cycle has four phases with a different type of activity predominant in each phase. However, while phase-related activities peak in terms of effort during a specific phase, activities of this type can also be executed during neighbouring phase(s). A project moves on to the next phase when the goals of its current phase have been deemed achieved as the results of a formal (or less formal) phase-exit review."
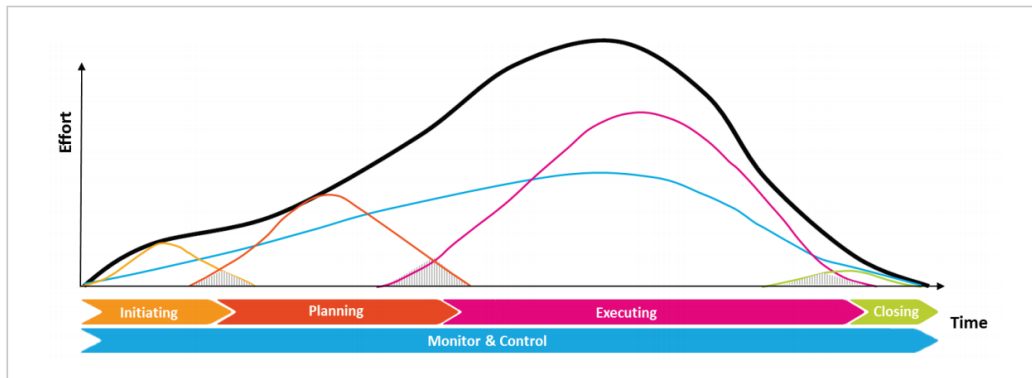
Figure 2: The PM2 Lifecycle

The focus of a project changes while it is moving forward. The phases adopted by this methodology coincide with the processes stated by the PMI. So, a project shifts from the initiating phase to the planning phase in the beginning, later to execution and it transitions to closing activities at the end. In the middle, and during the whole project duration, monitoring and controlling activities are carried out.

A description of the principal project management activities that need to be carried out in each project phase are presented as described in the PM2 Guide.

Project phase	Description
1. Initiating	Define the desired outcomes. Create a Business Base. Define the project scope. Get the project off to a good start.
2. Planning	Assigned Project Core Team (PCT). Elaborate the project scope. Plan the work.
3. Executing	Coordinate the execution of project plans. Produce deliverables.
4. Closing	Coordinate formal acceptance of the project. Report on project performance. Capture Lessons Learned and post-project recommendations. Close the project administratively.

Monitor & Control	Oversee all project work and management activities over the duration of the project: monitor project performance, measure progress, manage changes, address risks and issues, identify corrective actions, etc.

Table 5: Project phase's description

1.6 Project Success

Project success is among the top priorities of project managers and project stakeholders. But success can mean different things to different people, moreover, project success can be perceived differently according to the person who is judging it. So, to reach a common understanding of what project success is, some research was done.

According to Müller & Turner, project success needs to be defined in terms of success criteria (Müller & Turner, 2007b). Success criteria are the measurements used to assess a project's success or failure.

Morris and Hough (1987) were the first to propose a complete framework for project success preconditions and developed a framework depicting the elements of project success. Similarly, Turner (1999) builds on this framework presented by Morris and Hough and states multiple subjective and objective criteria to discuss and measure how successful projects are.

In this way, Turner (1999) stated that a successful project should:

"a) meet its stated business purpose, b) provide satisfactory benefits to the owner, c) satisfy the needs of owners, users, and stakeholders, d) meet its pre stated objectives to produce the facility, e) have a deliverable that should be produced to specification, within budget, and on time, f) satisfy the needs of the project team and supporters, and g) make a profit for them."

Also, the *Guide to the Project Management Body of Knowledge (PMBOK® Guide)* (Project Management Institute, 2013) states:

"*Since projects are temporary in nature, the success of the project should be measured in terms of completing the project within the constraints of scope, time, cost, quality, resources, and risk as approved between the project managers and senior management*."

Hence, we can all agree that project success is multidimensional and consists of many aspects and even though there are different ways to measure or define project success, it is important to reach an agreement between all stakeholders on what is going to be the most appropriate way to evaluate project success and what criteria is going to be used.

1.7 Research Objectives

1.7.1 General Objective

The general objective of this research is to explore the usage of Project Management methodologies and good practices in the "Horizon 2020" research programs and establish whether the level of the application of those methodologies has any impact on the success of the project.

1.7.2 Specific objectives

Based on the general objective, specific objectives of this study were identified and formulated as follows:

a. Explore and get familiar with the "Horizon 2020 research and innovation programme".
b. Investigate the concepts of project management, project management methodologies and project success.
c. Make use of the literature review and past studies related to the corresponding concepts mentioned above to build on them accordingly.
d. Develop a survey to assess the usage of PM methodologies and good practices for these projects funded by the European Union.
e. Decide how project success will be evaluated and define different criteria to measure the level of results and project success.
f. Collect the data of these two aspects to obtain the necessary information in order to define a level for each of them in the different dimensions analysed, based on the surveys elaborated.
g. Systematize the information collected in the survey in order to obtain a final assessment regarding PM methodologies usage and an evaluation of project success.
h. Determine whether there exists a relation between the usage of PM methodologies and project success and what is that existing correlation.
i. Identify strengths in terms of application of PM methodologies and good practices and provide feedback, suggestions, and opportunities for improvement.

1.8 Research Question

Considering the goals of the study taken into consideration previously, the research focuses on finding solutions to the following questions:

a. *What is the level of usage of PM methodologies in projects that are part of the "Horizon 2020 research programme"?*
b. *Is there any correlation between project success and usage of PM methodologies? What is that correlation?*

The unit of analysis is the relationship between the project methodology and project success.

1.9 Action Plan

The following steps represent the action plan used to carry out the research and achieve the objectives:

1. Look into the "Horizon 2020" programme for research and innovation and carry out an analysis of its scheme, projects, and categories.
2. Get familiar with the dataset and categorize the projects in order to structure the subsequent investigation and obtain accurate results that allow us to arrive at better conclusions.

3. Examine past studies related to project management maturity and project methodologies and, as appropriate, build on that prior research.
4. Develop a methodology to evaluate the perceived usage of PM methodologies and the level of these as well as the project performance and success.
5. Select target projects to investigate and analyse the perceived usage of PM by involved professionals.
6. Carry out the interviews and collect information.
7. Analyse information and identify a possible correlation between the project's perceived usage of PM and its performance.
8. Identify strengths in terms of application of PM practices and provide suggestions and recommendations for future projects.

1.10 Thesis structure

In order to achieve the objectives of the research three main work stages were carried out. The first stage consisted in the elaboration of adequate surveys used to perform the data survey and collect the necessary data. In order to do that, the examination of previous studies and bibliography review as well as a research of the programme and a background check were necessary and carried out properly. The objective of the elaboration of this survey was to define a level of perceived usage of the application of PM methodologies related to each area of knowledge and process (defined by the Project Management Institute) and to evaluate whether the project was successful or not based on the perception of the project team, to later check if there is a correlation between those two measures.

An explanation of the technique chosen is presented, and the questionnaire was created considering the structure and methodology presented in the "Project Management Methodology Guide" written by the European Commission, which was the manual chosen for these projects. The reason behind this decision is to have a common basis among all projects, being sure that everyone used the same concepts and guidelines and make the comparison possible.

The second stage corresponds to the process of carrying out the surveys. To be able to collect the necessary data, some other previous steps were essential, such as the selection of the sample that was going to be interviewed, the creation of a database to contact the projects selected and the selection of the appropriate software to use for the questionnaires and to send the emails, to assure the respondents the reliability of the source, and the privacy and confidentiality of their responses.

Finally, after all the questionnaires were sent and all the necessary data was collected, the next step was the performance of an analysis of the information collected and the verification of the existence of correlation among the variables measured. To do this, a common scale was defined to make the comparison possible, and a proper statistical software was used.

Afterwards the analysis was done, some conclusions were stated according to the results obtained. On the first hand, strengths and weaknesses were identified in terms of application of PM methodologies, to give advice and recommendations for future projects financed by the EU. On the other hand, suggestions related to the tool used to evaluate the different measurements were given, as to change and improve it and use it in future studies.

Chapter 2: Research Methodology

A research methodology describes the "general research strategy that outlines the way in which research is to be undertaken" (An Introduction to the Philosophy of Methodology, Howell 2013).

The aim of this research is to determine if the application of project management methodologies and good practices result in an increased rate of project success in projects financed by the Horizon 2020 program and investigate this link within this environment.

Therefore, the research methodology used for this study is explained in six sections. The first section discusses the research design and specifically why a questionnaire research method was used and how it was created. The second section describes the target population and sampling procedure in order to obtain necessary data to achieve the objectives of the research. The third and fourth section focus on the process of data collection (which method was used to gather all the information, how the questionnaire was composed and how the database was created) and the process of data analysis and software selection. Finally in the last two sections, the validity and reliability of the research findings were stated as well as the ethical considerations.

2.1 Research design

Research design is a plan to answer the research question, it refers to the general structure of the research. As Bryman (2012) points out, it is, therefore, a framework for the generation of evidence that is suited both to a certain set of criteria and to the research question in which the investigator is interested.

The research design can be referred to as either 'quantitative research' or 'qualitative research'. We can also find another category known as "mixed methods research".

Qualitative research is the process of collecting, analysing, and interpreting non-numerical data, such as language. Generally, Exploratory research using a qualitative methodology aims to explain "how" and "why" a given phenomenon, or behaviour, acts as it does in a certain setting. The most common methods used under this approach are in-depth interviews, documents, focus groups, case study research, among others.
On the other side, quantitative research entails the technique of objectively gathering and analysing numerical data in order to describe, predict, or manage variables of interest. This type of research aims to explore and test causal relationships among variables, make predictions and generalize findings to bigger more extensive and wider populations. The most common methods in this category are experiments, as they are interested in measuring things. Other research methods, such as controlled observations and questionnaires, can, however, generate both quantitative and qualitative data.

This study employed quantitative research methods. Self-completion questionnaires were designed and created so as to be able to collect a great number of responses, since we aim to establish a relationship among the variables of study that could be extended to every project in the Horizon 2020 programme. Another reason that led to the decision of using questionnaires is its ability to extract specific data needed, avoiding unnecessary information, and in this sense, to obtain precise answers for what we intend to know.

More explanation about the method selected will be provided in the next sections, to justify our selection.

2.1.1 The study area

According to Fraenkel and Warren (2002), population refers to the entire group of individuals (subjects or events) who share the same characteristics in which the researcher is interested. The population of this research is every project who got funds from the "Horizon 2020" programme and ended before 2021. This is an excluding condition, since we intend to establish a relationship between PM methodologies and project success, so in order to measure the last variable, the project needs to be finished.

2.1.2 Data source

As Kabir states in his book, there are many ways of classifying data, the most common classification is based upon who collected the data (Kabir, 2016). The one that has been collected from first-hand experience is known as primary data. If it is not collected first-hand, but from a source that has already been published in any form, it is called secondary data.

For the purpose of this research all data was obtained from the original source of information, since that primary data is more reliable, authentic, objective and has more confidence-level for the results and conclusions to be made. This data comes from the answers obtained from the questionnaires sent. The intended respondent of each questionnaire is the project manager of the project, so as to gather information as accurate as possible from a concept point of view and within the limits established by one's own subjectivity.

2.1.3 Database creation

To be able to collect all necessary information for the research purposes, it was mandatory to create a database to contact every project manager, since it was not available in the official website of the programme. For it, some steps were followed.

First, it was possible to access the European Union "web gate" where it was possible to find a list of all the projects participating in the programme and some other information regarding them such as pillar, thematic priority, project number id, project name, organizations participating, funds provided, among many others. One important information collected from this site was the link of every project to the official webpage of the programme, where we could find some important data such as the objectives, results and moreover, a link to the website of each project.

Second, and making use of each project website, we proceed to look for a suitable email, to be able to contact the project organization and invite them to participate in this survey.

One downside of this methodology was that many of the emails collected had an "info" or "contact" format, so it was not possible to be sure that the correct person was reached or that it was delegated to the appropriate person. Also, since the same email was used for all types of concerns, the response time was longer than expected.

To diminish these disadvantages, the database was larger than necessary (according to the sample size required) to be sure that the necessary number of responses in order to do a representative analysis.

Database is presented in Appendix D and several information is provided and the analysis regarding respondents information is presented for a more comprehensive understanding off the sample.

2.2 Population and Sampling Procedure

2.2.1 Population of the Study

The population of this study, as previously mentioned, includes every project that received funding from the "Horizon 2020" initiative and ended earlier than 2021, which is strictly necessary to achieve the goals stated for the research.

2.2.2 Sampling Procedure

Before starting the process of collecting data, we need to select the portion of the population who will actually participate in the research. This step is particularly important since we need to select a sample that is representative of the group as a whole, in order to be able to infer and give an opinion regarding the population.

There are many ways to select a sample, the principal categories are probability sampling and non-probability sampling. In this study both sampling methods, probabilistic (cluster sampling) and non-probabilistic (purposive and judgmental), were used due to the nature of the Horizon 2020 programme.

First, we proceed with a non-probability method based on non-random criteria in which not every individual has a chance of being included. The reason behind this decision is that, from the beginning of the programme to the moment in which this research has started, more than 30,000 grants for different projects have been signed. Therefore, there are many projects that are still running and have not ended yet, so they cannot evaluate their success. Because of that, our first selection is based on the project completion date, bringing the maximum sample size to nearly 14,500 projects, using the method known as intentional sampling.

Next, we selected a probability sampling method that is used primarily in quantitative studies. This term refers to the fact that each individual in the population has a fair chance of being chosen, making it the best option to produce results that are representative of the entire population. In this category, we have specifically performed a simple random sample that means that every project of the population has an equal chance of being selected. Horizon 2020 funded projects on a wide range of areas and topics, classified into 3 main pillars and two specific objectives. In consequence, for this step we considered all of those pillars in which the programme is organized.

Later, and since the number of projects was considered large for the means available to reach the corresponding respondents, we decided to create a database for projects finished during the years 2019 and 2020, basing the decision on two principal reasons; the first, projects with a closer end-date to the actual date are more likely to answer with a higher-level accuracy due to a "fresher memory" related to the project development. The second, because this selection reduced the sample size to 2300 projects and considering the impediments to be faced during database creation and a rate of answer of 10% or less, we would obtain the number of answers to get optimal and reasonable information to carry out the analysis and assure certain level of representativeness.

2.3 Data Collection Procedure

Research methods are strategies, processes or techniques utilized in the collection of data or evidence for analysis in order to uncover new information or create a better understanding of a topic. As Bryman says, this is characterized by use of specific instruments such as structured interviews or use of a self-completion questionnaire for collection of data (Bryman, 2012).

Data collection was one of the major challenges in this study. The main reason was that no database was available, and that PM tools and practices were still relatively new to many organizations participating in the projects, so it was difficult to recruit organizations to participate in this research. Because of this reason, the method chosen to collect data was a self-completion questionnaire. "*With a self-completion questionnaire, respondents answer questions by completing the questionnaire themselves*" (Bryman, 2012).

Alan Bryman in his book, explains the advantages and disadvantages of a self-completion questionnaire, which will be presented next.

Advantages of the self-completion questionnaire over the structured interview:

- Cheaper to administer.
- Quicker to administer: Self-completion questionnaires are easier to administer since they may be mailed or distributed in large numbers at the same time. It is crucial to keep in mind, however, that not all questionnaires are returned quickly, and some may take several weeks.
- Absence of interviewer effects: since there is no interviewer to ask the questions, interviewer effects, such as biassing the answer that respondents provide, are eliminated.
- No interviewer variability: Interviewers asking questions in a different order or in different ways is not a concern with self-completion surveys.
- Convenience for respondents: Self-completion questionnaires are more convenient for respondents because they can complete them whenever they choose and at their own pace.
- Can be carried out by the researcher or by any number of people with limited affect to its validity and reliability.

Some disadvantages of the self-completion questionnaire in comparison with the structured interview:

- Cannot prompt: There is no one to assist respondents who are having trouble answering a question. That is why it is vital to create an instrument easy to follow, make sure the questions are plain, unambiguous, and clear.
- Cannot probe: There is no opportunity to probe respondents to elaborate an answer.
- Difficulty of asking other kinds of questions: it is convenient to limit to a small number of open questions (because respondents frequently do not want to write a lot).
- Do not know who answers: When it comes to postal questionnaires, you never know if the correct person has responded, or whether non-respondents interfere with the answers, or if it was delegated to someone not appropriate.
- Cannot collect additional data.
- Difficult to ask a lot of questions: long questionnaires are rarely practical due to the risk of "respondent fatigue".

- Lower response rates: One of the most serious flaws is that emailed questionnaire surveys often have lower response rates than equivalent interview-based research. The significance of a response rate is that there is a risk of bias unless it can be demonstrated that those who do not participate are not different from those who do.

Considering all these advantages and disadvantages, the limitations related to the possibility of reaching the project managers of every project, the high number of projects involved in the programme, the constraints related to time, and studying other possible methods of collecting data, the decision of creating a questionnaire was made.

2.3.1 Questionnaire composition

The questionnaire consisted of four conceptual sections:

- Questionnaire instructions and description (See Appendix A).
- Respondent demographic and general information (See Appendix B).
- Perceived usage of Project Management practices questionnaire (See Appendix B).
- Project success questionnaire (See Appendix B).

2.3.1.1 Questionnaire instructions and description

To start creating the questionnaire, it was decided that it would be run through a web survey, due to its advantages such as the possibility of styling its appearance, it can be found and completed online, the possibility to structure it respecting the filter questions and facilitating its flow, and above all, the possibility to program respondents' answers so they can be automatically download into a database thus eliminating the tedious task of coding, reducing the likelihood of errors during the processing of data and saving time.

The software package used in the present research was "Lime Survey", which allows the creation of questionnaires with all the features mentioned above.

Once the questionnaire was produced and database created, invitation letters were sent out to potential participants via email, presenting the researcher, the research goals, stating the manual chosen as a basis and clearly informing and pointing out the confidentiality and anonymity of the responses.

Then, clear instructions about how to answer and complete each part of the questionnaire were properly stated at the beginning of each part on the website.

2.3.1.2 Respondent demographic and general information

The first part of the questionnaire is allotted to project information to be able to identify it (project number, title, thematic priority description). Also, objective information is required to be able to measure the project success and general information of the respondents in terms of educational experience, occupational level and role in the organization and the consortium.

2.3.1.3 Perceived usage of Project Management practices questionnaire

The second portion of the questionnaire is composed of questions on the different knowledge areas of project management where the respondent was expected to rate from 1 to 5 the degree of agreement with the statements, based on their perceived usage of PM methodologies and techniques.

The rating scale allows rapid survey completion, the creation of quantitative data and permits an easier processing of data for computer analysis. The coding for the Likert scale was 1=strongly disagree, 2=disagree, 3=neutral/undecided, 4=agree and 5=strongly agree.

The questionnaire was based on the "PM² Project Management Methodology Guide" since it is the manual chosen for this programme and which should have been read and studied by all the project managers of the different projects. It is the common knowledge base regarding PM, even though each project can have a certain level of tailoring and customisation to ensure that the PM² Methodology effectively serves their project's needs.

The PM² presents its best practices, tools and techniques by process and focuses on the activities and artefacts for each phase. At the same time, it is important to note that each activity carried out during each phase corresponds to a specific area of knowledge and contributes to the correct performance of that area and its objective, in order to achieve the overall objectives.

For this reason, each question was formulated in such a way that it corresponds to a specific area of knowledge and a project process.

A list of the questions is given below, presented by phase, and making a reference to its area of knowledge.

Initiating phase

"During this phase, the people involved formulate the project's objective(s), ensure the project's alignment to the organisation's strategic objectives, undertake some initial planning to get the project off to a good start, and put together the information required to gain approval to continue to the Planning Phase" (European Commission, 2021, 14)

According to the PM² guide, in this process we have to main areas of knowledge that require attention. Therefore, the questions were formulated as follow:

CODE	QUESTION	AREA
SC01	During the proposal phase, the project objectives were clearly defined, the impact the project is expected to bring and the success criteria against which it will be evaluated.	SCOPE
SC02	During the proposal phase, an appropriate Business Case was created providing justification for the project (context, problem description, possible solutions, costs, and timescale).	SCOPE
SK01	During the proposal phase all project's stakeholders were identified (internal and external members)	STAKEHOLDERS

Table 6: Initiating phase questions

Planning phase

"During the Planning Phase, the project's objective is developed into a specific and workable plan ready to be executed. The Project Work Plan specifies the project scope and appropriate approach, decides on a schedule for the tasks involved, estimates the necessary resources, and develops the detail of the project plans. Several times during the Planning Phase, the Project Work Plan can be updated. Once agreed and finalised it is baselined and signed off." (European Commission, 2021, 15)

Here, we have almost every area involved, since it is incredibly important to think about all the elements in a project and plan them accordingly, since it sets the basis for the execution of the project, and its success. Creating appropriate plans to manage each area is a key activity, to establish a common agreement on how to proceed when it comes to manage and execute the corresponding activities and setting a baseline schedule and budget is useful to have a reference to measure project progress.

The following questions were formulated:

CODE	QUESTION	AREA
CM01	At the beginning of the project, a Communications Management Plan was created to ensure that all project stakeholders have the information they need and to define a communication strategy (frequency, format, and media to be used as well as the responsible one for it).	COMMUNICATION
CO01	At the beginning of the project, the Cost Estimates were developed to outline resources needed and estimate them as well as the time required to complete each task, within the constraints of resource availability and capabilities.	COST
HR01	At the beginning of the project, the Roles & Responsibilities were identified in every layer, documented, and clearly described.	HUMAN RESOURCE
QY01	At the beginning of the project, a Quality Management Plan was created to define and document the project's quality requirements, responsibilities, control activities, quality metrics, quality management objectives and characteristics and the tools and techniques that will be used for quality planning and quality assurance and control.	QUALITY
QY02	At the beginning of the project, the project quality characteristics were defined and agreed considering project needs, constraints, and a cost/benefit analysis.	QUALITY
RK01	At the beginning of the project, a Risk Management Plan was created to define and document how risks will be identified and assessed, the tools and techniques to be used, the evaluation scales and tolerances, the roles and responsibilities, risk monitoring and risk response strategies (avoid, transfer/share, reduce, and accept).	RISK
RK02	At the beginning of the project, the risk response strategies were developed to plan actions to manage the risks.	RISK
SC03	At the beginning of the project, the project scope statement was further developed (detailed description of the project and list of deliverables) and strategies for completing the project were decided.	SCOPE
SC04	At the beginning of the project, a proper Work Breakdown Structure was developed (hierarchical subdivision of all the work that must be done).	SCOPE
SC05	At the beginning of the project, a Requirements Management Plan was created to define and document the requirements, responsibilities as well as the artefacts tools and techniques used for the documentation and management of the requirements.	SCOPE
SC06	At the beginning of the project, a Project Change Management Plan was created to define and document the change process (activities, roles	SCOPE

	and responsibilities related to identifying, documenting, approving, implementing, controlling, and communicating project changes).	
SC07	At the beginning of the project, a Deliverables Acceptance Plan was created to document the agreed criteria for deliverables acceptance.	SCOPE
SC08	At the beginning of the project, a Planning Kick-off Meeting was run to ensure that everyone understands the project scope and to discuss the project plans.	SCOPE
TM01	At the beginning of the project, a Project Schedule was created to identify dependencies between tasks, pinpointing their start and end dates, to establish the overall project duration.	TIME

Table 7: Planning phase questions

Executing phase

"The third phase of a PM² project is the Executing Phase. During the Executing Phase the project team produces the project deliverables (outputs) as outlined in the Project Work Plan. This is typically the stage of the project lifecycle that involves the most resources and requires the most monitoring." (European Commission, 2021, 15)

In this part, the focus is on the development of the activities needed to be done in order to obtain the output, so from the PM perspective, the most important activities are to assure that each part is doing its job properly, manage the resources, be willing to help with any task that requires it, and assure a good information flow and communication.

The questions for this phase are:

CODE	QUESTION	AREA
CM02	During the project execution, Project Reporting was carried out to document and summarise the status of various dimensions, the project's progress, and performance, to inform project stakeholders.	COMMUNICATION
CM03	During the project execution, relevant information resulting from the execution of the project was provided to appropriate parties at the right time and in the appropriate format.	COMMUNICATION
HR02	During the project execution, the Project Manager (PM) coordinated people, resources, meetings, and activities.	HUMAN RESOURCE
HR03	During the project execution, the Project Manager (PM) showed technical and behavioural skills	HUMAN RESOURCE
HR04	During the project execution, the Project Manager (PM) provided leadership and motivated the project team through the application of appropriate people management techniques.	HUMAN RESOURCE
HR05	During the project execution, a Training Plan was defined and carried out to train personnel according to needs.	HUMAN RESOURCE
IN01	During the project execution, the Project Team executed the activities defined and scheduled in the Project Work Plan to produce project deliverables in accordance with the project plans.	INTEGRATION

CODE	QUESTION	AREA
QY03	During the project execution, quality assurance standards were selected and communicated.	QUALITY
QY04	During the project execution, quality assurance activities were executed to review the compliance of project processes, outputs and deliverables to the standards chosen.	QUALITY
QY05	During the project execution, the Project Manager (PM) produced quality review reports to give an overview of the status of all project quality management activities.	QUALITY
SC09	During the project execution your team used the Deliverable Acceptance Plan to produce deliverables according to it	SCOPE
TM02	During the project execution, your consortium used an appropriate software or system for time management to determine status of the project	TIME

Table 8: Executing phase questions

Closing phase

"The final phase of a PM² project is the Closing Phase. During a project's Closing Phase, the finished deliverables are officially transferred into the care, custody, and control of the Project Owner (PO) and the project is administratively closed. Information on overall project performance and Lessons Learned is captured in the Project-End Report. The Project Manager (PM) ensures that the deliverables produced are accepted, all project documents are correctly filed and archived, and that all resources used by the project are formally released." (European Commission, 2021, 16)

Here, the most important responsibility of the project manager is to assure the whole integration of the project, which means that he/she needs to ensure that the project is finished and has achieved the objectives stated with the expected performance.

The most important steps to be verified are presented in the questions:

CODE	QUESTION	AREA
IN05	At the end of the project, a Project-End review meeting was held where the project statistics and the project's performance and experience was discussed.	INTEGRATION
IN06	At the end of the project, the project's overall experience was summarised in a report.	INTEGRATION
IN07	At the end of the project, the project was administratively closed, and all project documentation was reviewed, organised, and securely archived.	INTEGRATION
IN08	At the end of the project, the Project Team was officially dissolved, and all resources were released.	INTEGRATION
SK02	At the end of the project, the consortium ensured that all deliverables were accepted by the relevant stakeholders based on a predefined/documented quality/acceptance criteria and the agreed acceptance process.	STAKEHOLDERS

Table 9: Closing phase questions

Monitor and control phase

"Monitor & Control activities run throughout the project's lifecycle. During Monitor & Control, all work is observed from the point of view of the Project Manager (PM). Monitoring is about measuring ongoing activities and assessing project performance against project plans. Controlling is about identifying and taking corrective action to address deviations from plans and to address issues and risks." (European Commission, 2021, 16)

This is a horizontal phase, meaning that it is run in parallel to all other phases, since its purpose is to ensure that every activity is going as planned, and having the correct and desired performance. It requires an active performance of the project manager, who must measure and evaluate the ongoing activities and decide whether corrective actions are needed or not.

Every area must be monitored and controlled, anyway the most important activities are listed and added to the questionnaire:

CODE	QUESTION	AREA
CO02	During action of the project, the Project Manager (PM) regularly monitored the budget and tracked the difference between budgeted, actual, and forecasted costs.	COST
CO03	During action of the project, corrective actions were devised and implemented to bring the budget back on track.	COST
IN02	During action of the project, project Changes were identified, documented, approved, and communicated to relevant stakeholders.	INTEGRATION
IN03	During action of the project, the Project Manager (PM) ensured that every deliverable was formally accepted on time and according to organisational standards.	INTEGRATION
IN04	During action of the project, the consortium managed the transition to ensure the correct transfer of project deliverables to the client organisation.	INTEGRATION
QY06	During action of the project, the Project Manager (PM) performed quality assurance and controlled activities to identify any non-conformity, analyse the root cause, and implement corrective actions.	QUALITY
RK03	During action of the project, the consortium ensured that risk management activities were carried out as per the Risk Management Plan.	RISK
RK04	During action of the project, risks that could impact the project's objectives were identified, documented and the likelihood and the severity of the impact was assessed.	RISK
RK05	During action of the project, the implementation of risk response activities was monitored and controlled.	RISK
SC10	During action of the project, the project's performance was monitored to identify/rectify any deviations from the project plans.	SCOPE
TM03	During action of the project, the Project Manager (PM) regularly monitored the schedule and tracked the difference between planned, actual, and forecasted activities/deadlines.	TIME
TM04	During action of the project, corrective actions were devised, agreed, and implemented when needed to bring the schedule back on track.	TIME

Table 10: Monitoring and control phase questions

2.1.1.4 Questionnaire layout

Since most project managers are also familiar with the PMBoK, and to make it simpler to read and evaluate, the questionnaire was organized by areas of knowledge. The main reason for this decision is that it is easier to evaluate activities and understand the limits of each activity when they are grouped in the same category.

Hence, it is also simple to point to which process each question belongs to, just adding a clarification at the beginning of the statement as it corresponds.

- Initiating phase: "During the proposal phase"
- Planning phase: "At the beginning of the project"
- Executing phase: "During the project execution"
- Closing phase: "At the end of the project"
- Monitoring and controlling phase: "During action of the project".

For a better understanding on how each question corresponds to an area and a process at the same time, a table is presented in the Appendix C.

2.3.1.5 Project success questionnaire

The third part is dedicated to the respondent's evaluation of their project's level of success. To answer the questions respondents were required to rate their project's performance on some important parameters.

In first place, respondents are asked to rate the successfulness of their projects, related to their target impact expected. This impact target refers to their principal objectives specified during the proposal phase, before being granted with funds. In this section, also a Likert Scale was proposed, to obtain quantitative and comparable data.

Then, they are required to evaluate their compliance with budget, time, and quality (in terms of delivering the output exactly as expected). Again, with a 1 to 5 scale, so quantitative data can be obtained and in this way be able to compare all the projects.

Finally, they are asked to state their principal deliverables and also evaluate the impact of them, on a 1 to 5 scale.

This section of the questionnaire is important to determine the successfulness of every project to be able to establish a correlation. A special effort was made to collect data on PM procedures and practices as impartial, non-biased, and representative as possible, but it is important to point and keep in mind that the evaluation is subject to the subjectivity of the responses provided by the project managers, given that since they are projects of diverse nature and executed by different organizations, it was not possible to establish a common representative indicator for all projects.

2.4 Data Analysis Procedure

Quantitative data were obtained from sources discussed above. The data analysis was done using mainly two tools: Excel and SPSS® software platform.

Before analysis, it is necessary to point out that all of the questions were pre-coded and, thanks to the software chosen to run surveys, also it was possible to code all responses in order to easily analyse the data obtained. Once checked that all responses were properly coded, the data were then entered to a statistical analysis software package for the next steps.

The data obtained from the questionnaire respondents used to assess the perceived usage of project management methodologies and project management success level was analysed using SPSS® on Windows 10.

Some important considerations were taken into account before proceeding with the analysis. Since we aim to measure the strength and direction of the association between two variables, we need to select a correlation method.

"Correlation is a bivariate analysis that measures the strength of association between two variables and the direction of the relationship" (Statistics Solutions). Usually, in statistics, there are different kinds of correlations. The most common ones are Pearson correlation, Kendall rank correlation, Spearman correlation and the Point-Biserial correlation.

SPSS, the software chosen, offers three methods: the Pearson product moment correlation, the Spearman rank order correlation and the Kendall's Tau-b correlation.

"The Pearson product-moment correlation coefficient (Pearson's correlation, for short) is a measure of the strength and direction of association that exists between two variables measured on at least an interval scale." "The Pearson product-moment correlation coefficient (or Pearson correlation coefficient, for short) is a measure of the strength of a linear association between two variables and is denoted by r." (Laerd Statistics)

"The Spearman rank-order correlation coefficient (Spearman's correlation, for short) is a nonparametric measure of the strength and direction of association that exists between two variables measured on at least an ordinal scale." (Laerd Statistics)

"Kendall's tau-b (τb) correlation coefficient (Kendall's tau-b, for short) is a nonparametric measure of the strength and direction of association that exists between two variables measured on at least an ordinal scale." (Laerd Statistics)

To make a decision about which method use in the present study, the nature of the data was the principal point considered. The variables are classified as ordinal, so the Spearman rank-order correlation or Kendall's tau-b were possible choices. Therefore, other considerations were taken into account to make the decision. For practical reasons and considering that the Spearman rho correlation is more popular in practice, this was the method used to establish the correlation, i.e., the extent to which two variables tend to change together. We considered popularity as an important factor, since it was essential to understand the method and the meaning of the correlation coefficient.

Mathematically, the Spearman correlation use difference in rank measurements to calculate the strength of association. Too interpret its value is simple; first if the sign of the Spearman coefficient indicates the direction of association between variables. If positive, the dependent variable tends to increase while the independent variable increases. If the dependent variable tends to decrease while the independent increases, the correlation coefficient is negative. A zero value indicates no tendency at all. Second, the magnitude depicts how close or far the variables are to be a perfectly monotone function. The closer to 1, the more perfect the association and the closer to zero, the weaker the association, while a 0 value indicates no association between ranks.

In order to analyse the data, the following statistical tests were performed:

Before proceeding with a correlation analysis of any kind, it is incredibly important to verify the reliability of data. Therefore, our first step to continue with the investigation is to test this. For this purpose, a reliability analysis with SPSS is going to be done and presented.

Once reliability is checked, the correlation is going to be done, but to be sure that it is possible to use this method, there are three assumptions that should be met. The first is that the two variables must be measured at an ordinal, interval, or ratio level. Therefore, it was important to make sure that the scales used to evaluate projects were appropriate to move on with the analysis.

The second assumption is that the two variables represent paired observations, meaning that a single paired observation reflects the score on each variable for a single participant. No test needs to be run to verify this assumption, due to the nature and structure of the questionnaire. Each participant measured the application of PM tools and techniques as well as their project success.

The third and last assumption states that there needs to be a monotonic relationship between the two variables. To check that this relationship exists, a scatterplot will be created using SPSS, where it is possible to plot the two variables against each other.

Then, the correlation test was run to determine the link between the variables of study. Spearman's rank order correlation was chosen for determining it and it will be computed using SPSS software. The objective of this test is to determine not only whether there exists a relation between variables but also the strength of the connection and the direction. The output of this part will give us two values; the "rho" value, which is the correlation coefficient and the Sig. (2-tailed) which is the p-value or significance level. According to Burns and Burns, the size of the correlation coefficient indicates the strength of the association. The greater the relationship, the closer the coefficient is to one. Levels of significance are calculated at both the 5% and 1%. Reduced levels of significance suggest a lower likelihood that the link is not a coincidence, while higher levels of significance indicate that the researcher has more confidence that the association observed is statistically significant. (Burns & Burns, 2008)

The results of the analysis have been presented in the form of descriptive statistics, graphics and tables with an explanation associated with each of them.

2.4.1 Statistical analysis

The data was entered and analysed using SPSS® on Windows 10. The analysis, which was aided by SPSS software, played a significant role in the research. It had helped to validate the data and ensure that the SPSS results were correct. The software compared and analysed the outcomes of many variables utilized in the study questionnaire. Excel was also used to create the illustrations and perform some analytical calculations.

2.5 Validity and Reliability

The reliability of measurements specifies the amount to which it is without bias (error free) and hence ensures consistent measurement across time and across the various items in the instrument. (Sekaran & Bougie, 2016).

In order to obtain meaningful interpretations, Creswell (2014) emphasizes the importance of validating data validity and reliability.

When carrying out quantitative research (as it is the case of the present study), it is important to consider and measure the reliability and validity of the measuring instruments and research methods. As mentioned, reliability is an indicator of how consistent an instrument or method measures something.

There are four main types of reliability analysis, measuring the consistency of different variables:

- Test-retest: measures the consistency of the same test over time
- Interrater: measures the consistency of the same test conducted by different people
- Parallel forms: measures the consistency of different versions of a test which are designed to be equivalent
- Internal consistency: measures the consistency of the individual items

Regarding the present study, the research method was a unique questionnaire used to measure variables just once and not over time, it was a self-completion questionnaire so it was not conducted by different people, just one questionnaire was used to measure the variables so there were no parallel version of the test and finally, in the same questionnaire multiple items were used to measure the same underlying construct (there were many questions asking different things, but when combined, they were measuring the overall perceived usage of PM methodologies and overall perceived success). Therefore, due to the nature of the research, and research method used to collect the necessary data, an internal consistency is the necessary reliability analysis that should be run.

Internal consistency is important since, when creating a collection of questions or ratings that will be merged to get an overall score, we must be sure that each item truly reflects the same thing. The test may be inaccurate or unreliable if replies to various items contradict one another.

"There are three primary types of internal consistency reliability: Cronbach's alpha, split-half, and Kudar-Richardson 20 (KR-20).

- Cronbach's Alpha: Internal consistency reliability of survey items with response sets measured at an ordinal level (Likert-type scales).
- Split-Half Reliability: Internal consistency reliability that assumes two randomly assigned halves of a survey instrument should significantly correlate.
- Kudar-Richardson 20 (KR-20): Internal consistency reliability of survey items with response sets measured at a categorical level (yes/no)." (Scale Statistics, 2021)

Once again, considering the questionnaire created to measure the variables of interest, the most accurate reliability analysis is Cronbach's Alpha (α), as Creswell (2014) also suggests as a reliability check for the scales' internal consistency.

Cronbach's Alpha is a test used to estimate internal consistency of a composite score. It is generally used for calculating reliability coefficients for survey instruments that use Likert-type response sets. "The resulting α coefficient of reliability ranges from 0 to 1 in providing this overall assessment of a measure's reliability. If all of the scale items are entirely independent from one another (i.e., are not correlated or share no covariance), then $\alpha = 0$; and, if all of the items have high covariances, then α will approach 1 as the number of items in the scale approaches infinity. In other words, the higher the α coefficient, the more the items have shared covariance and probably measure the same underlying concept." (University of Virginia Library).

Cronbach's alpha is used in this study to examine the validity and reliability of data because of its application, as highlighted by Creswell.

The Cronbach's Alpha value for the whole questionnaire regarding PM's perceived level of usage is 0.963, indicating that the set of questions developed are measuring the same overall construct. Nonetheless, a more specific reliability analysis will be done for each category inside

the questionnaire, to be sure that they are also accurate and measure correctly the variables used for the posterior correlation analysis.

2.6 Ethical Consideration

Anonymity and confidentiality were among the ethical considerations made and kept throughout the investigation.

Before participants fill out the questionnaire, they have been informed about the study's goal, who is conducting it, the expected outcome, as well as their position in the study.

The study participants were promised that the information they submitted would be kept private and only used in the data analysis process, and that their identities would not be divulged in connection with their responses. (Only the principal researchers knew the identity of the organizations)

A copy of the results will be sent to the respective projects. The privacy of the organizations answering the questionnaire were not included in the study.

Chapter 3: Data Analysis

3.1 Introduction

Questionnaires were distributed via email to more than 1000 projects included in the EU Horizon 2020 research programme, intending to reach the project manager or project leader to complete them. Out of them, 102 responses were received, representing around 10% response rate, which is an acceptable value considering the surveys were distributed from an unknown sender, or a not official source related to the programme.

In an introductory email, inviting them to participate in the survey and complete the questionnaire, respondents were informed that their participation was part of a master's thesis investigation, aiming to determine a correlation between PM methodologies and project success. They were also assured that their responses would remain confidential and anonymous.

Analysis of data is presented in the same order as the questionnaire was structured, this means that general information is analysed first, followed by the analysis of reliability related to both areas of knowledge and project process, and finally project success criteria.

Finally, correlations are analysed between the level of utilization and application of the correspondent techniques related to PM and the level of success achieved, measured by different criteria related to project success and PM success.

3.2 Demographic data

Regarding the first part related to demographics and general information, some information provided by respondents was omitted to keep their privacy and because it is not relevant to the question we intend to answer. For that reason, information about project ID number, project name, target impact and role of the person and the organization in the consortium are not included in the following analysis. That information was useful to determine whether target respondents are indeed responsible for managing projects or have the level of knowledge about the whole project to be able to respond to it with a certain level of accuracy.

3.3 Pillar and thematic priority description

As stated, Horizon 2020 classifies all projects in different pillars. These questions aimed to observe the distribution of the respondents among those pillars and in this way, have a measure on the variety of respondents and the representativeness of the investigation.

On Figure 3: Distribution of projects participants by pillar is presented the percentages of project respondents belonging to the different pillars.
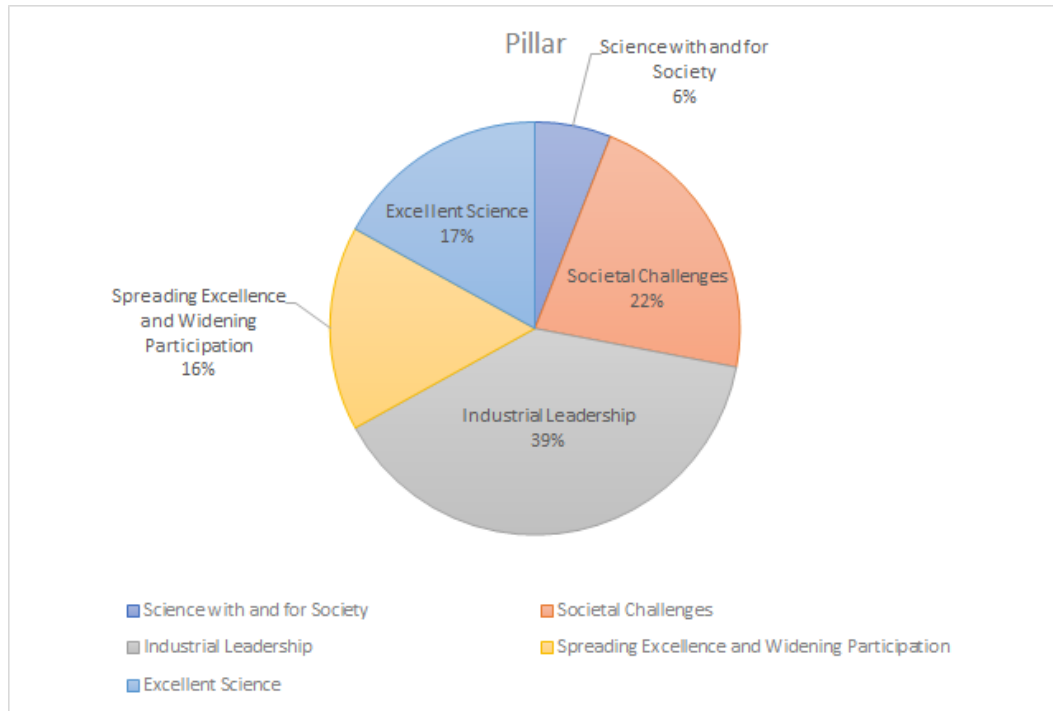
Figure 3: Distribution of projects participants by pillar

In Figure 4: Distribution of projects participants by thematic in Excellent Science pillar, Figure 5: Distribution of projects participants by thematic in Industrial Leadership pillar, Figure 6: Distribution of projects participants by thematic in Societal Challenges pillar, Figure 7: Distribution of projects participants by thematic in Excellence and Widening Participation objective and Figure 8: Distribution of projects participants by thematic in Science with and for Society objective projects were separated by thematic priority for each pillar.
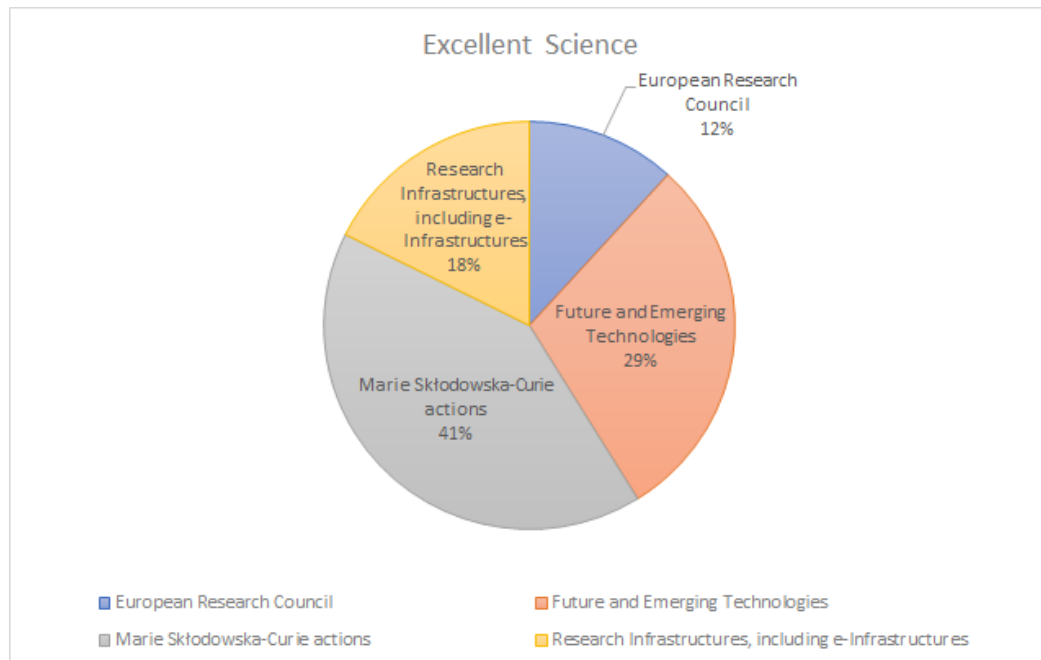
Figure 4: Distribution of projects participants by thematic in Excellent Science pillar
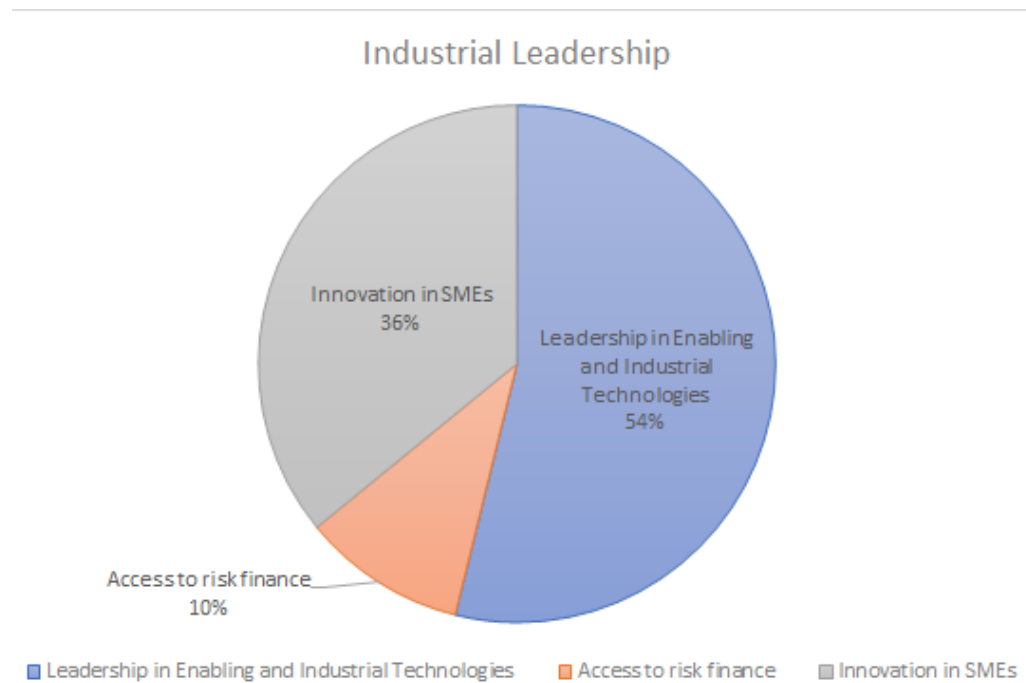
Figure 5: Distribution of projects participants by thematic in Industrial Leadership pillar
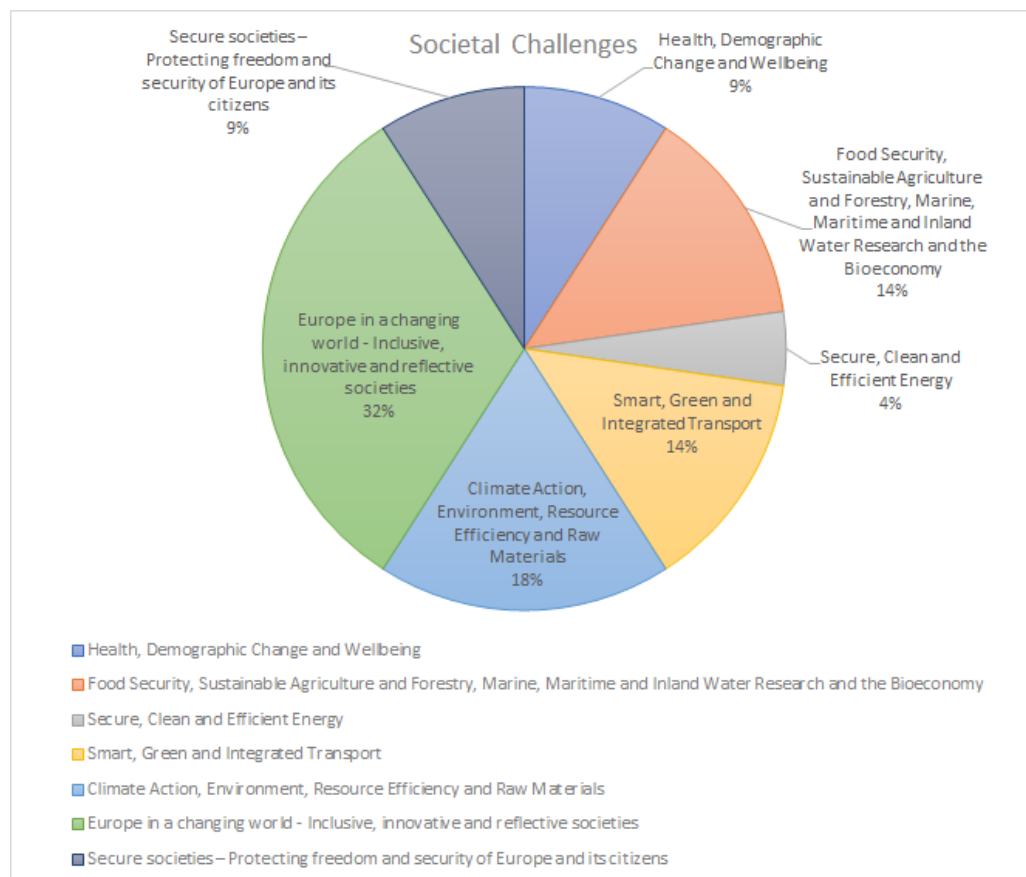
Figure 6: Distribution of projects participants by thematic in Societal Challenges pillar
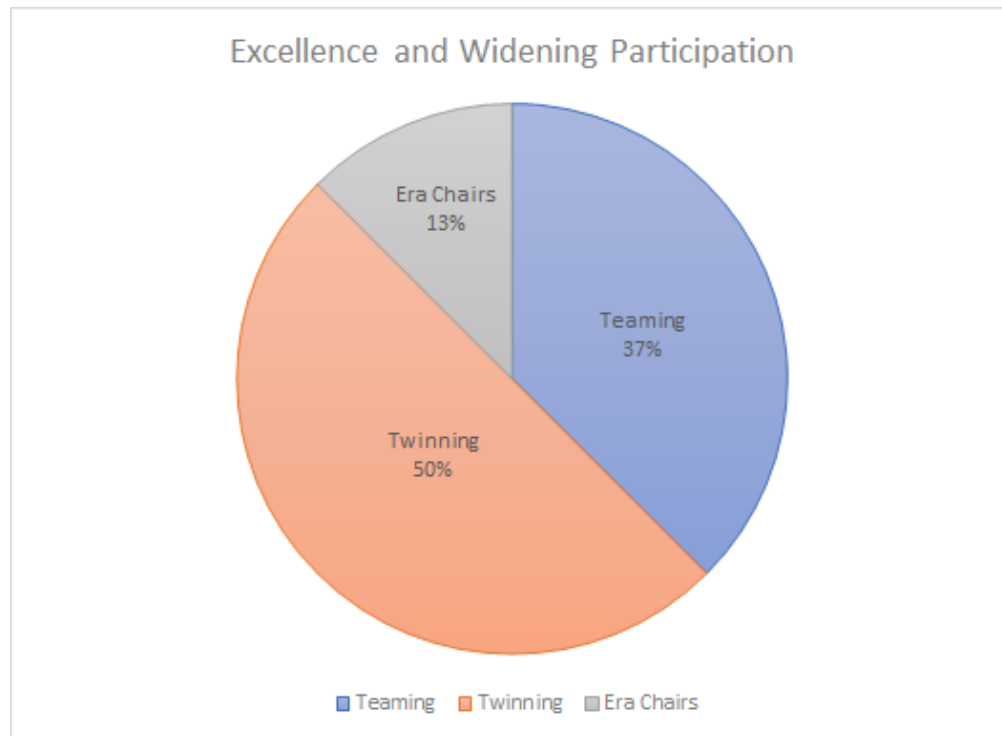
Figure 7: Distribution of projects participants by thematic in Excellence and Widening Participation objective

Figure 8: Distribution of projects participants by thematic in Science with and for Society objective

As we can observe in the graphics, projects belonging to every pillar stated by the programme participated in the survey. The pillars "Societal challenges", "Industrial Leadership"

and "Excellent Science" represent 78% of the total responses. If we compare this number to the percentage of total projects financed and completed in these categories, we could say that the proportion is maintained in general terms, since this percentage is 85% (data obtained from official data web site for Horizon 2020 programme).

Another important fact related to this information is that at least one project of every thematic pillar participated and is represented in the analysis.

Then, we could say that all conclusions to be obtained during the analysis could be extended to all projects belonging to the programme.

3.4 Project Manager

The next information asked, and a key point for this research, is if there was someone specifically pointed out as the project manager. Respondents were asked to indicate whether they have assigned a responsible person for managing the project.

Figure 9: Presence of Project Manager

As we can see, data indicated that most of the projects had someone exclusively working in the position of project manager, this accounted for 99% of the respondents. The other 1% could represent an error from the person who completed the questionnaire, but this percentage is not considered relevant for our studies purposes.

3.5 Certified Project Manager

Another important question in this section was whether the project manager was certified or not. This information would give us the certainty that the project manager assigned to the project has completed some form of formal project management training and is likely aware of many of the methodologies, tools and techniques that are evaluated in the assessment of usage of them.
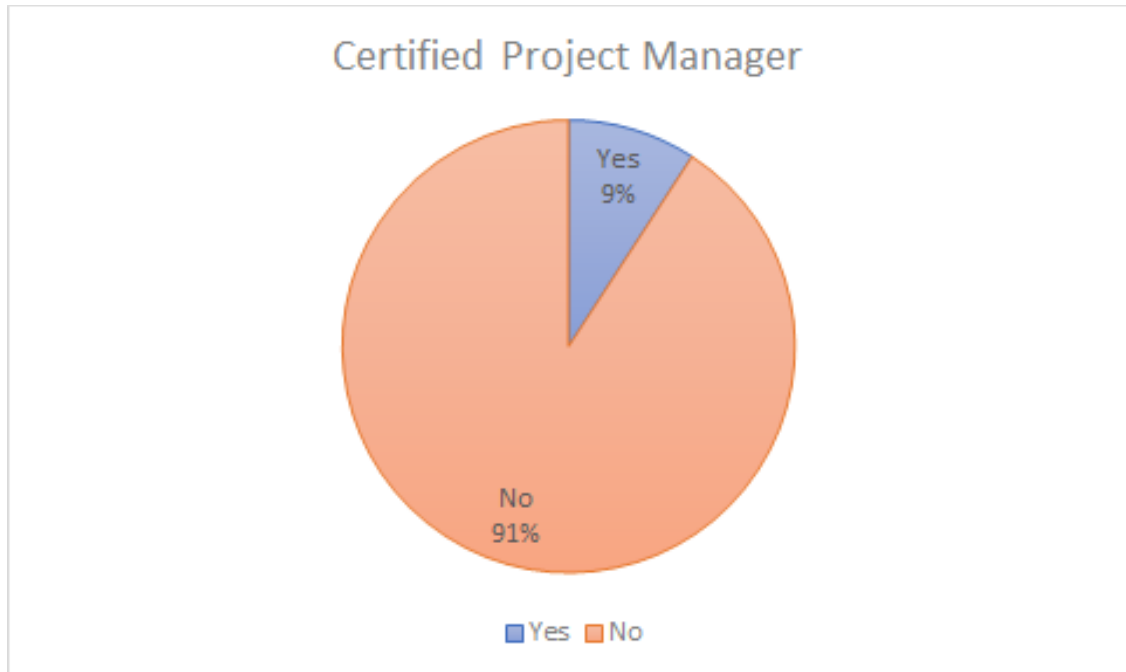
Figure 10: Presence of certified project managers

Just 9% of the respondents answered yes to this question, so we can say that the level of formal training is low but that does not mean that the project managers do not know at all the techniques and tools of this discipline.

3.6 Perceived usage of Project Management Methodologies

The second section of the questionnaire aims to determine the level of usage of the project management tools and techniques presented in the PM2 Guide by the European Commission. The analysis of this set of data will be done both ways, by area of knowledge and by process, so we can better determine the specific level for these categories, as well as the overall level, so we can draw more accurate and precise conclusions.

3.6.1 Project Management Methodologies by area of knowledge

The perceived level of usage of the methodologies, tools and techniques of Project Management was calculated by area of knowledge calculating the mode for each one and analysing the frequency for each associated question of each knowledge area. This is presented in Figure 11: Levels of perceived usage of PM methodologies.

It is important to point out that, since we used Likert scales in our questionnaire, the mean is not the best statistic value. In fact, the most appropriate measures to analyse and compare the different areas of knowledge are the median and the mode. The median is the middle of the set numbers, and the mode is the number that appears the most.

Therefore, as stated, the mode is our statistical parameter to assess the level of usage for each area.
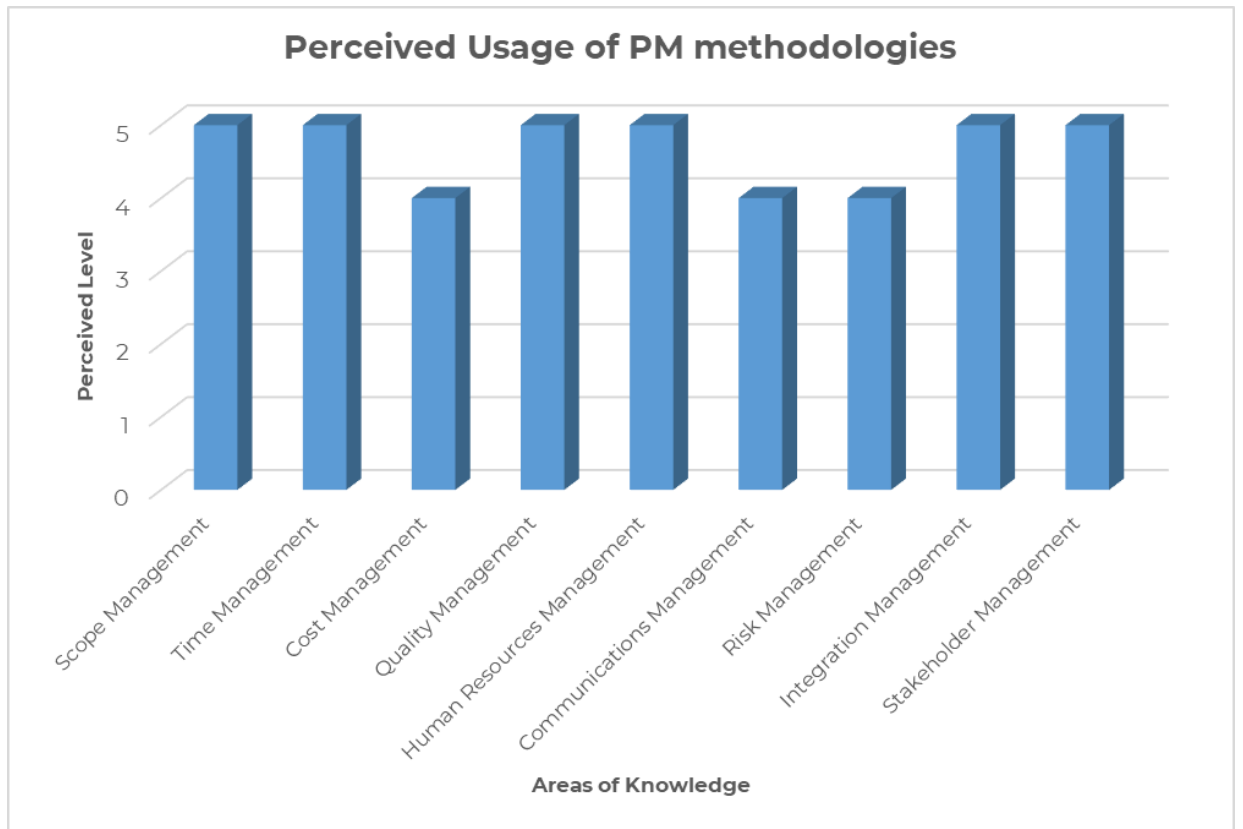
Figure 11: Levels of perceived usage of PM methodologies

Also, data analysis of the above figure is presented in Table 11: Data analysis for Levels of perceived usage of PM methodologies per PM Knowledge Area.

	Descriptive statistics								
	Scope	Time	Cost	Quality	Human Resources	Communi cations	Risk	Integratio n	Stakehold er
N	1000	400	300	600	500	300	500	800	200
Mean	4,27	4,35	4,25	4,20	4,26	4,28	4,23	4,34	4,35
Median	4	4	4	4	4	4	4	4	5
Mode	5	5	4	5	5	4	4	5	5
Std. Deviation	0,802	0,740	0,792	0,871	0,826	0,733	0,764	0,731	0,794
Minimum	1	1	1	1	1	2	1	1	2
Maximu m	5	5	5	5	5	5	5	5	5

Table 11: Data analysis for Levels of perceived usage of PM methodologies per PM Knowledge Area

Furthermore, for a better comprehension of the distribution of answers, data related to the frequencies of responses is presented in Table 12: Analysis of response frequencies by area of knowledge presented below:

	Descriptive Statistics						
		1	2	3	4	5	**Total**
Scope	Frequency	6	34	84	434	442	**1000**
	Percentage	0,6%	3,4%	8,4%	43,4%	44,2%	**100,0%**
Time	Frequency	3	7	25	178	187	**400**
	Percentage	0,8%	1,8%	6,3%	44,5%	46,8%	**100,0%**
Cost	Frequency	2	12	18	146	122	**300**
	Percentage	0,7%	4,0%	6,0%	48,7%	40,7%	**100,0%**
Quality	Frequency	4	28	72	238	258	**600**
	Percentage	0,7%	4,7%	12,0%	39,7%	43,0%	**100,0%**
Human Resources	Frequency	3	19	47	207	224	**500**
	Percentage	0,6%	3,8%	9,4%	41,4%	44,8%	**100,0%**
Communications	Frequency	-	10	20	146	124	**300**
	Percentage	0,0%	3,3%	6,7%	48,7%	41,3%	**100,0%**
Risk	Frequency	4	8	53	238	197	**500**
	Percentage	0,8%	1,6%	10,6%	47,6%	39,4%	**100,0%**
Integration	Frequency	3	17	55	355	370	**800**
	Percentage	0,4%	2,1%	6,9%	44,4%	46,3%	**100,0%**
Stakeholder	Frequency	-	9	13	77	101	**200**
	Percentage	0,0%	4,5%	6,5%	38,5%	50,5%	**100,0%**

Table 12: Analysis of response frequencies by area of knowledge

Afterwards, a reliability analysis was done since "Reliability analysis allows you to study the properties of measurement scales and the items that compose the scales. The Reliability Analysis procedure calculates a number of commonly used measures of scale reliability and provides information about the relationships between individual items in the scale." (IBM). Cronbach's Alpha was used to determine reliability of each question with the desired construct. Minimum level of acceptance was 0.7 and scores above 0.8 were highly desirable.

3.6.1.1 Project Scope Management

Questions SC01 - SC10 in part 2 of the questionnaire address the usage of methodologies, techniques, and tools within the Project Scope Management knowledge area.

A Cronbach's Alpha analysis was run with the SPSS Software and the output is presented.

Reliability Statistics	
Cronbach's Alpha	N of items
0,886	10

Table 13: Project Scope Management's Cronbach Alpha

	Item-Total Statistics			
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
SC01	38,33	25,981	0,682	0,871
SC02	38,35	25,927	0,634	0,874
SC03	38,41	25,962	0,615	0,875
SC04	38,45	25,806	0,598	0,877
SC05	38,62	25,45	0,637	0,874
SC06	38,61	25,17	0,614	0,876
SC07	38,59	25,012	0,669	0,871
SC08	38,37	26,922	0,499	0,883
SC09	38,41	25,012	0,636	0,874
SC10	38,34	26,449	0,629	0,875

Table 14: Project Scope Management Cronbach Alpha per Question

Table 13: Project Scope Management's Cronbach Alpha and Table 14: Project Scope Management Cronbach Alpha per Question display the reliability of the construct.

The first two columns (Scale Mean if Item Deleted and Scale Variance if Item Deleted) are not really informative and useful. These columns indicate the calculation of the mean and the variance excluding the individual item listed, but in our case the information is not really significant since we are using Likert scales.

The third column, on the other hand, shows the correlation between a single element and the total of all the other items. This indicates how effectively that single element "goes with" the rest of the collection. The last column, named "Alpha if item deleted" is a significant column, which calculates what the Cronbach's Alpha would be if a specific item were removed. This explanation about the table applies to every analysis done.

Regarding Project Scope Management, it received a total score of 0,886 which is highly desirable and indicates that all questions relate to the target construct. The first item on the table appears to be the best one, since it has the higher item-total correlation with a value of $r = 0,682$. The item with the lowest item-total correlation is SC08 ($r = 0,499$). If this number were close to zero, then considering removing it from the scale would be appropriate since, if this happens, it means that it is not measuring the same thing as the rest of the items.

In this case, no items need to be dropped, since none of the values in the column "Cronbach's Alpha if Item Deleted" is greater than the current alpha of the whole scale.

3.6.1.2 Project Integration Management

Questions IN01 - IN08 in part 2 of the questionnaire address the usage of methodologies, techniques, and tools within the Project Integration Management knowledge area.

A Cronbach's Alpha analysis was run with the SPSS Software and the output is presented.

Reliability Statistics	
Cronbach's Alpha	N of items
0,815	8

Table 15: Project Integration Management's Cronbach Alpha

	Item-Total Statistics			
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
IN01	30,50	11,263	0,637	0,779
IN02	30,24	11,780	0,566	0,790
IN03	30,38	11,571	0,603	0,784
IN04	30,39	12,099	0,530	0,795
IN05	30,40	11,758	0,520	0,796
IN06	30,39	12,058	0,508	0,797
IN07	30,34	11,843	0,563	0,790
IN08	30,40	11,495	0,399	0,822

Table 16: Project Integration Management Cronbach Alpha per Question

Table 15: Project Integration Management's Cronbach Alpha and Table 16: Project Integration Management Cronbach Alpha per Question display the reliability of the construct. It received a total score of 0,815 which is highly desirable and indicates that all questions relate to the desired construct.

3.6.1.3 Project Time Management

Questions TM01 - TM04 in part 2 of the questionnaire address the usage of methodologies, techniques, and tools within the Project Time Management knowledge area.

A Cronbach's Alpha analysis was run with the SPSS Software and the output is presented.

Reliability Statistics	
Cronbach's Alpha	N of items
0,680	4

Table 17: Project Time Management's Cronbach Alpha

	Item-Total Statistics			
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
TM01	13,02	2,727	0,494	0,594
TM02	13,12	2,410	0,488	0,602
TM03	13,10	2,899	0,468	0,612
TM04	12,93	3,076	0,413	0,645

Table 18: Project Time Management Cronbach Alpha per Question

Table 17: Project Time Management's Cronbach Alpha and Table 18: Project Time Management Cronbach Alpha per Question indicate the reliability of the construct which was tested using Cronbach's Alpha with a total score of 0.680 which is below the 0.7 limit of acceptability and therefore suggests that the four items do not measure the same construct. However, none of the items should be removed because this action would not improve the Cronbach's Alpha value. For this reason and considering that 0,680 is not too far from 0,7 we will accept the scale.

3.6.1.4 Project Cost Management

Questions CO01 - CO03 in part 2 of the questionnaire address the usage of methodologies, techniques, and tools within the Project Cost Management knowledge area.

A Cronbach's Alpha analysis was run with the SPSS Software and the output is presented.

Reliability Statistics	
Cronbach's Alpha	N of items
0,637	3

Table 19: Project Cost Management's Cronbach Alpha

	Item-Total Statistics			
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
CO01	8,45	1,705	0,415	0,585
CO02	8,43	1,702	0,514	0,450

CO03	8,60	1,737	0,415	0,582

Table 20: Project Cost Management Cronbach Alpha per Question

Table 19: Project Cost Management's Cronbach Alpha and Table 20: Project Cost Management Cronbach Alpha per Question indicate the reliability of the construct which was tested using Cronbach's Alpha with a total score of 0.637 which is below the 0.7 limit of acceptability and therefore suggests that the three items do not measure the same construct. However, none of the items will be removed because this action would not improve the Cronbach's Alpha value.

3.6.1.5 Project Quality Management

Questions QY01 - QY06 in part 2 of the questionnaire address the usage of methodologies, techniques, and tools within the Project Quality Management knowledge area.

A Cronbach's Alpha analysis was run with the SPSS Software and the output is presented.

Reliability Statistics	
Cronbach's Alpha	N of items
0,895	6

Table 21: Project Quality Management's Cronbach Alpha

	Item-Total Statistics			
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
QY01	20,89	12,766	0,734	0,875
QY02	21,01	12,616	0,752	0,872
QY03	20,97	12,898	0,735	0,875
QY04	20,94	12,946	0,728	0,876
QY05	21,11	12,220	0,715	0,879
QY06	20,98	13,070	0,655	0,887

Table 22: Project Quality Management Cronbach Alpha per Question

Table 21: Project Quality Management's Cronbach Alpha and Table 22: Project Quality Management Cronbach Alpha per Question display the reliability of the construct. It received a total score of 0,895 which is highly desirable and indicates that all questions relate to the desired construct.

In this case, no items need to be dropped, since none of the values in the column "Cronbach's Alpha if Item Deleted" is greater than the current alpha of the whole scale.

3.6.1.6 Project Human Resources Management

Questions HR01 - HR05 in part 2 of the questionnaire address the usage of methodologies, techniques, and tools within the Project Human Resources Management knowledge area.

A Cronbach's Alpha analysis was run with the SPSS Software and the output is presented.

Reliability Statistics	
Cronbach's Alpha	N of items
0,765	5

Table 23: Project Human Resources Management's Cronbach Alpha

	Item-Total Statistics			
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
HR01	16,99	5,929	0,527	0,724
HR02	16,98	5,555	0,671	0,674
HR03	16,93	6,046	0,580	0,709
HR04	17,04	5,817	0,639	0,689
HR05	17,26	6,053	0,334	0,809

Table 24: Project Human Resources Management Cronbach Alpha per Question

Table 23: Project Human Resources Management's Cronbach Alpha and Table 24: Project Human Resources Management Cronbach Alpha per Question indicate the reliability of the construct which shows a total score of 0.765 which is above 0.7 limit of acceptability and indicates that all questions relate to the target construct. In this case, we could get rid of item "HR05", and our reliability would improve, increasing to 0,809. However, the item will not be removed because the reliability value is above the limit of acceptability and, since the same item is related to a specific process (besides this area of knowledge), removing it would directly affect the reliability of that category.

3.6.1.7 Project Communications Management

Questions CM01 - CM03 in part 2 of the questionnaire address the usage of methodologies, techniques, and tools within the Project Communications Management knowledge area.

A Cronbach's Alpha analysis was run with the SPSS Software and the output is presented.

Reliability Statistics	
Cronbach's Alpha	N of items
0,753	3

Table 25: Project Communications Management's Cronbach

	Item-Total Statistics			
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
CM01	8,59	1,739	0,527	0,730
CM02	8,58	1,539	0,599	0,650
CM03	8,51	1,586	0,621	0,624

Table 26: Project Communications Management Cronbach Alpha per Question

Table 25: Project Communications Management's Cronbach and Table 26: Project Communications Management Cronbach Alpha per Question display the reliability of the construct which shows a total score of 0,753 which is above the 0,7 limit of acceptability and indicates that all questions relate to the target construct.

3.6.1.8 Project Risk Management

Questions RK01 - RK05 in part 2 of the questionnaire address the usage of methodologies, techniques, and tools within the Project Risk Management knowledge area.

A Cronbach's Alpha analysis was run with the SPSS Software and the output is presented.

Reliability Statistics	
Cronbach's Alpha	N of items
0,802	5

Table 27: Project Risk Management's Cronbach Alpha

	Item-Total Statistics			
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
RK01	16,88	4,773	0,654	0,742
RK02	16,99	5,182	0,635	0,747
RK03	16,95	6,088	0,472	0,796
RK04	16,85	5,684	0,604	0,759

RK05	16,97	5,666	0,575	0,767

Table 28: Project Risk Management Cronbach Alpha per Question

Table 27: Project Risk Management's Cronbach Alpha and Table 28: Project Risk Management Cronbach Alpha per Question indicate the reliability of the construct. The item received a total score of 0.802 which is highly desirable and indicates that all questions relate to the target construct. Also, no items need to be dropped, since none of the values in the column "Cronbach's Alpha if Item Deleted" is greater than the current alpha of the whole scale.

3.6.1.9 Project Stakeholder Management

Questions SK01 - SK02 in part 2 of the questionnaire address the usage of methodologies, techniques, and tools within the Project Stakeholder Management knowledge area.

A Cronbach's Alpha analysis was run with the SPSS Software and the output is presented.

Reliability Statistics	
Cronbach's Alpha	N of items
0,726	2

Table 29: Project Stakeholder Management's Cronbach Alpha

	Item-Total Statistics			
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
SK01	4,36	0,617	0,570	-
SK02	4,34	0,651	0,570	-

Table 30: Project Stakeholder Management Cronbach Alpha per Question

Table 29: Project Stakeholder Management's Cronbach Alpha and Table 30: Project Stakeholder Management Cronbach Alpha per Question display the reliability of the construct which shows a total score of 0,726 which is above the 0,7 limit of acceptability and indicates that all questions relate to the target construct.

Also, no item should be dropped, otherwise instead of being a construction of a category it will be just a question.

3.6.2 Project Management Methodologies by processes

The perceived level of usage of the methodologies, tools and techniques of Project Management was also calculated by processes calculating the mode for each one and analysing the frequency for each associated question of each process of the project. This is presented in Figure 12: Levels of perceived usage of PM process.

Also in this section, the most appropriate measures to analyse and compare the different areas of knowledge are the median and the mode. Therefore, as stated, the mode is our statistical parameter to assess the level of usage for each area.

The reason for doing this analysis this way, is that the manual set by the European Commission is organized like this, and, because we intend to determine if PM methodologies are applied during the whole lifecycle of the project, and not just during the initiating phase where it is a requisite to use them in order to be granted with funds.
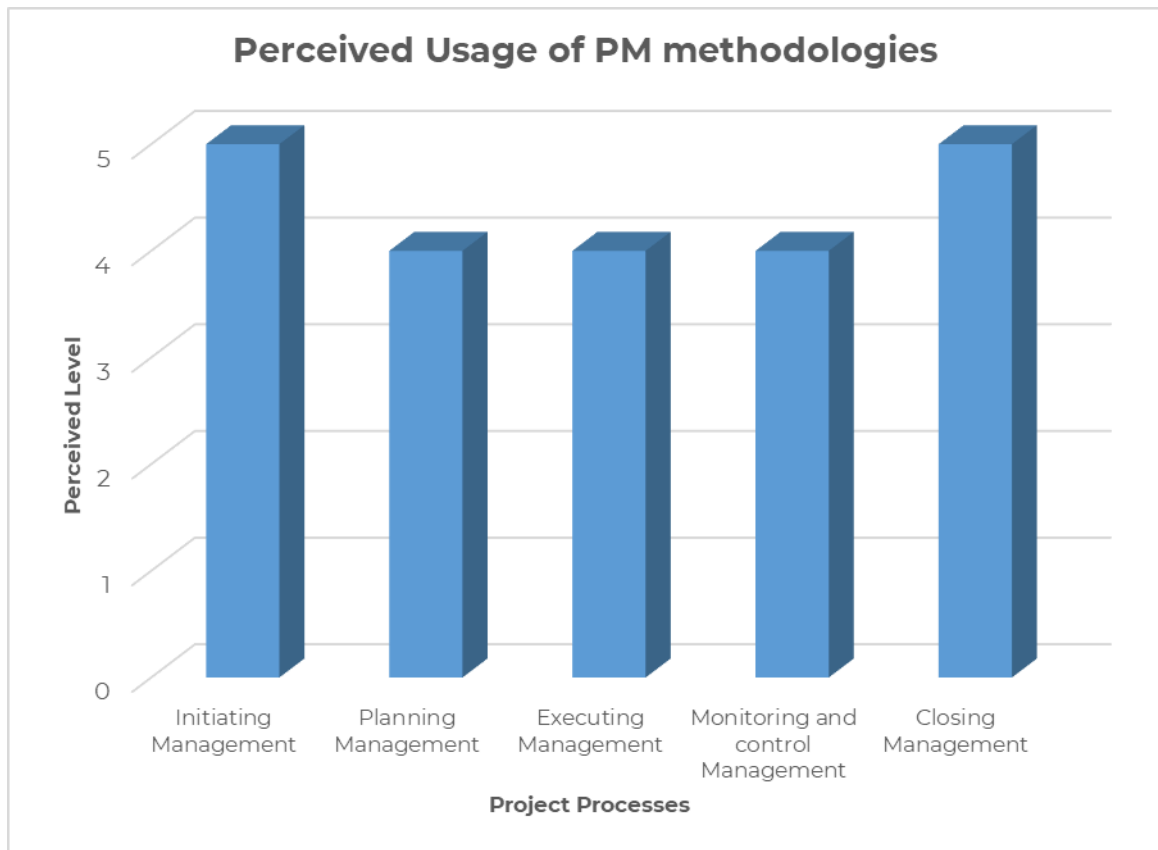
Figure 12: Levels of perceived usage of PM process

Also, data analysis of the above figure is presented in Table 31: Data analysis for Levels of perceived usage of PM methodologies per PM Process.

	Descriptive statistics				
	Initiating	Planning	Executing	Monitoring and control	Closing
N	300	1400	1200	1200	500
Mean	4,37	4,24	4,24	4,30	4,34
Median	5	4	4	4	4
Mode	5	4	4	4	5
Std. Deviation	0,758	0,818	0,828	0,723	0,768

Minimum	2	1	1	1	1
Maximum	5	5	5	5	5

Table 31: Data analysis for Levels of perceived usage of PM methodologies per PM Process

Furthermore, for a better comprehension of the distribution of answers, data related to the frequencies of responses is presented in Table 32: Analysis of response frequencies by project process presented below:

			Descriptive Statistics					
			1	2	3	4	5	**Total**
Project Phase	Initiating	Frequency	-	8	27	112	153	**300**
		Percentage	0,0%	2,7%	9,0%	37,3%	51,0%	**100,0%**
	Planning	Frequency	12	50	117	628	593	**1400**
		Percentage	0,9%	3,6%	8,4%	44,9%	42,4%	**100,0%**
	Executing	Frequency	9	46	109	518	518	**1200**
		Percentage	0,8%	3,8%	9,1%	43,2%	43,2%	**100,0%**
	Monitoring and control	Frequency	1	26	103	548	522	**1200**
		Percentage	0,1%	2,2%	8,6%	45,7%	43,5%	**100,0%**
	Closing	Frequency	3	14	31	213	239	**500**
		Percentage	0,6%	2,8%	6,2%	42,6%	47,8%	**100,0%**

Table 32: Analysis of response frequencies by project process

Afterwards, a reliability analysis was also done for this set of categories. Cronbach's Alpha was used to determine reliability of each question with the desired construct. Minimum level of acceptance was 0.7 and scores above 0.8 were highly desirable.

3.6.2.1 Project Initiating Management

Questions INIT01 - INIT03 in part 2 of the questionnaire address the usage of methodologies, techniques, and tools within the Project Initiating Management. It is important to point out that each of these questions is associated with a code corresponding to the specific area of knowledge and is not a separate question.

Reliability Statistics	
Cronbach's Alpha	N of items
0,754	3

Table 33: Project Initiating Management's Cronbach Alpha

	Item-Total Statistics			
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
INIT01	8,71	1,723	0,676	0,573
INIT02	8,73	1,674	0,626	0,621
INIT03	8,76	1,821	0,465	0,812

Table 34: Project Initiating Management Cronbach Alpha per Question

Table 33: Project Initiating Management's Cronbach Alpha and Table 34: Project Initiating Management Cronbach Alpha per Question indicate the reliability of the construct which shows a total score of 0.754 which is above 0.7 limit of acceptability and indicates that all questions relate to the target construct. In this case, we could get rid of item "INIT03" to improve the reliability of the category and reach a Cronbach's Alpha of 0,812. However, the item will not be removed since the same item is related to a specific area of knowledge, removing it would directly affect the reliability of that category, and also because the reliability value is above the limit of acceptability.

3.6.2.2 Project Planning Management

Questions PLAN01 - PLAN14 in part 2 of the questionnaire address the usage of methodologies, techniques, and tools within the Project Planning Management. Here as well each of these questions is associated with a code corresponding to the specific area of knowledge and is not a separate question.

Reliability Statistics	
Cronbach's Alpha	N of items
0,904	14

Table 35: Project Planning Management's Cronbach Alpha

	Item-Total Statistics			
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
PLAN01	55,15	52,492	0,495	0,901
PLAN02	55,11	50,745	0,575	0,898
PLAN03	55,09	50,830	0,574	0,898
PLAN04	55,11	50,099	0,603	0,897
PLAN05	55,23	49,088	0,685	0,894
PLAN06	55,12	48,329	0,720	0,892
PLAN07	55,23	50,866	0,577	0,898

PLAN08	55,09	50,467	0,643	0,896
PLAN09	55,13	49,872	0,661	0,895
PLAN10	55,30	49,707	0,669	0,894
PLAN11	55,29	49,905	0,595	0,898
PLAN12	55,27	49,997	0,619	0,896
PLAN13	55,05	53,321	0,384	0,905
PLAN14	55,03	51,322	0,597	0,897

Table 36: Project Planning Management Cronbach Alpha per Question

Table 35: Project Planning Management's Cronbach Alpha and Table 36: Project Planning Management Cronbach Alpha per Question display the reliability of the construct. It received a total score of 0,904 which is highly desirable and indicates that all questions relate to the desired construct.

In this case, no items need to be dropped, since none of the values in the column "Cronbach's Alpha if Item Deleted" is significantly greater than the current alpha of the whole scale (removing "PLAN13" would just improve the value on 0,001).

3.6.2.3 Project Executing Management

Questions EXEC01 - EXEC12 in part 2 of the questionnaire address the usage of methodologies, techniques, and tools within the Project Executing Management. Here also each of these questions is associated with a code corresponding to the specific area of knowledge and is not a separate question.

Reliability Statistics	
Cronbach's Alpha	N of items
0,876	12

Table 37: Project Executing Management's Cronbach Alpha

	Item-Total Statistics			
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
EXEC01	46,64	35,606	0,591	0,865
EXEC02	46,57	36,490	0,517	0,869
EXEC03	46,58	35,337	0,595	0,864
EXEC04	46,53	36,252	0,538	0,868
EXEC05	46,64	35,748	0,587	0,865
EXEC06	46,86	33,718	0,592	0,865

EXEC07	46,68	36,482	0,511	0,869
EXEC08	46,69	34,640	0,634	0,862
EXEC09	46,66	35,055	0,590	0,865
EXEC10	46,83	34,062	0,580	0,866
EXEC11	46,59	34,891	0,562	0,866
EXEC12	46,63	35,367	0,529	0,868

Table 38: Project Executing Management Cronbach Alpha per Question

Table 37: Project Executing Management's Cronbach Alpha and Table 38: Project Executing Management Cronbach Alpha per Question display the reliability of the construct. It received a total score of 0,876 which is highly desirable and indicates that all questions relate to the desired construct.

In this case, no items need to be dropped, since none of the values in the column "Cronbach's Alpha if Item Deleted" is significantly greater than the current alpha of the whole scale.

3.6.2.4 Project Monitoring and Control Management

Questions MONIT01 - MONIT12 in part 2 of the questionnaire address the usage of methodologies, techniques and tools within the Project Monitoring and Control Management. Here also each of these questions is associated with a code corresponding to the specific area of knowledge and is not a separate question.

Reliability Statistics	
Cronbach's Alpha	N of items
0,876	12

Table 39: Project Monitoring and Control Management's Cronbach Alpha

	Item-Total Statistics			
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
MONIT01	47,33	26,324	0,599	0,864
MONIT02	47,50	26,697	0,498	0,871
MONIT03	47,16	26,661	0,612	0,863
MONIT04	47,30	26,818	0,577	0,865
MONIT05	47,31	27,166	0,573	0,866
MONIT06	47,44	25,421	0,600	0,864
MONIT07	47,43	26,934	0,573	0,865

MONIT08	47,33	27,435	0,493	0,870
MONIT09	47,45	26,175	0,571	0,865
MONIT10	47,26	26,679	0,604	0,864
MONIT11	47,35	26,412	0,653	0,861
MONIT12	47,18	27,806	0,468	0,871

Table 40: Project Monitoring and Control Management Cronbach Alpha per Question

Table 39: Project Monitoring and Control Management's Cronbach Alpha and Table 40: Project Monitoring and Control Management Cronbach Alpha per Question display the reliability of the construct. It received a total score of 0,876 which is highly desirable and indicates that all questions relate to the desired construct.

In this case, no items need to be dropped, since none of the values in the column "Cronbach's Alpha if Item Deleted" is significantly greater than the current alpha of the whole scale.

3.6.2.5 Project Closing Management

Questions CLOS01 - CLOS05 in part 2 of the questionnaire address the usage of methodologies, techniques, and tools within the Project Closing Management. Here also each of these questions is associated with a code corresponding to the specific area of knowledge and is not a separate question.

Reliability Statistics	
Cronbach's Alpha	N of items
0,724	5

Table 41: Project Closing Management's Cronbach Alpha

	Item-Total Statistics			
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
CLOS01	17,39	4,947	0,478	0,679
CLOS02	17,38	5,006	0,519	0,666
CLOS03	17,33	5,052	0,507	0,670
CLOS04	17,39	4,483	0,423	0,713
CLOS05	17,35	4,654	0,527	0,659

Table 42: Project Closing Management Cronbach Alpha per Question

Table 41: Project Closing Management's Cronbach Alpha and Table 42: Project Closing Management Cronbach Alpha per Question indicate the reliability of the construct which shows a total score of 0.724 which is above 0.7 limit of acceptability and indicates that all questions relate to the target construct. In this case, no items need to be dropped, since none

of the values in the column "Cronbach's Alpha if Item Deleted" is significantly greater than the current alpha of the whole scale.

3.7 Project Success

In this section, an analysis of data collected related to project success is done. Five different criteria were collected, three of them related to project management success and two regarding the overall success of the project, i.e., the achievement of goals and impact desired and the outcome expected.

In the third part of the questionnaire, respondents were asked to reflect on the outcome of their project, therefore they indicated on a one to five scale how they would rate each of the statements or questions, being one the worst value and five the best.

Descriptive Statistics					
	How successful do you think your project was?	Compliance with budget	Compliance with time	Compliance with quality	Rate from 1 to 5 your deliverable
N	100	100	100	100	100
Mean	4,39	4,31	4,24	4,43	4,45
Median	4	4	4	5	5
Mode	4	4	4	5	5
Minimum	2	2	1	2	1
Maximum	5	5	5	5	5

Table 43: Project Success Data Analysis

The data in Table 43: Project Success Data Analysis indicates that in general terms, the respondents perceive their project success high as well as project management, as measured by the correspondent criteria.

3.8 Correlation between Project Management perceived usage and project success

After checking the reliability of the data and accepting it, the analysis of correlation was done, to answer the research question that this study intends to solve. As well as with the reliability analysis, we proceed to do it by areas of knowledge and by processes, to have a better insight on how the different elements are correlated and to what extent.

To proceed with this part of the analysis, some aspects need to be highlighted regarding the interpretation of the results, as stated by "Scale Statistics":

"The Correlation Coefficient is the actual correlation value that denotes magnitude and direction. Higher rho coefficients denote a stronger magnitude of relationship between variables. Regarding the magnitude, smaller rho coefficients denote weaker relationships. We should also be aware of the direction; Positive correlations denote a relationship that travels at the same trajectory. As one value goes up, then the other value goes up. Also, as one value goes down, then the other value goes down too. Negative correlations denote a relationship that travels in different directions. As one value goes up, the other value goes down. Also, as one value goes down, then the other value goes up".

"The Sig. (2-tailed) is the p-value that is interpreted. If the p-value is less than .05, then researchers have evidence of a statistically significant bivariate association between the two ordinal variables. If the p-value is more than .05, then researchers have evidence that there is not a statistically significant association between the two ordinal variables."

3.8.1 Correlation between areas of knowledge and success

The correlation among different knowledge areas is tested first. The analysis is done with each success criteria measured, to better understand the impact of implementing PM tools and techniques in project outcomes and results as well as project management success. The significance level was established at 1%, and the closer the correlation coefficient to one the better.

3.8.1.1 Project Integration Management and Project Success

Table 44: Project Integration Management and Project Success Correlations indicates the correlations between Project Integration Management and the six different criteria adopted to measure project success.

	Project Success Criteria		Integration Management	
Spearman's Rho	How successful do you think your project was?	Correlation Coefficient	0,359	**
		Sig. (2-tailed)	<,001	
		N	100	
	Compliance with budget	Correlation Coefficient	0,439	**
		Sig. (2-tailed)	<,001	
		N	100	
	Compliance with time	Correlation Coefficient	0,182	
		Sig. (2-tailed)	0,069	
		N	100	
	Compliance with quality	Correlation Coefficient	0,268	**
		Sig. (2-tailed)	0,007	
		N	100	
	Rate the deliverables from 1 to 5	Correlation Coefficient	0,305	**
		Sig. (2-tailed)	0,002	

		N	100

Table 44: Project Integration Management and Project Success Correlations

The significant success criteria for this category are:

- The level of success perceived by the consortium's point of view where a Spearman rho of 0,359 with a significance level <.001, which means there is a weak positive statistically significant relationship between Project Integration Management and whether projects achieve the objectives stated at the initiating phase of it and its impact expected.
- The completion of projects within budget with a Spearman rho of 0,439 and <.001 significance level, which means there is a moderate positive statistically significant relationship between Project Integration Management and the completion of a project within budget.

For the other criteria, small values of Spearman rho were funded, meaning weak and small statically relationship or no significant relationship at all due to not enough significance levels.

3.8.1.2 Project Scope Management and Project Success

Table 45: Project Scope Management and Project Success Correlations indicates the correlations between Project Scope Management and the six different criteria adopted to measure project success.

	Project Success Criteria		Scope Management	
Spearman's Rho	How successful do you think your project was?	Correlation Coefficient	0,476	**
		Sig. (2-tailed)	<,001	
		N	100	
	Compliance with budget	Correlation Coefficient	0,389	**
		Sig. (2-tailed)	<,001	
		N	100	
	Compliance with time	Correlation Coefficient	0,227	*
		Sig. (2-tailed)	0,023	
		N	100	
	Compliance with quality	Correlation Coefficient	0,377	**
		Sig. (2-tailed)	<,001	
		N	100	

		Correlation Coefficient	0,356	**
	Rate the deliverables from 1 to 5	Sig. (2-tailed)	<,001	
		N	100	

Table 45: Project Scope Management and Project Success Correlations

The significant success criteria related to Project Scope Management are:

- the level of success perceived by the consortium's point of view with a Spearman rho of 0,476 and a significance level <,001, indicating there is a moderate positive statistically significant relationship between Project Scope Management and whether projects achieve the objectives stated at the initiating phase of it and its impact expected.
- the completion of projects within budget, with A Spearman rho of 0,389 and the <,001 significance level. This depicts a moderate positive statistically significant relationship between Project Scope Management and the completion of a project within budget.
- the delivery of projects to a high standard of quality with a Spearman rho of 0.377 and <,001 significance level, showing is a weak and positive statistically significant relationship between Project Scope Management and the completion of a project within the quality values stated and expected.
- whether project outcomes are regarded as a success by the consortium with a Spearman rho of 0.356 and <.001 significance level. This demonstrates a weak positive statistically significant relationship between Project Scope Management and whether project outcomes and deliverables are regarded as a success by the consortium.

The criterion left is not relevant since the significance level found was not high enough.

3.8.1.3 Project Time Management and Project Success

Table 46: Project Time Management and Project Success Correlations indicates the correlations between Project Time Management and the six different criteria adopted to measure project success.

Project Success Criteria			Time Management	
Spearman's Rho	How successful do you think your project was?	Correlation Coefficient	0,46	**
		Sig. (2-tailed)	<,001	
		N	100	
	Compliance with budget	Correlation Coefficient	0,43	**
		Sig. (2-tailed)	<,001	
		N	100	

	Compliance with time	Correlation Coefficient	0,403	**
		Sig. (2-tailed)	<,001	
		N	100	
	Compliance with quality	Correlation Coefficient	0,312	**
		Sig. (2-tailed)	0,002	
		N	100	
	Rate the deliverables from 1 to 5	Correlation Coefficient	0,411	**
		Sig. (2-tailed)	<,001	
		N	100	

Table 46: Project Time Management and Project Success Correlations

When analysing Project Time Management, we found that every success criterion considered are relevant and significant.

- The level of success perceived by the consortium's point of view, with a Spearman rho value of 0,460 and <,001 significance level, indicating a moderate positive statistically significant relationship between Project Time Management and whether projects achieve the objectives stated at the initiating phase of it and its impact expected.
- The completion of projects within budget with A Spearman rho of 0,430 and <,001 significance level.
- The completion of projects on time with a Spearman rho of 0,403 and <,001 significance level.
- The delivery of projects to a high standard of quality with a Spearman rho of 0.312 and 0,002-significance level.
- And whether project outcomes are regarded as a success by the consortium with a Spearman rho of 0.411 and <,001 significance level.

3.8.1.4 Project Cost Management and Project Success

Table 47: Project Cost Management and Project Success Correlations indicates the correlations between Project Cost Management and the six different criteria adopted to measure project success.

Project Success Criteria		Cost Management	
Spearman's Rho	How successful do you think your project was?	Correlation Coefficient	0,172	
		Sig. (2-tailed)	0,087	
		N	100	

	Compliance with budget	Correlation Coefficient	0,375	**
		Sig. (2-tailed)	<,001	
		N	100	
	Compliance with time	Correlation Coefficient	0,316	**
		Sig. (2-tailed)	0,001	
		N	100	
	Compliance with quality	Correlation Coefficient	0,17	
		Sig. (2-tailed)	0,091	
		N	100	
	Rate the deliverables from 1 to 5	Correlation Coefficient	0,186	
		Sig. (2-tailed)	0,064	
		N	100	

Table 47: Project Cost Management and Project Success Correlations

The significant success criteria for this category are:

- the completion of projects within budget, with a Spearman rho of 0,375 showing a weak positive statistically significant relationship.
- the completion of projects on time with Spearman rho of 0,316.

For the other criteria, no significant relationships at all were found.

3.8.1.5 Project Quality Management and Project Success

Table 48: Project Quality Management and Project Success Correlations indicates the correlations between Project Quality Management and the six different criteria adopted to measure project success.

Project Success Criteria			Quality Management	
Spearman's Rho	How successful do you think your project was?	Correlation Coefficient	0,334	**
		Sig. (2-tailed)	<,001	
		N	100	
	Compliance with budget	Correlation Coefficient	0,263	**

		Sig. (2-tailed)	0,008	
		N	100	
	Compliance with time	Correlation Coefficient	0,314	**
		Sig. (2-tailed)	0,001	
		N	100	
	Compliance with quality	Correlation Coefficient	0,431	**
		Sig. (2-tailed)	<,001	
		N	100	
	Rate the deliverables from 1 to 5	Correlation Coefficient	0,277	**
		Sig. (2-tailed)	0,005	
		N	100	

Table 48: Project Quality Management and Project Success Correlations

The most significant success criteria for this category are:

- whether projects achieve the objectives stated at the initiating phase of it and its impact expected with a Spearman rho of 0.334 showing a weak positive statistically significant relationship with Project Quality Management.
- the delivery of projects to a high standard of quality with a Spearman rho of 0.431 which shows a moderate and positive statistically significant relationship.

Also, weaker relationships were found for completion of projects within budget, the completion of a project on time and whether project outcomes and deliverables are regarded as a success by the consortium.

3.8.1.6 Project Human Resources Management and Project Success

Table 49: Project Human Resources Management and Project Success Correlations indicates the correlations between Project Human Resources Management and the six different criteria adopted to measure project success.

Project Success Criteria			HR Management	
Spearman's Rho	How successful do you think your project was?	Correlation Coefficient	0,411	**
		Sig. (2-tailed)	<,001	
		N	100	
	Compliance with budget	Correlation Coefficient	0,293	**

		Sig. (2-tailed)	0,003	
		N	100	
	Compliance with time	Correlation Coefficient	0,152	
		Sig. (2-tailed)	0,131	
		N	100	
	Compliance with quality	Correlation Coefficient	0,341	**
		Sig. (2-tailed)	<,001	
		N	100	
	Rate the deliverables from 1 to 5	Correlation Coefficient	0,306	**
		Sig. (2-tailed)	0,002	
		N	100	

Table 49: Project Human Resources Management and Project Success Correlations

When analysing Human Resources Management, we found that the significant success criteria are:

- the level of success perceived by the consortium's point of view with a Spearman rho of 0,411 indicating a moderate positive statistically significant relationship between variables.
- the delivery of projects to a high standard of quality with a Spearman rho of 0.341.

Also, weaker relationships were found between HR Management and compliance with budget and whether project outcomes and deliverables are regarded as a success by the consortium. For compliance with time the relationship was not significant.

3.8.1.7 Project Communications Management and Project Success

Table 50: Project Communications Management and Project Success Correlations indicates the correlations between Project Communications Management and the six different criteria adopted to measure project success.

Project Success Criteria			Communications Management	
Spearman's Rho	How successful do you think your project was?	Correlation Coefficient	0,299	**
		Sig. (2-tailed)	0,003	
		N	100	

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	Compliance with budget	Correlation Coefficient	0,428	**
		Sig. (2-tailed)	<,001	
		N	100	
	Compliance with time	Correlation Coefficient	0,387	**
		Sig. (2-tailed)	<,001	
		N	100	
	Compliance with quality	Correlation Coefficient	0,245	*
		Sig. (2-tailed)	0,014	
		N	100	
	Rate the deliverables from 1 to 5	Correlation Coefficient	0,203	*
		Sig. (2-tailed)	0,043	
		N	100	

Table 50: Project Communications Management and Project Success Correlations

The significant success criteria for this category are:

- the completion of projects within budget with a Spearman rho of 0,428 indicating a moderate positive statistically significant relationship between Project Communications Management and the completion of a project within budget.
- the completion of projects on time with a Spearman rho of 0,387 showing a weak positive statistically significant relationship between the Project Communications Management and the completion of a project on time.

For the other criteria, small values of Spearman rho were funded, meaning weak and small statically relationship or no significant relationship at all due to not enough significance levels.

3.8.1.8 Project Risk Management and Project Success

Table 51: Project Risk Management and Project Success Correlations indicates the correlations between Project Risk Management and the six different criteria adopted to measure project success.

Project Success Criteria			Risk Management	
Spearman's Rho	How successful do you think your project was?	Correlation Coefficient	0,306	**
		Sig. (2-tailed)	0,002	

		N	100	
	Compliance with budget	Correlation Coefficient	0,263	**
		Sig. (2-tailed)	0,008	
		N	100	
	Compliance with time	Correlation Coefficient	0,26	**
		Sig. (2-tailed)	0,009	
		N	100	
	Compliance with quality	Correlation Coefficient	0,399	**
		Sig. (2-tailed)	<,001	
		N	100	
	Rate the deliverables from 1 to 5	Correlation Coefficient	0,306	**
		Sig. (2-tailed)	0,002	
		N	100	

Table 51: Project Risk Management and Project Success Correlations

The most significant success criterion for this category is the completion of a project within the quality values stated and expected with a Spearman rho of 0.399 indicating moderate and positive statistically significant relationship between variables.

Also, weaker relationships were found with the level of success perceived by the consortium's point of view and whether project outcomes and deliverables are regarded as a success by the consortium both with a Spearman rho of 0,306.

Finally, much smaller, and weaker relationships were found for the rest of the criteria.

3.8.1.9 Project Stakeholders Management and Project Success

Table 52: Project Stakeholders Management and Project Success Correlations indicates the correlations between Project Stakeholders Management and the six different criteria adopted to measure project success.

	Project Success Criteria		Stakeholders Management	
Spearman's Rho	How successful do you think your project was?	Correlation Coefficient	0,295	**
		Sig. (2-tailed)	0,003	

		N	100	
	Compliance with budget	Correlation Coefficient	0,448	**
		Sig. (2-tailed)	<,001	
		N	100	
	Compliance with time	Correlation Coefficient	0,331	**
		Sig. (2-tailed)	<,001	
		N	100	
	Compliance with quality	Correlation Coefficient	0,33	**
		Sig. (2-tailed)	<,001	
		N	100	
	Rate the deliverables from 1 to 5	Correlation Coefficient	0,23	**
		Sig. (2-tailed)	0,021	
		N	100	

Table 52: Project Stakeholders Management and Project Success Correlations

The significant success criteria for this category are:

- the completion of projects within budget with a Spearman rho of 0,448 indicating a moderate positive statistically significant relationship between Project Stakeholders Management and the completion of a project within budget.
- the completion of projects on time with a Spearman rho of 0,331 showing a weak positive statistically significant relationship between the Project Stakeholders Management and the completion of a project on time.
- the delivery of projects to a high standard of quality with a Spearman rho of 0.330 demonstrating a weak and positive statistically significant relationship between Project Stakeholders Management and the completion of a project within the quality values stated and expected.

For the other criteria, small values of Spearman rho were funded, meaning weak and small statically relationships.

3.8.2 Correlation between processes and project success

After testing correlation by areas of knowledge, the same procedure was carried out but considering the different stages of a project. Here as well, the analysis is done with each success criteria measured, to better understand the impact of implementing PM tools and techniques

among the different moments of a project and how this can influence project outcomes and results as well as project management success.

3.8.2.1 Project Initiating Management and Project Success

Table 53: Project Initiating Management and Project Success Correlations indicates the correlations between Project Initiating Management and the six different criteria adopted to measure project success.

Project Success Criteria			Initiating Process	
Spearman's Rho	How successful do you think your project was?	Correlation Coefficient	0,456	**
		Sig. (2-tailed)	<,001	
		N	100	
	Compliance with budget	Correlation Coefficient	0,462	**
		Sig. (2-tailed)	<,001	
		N	100	
	Compliance with time	Correlation Coefficient	0,347	**
		Sig. (2-tailed)	<,001	
		N	100	
	Compliance with quality	Correlation Coefficient	0,271	**
		Sig. (2-tailed)	0,006	
		N	100	
	Rate the deliverables from 1 to 5	Correlation Coefficient	0,305	**
		Sig. (2-tailed)	0,002	
		N	100	

Table 53: Project Initiating Management and Project Success Correlations

The most significant success criteria for this category are:

- whether projects achieve the objectives stated at the initiating phase of it and its impact expected with a Spearman rho of 0.456 showing a moderate positive statistically significant relationship with Project Initiating Management.
- the completion of projects within budget with a Spearman rho of 0,462 indicating a moderate positive statistically significant relationship between variables.

- the delivery of projects on time with a Spearman rho of 0.4347 which shows a weak positive statistically significant relationship between the Project Initiating Management and the completion of a project on time.

For the other criteria, small values of Spearman rho were funded, meaning weak and small statically relationships.

3.8.2.2 Project Planning Management and Project Success

Table 54: Project Planning Management and Project Success Correlations indicates the correlations between Project Planning Management and the six different criteria adopted to measure project success.

Project Success Criteria			Planning Process	
Spearman's Rho	How successful do you think your project was?	Correlation Coefficient	0,366	**
		Sig. (2-tailed)	<,001	
		N	100	
	Compliance with budget	Correlation Coefficient	0,352	**
		Sig. (2-tailed)	<,001	
		N	100	
	Compliance with time	Correlation Coefficient	0,33	**
		Sig. (2-tailed)	<,001	
		N	100	
	Compliance with quality	Correlation Coefficient	0,403	**
		Sig. (2-tailed)	<,001	
		N	100	
	Rate the deliverables from 1 to 5	Correlation Coefficient	0,298	**
		Sig. (2-tailed)	0,003	
		N	100	

Table 54: Project Planning Management and Project Success Correlations

The significant success criteria for this category are:

- the completion of a project within the quality values stated and expected with a Spearman rho value of 0.403.

- whether projects achieve the objectives stated at the initiating phase of it and its impact expected (perceived success) with a Spearman rho of 0,366.
- the completion of projects within budget, with a Spearman rho of 0,352 showing a weak positive statistically significant relationship.

For the other criteria, small values of Spearman rho were funded, meaning weak and small statically relationships.

3.8.2.3 Project Executing Management and Project Success

Table 55: Project Executing Management and Project Success Correlations indicates the correlations between Project Executing Management and the six different criteria adopted to measure project success.

Project Success Criteria			Executing Process	
Spearman's Rho	How successful do you think your project was?	Correlation Coefficient	0,411	**
		Sig. (2-tailed)	<,001	
		N	100	
	Compliance with budget	Correlation Coefficient	0,334	**
		Sig. (2-tailed)	<,001	
		N	100	
	Compliance with time	Correlation Coefficient	0,277	**
		Sig. (2-tailed)	0,005	
		N	100	
	Compliance with quality	Correlation Coefficient	0,354	**
		Sig. (2-tailed)	<,001	
		N	100	
	Rate the deliverables from 1 to 5	Correlation Coefficient	0,365	**
		Sig. (2-tailed)	<,001	
		N	100	

Table 55: Project Executing Management and Project Success Correlations

The significant success criteria for this category are:

- the level of success perceived by the consortium's point of view with a Spearman rho of 0,411 depicting a moderate positive statistically significant relationship

between Project Executing Management and whether projects achieve the objectives stated at the initiating phase of it and its impact expected.
- whether project outcomes are regarded as a success by the consortium with a Spearman rho of 0.365.
- the delivery of projects to a high standard of quality with a Spearman rho of 0.354 showing a weak positive statistically significant relationship.

For the other criteria, small values of Spearman rho were funded, meaning weak and small statically relationships.

3.8.2.4 Project Monitoring and Control Management and Project Success

Table 56: Project Monitoring and Control Management and Project Success Correlations indicates the correlations between Project Monitoring and Control Management and the six different criteria adopted to measure project success.

Project Success Criteria			Monitoring and control Process	
Spearman's Rho	How successful do you think your project was?	Correlation Coefficient	0,363	**
		Sig. (2-tailed)	<,001	
		N	100	
	Compliance with budget	Correlation Coefficient	0,454	**
		Sig. (2-tailed)	<,001	
		N	100	
	Compliance with time	Correlation Coefficient	0,285	**
		Sig. (2-tailed)	0,004	
		N	100	
	Compliance with quality	Correlation Coefficient	0,357	**
		Sig. (2-tailed)	<,001	
		N	100	
	Rate the deliverables from 1 to 5	Correlation Coefficient	0,345	**
		Sig. (2-tailed)	<,001	
		N	100	

Table 56: Project Monitoring and Control Management and Project Success Correlations

The most significant success criterion for this category is the completion of a project within budget with a Spearman rho of 0.454 indicating a moderate and positive statistically significant relationship between variables.

Also, weaker relationships were found with the level of success perceived by the consortium's point of view (Spearman rho 0.363), the completion of a project within the quality values stated and expected (Spearman rho 0.357) and whether project outcomes and deliverables are regarded as a success (Spearman rho 0.345).

Finally, much smaller, and weaker relationships were found for the rest of the criteria.

3.8.2.5 Project Closing Management and Project Success

Table 57: Project Closing Management and Project Success Correlations indicates the correlations between Project Closing Management and the six different criteria adopted to measure project success.

Project Success Criteria			Closing Process	
Spearman's Rho	How successful do you think your project was?	Correlation Coefficient	0,325	**
		Sig. (2-tailed)	<,001	
		N	100	
	Compliance with budget	Correlation Coefficient	0,461	**
		Sig. (2-tailed)	<,001	
		N	100	
	Compliance with time	Correlation Coefficient	0,256	**
		Sig. (2-tailed)	0,01	
		N	100	
	Compliance with quality	Correlation Coefficient	0,41	**
		Sig. (2-tailed)	<,001	
		N	100	
	Rate the deliverables from 1 to 5	Correlation Coefficient	0,217	**
		Sig. (2-tailed)	0,03	
		N	100	

Table 57: Project Closing Management and Project Success Correlations

The significant success criteria for this category are:

- the completion of projects within budget with a Spearman rho of 0,461, indicating a moderate positive statistically significant relationship between Project Closing Management and the completion of a project within budget.
- the delivery of projects to a high standard of quality with a Spearman rho of 0.410 showing a moderate positive statistically significant relationship between Project Closing Management and the completion of a project within the quality values stated and expected.

For the other criteria, small values of Spearman rho were funded, meaning weak and small statically relationships.

Chapter 4: Findings and conclusion

4.1 Introduction

As it has been mentioned in the prior chapters, the aim of this study is to gain additional insights into Horizon 2020 projects and investigate the relationship between the application of project management tools, techniques and methodologies and project success, to determine whether there exists a relationship among these variables and the degree of it.

Consequently, data was collected through a questionnaire constructed specifically for this purpose and analysed accordingly. The independent variable was defined as the level of perceived application of PM methodologies among different moments of the project and different areas. It was named as "PM usage level". The dependent variable, on the other hand, was defined by five project success criteria related to project management success and project success related to the achievement of objectives, impact and deliverables desired. The name of this variable was defined as "project management success".

All the findings of the research assisted in answering the main research question. Hence, this chapter presents these results and discussions related to those findings obtained during the corresponding analysis. This is then followed by a list of recommendations on how EU programmes can improve the rate of success of the projects they finance by improving and increasing the implementation of PM techniques, recommendations, and future research.

4.2 Findings and recommendations

To better understand how the independent variable influences the dependent one, it is important to keep in mind both, the degree of application of the techniques in the project and afterwards, the influence this has on project success.

For this reason, the construction of inferences is strictly attached to the level of usage of the previously mentioned methodologies.

Summary of findings are presented below by areas and processes in Table 58: Summary of correlation between project areas and project success and Table 59: Summary of correlation between project processes and project success.

				Project Success				
		Cronbach's Alpha	**Correlation**	Level of perceived success	Budget	Time	Quality	Deliverable success
Areas of Knowledge	Project Scope Management	0,886	Correlation Coefficient	0,476	0,389	0,227	0,377	0,356
			Significance	<,001	<,001	0,023	<,001	<,001
	Project Time Management	0,68	Correlation Coefficient	0,46	0,43	0,403	0,312	0,411
			Significance	<,001	<,001	<,001	0,002	<,001

	Cronbach's Alpha	Correlation	Level of perceived success	Budget	Time	Quality	Deliverable success
Project Cost Management	0,637	Correlation Coefficient	0,172	0,375	0,316	0,17	0,186
		Significance	0,087	<,001	0,001	0,091	0,064
Project Quality Management	0,895	Correlation Coefficient	0,334	0,263	0,314	0,431	0,277
		Significance	<,001	0,008	0,001	<,001	0,005
Project HR Management	0,765	Correlation Coefficient	0,411	0,293	0,152	0,341	0,306
		Significance	<,001	0,003	0,131	<,001	0,002
Project Communications Management	0,753	Correlation Coefficient	0,299	0,428	0,387	0,245	0,203
		Significance	0,003	<,001	<,001	0,014	0,043
Project Risk Management	0,802	Correlation Coefficient	0,306	0,263	0,26	0,399	0,306
		Significance	0,002	0,008	0,009	<,001	0,002
Project Integration Management	0,815	Correlation Coefficient	0,359	0,439	0,182	0,268	0,305
		Significance	<,001	<,001	0,069	0,007	0,002
Project Stakeholder Management	0,726	Correlation Coefficient	0,295	0,448	0,331	0,33	0,23
		Significance	0,003	<,001	<,001	<,001	0,021

Table 58: Summary of correlation between project areas and project success

		Cronbach's Alpha	Correlation	Project Success				
				Level of perceived success	Budget	Time	Quality	Deliverable success
Project Processes	Project Initiating Management	0,754	Correlation Coefficient	0,456	0,462	0,347	0,271	0,305
			Significance	<,001	<,001	<,001	0,006	0,002
	Project Planning Management	0,904	Correlation Coefficient	0,366	0,352	0,33	0,403	0,298
			Significance	<,001	<,001	<,001	<,001	0,003
	Project Executing Management	0,876	Correlation Coefficient	0,411	0,334	0,277	0,354	0,365
			Significance	<,001	<,001	0,005	<,001	<,001
	Project Monitoring and Control Management	0,876	Correlation Coefficient	0,363	0,454	0,285	0,357	0,345
			Significance	<,001	<,001	0,004	<,001	<,001
	Project Closing Management	0,724	Correlation Coefficient	0,325	0,461	0,256	0,41	0,217
			Significance	<,001	<,001	0,01	<,001	0,03

Table 59: Summary of correlation between project processes and project success

4.2.1 Project Integration Management and Project Success

In Table 60: Relationship between Project Integration Management and Project Success below it is summed up the relationship between Project Integration Management and Project Success. It is a summary of the degree of correlation between the independent variable and the dependent ones.

PM level of usage	Correlation strength	Project Success
Project Integration Management	Low	Level of perceived success
	Moderate	Budget
	None	Time
	Low	Quality
	Low	Deliverable success

Table 60: Relationship between Project Integration Management and Project Success

When calculating the mode and the frequencies of responses used to measure the level of usage of project integration management tools, techniques, and methodologies, we found that the most repeated value is 5 with more than 46% of the answers followed by the value 4 with 44,4% both representing 90,6% of answers, suggesting that the application is well developed, even though this does not mean that it is effectively used.

Looking into the results obtained, we can say that there was no statistically significant relationship between the application of Integration Management techniques and one of the success criteria which is time. A low relationship was however found between Project Integration Management and three of the success criteria stated which are level of perceived success, quality, and deliverable success. Finally, a moderate relationship was found regarding compliance with the budget. This can be related to the fact that projects carried out under this programme cannot change their budgets during the execution of the project, since they are just granted with the amount of money awarded during the proposal phase.

The results to which we arrived are the ones expected. Even though there is not a strong correlation between Project Integration Management and the success of the project or the outcome, it has a central role in the coordination of all elements of the project and therefore, maybe we cannot relate it directly to a specific success criterion, it has some influence in all of them. The absence of correlation with the criterion related to completion of the project on time is strictly related to the fact that Horizon 2020 projects have a fixed period of time, and it cannot be changed.

4.2.2 Project Scope Management and Project Success

In Table 61: Relationship between Project Scope Management and Project Success below it is summed up the relationship between Project Scope Management and Project

Success. It is a summary of the degree of correlation between the independent variable and the dependent ones.

PM level of usage	Correlation strength	Project Success
Project Scope Management	Moderate	Level of perceived success
	Low	Budget
	None	Time
	Low	Quality
	Low	Deliverable success

Table 61: Relationship between Project Scope Management and Project Success

Analysing the mode and the frequencies of responses use to measure the level of usage of project scope management tools, techniques, and methodologies, we see that the most repeated value is 5 with 44,2% of answers followed by the value 4 with 43,4% both representing more than the 87% of total answers. This tells us that according to the respondent's point of view, these techniques and methodologies are being applied and used.

No statistically significant relationship was found between Project Scope Management and the completion of a project on time. There was a low correlation between Project Scope Management and compliance of the project within the budget, to a high standard quality level and obtaining the expected level of success for deliverables. However, a substantial relationship was found related to whether projects are regarded as a success by the consortium (the level of perceived success of the project). This last relationship is understandable and logical since Project Scope Management involves defining and documenting what work and activities are required to complete a project successfully.

We conclude that this area of knowledge has a direct influence on project success due to its nature, and to a lesser extent in almost all project success criteria defined.

The results obtained are logical and are the expected ones. Project Scope Management is a main character during the initiating phase of a project, and that project stage is expected to be the most developed one in these projects since it is crucial and determinant for the obtention of funds. For this reason, we expected higher correlations with the criteria related to the level of success achieved by the project and the successfulness of the deliverables, also because during scope all work activities to be carried out are stated and defining those properly would be a great starting point to achieve greater levels of success.

4.2.3 Project Time Management and Project Success

In Table 62: Relationship between Project Time Management and Project Success below it is summed up the relationship between Project Time Management and Project Success. It is a summary of the degree of correlation between the independent variable and the dependent ones.

PM level of usage	Correlation strength	Project Success
Project Time Management	Moderate	Level of perceived success
	Moderate	Budget
	Moderate	Time
	Low	Quality
	Moderate	Deliverable success

Table 62: Relationship between Project Time Management and Project Success

Regarding the mode and the frequencies of responses used to measure the level of usage of Project Time Management tools, techniques, and methodologies, we see that the most repeated value is 5 with almost 47% of answers, followed by the value 4 with 44,5% both representing more than 91% of total answers. This indicates that, on one side, project time management tools and techniques are one of the most spread ones, on the other hand not only are spread and well-known but also applied.

A low statically significant relationship was found between time management and compliance with quality stated. However, a moderate relationship was found with the other success criteria defined.

Data seems to suggest that the use of techniques related to project time management not only have an impact on delivering a project on time, but also in other success criteria such as level of perceived success and deliverable success.

If we concentrate on the low impact of Project Time Management with quality success criteria, we can say that carrying out the tasks on time does not mean that are carried out properly, and sometimes when teams are trying to perform activities on time, they "sacrifice" some quality.

The Cronbach's Alpha of this category is slightly under the level of acceptance so it does not allow the researcher to draw accurate conclusions, since items are not well correlated, and it can lead to misinterpretations or poor conclusions. The low value may be caused by the fixed duration of projects, which leads to not giving much attention to this area of knowledge during the development of these projects.

4.2.4 Project Cost Management and Project Success

In Table 63: Relationship between Project Cost Management and Project Success below it is summed up the relationship between Project Cost Management and Project Success. It is a summary of the degree of correlation between the independent variable and the dependent ones.

PM level of usage	Correlation strength	Project Success
Project Cost Management	None	Level of perceived success
	Low	Budget

	Low	Time
	None	Quality
	None	Deliverable success

Table 63: Relationship between Project Cost Management and Project Success

When calculating the mode and the frequencies of responses used to measure the level of usage of project cost management tools, techniques, and methodologies, we found that the most repeated value is 4 with more than 48% of the answers followed by the value 4 with 40,7% both representing 89,3% of answers, suggesting that the application is well developed, even though this does not mean that it is effectively use.

Interestingly, we see that the correlation is low or non-existent in every case. This could be related to the fact that the Cronbach Alpha found was 0.637 (below the desired acceptance value of 0.7) and that indicates that not all items are measuring the desired construct. Therefore, no conclusions will be drawn related to the influence or correlation between this area of knowledge and project success.

Anyway, it is important to highlight that Horizon 2020 projects define their budget during the proposal phase, and once they are granted it cannot be changed so they need to adjust all their activities to the predetermine amount of money they were granted. This is why, no matter how much or how well cost management tools and techniques are implemented, they will not have a direct impact on the success criteria defined.

4.2.5 Project Quality Management and Project Success

In Table 64: Relationship between Project Quality Management and Project Success below it is summed up the relationship between Project Quality Management and Project Success. It is a summary of the degree of correlation between the independent variable and the dependent ones.

PM level of usage	Correlation strength	Project Success
Project Quality Management	Low	Level of perceived success
	Low	Budget
	Low	Time
	Moderate	Quality
	Low	Deliverable success

Table 64: Relationship between Project Quality Management and Project Success

When measuring the mode and the frequencies of responses used to measure the level of usage of project quality management tools, techniques, and methodologies, we found that the most repeated value is 5 with 43% of the answers followed by the value 4 with 39,7% of answers, both representing 82,7% of answers. Even though the values are fairly good, it is the lowest total percentage of answers 4 and 5 found among all areas.

In this case, data indicated a low relationship between project quality management and every success criterion except for the "compliance with quality" criterion.

Project quality management is the process through which quality is managed and maintained throughout a project. It is therefore understandable that it would have a link with the achievement of the quality level expected by the consortium. The findings corroborate with the PMBOK definition of project time management. Therefore, we conclude that a good quality management plan, definition of strategies to perform quality assurance and carrying out those plans, have a great impact on the achievement of the level of quality desired for a project.

Furthermore, quality is the most significant aspect in Horizon2020 projects since, when dealing with research, innovation and development projects, the good quality of the results obtained is the main objective. All projects seek to achieve high-quality innovations and deliverables, which is why quality management becomes a central factor to be considered during the life of the project. The results to which we arrived show that, quality management impacts on the success criteria stated, especially with the compliance of the project with high levels of quality.

4.2.6 Project Human Resources Management and Project Success

In Table 65: Relationship between Project Human Resources Management and Project Success below it is summed up the relationship between Project Human Resources Management and Project Success. It is a summary of the degree of correlation between the independent variable and the dependent ones.

PM level of usage	Correlation strength	Project Success
Project Human Resources Management	Moderate	Level of perceived success
	Low	Budget
	None	Time
	Low	Quality
	Low	Deliverable success

Table 65: Relationship between Project Human Resources Management and Project Success

Analysing the mode and the frequencies of responses use to measure the level of usage of project human resources management tools, techniques, and methodologies, we see that the most repeated value is 5 with 44,8% of answers followed by the value4 with 41,4% both representing more than the 86% of total answers. This tells us that according to the respondent's point of view, these techniques and methodologies are being applied and used.

Data indicated that a low correlation was found between project human resource management tools, techniques and methodologies and compliance with budget, the desired quality and deliverable success criteria. No statistically significant relationship was found with the completion of the project on time. Finally, a moderate correlation was found with the level of success of the project perceived by the consortium.

Human Resources management focuses on assigning the right people to different tasks and making sure they have the necessary training to carry out the work. These findings

indicate that this area is important and contributes to achieving the level of success desired by the consortium since chances of getting the job done correctly are higher when people are trained for that. We expected a higher impact on quality, since one important activity of project human resources management is to assign the right people for the tasks to be carried out. Appropriately trained people are more likely to carry out their tasks according to desired requirements and quality levels.

4.2.7 Project Communications Management and Project Success

In Table 66: Relationship between Project Communications Management and Project Success below it is summed up the relationship between Project Communications Management and Project Success. It is a summary of the degree of correlation between the independent variable and the dependent ones.

PM level of usage	Correlation strength	Project Success
Project Communications Management	Low	Level of perceived success
	Moderate	Budget
	Low	Time
	None	Quality
	None	Deliverable success

Table 66: Relationship between Project Communications Management and Project Success

When calculating the mode and the frequencies of responses used to measure the level of usage of project management tools, techniques, and methodologies regarding communications management, we found that the most repeated value is 4 with more than 48% of the answers followed by the value 4 with 41,3% both representing 90% of answers, suggesting that the application is well developed, even though this does not mean that it is effectively use.

Data indicated that there is no statistically significant relationship between the application of Project Communications Management tools and techniques and the completion of a project to a high standard of quality or achieving the desired level of success related to the deliverables. Low correlations were found with a project's ability to be perceived as a success by the consortium and finishing it on time and moderate correlation was found with the completion of the project within budget.

Counterintuitive results were reached in this area. Communications management seems that is not significant in terms of providing quality and successful deliverables, contrary to expectations. Good communication among team members is an important factor to avoid mistakes, create team solutions to the problems that appear and discuss the best way to proceed to achieve the expected levels of quality. In this case, the correlation coefficient does not indicate that. Moreover, there is also no correlation with successfulness of the outcomes.

4.2.8 Project Risk Management and Project Success

In Table 67: Relationship between Project Risk Management and Project Success below it is summed up the relationship between Project Risk Management and Project Success. It is a summary of the degree of correlation between the independent variable and the dependent ones.

PM level of usage	Correlation strength	Project Success
Project Risk Management	Low	Level of perceived success
	Low	Budget
	Low	Time
	Moderate	Quality
	Low	Deliverable success

Table 67: Relationship between Project Risk Management and Project Success

When measuring the mode and the frequencies of responses used to measure the level of usage of project management tools, techniques, and methodologies regarding project risk management, we found that the most repeated value is 4 with more than 47% of the answers followed by the value 5 with 39,4% both representing 87% of answers. This tells us that according to the respondent's point of view, these are being applied and used.

Data further indicated low correlations with the organization views the project as a success, the success desired for the deliverables and the compliance of the project within budget and on time.

A moderate relationship was found with the completion of a project to a high standard of quality, the reason behind this correlation could be the importance of a risk management plan and response strategies to avoid or quick solve potential issues with related to the completion of tasks within the quality measures defined, and how important it is to achieve the quality standards set.

Risk management has influence in every success criterion to a greater or a lesser extent. Project risk management allows team members to identify potential risks and develop plan risk responses and strategies to control them regarding every aspect of a project. Therefore, as expected, the impact of risk management is evident in all the factors measured.

4.2.9 Project Stakeholders Management and Project Success

In Table 68: Relationship between Project Stakeholders Management and Project Success below it is summed up the relationship between Project Stakeholders Management and Project Success. It is a summary of the degree of correlation between the independent variable and the dependent ones.

PM level of usage	Correlation strength	Project Success
Project Stakeholders Management	Low	Level of perceived success
	Moderate	Budget
	None	Time
	Low	Quality
	Low	Deliverable success

Table 68: Relationship between Project Stakeholders Management and Project Success

When calculating the mode and the frequencies of responses used to measure the level of usage of project management tools, techniques, and methodologies regarding stakeholders management, we found that the most repeated value is 5 with more than 50% of the answers followed by the value 4 with 38,5% both representing 89% of answers. This tells us that according to the respondent's point of view, these are being applied and used, even though this does not mean that it is effectively use.

Data on correlations indicate no relationship with the completion of the project on time, low correlations with whether the consortium views the project as a success, the achievement of high quality standards and the success related to the deliverables produced.

A moderate correlation was found regarding the completion of the project within budget.

This is this way due to the fact that in this type of projects financed by the EU, stakeholders management is not a key area, since the external stakeholder of every project is the European commission and the objective of the programme is to "to help to build a society and an economy based on knowledge and innovation, to provide funding for research, development and innovation" so its focus is not strictly related to the specific deliverables but with the impact that this will have on the growing opportunities to the society in long term view.

4.2.10 Project Initiating Management and Project Success

In Table 69: Relationship between Project Initiating Management and Project Success below it is summed up the relationship between Project Initiating Management and Project Success. It is a summary of the degree of correlation between the independent variable and the dependent ones.

PM level of usage	Correlation strength	Project Success
Project Initiating Management	Low	Level of perceived success
	Moderate	Budget
	Low	Time
	Low	Quality

	Low	Deliverable success

Table 69: Relationship between Project Initiating Management and Project Success

According to the mode and the frequencies of responses used to measure the level of usage of PM tools, techniques, and methodologies during the initiating phase of a project, this is the stage with the highest percentage of answers indicating a value of 5 with a 51%, followed by the value 4 with 37,3% both representing almost 89% of answers. This stage is pretty developed, and this could be strongly related to the fact that this is a critical phase and lots of attention is put into it since granting of funds depends on the proposal.

Pretty related to the previously mentioned, project integration management presents a moderate correlation with compliance with budget. The reason for this relationship, as mentioned before, is the importance of the proposal and the planification of a complete and correct budget is crucial in order to be granted with funds. Therefore, and since budgeting is not a simple task, it is given with lots of attention and is developed carefully with high levels of awareness to not miss anything. Also, it is controlled during the whole duration of the project because no extra funds are given during the development of the project.

With respect to the other success criteria, a low statically significant relationship was found. The results obtained are weaker than expected. During the initiating process the proposal is created, and all the objectives and requirements are stated, and stakeholders identified. The determination of clear and achievable objectives, and the fact that all team members have a clear idea about them could lead to the achievement of the levels of success desired and compliance with the standards set. The definition of clear and attainable goals is the first step to obtain them, which is why a greater corelation with this criterion was expected. Nonetheless, there exists a correlation to every criterion, despite the weaker strength.

4.2.11 Project Planning Management and Project Success

In Table 70: Relationship between Project Planning Management and Project Success below it is summed up the relationship between Project Planning Management and Project Success. It is a summary of the degree of correlation between the independent variable and the dependent ones.

PM level of usage	Correlation strength	Project Success
	Low	Level of perceived success
	Low	Budget
Project Planning Management	Low	Time
	Moderate	Quality
	Low	Deliverable success

Table 70: Relationship between Project Planning Management and Project Success

Regarding the mode and the frequencies of responses used to measure the level of usage of Project Management tools, techniques, and methodologies during the planning

phase, we see that the most repeated value is 4 with almost 45%, followed by value 5 with 42,4%, both representing more than the 87% of answers.

A moderate relationship was found between Project Planning Management and achieving the levels of quality desired. When talking about quality achievement, creating a plan to measure quality, the requirements and quality standards, could turn out to be a key step, to measure progress and to know how to avoid mistakes or correct them on time and properly, to obtain the desired results.

Contrary to expectations, data indicated a low statistically significant relationship between Project Planning Management and all the success criteria presented except for compliance with the quality. Project Planning Management is focused on the creation and design of plans related to how to proceed when it comes to managing and executing the activities, how progress will be measured, and the creation of workable schemes to meet project's objectives regarding all vertices of the project. Despite planning is a big and important step of a project, if the plans are not followed it will not be possible to achieve success. Therefore, the low relationship may be due to the fact that planning is important but does not assure the success of the project by itself. In this way, execution becomes a determiner.

4.2.12 Project Executing Management and Project Success

In Table 71: Relationship between Project Executing Management and Project Success below it is summed up the relationship between Project Executing Management and Project Success. It is a summary of the degree of correlation between the independent variable and the dependent ones.

PM level of usage	Correlation strength	Project Success
Project Executing Management	Moderate	Level of perceived success
	Low	Budget
	Low	Time
	Low	Quality
	Low	Deliverable success

Table 71: Relationship between Project Executing Management and Project Success

Analysing the mode and the frequencies of responses use to measure the level of usage of project management tools, techniques, and methodologies during the closing phase of the project, we see that the most repeated values are 4 and 5 with 43,2% each one, representing more than the 86% of answers. This tells us that according to the respondent's point of view, these techniques and methodologies are being applied and used.

Data indicates a low correlation between the application of PM tools and techniques during this phase and compliance with budget, on time, with the quality expected and deliverable success. A substantial relationship was found with whether projects achieve the objectives stated at the initiating phase of it and its impact expected. The reason why this relationship occurs is that the main focus of this stage is on the development of the activities needed to be done in order to obtain the output and to achieve the objectives desired.

Therefore, special attention is given to do all necessary to obtain the impact stated in earlier phases.

This phase is the one with the greatest discrepancies with the expected result. The project execution process aims to bring together all necessary resources and execute tasks outlined in the plans to ensure that the project is completed, and requirements are met. The tasks outlined, if planning was done properly, refer to all dimensions of a project, not just the outcome. Therefore, as Horizon 2020 projects self-evaluation indicates well developed executing phase, we would have expected a higher correlation with all success criteria.

4.2.13 Project Monitoring and Control Management and Project Success

In Table 72: Relationship between Project Monitoring and Control Management and Project Success below it is summed up the relationship between Project Monitoring and control Management and Project Success. It is a summary of the degree of correlation between the independent variable and the dependent ones.

PM level of usage	Correlation strength	Project Success
Project Monitoring and Control Management	Low	Level of perceived success
	Moderate	Budget
	Low	Time
	Low	Quality
	Low	Deliverable success

Table 72: Relationship between Project Monitoring and Control Management and Project Success

When measuring the mode and the frequencies of responses used to measure the level of usage of project management tools, techniques and methodologies during monitoring and control of the project, the most repeated value is 4 with almost 46% of the answers followed by the value 5 with 43,5% both representing 89% of answers. This tells us that according to the respondent's point of view, these are being applied and used.

Data indicated that weak correlations were found with the delivery of a project to a high standard of quality, on time, whether the consortium views the project as a success and the success of the deliverables produced.

The moderate relationship found between monitoring and control management and the compliance with budget is explained through the fact that monetary resources are limited to the sum granted, therefore, it needs to be closely monitored to not face any problem related to them and stay within budget the whole project.

The results obtained are way weaker than expected. In fact, we expected that Monitoring and Control Management had a great impact in every success criterion since the activities related to monitoring and control are carried out during the whole duration of the project with the aim of guaranteeing the accomplishment of the objectives by tracking, reviewing, and implementing the required adjustments. Every activity is focused on avoiding error, or failing that, correcting them to achieve the objectives set for all dimensions of the

project (time, budget, quality, outcomes, among others), that is the reason why stronger relationships were expected. In spite of this situation, there exists a correlation with every success criterion.

4.2.14 Project Closing Management and Project Success

In Table 73: Relationship between Project Closing Management and Project Success below it is summed up the relationship between Project Closing Management and Project Success. It is a summary of the degree of correlation between the independent variable and the dependent ones.

PM level of usage	Correlation strength	Project Success
Project Closing Management	Low	Level of perceived success
	Moderate	Budget
	Low	Time
	Moderate	Quality
	Low	Deliverable success

Table 73: Relationship between Project Closing Management and Project Success

Analysing the mode and the frequencies of responses use to measure the level of usage of project management tools, techniques, and methodologies during the closing phase of the project, we see that the most repeated value is 5 with almost 48% of the answers followed by the value 4 with 42,6% both representing more than the 90% of answers. This tells us that according to the respondent's point of view, these techniques and methodologies are being applied and used.

Data indicated a low correlation between Project Closing Management and the level of perceived success as well as finishing the project on time and the success related to the deliverables produced.

The moderate correlation with compliance with the quality levels stated is closely related to the fact that once finished the development of activities to reach the desires outcomes, the principal activity of this phase is the assurance that all deliverables are accepted based on the documented quality acceptance criteria upon the agreed process. For this reason, this stage has an important impact on that success criterion.

Also, a substantial relationship was found with compliance with budget, this could be related to the fact that consortiums need to present a final financial report when finishing the project and carrying out all activities within budget is a key element in these projects.

The results obtained coincide with the envisioned ones, since this stage has not a great impact on the activities necessary to develop the project itself, but simple the objective is to formally close the project and evaluate its performance in order to apply the lessons learned in future projects.

4.3 Conclusion

After doing the correspondent literature review in addition to the correspondent collection of data of the studied population and carrying out the correlation analysis of the gathered data, the present conclusion was obtained.

First, and to have an overall view of the impact of the application of PM tools, techniques, and methodologies a scatter plot was done, in which it is possible to observe the relationship between the average level of PM measured in Horizon 2020 projects and the levels of success perceived by the consortiums.
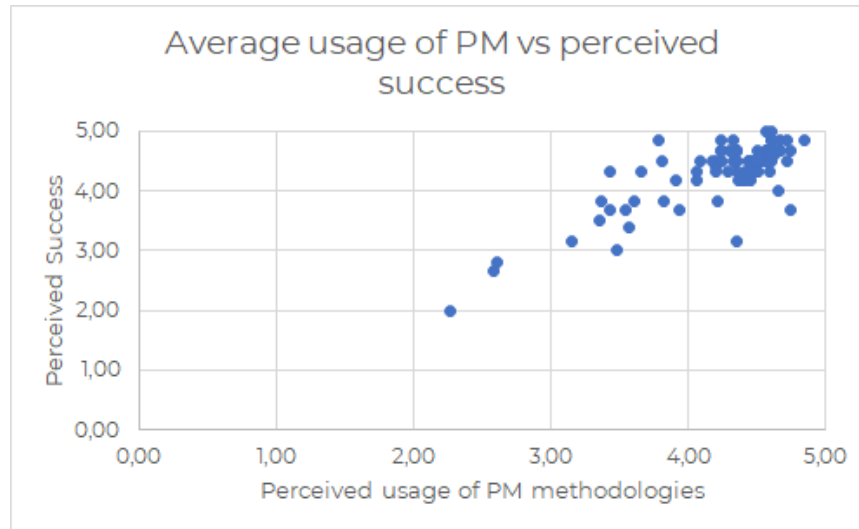

Figure 13: Average usage of PM vs perceived success

The overall level of usage of PM methodologies was then calculated by averaging the score of every question, belonging to the different areas of knowledge. In the graphic we can observe that, the more the application of project management tools, techniques, and methodologies, the higher is the perceived level of success achieved by the projects.

We would expect to observe that behaviour, since majority of studies related to application of Project Management and Project Success indicated a positive correlation between those variables. Also, the main purpose of Project Management is the successful development of the project's procedures and the guidance of the project team's operations to achieve all the agreed upon goals, so, the expected conclusion would be a direct impact of PM into the success of projects.

Project management growing popularity is not just a fad, in fact it is being increasingly applied due to the advantages it brings. Projects belonging to the Horizon 2020 programme are not an exception.

However, a more in-depth analysis and conclusion is necessary given since we intend to have a deeper understanding on how each area of knowledge affects the success obtained and how it varies in the different moments of the project.

Based on the descriptive statistics obtained, the first point of fact to highlight, is the overall perceived usage of PM tools and methodologies in projects financed by the European Commission under the "Horizon 2020" research programme, being even higher than expected, reached a statistical mode of 4 or 5 in every category which means that most answers were

given that value, indicating that in general terms, project management methodologies are applied and used across every area and process of the project.

Considering the correlation analysis carried out, the research successfully revealed that there is a positive relationship between project management use and performance and project success. This is the most important fact because, even though relationships founded are not as strong as expected, there is a significant relationship between the variables of study, meaning that most of the aspects that we have studied are related to each other.

The degree of correlation or strength showed differences among different areas of knowledge and stages. Focusing on project phases, it is clear that the initiating phase is the one with most influence on project success. This is not a coincidence, since in Horizon 2020 European Union framework programme all projects need to first submit their proposals and after evaluation by experts, the European Union decides if they will get funds and signs a grant agreement. Therefore, much more attention is given to project management during it for obtaining approval from the European Commission and getting the monetary contribution they need to carry out their projects. On the opposite side, the phase with less impact on project success is the closing phase, since this one focuses on administratively closing the project and collecting lessons learned for future projects, but most likely the consortiums crated for the development of these projects will be dissolved and will not carry out another project together.

Then, if we concentrate on the different areas of knowledge, every area has an impact on project success, each one contributing to different aspects of the project. Examining the project management triangle, we notice that cost and time presented a low Cronbach's Alpha Projects funded by the EU Horizon 2020 framework, have a fixed time and budget scheme and as a consequence these areas have not influence on project success. The duration of the projects and the money they have available to spend remains constant, it does not matter how well project cost and time management techniques are applied.

The third constraint in the project management triangle is scope, which on the contrary to the previous mentioned, has a great impact on project success. This area is crucial in these projects, since stating objectives and goals is determinative and can lead to the achievement of excellent results.

Additionally, project quality management is other area with great impact on success because of its high importance in research and development projects and because the European Union relies on the success of the outcomes since these deliverables are the ones that will generate great advances to produce high-quality science and allow impacts on society.

Project management is important and critical for the overall success of these projects and all project management areas are important to reach project success as well as all project management processes are needed for that same objective.

The reason behind weak correlation coefficients may lie in the fact that questionnaires measure perceived usage of PM and perceived success, and respondents are the project coordinators or project managers, so the answers could be strongly biased. One possible solution to obtain more objective data is to utilize the interview research method instead of self-completion questionnaire, which has some benefits that allow to diminish the biased answers. The advantages are that it provides flexibility to the interviewers, the response rate is higher, the interviewer can judge non-verbal behaviour and draw some conclusions, and also

the interviewer can make additional questions to gain some extra information to make better judgements.

Also, and not less important, the presence and active participation of a project manager with experience, improves the overall project management performance and is considered a key part to make a proper use of project management techniques and achieve success.

To conclude, relationships were found among all areas and processes of project management, so all dimensions of a project are needed to be taken into consideration to obtain the best outcomes and achieve success.

4.4 Recommendations

The next research programme to be funded by the European Commission is named "Horizon Europe" whose principal objectives are "to tackle climate change, help to achieve the UN's Sustainable Development Goals and boost the EU's competitiveness and growth" (European Union, 2021).

Therefore, based on the conclusion of the study, some recommendations for this future programme are stated:

- Implementing a new requisite related to the incorporation of a certified project manager or someone with experience in the field, to have higher certainty related to the fact that PM methodologies will be implemented properly, and PM tools and techniques will be effectively used.
- Intensify controls regarding PM implementation to encourage teams and consortiums to effectively use and apply the techniques during the whole duration of the project and not just at the beginning with the purpose of obtaining funds.
- Provide the possibility to participate in a course of capacitation of the PM2 methodology so every person being part of a team can get the necessary knowledge to improve their performance regarding PM methodologies.
- Define a common indicator to measure project success regardless of the nature of the projects, so as to be able to objectively compare their success.

4.5 Future research

If it is desired to conduct more studies related to the application and usage of PM methodologies in projects funded by the European Union, there are some aspects related to this study that would be productive to improve, so to have a better measure of the variables and therefore, to draw more accurate conclusions.

One important improvement to reduce the subjectivity of the responses could be the conduction of interviews instead of self-completion questionnaires to eliminate the biased answers from the people working on the projects and have a more objective and clear view and evaluation of the application and use of project management tools and techniques.

Another important betterment would be to rebuild the questionnaire to assure the reliability of every section of it, and to be sure that every question or statement is relevant for the study.

One last interesting upgrade would be to run the interviews or questionnaire as soon as the projects are finished, so project managers have fresh information about their projects

and no information is missed due to the passage of time (having in mind that this programmes usually lasts many years and once the project is finished, the different organizations are released and keep working on their own projects).

Future research should also make efforts to analyse and differentiate the application of PM methodologies in the different pillars of the programme, to observe how developed and implemented are the tools and techniques in different fields and to analyse organizations operating in different sectors. After all, "project management is here to stay!" (Kerzner, 2003).

Appendix A

Invitation letter

Dear Project Management Professional,

You are receiving this email because you are a Project Manager or Project Leader, or a professional with appropriate knowledge of Project Management practices and project results.

My name is Lara Victoria Fornero, Master Degree candidate at Politecnico di Torino, currently working with the Project Management Lab https://www.reslog.polito.it/PMLab/ in investigating the usage of Project Management practices in the Horizon 2020 EU-funded research program.

I am occasionally asking you to answer the following questionnaire which should take no more than 15 minutes to complete.

This questionnaire is set out with the sole aim of acquiring information needed to evaluate the relationship between perceived usage of Project Management methodologies and project success.

The manual used to create the questionnaire is the "Project Management Methodology (PM2)" which is the standard imposed by the European Commission for Horizon 2020 projects.

The results of this research will contribute greatly to furthering our understanding of the impact of the aforementioned practices in improving project's performance in EU-funded research projects.

Every answer I receive helps me in my research efforts. Please know that the answers are recorded and that the confidentiality and anonymity of your identity and your responses will be kept throughout the course of this study by the Project Management Laboratory, Dept. of Management and Production Engineering, Politecnico di Torino. However, if you leave an email address at the end of the questionnaire, I'll be contacting you to send the results.

It would be really appreciated if you could complete the survey as soon as possible, and no later than May 26th.

If this email address does not correspond, I would appreciate if you could send me a suitable email address of a substitute person*

Link to questionnaire: https://polito-it.limesurvey.net/622898?lang=en

Thank you for your time.
Lara Victoria Fornero

Appendix B

Questionnaire

PART 1: Demographics and general information

The first part of the questionnaire is allotted to project information to be able to identify it, objectives information to be able to measure the project success and general information of the respondents in terms of educational experience, occupational level and role in the organization and the consortium.

❋Project ID number

ⓘ Only numbers may be entered in this field.

[   ]

❋Project name

[   ]

❋Pillar

ⓘ Choose one of the following answers

[Please choose...   ⌄]

❋ *Thematic priority description*

ⓘ Choose one of the following answers

[Please choose...   ⌄]

❋Role of your organization in the consortium

ⓘ Choose one of the following answers

[Please choose...   ⌄]

❋Occupational level

ⓘ Choose one of the following answers

[Please choose...   ⌄]

＊Did someone work in the position of "Project Manager"?

✔ Yes	⊘ No

＊Is the Project Manager certified?

✔ Yes	⊘ No

PART 2: Perceived usage of Project Management practices

The second portion of the questionnaire is composed of questions on the different knowledge areas of project management where you, the respondent, are expected to rate from 1 to 5 the **degree of agreement** with the statements, based on your perceived usage of PM methodologies and techniques.

Note that:

- 1=strongly disagree

- 2=disagree

- 3=neutral

- 4=agree

- 5=strongly agree

＊SCOPE

During the proposal phase, the project objectives were clearly defined, the impact the project is expected to bring and the success criteria against which it will be evaluated.

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

＊SCOPE

During the proposal phase, an appropriate Business Case was created providing justification for the project (context, problem description, possible solutions, costs, and timescale).

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

✱SCOPE

At the beginning of the project, the project scope statement was further developed (detailed description of the project and list of deliverables) and strategies for completing the project were decided.

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

❓ Remember: 1=strongly disagree, 2=disagree, 3=neutral, 4=agree , 5=strongly agree

✱SCOPE

At the beginning of the project, a proper Work Breakdown Structure was developed (hierarchical subdivision of all the work that must be done).

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

✱SCOPE

At the beginning of the project, a Requirements Management Plan was created to define and document the requirements, responsibilities as well as the artefacts tools and techniques used for the documentation and management of the requirements.

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

✱SCOPE

At the beginning of the project, a Project Change Management Plan was created to define and document the change process (activities, roles and responsibilities related to identifying, documenting, approving, implementing, controlling, and communicating project changes).

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

✱SCOPE

At the beginning of the project, a Deliverables Acceptance Plan was created to document the agreed criteria for deliverables acceptance.

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

❓ Remember: 1=strongly disagree, 2=disagree, 3=neutral, 4=agree , 5=strongly agree

∗SCOPE

At the beginning of the project, a Planning Kick-off Meeting was run to ensure that everyone understands the project scope and to discuss the project plans.

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

∗SCOPE

During the project execution your team used the Deliverable Acceptance Plan to produce deliverables according to it

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

∗SCOPE

During action of the project, the project's performance was monitored to identify/rectify any deviations from the project plans.

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

∗TIME

At the beginning of the project, a Project Schedule was created to identify dependencies between tasks, pinpointing their start and end dates, to establish the overall project duration.

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

❓ Remember: 1=strongly disagree, 2=disagree, 3=neutral, 4=agree , 5=strongly agree

∗TIME

During the project execution, your consortium used an appropriate software or system for time management to determine status of the project.

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

∗TIME

During action of the project, the Project Manager (PM) regularly monitored the schedule and tracked the difference between planned, actual, and forecasted activities/deadlines.

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

*TIME

During action of the project, corrective actions were devised, agreed, and implemented when needed to bring the schedule back on track.

○ 1　　○ 2　　○ 3　　○ 4　　○ 5

❷ Remember: 1=strongly disagree, 2=disagree, 3=neutral, 4=agree , 5=strongly agree

---

*COST

At the beginning of the project, the Cost Estimates were developed to outline resources needed and estimate them as well as the time required to complete each task, within the constraints of resource availability and capabilities.

○ 1　　○ 2　　○ 3　　○ 4　　○ 5

---

*COST

During action of the project, the Project Manager (PM) regularly monitored the budget and tracked the difference between budgeted, actual, and forecasted costs.

○ 1　　○ 2　　○ 3　　○ 4　　○ 5

---

*COST

During action of the project, corrective actions were devised and implemented to bring the budget back on track.

○ 1　　○ 2　　○ 3　　○ 4　　○ 5

❷ Remember: 1=strongly disagree, 2=disagree, 3=neutral, 4=agree , 5=strongly agree

---

*QUALITY

At the beginning of the project, a Quality Management Plan was created to define and document the project's quality require-ments, responsibilities, control activities, quality metrics, quality management objectives and characteristics and the tools and techniques that will be used for quality planning and quality assurance and control.

○ 1　　○ 2　　○ 3　　○ 4　　○ 5

---

*QUALITY

At the beginning of the project, the project quality characteristics were defined and agreed considering project needs, con-straints, and a cost/benefit analysis.

○ 1　　○ 2　　○ 3　　○ 4　　○ 5

＊QUALITY

During the project execution, quality assurance standards were selected and communicated.

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

＊QUALITY

During the project execution, quality assurance activities were executed to review the compliance of project processes, outputs and deliverables to the standards chosen.

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

❓ Remember: 1=strongly disagree, 2=disagree, 3=neutral, 4=agree , 5=strongly agree

---

＊QUALITY

During the project execution, the Project Manager (PM) produced quality review reports to give an overview of the status of all project quality management activities.

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

＊QUALITY

During action of the project, the Project Manager (PM) performed quality assurance and controlled activities to identify any non-conformity, analyse the root cause, and implement corrective actions.

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

＊HUMAN RESOURCES

At the beginning of the project, the Roles & Responsibilities were identified in every layer, documented, and clearly described.

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

＊HUMAN RESOURCES

During the project execution, the Project Manager (PM) coordinated people, resources, meetings, and activities.

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

✳HUMAN RESOURCES

During the project execution, the Project Manager (PM) showed technical and behavioural skills

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

✳HUMAN RESOURCES

During the project execution, the Project Manager (PM) provided leadership and motivated the project team through the application of appropriate people management techniques.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

✳HUMAN RESOURCES

During the project execution, a Training Plan was defined and carried out to train personnel according to needs.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

❓ Remember: 1=strongly disagree, 2=disagree, 3=neutral, 4=agree , 5=strongly agree

✳COMMUNICATION

At the beginning of the project, a Communications Management Plan was created to ensure that all project stakeholders have the information they need and to define a communication strategy (frequency, format, and media to be used as well as the responsible one for it).

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

✳COMMUNICATION

During the project execution, Project Reporting was carried out to document and summarise the status of various dimensions, the project's progress, and performance, to inform project stakeholders.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

✳COMMUNICATION

During the project execution, relevant information resulting from the execution of the project was provided to appropriate parties at the right time and in the appropriate format.

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

❓ Remember: 1=strongly disagree, 2=disagree, 3=neutral, 4=agree , 5=strongly agree

*RISK

At the beginning of the project, a Risk Management Plan was created to define and document how risks will be identified and assessed, the tools and techniques to be used, the evaluation scales and tolerances, the roles and responsibilities, risk monitoring and risk response strategies (avoid, transfer/share, reduce, and accept).

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

*RISK

At the beginning of the project, the risk response strategies were developed to plan actions to manage the risks.

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

*RISK

During action of the project, the consortium ensured that risk management activities were carried out as per the Risk Management Plan.

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

*RISK

During action of the project, risks that could impact the project's objectives were identified, documented and the likelihood and the severity of the impact was assessed.

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

❓ Remember: 1=strongly disagree, 2=disagree, 3=neutral, 4=agree , 5=strongly agree

*RISK

During action of the project, the implementation of risk response activities was monitored and controlled.

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

*INTEGRATION

During the project execution, the Project Team executed the activities defined and scheduled in the Project Work Plan to produce project deliverables in accordance with the project plans.

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

*INTEGRATION

During action of the project, project Changes were identified, documented, approved, and communicated to relevant stakeholders.

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

*INTEGRATION

During action of the project, the Project Manager (PM) ensured that every deliverable was formally accepted on time and according to organisational standards.

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

*INTEGRATION

During action of the project, the consortium managed the transition to ensure the correct transfer of project deliverables to the client organisation.

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

*INTEGRATION

At the end of the project, a Project-End review meeting was held where the project statistics and the project's performance and experience was discussed.

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

*INTEGRATION

At the end of the project, the project's overall experience was summarised in a report.

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

*INTEGRATION

At the end of the project, the project was administratively closed, and all project documentation was reviewed, organised, and securely archived.

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

∗INTEGRATION

At the end of the project, the Project Team was officially dissolved, and all resources were released.

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

∗STAKEHOLDERS

During the proposal phase all project's stakeholders were identified (internal and external members)

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

∗STAKEHOLDERS

At the end of the project, the consortium ensured that all deliverables were accepted by the relevant stakeholders based on a predefined/documented quality/acceptance criteria and the agreed acceptance process.

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

PART 3: Project Success

The third part is dedicated to the respondent's evaluation of their projects level of success. Answer the following questions and rate your project's performance on the following parameters.

∗Did you reach the impact target stated in your proposal?

✔ Yes	⊘ No

∗How successful do you think your project was?

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

∗Compliance with budget

○ 1   ○ 2   ○ 3   ○ 4   ○ 5

*Compliance with time

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

*Compliance with quality

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

*Select your deliverable

❶ Choose one of the following answers

○ Patent

○ Innovations to the company or to the market (process, product, method)

○ Prototypes

○ Testing activities

○ Clinical trials

○ Design

○ Trademark

○ Utility model application

○ Publications

○ Book chapters

○ Reports

○ Documents

○ Conference proceedings

○ Websites

○ Other: _____

*Rate from 1 to 5 the impact of it

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

Appendix C

Areas-processes questions

	INITIATING PHASE	PLANNING PHASE	EXECUTING PHASE	MONITOR AND CONTROL	CLOSING PHASE
INTEGRATION			During the project execution, the Project Team executed the activities defined and scheduled in the Project Work Plan to produce project deliverables in accordance with the project plans.	During action of the project, project Changes were identified, documented, approved, and communicated to relevant stakeholders.	At the end of the project, a Project-End review meeting was held where the project statistics and the project's performance and experience was discussed.
				During action of the project, the Project Manager (PM) ensured that every deliverable was formally accepted on time and according to organisational standards.	At the end of the project, the project's overall experience was summarised in a report.
				During action of the project, the consortium managed the transition to ensure the correct transfer of project deliverables to the client organisation.	At the end of the project, the project was administratively closed, and all project documentation was reviewed, organised, and securely archived.
					At the end of the project, the Project Team was officially dissolved, and all resources were released.
SCOPE	During the proposal phase, the project objectives were clearly defined, the impact the project is expected to bring and the success criteria against which it will be evaluated.	At the beginning of the project, the project scope statement was further developed (detailed description of the project and list of deliverables) and strategies for completing the project were decided.	During the project execution your team used the Deliverable Acceptance Plan to produce deliverables according to it	During action of the project, the project's performance was monitored to identify/rectify any deviations from the project plans.	
	During the proposal phase, an appropriate Business Case was created providing justification for the project (context, problem description, possible solutions, costs, and timescale).	At the beginning of the project, a proper Work Breakdown Structure was developed (hierarchical subdivision of all the work that must be done).			
		At the beginning of the project, a Requirements Management Plan was created to define and document the requirements, responsibilities as well as the artefacts tools and techniques used for the documentation and management of the requirements.			

		At the beginning of the project, a Project Change Management Plan was created to define and document the change process (activities, roles and responsibilities related to identifying, documenting, approving, implementing, controlling, and communicating project changes).		
		At the beginning of the project, a Deliverables Acceptance Plan was created to document the agreed criteria for deliverables acceptance.		
		At the beginning of the project, a Planning Kick-off Meeting was run to ensure that everyone understands the project scope and to discuss the project plans.		
TIME		At the beginning of the project, a Project Schedule was created to identify dependencies between tasks, pinpointing their start and end dates, to establish the overall project duration.	During the project execution, your consortium used an appropriate software or system for time management to determine status of the project	During action of the project, the Project Manager (PM) regularly monitored the schedule and tracked the difference between planned, actual, and forecasted activities/deadlines.
				During action of the project, corrective actions were devised, agreed, and implemented when needed to bring the schedule back on track.
COST		At the beginning of the project, the Cost Estimates were developed to outline resources needed and estimate them as well as the time required to complete each task, within the constraints of resource availability and capabilities.		During action of the project, the Project Manager (PM) regularly monitored the budget and tracked the difference between budgeted, actual, and forecasted costs.
				During action of the project, corrective actions were devised and implemented to bring the budget back on track.
QUALITY		At the beginning of the project, a Quality Management Plan was created to define and document the project's quality requirements, responsibilities, control activities, quality metrics, quality management objectives and characteristics and the tools and techniques that will be used for	During the project execution, quality assurance standards were selected and communicated.	During action of the project, the Project Manager (PM) performed quality assurance and controlled activities to identify any non-conformity, analyse the root cause, and implement corrective actions.

		quality planning and quality assurance and control.			
		At the beginning of the project, the project quality characteristics were defined and agreed considering project needs, constraints, and a cost/benefit analysis.	During the project execution, quality assurance activities were executed to review the compliance of project processes, outputs and deliverables to the standards chosen.		
			During the project execution, the Project Manager (PM) produced quality review reports to give an overview of the status of all project quality management activities.		
HUMAN RESOURCES		At the beginning of the project, the Roles & Responsibilities were identified in every layer, documented, and clearly described.	During the project execution, the Project Manager (PM) coordinated people, resources, meetings, and activities.		
			During the project execution, the Project Manager (PM) showed technical and behavioural skills		
			During the project execution, the Project Manager (PM) provided leadership and motivated the project team through the application of appropriate people management techniques.		
			During the project execution, a Training Plan was defined and carried out to train personnel according to needs.		
COMMUNICATION		At the beginning of the project, a Communications Management Plan was created to ensure that all project stakeholders have the information they need and to define a communication strategy (frequency, format, and media to be used as well as the responsible one for it).	During the project execution, Project Reporting was carried out to document and summarise the status of various dimensions, the project's progress, and performance, to inform project stakeholders.		
			During the project execution, relevant information resulting from the execution of the project was provided to appropriate parties at the right time and in the appropriate format.		
RISK		At the beginning of the project, a Risk Management Plan was created to define and		During action of the project, the consortium ensured that risk management activities	

	document how risks will be identified and assessed, the tools and techniques to be used, the evaluation scales and tolerances, the roles and responsibilities, risk monitoring and risk response strategies (avoid, transfer/share, reduce, and accept).		were carried out as per the Risk Management Plan.	
	At the beginning of the project, the risk response strategies were developed to plan actions to manage the risks.		During action of the project, risks that could impact the project's objectives were identified, documented and the likelihood and the severity of the impact was assessed.	
			During action of the project, the implementation of risk response activities was monitored and controlled.	
STAKEHOLDER	During the proposal phase all project's stakeholders were identified (internal and external members)			At the end of the project, the consortium ensured that all deliverables were accepted by the relevant stakeholders based on a predefined/documented quality/acceptance criteria and the agreed acceptance process.

Table 74: Relation of questions among areas and processes

Appendix D

Dataset

The primary data collected from questionnaire responses is attached onto the link below.

https://docs.google.com/spreadsheets/d/1VP-btsCuEry4WTrBbTfYIeM7zSC7f-gw/edit#gid=668918022

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