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# MGI

Master Degree Program in  
**Information Management**

**Project management techniques- How can we choose?**

Bruno Correia Nunes

Master Thesis

presented as partial requirement for obtaining a Master's Degree in Information Management

**NOVA Information Management School**

**Instituto Superior de Estatística e Gestão de Informação**

Universidade Nova de Lisboa



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by

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Master Thesis presented as partial requirement for obtaining the Master's degree in Information  
Management, specializing in Information Systems Management

**Supervised by**

Américo Rio, PhD, NOVA Information Management School

July, 2025

## **STATEMENT OF INTEGRITY**

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism, any form of undue use of information or falsification of results along the process leading to its elaboration. I further declare that I have fully acknowledged the Rules of Conduct and Code of Honor from the NOVA Information Management School.

[Lisbon, 01/07/2025]

Bruno Correia Nunes

## DEDICATION

Para ti, Avó.

## **ACKNOWLEDGEMENTS**

With the conclusion of this long and arduous journey, I can only look back and remember all the moments and people who accompanied me and helped me get to where I am today.

### **To my family**

To my mother, thank you for getting me interested in studying from a young age, following my entire journey with the same curiosity as me and always trying to make me a better student and person.

To my brother, Mário, thank you for always being there to give me a hard time and make sure I don't step out of line.

To my grandparents, and for everything you have done for me and continue to do, there are not enough words to describe what you mean to me, always believing and never letting me doubt myself, and for that, I will never forget. I will not forget the affection with which you taught me fractions or forced me to read because it was a "good habit to have", I will not forget the times when I came home and they were ready to help me with my homework, even without knowing anything, just with the aim of seeing me better.

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And lastly, but certainly not least, to you, Mariana. Thank you for always being there for me, through the ups and downs, always believing in me and making me a better person. This journey wouldn't have been the same without you by my side, always pushing me and ensuring I gave my best. Can't wait to see what the future holds for both of us together.

## ABSTRACT

The main goal for this thesis was to present a study regarding the process of choosing the appropriate methodology - Agile, Scrum, Waterfall and Lean - to oversee a project, as well as understanding the weaknesses, advantages and opportunities for improvement. To reach that goal, a Mixed Methods Approach was applied, which would combine a quantitative and qualitative strategy using questionnaires that were sent to different professionals in different areas, like IT, Auditing, Cybersecurity, pharmaceuticals and banking. To be able to reach the expected conclusions, the study analyzed how these techniques were implemented on different projects with different characteristics, focusing on factors like complexity of the projects, duration of the projects, stakeholder involvement in the projects, Risk associated with the projects, amongst other.

After compiling all the information received and analyzing the data itself, it was possible to say that there is no such thing as a universal technique, and in most cases, the best way to guarantee the success of a project is through the modification/combination of the already existing methodologies. A clear example relates to Agile, which is better equipped to handle changing requirements and focuses a lot on communication with the stakeholder while waterfall is more directed to projects where the objectives are well-established and communication with the stakeholders is minimal.

According to the answers provided by the professionals, the main recommendation is all about the development of hybrid techniques to capitalize on the strengths of the different methodologies, as well as implement ongoing training programs. By doing so, the organizations will have a higher chance of ensuring that productivity is increased and that the project goal is attained.

## KEYWORDS

Project Management Techniques; Projects; Agile; Waterfall; Scrum; Lean

### Sustainable Development Goals (SGD):



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# 1 INTRODUCTION

When it comes to projects, most of them fail to meet the expectations placed on them by an organization or the stakeholders, and, in most of the said cases, failures involve projects that end up going over budget or failing to meet the established schedule. Projects tend to vary in size and complexity, and this is a critical factor that is going to impact the decision of an organization regarding the techniques and methods utilized to manage the project, having the ability to assist in making the proper decisions at the right time, always thinking about the requirements as well as the time constraints (Riahi, 2015). With this said, it is important to have the proper project management techniques in place to ensure the projects are delivered to the customer on time, within the budget, and all the requirements are met.

With this paper, the main goal was to answer the question “What is/are the most appropriate project management methodologies that a company can adopt to have a better performance in managing projects”. This paper aimed to shed light on what kind of factors can influence a company's decision when selecting a specific project management methodology and the importance of the specificities of the environment (Toljaga-Nikolic et al., 2017), how the different techniques can impact the project's success based on the industry and the project size and to identify the variables responsible for selecting a project management methodology (Nara et al., 2015).

To complete the thesis, the research was based on the consultation of scientific articles, ending up building a model with different strategies based on what was learned.

It was hoped that, with the results, a model could be developed to be used by companies in project management, allowing them to determine whether a single technique can be universally applied or if adaptations are required to meet the specific needs of each project.

The following chapters will provide a comprehensive review of the existing work in the field, an introduction to the various techniques employed, a presentation of the results obtained and a detailed analysis aimed at extracting valuable insights.

## **2 LITERATURE REVIEW**

### **2.1 BACKGROUND**

Well before the creation of an institute for project management, history shows us numerous instances of enormous enterprises that have been successfully accomplished, from the pyramids of Giza to the Coliseum and the Great Wall of China (Haughey, 2021). Despite the immense challenges and uncertainties, these projects were delivered, demonstrating that even in the absence of formalized methods, some level of planning and organization was crucial for success. However, not much information is documented about the processes and procedures used in ancient times (Seymour et al., 2014).

Fast forward to the Industrial Revolution, this era had a profound impact on the development of project management since it brought important development changes in technology, transportation and manufacturing, increasing the necessity for structured project management practices (Azzopardi, 2007). It was not until the 1950s that project management, as a structured discipline, began to emerge (Seymour et al., 2014).

When we start to think about project management, it only emerged when businesses and other organizations started to understand the advantages behind structuring the work around projects. Beginning around 1950, this project-centric view continued to develop as companies realized the importance of collaboration and communication among their workers while integrating their work across several departments. This understanding of business as a human organism suggests that all the different components of a company must cooperate to achieve the common goal so that the company can grow and scale. Today, we can summarize the principle of project management with the project triangle and, to better understand it, it's important to analyze the critical components of the project triangle: Scope, Time and Cost (Caccamese et al., 2012).

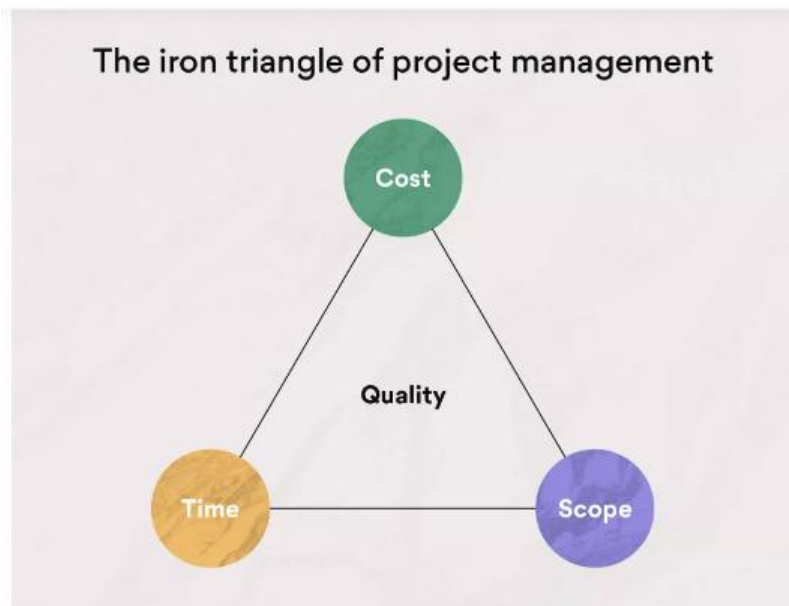


Figure 2-1- Iron Triangle

### 2.1.1 SCOPE

Regarding the project triangle, we can define “Scope” as the project’s deliverables or the result, needing to be properly established before the beginning of the work and closely reviewed throughout it (Westland, 2022).

### 2.1.2 TIME

At its core, the project schedule is the approximate amount of time necessary to complete the project or create the final product, and this is often determined by estimating how long each project task will take. The project tasks can be identified using a Work Breakdown Structure (WBS), which will allow to then determine the overall time (Westland, 2022).

### 2.1.3 COST

When it comes to Cost, this is much more than just the amount of money allocated to a project and it is going to encompass the resources needed to accomplish the project’s goals, like the team that works on it, the outside resources, tools and tangible resources, for example, equipment or facilities (Taylor, 2024).

To ensure that the cooperation is efficient and aligned with the company’s objectives, it is crucial to adopt structured approaches/methods that can facilitate both resource management as well as coordination. This is where the different project management methodologies come into play, providing the necessary steps to help teams work together more effectively (Siles, 2024). In the modern

corporate environment, where the expectations are high and the deadlines are tight, the project manager's job is more important than ever, but being a project manager involves more than just completing a project, it needs to be able to take a set of ideas and understand it so that it can provide the proper outcome (Joubert, 2020).

## **2.2 INTRODUCTION TO THE TECHNIQUES**

However, to meet these growing demands and expectations in the corporate environment, project managers also need to choose and apply the appropriate methodologies for each type of project. When we say "project management methodologies", we refer to a set of different principles, tools, and techniques that are going to be used to plan, execute, and manage projects. Considering the main goal for any project undertaken - delivery on time and within the stipulated budget- these methodologies can assist a company by providing a structured approach to organizing tasks, allocating resources, and fulfilling short-term and long-term goals (Tristancho, 2024).

To discover which techniques were predominantly chosen and used by the project managers, I had to conduct research in different databases to find the necessary information. According to (Jovanović, 2018), (Harsha et al., 2013) and (Mishra et al., 2023), the most used techniques are the Agile methodology, the SCRUM technique, the Waterfall framework, and the Lean approach. When combined, these approaches give the project manager a full arsenal to help them deal with the challenges of contemporary project contexts.

### **2.2.1 AGILE METHODOLOGY**

*"The Agile methodology is not a destination, but a journey. It's about continuous improvement, not just in our products, but in our people, processes, and culture"- Jeff Sutherland<sup>1</sup>*

Over the past 25 years, Agile software development has become the leading approach in the realm of software engineering (Hoda et al., 2018), emerging as a response to conventional software development practices, recognizing the necessity for a different approach rather than documentation-heavy, troublesome processes (Cohen et al., 2004) and with an emphasis on repeated cycles of development (iterations), incorporating customer input, organized teams, and adaptability (Rico et al., 2008). The increased adoption of agile in project management can be associated with factors like globalization, mass production, and the ever-changing demands from customers that make it difficult

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<sup>1</sup>Source: <https://medium.com/@AdvanceAgility/how-agile-methodology-is-different-from-traditional-approach-bdd22cacbf8b>

for a company to adapt (Omonije, 2024) as it provides versatility, flexibility and focuses on the customer, making it ideal for modern organizations that operate in fast-paced environments (Celestin, 2024).

In the current market environment, where established firms are fiercely competing against each other, the idea of a swift and adaptable organization is very attractive to everyone (Rigby et al., 2018), with the agile methodology being incorporated in multiple fields like Agriculture, Aerospace and Defense, Cloud Services and Logistics (Rigby et al., 2016), all while experiencing an increase in productivity due to embracing new technologies, novel methods and enhancing existing techniques and abilities (Sutherland, 2018).

As per a study conducted by the Project Management Institute, around 70% of organizations experienced enhanced team performance and productivity after implementing Agile (Celestin, 2024)

Table 2-1- Adoption of Agile Methodology

<b>Year</b>	<b>Agile adoption Rate</b>	<b>Key industry adopters</b>
2001	15%	Software Develop
2010	40%	IT Marketing
2020	70%	IT, Healthcare, Education

Agile methodologies were founded from the dissatisfaction of a group of software developers who criticized the traditional corporate software practices and sought to enhance both the process and the results (Zaitsev et al., 2018). In February 2001, 17 independent-minded software developers met in Utah and the outcome of it would be the Agile Manifesto, and even though they were considered competitors at the time, they were all able to agree on the content of the Manifesto (Croix, 2018).

The Agile Manifesto is a key component of the Agile Movement, responsible for highlighting the values of Agile methods and differentiating them from traditional approaches. These values are all based on confidence, mutual regard, teamwork, and a supportive workplace (Croix, 2018)

## 2.2.2 WATERFALL

When talking about project management techniques, most likely the first one that comes to mind is the Waterfall methodology, regarded as a traditional method due to its sequential structure and simple design (Henriquez et al., 2024). By the late 1950s, software development projects were being managed using various trial-and-error techniques, and these early approaches were fundamental for discovering better techniques for obtaining and specifying project requirements, assessing issues and carrying out methodical problem implementation. While some of the methods were linear and sequential, like the Waterfall Model, others were gradual and iterative (Lei et al., 2017).

Waterfall is a methodology that consists of different stages, and even though there are different perspectives on the number of phases, it is said that there are six main categories that other steps fall under (Risener, 2022). As a static model that approaches systems development in a step-by-step, linear sequence, it is imperative to ensure that each activity is completed before moving on to the next one and that said phases do not overlap, so the name, "Waterfall Methodology" (Adenowo, 2020), with the next stage starting only after the defined set of goals is met.

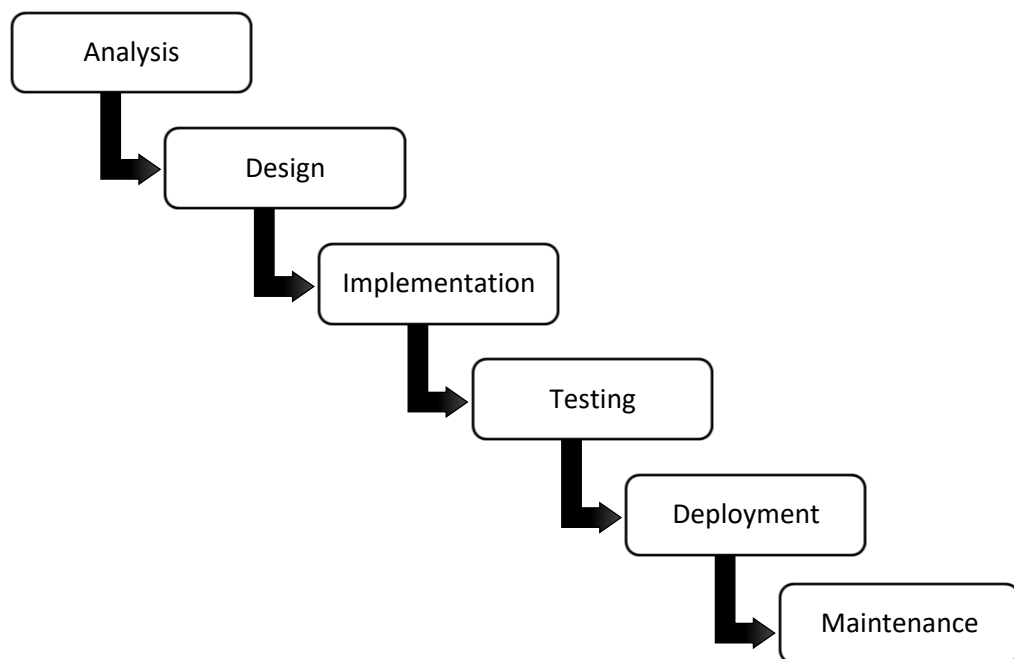


Figure 2-2- Waterfall Software Development Stages

### 2.2.2.1 FIRST STAGE- "ANALYSIS PHASE"

Commonly known as Software Requirement Specification (SRS), it is responsible for providing a detailed and thorough description of the intended behavior of the software to be developed (Senarath, 2021) and it can be carried out by conducting interviews and observations in the surrounding

environment to identify the functional and non-functional requirements of the system to be developed (Santonanda et al., 2022) with the requirements needing to be properly defined before proceeding to the next phase, and often, changes to these requirements will not be taken into account (Eason, 2016). Normally, functional requirements are typically outlined through use cases that detail how users will interact with the software. Such requirements encompass aspects like the system's purpose, the scope, perspective, functions, software attributes, user characteristics, functionality specifications, among others (Santonanda et al., 2022). On the other hand, non-functional requirements refer to the criteria and limitations that will affect the software's design and operation rather than specific behaviors. These will include attributes such as reliability, testability, performance, and quality standards (Senarath, 2021).

#### **2.2.2.2 SECOND STAGE- "DESIGN PHASE"**

The Design phase has the main goal of transforming the requirements that were collected during the Software Requirement Specification (SRS) into a format that facilitates coding in a programming language (Topperworld, 2024). In a nutshell, it is a process that involves planning and problem-solving for software solutions, where developers and software designers will analyze the requirements previously gathered and come up with solution plans. These plans include algorithm design, concept designs, graphical user interface designs, and data structure definitions, amongst others (Xin et al., 2020). This step is exceptionally important as it helps to identify potential issues early on and skipping it could result in problems during the later steps, as said issues become more challenging to resolve later in the process (Eason, 2016).

#### **2.2.2.3 THIRD STAGE- "IMPLEMENTATION PHASE"**

During this stage, the source code is created based on the models, logic, and requirements that were defined in earlier phases (Kirvan, 2024). It involves transforming the business requirements and design specifications into a tangible program, website, software component, and databases (Senarath, 2021).

#### **2.2.2.4 FOURTH STAGE- "TESTING PHASE"**

This phase, also commonly known as validation and verification, is responsible for checking whether a software solution satisfies the original specifications and requirements and achieves its intended goal (Xin et al., 2020). Typically, the system is developed into smaller parts/units, which are then assembled (Kirvan, 2024). Regarding the validation segment, it is the process of assessing software during or at the end of the development stage to ensure it meets the previously established requirements; while on the other hand, verification is the process of assessing software to determine if the outputs of a specific development phase meets the initial conditions set and the beginning of that phase.

This phase is extremely important because the quality of the final product depends on the effectiveness of the test conducted and a better output results in pleased customers, lower maintenance costs, and accurate results. (Topperworld, 2024)

#### **2.2.2.5 FIFTH STAGE- "DEPLOYMENT PHASE"**

This Second-to-last step involves seeing the software product implemented in the real world, always based on the specifications provided by the client. For example, the software could be made available exclusively to the client's company, or it could be launched online under the name of the client's company (Risener, 2022).

#### **2.2.2.6 SIXTH STAGE- "MAINTENANCE PHASE"**

The last step of the Waterfall model, the maintenance phase, includes the finding and resolution of errors that weren't found in the previous step, the testing phase (Xin et al., 2020). Extra maintenance activities can be executed during this stage, like adapting the software to the environment in which it will be inserted into, and once all the requirements are properly met and all the bugs discovered after release are fixed, the application is finally updated and ready to be released (Santonanda et al., 2022).

### **2.2.3 SCRUM**

When talking about Agile methodologies, one that falls under this umbrella is the Scrum methodology, which is a form of Agile technology that is comprised of roles, tools, and meetings designed to assist teams in collaborating on complex projects and in better organizing and managing their workload (Peek, 2023). When discussing Scrum, we can interpret it as a combination of the Incremental model and the Iterative model, as it involves incremental development of features, more precisely for object-oriented software, and successive builds (Srivastava et al., 2017), with tasks being performed at a higher pace and where self-organized teams tend to achieve superior quality results. This approach is going to question the hypothesis of the "traditional and sequential methodology" of product development and promote self-organization within teams by fostering close collaboration among all team members, all while promoting face-to-face communication (Sachdeva, 2016), improving the levels of motivation between the team members and, ultimately, achieving a higher level of productivity at a faster rate. With Scrum, the final product is going to be developed in a series of steps called "*Sprints*" (Sachdeva, 2016) that have a fixed length, generally around one month, and a new one starts immediately only when the previous sprint is concluded (in a summarized way, a sprint is the shortest phase in the Scrum framework, where a small team collaborates on specific tasks) (Srivastava et al., 2017). Sprints enhance predictability by guaranteeing regular adaptation and inspection of

progress towards a Product Goal and after each sprint, based on the feedback from the customer, additional features are developed in later sprints (Srivastava et al., 2017).

Unlike traditional project management methods, Scrum doesn't require the "traditional" roles such as task manager, product manager, or even team leader. Instead, a Scrum team has a unique structure comprised of three distinct roles- Product Owner, Scrum Master, and Development Team (Sachdeva, 2016).

As highlighted in a new study, a connection between the success of the Scrum teams and the following five high-level factors can be identified: (Verwijs et al., 2023)

- Responsiveness (Quickly adapt to change)
- Stakeholder concern (Engage with stakeholders and understand their needs)
- Continuous improvement (Scrum emphasizes iterative development and regular retrospectives)
- Team autonomy (Being self-organized and cross-functional, teams have the autonomy to make their own decisions)
- Management support (Effective management provides the necessary resources to ensure the team can complete the work they have)

Understanding these high-level factors is imperative for creating a successful Scrum environment, with the Scrum team playing a pivotal role in the process, as they are responsible for executing the tasks and improving the processes, however, they are also accountable for: (Schwaber et al., 2020)

- Formulating a strategy for the Sprint, including the Sprint Backlog
- Adjusting their strategy daily to align with the Sprint Goal
- Maintaining mutual accountability as professionals

#### **2.2.4 LEAN METHODOLOGY**

*"Waste is worse than loss. The time is coming when every person who lays claim to ability will keep the question of waste before him constantly. The scope of thrift is limitless"*

Lean is a structured production approach heavily focused on aggressively eliminating waste from the manufacturing process (Yamamoto et al., 2019), and its practices, also known as tools and techniques, are designed to address specific issues and eliminate non-value-added activities in lean production (Liang et al., 2015). Taiichi Ohno, the creator of the Toyota Production System (TPS), identified three types of waste: Muda, Mura, and Muri. Building on these foundations, Lean techniques are being

proposed and implemented across various industries - IT, Ship design, air travel, mechanical/civil industries - systematically applying lean concepts and achieving success in their respective fields (Deshmukh et al., 2017), with industries from western countries being the first ones, followed by east Asia and India (Amit et al., 2021).

A company should embody a learning organization, continually seeking daily improvements (Do, 2017a) by embedding ongoing enhancement into the team's culture, establishing a sustainable system that adapts to business needs, enhances productivity, and consistently delivers greater value to customers (Krasteva, 2025).

The main goal of Lean manufacturing is to optimize production by minimizing human effort, space, financial resources and material all while maintaining the same output, and in order to make it happen, 5 principles were identified: “value”, “value stream”, “flow”, “pull” and “perfection”, as shown on Figure 3 (Alefari et al., 2017).

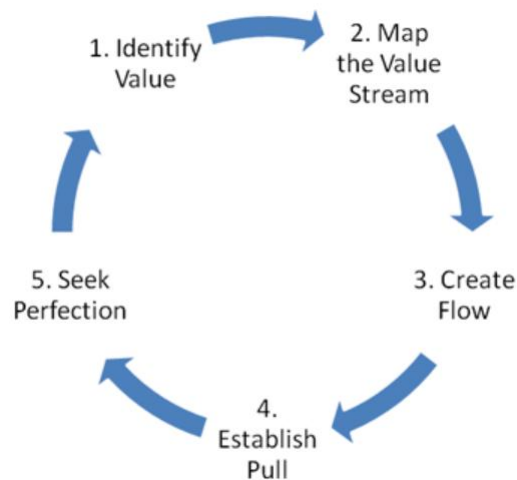


Figure 2-3- Five Principles of Lean

## 2.3 STATE OF THE ART

Within this chapter, it is presented the state of the art related to project management methodologies and project failure, with the main goal of contextualizing the research within the academic landscape, trying to understand the work previously carried out and the existing gaps to be explored.

For the purpose of finding the articles that would serve as the basis for my research, I had to use different search strings, with the chosen ones being:

- **"Project Management" AND ("techniques" OR "comparison" OR "advantages" OR "disadvantages"**
- **"Project Management" AND ("methods" OR "strategies" OR "benefits" OR "challenges")"**

Not only was it necessary to stipulate which search strings to apply, but it was also imperative to use different digital libraries, mainly [Scopus](#), [IEEE Xplore](#) and [Google Scholar](#) to get the information needed to draw conclusions. After identifying those that could suit my needs, it was then necessary to implement different inclusion and exclusion criteria, with the selected ones being:

- Less than 20 years
- Written in English
- Peer-reviewed (reviewed by specialists)

Since case studies were not the only method intended to use, it was also important to focus on publications that not only talked about other methodologies but would also provide information about a wider range of subjects related to my topic and, by doing so, It was possible to investigate the specific gaps that needed to be explored.

The subject of project failure has always been popular, however, the enigma of what drives initiatives to go off track is starting to disappear, since identifying the underlying reasons for failure has become easier for companies to do (Akinshipe et al., 2022). Recently, it has been stated that the “conventional project manager competencies”- such as project governance and project management methodology - will not be sufficient and two-thirds of the project managers jobs/skill sets will be subject to change by 2026 to face the new working environment (Longhurst et al., 2023). When the goal is to execute a project properly, many different issues are going to arise, like unrealistic deadlines, due to targets being unachievable and unrealistically set instead of calculated business requirements (Kashiap, 2024) or scope creeps, so it is vital to manage it to guarantee the timely and cost-effective execution of the project (Alotibe, 2024).

Despite numerous academics and professionals in project management having carried out extensive studies on the subject, creating a wide range of strategies and techniques that can be applied, they still tend to focus on specific and common topics. When it comes to planning, it is considered an essential component of contemporary project management, and it heavily emphasizes the necessity to invest in processes as well as procedures to support planning. This position is predicated on the idea that it will lower the uncertainty levels and raise the chances of the project's success (M. Kumar, 2022).

Another critical issue that often arises in project management is the handling of different requirements. One of the main causes of project failure can be attributed to ineffective requirement management procedures, or more frequently, the absence of such requirements at all. Given that design difficulties based on inadequate requirements are more costly and difficult to fix after the project development is underway, requirement concerns should be addressed as soon as possible in the project life cycle (V. Kumar, 2006). Since a well-coordinated requirement management process makes the difference between a successful project with satisfied stakeholders and an unsuccessful project with unhappy stakeholders, requirement management is crucial. Even though project management and cost engineering have greatly advanced in recent decades, delays and budget overruns are still very present when employing traditional techniques, particularly for bigger projects (Lichtenberg, 2016).

Although the studies have focused their attention on different methodologies and different gaps related to a project itself, no one has really focused on trying to combine the advantages of the various approaches into a single, universal framework. This specific gap offers a chance to investigate how to integrate the best practices from other approaches and try to create a strategy that is more flexible and successful. This kind of research can not only maximize the strengths of each methodology but also reduce their individual weaknesses, leading to improved project outcomes and, hopefully, higher success rates.

The present literature review was conducted to provide a solid theoretical foundation for the research with the methods used to carry out this review detailed in the methodology section. This methodological approach was carefully planned to ensure the inclusion of relevant sources and the critical analysis of the selected studies, allowing for a comprehensive understanding of the topic at hand.

### 3 METHODOLOGY

In this chapter, it is going to be discussed the methodology behind the process of creating this study, the tools used and the approach to the data that was chosen.

With this research, the goal was to analyze different project management techniques and frameworks to understand the different scopes of each one of them, understand how they work and how they impact specific projects, and, ultimately, to provide an answer to the following questions:

RQ1- Can there be a universal approach?

RQ2- How can the different techniques be improved?

RQ3- What are the most used techniques?

Since the goal was to understand how the different project management techniques impact the corporate world when it comes to completing a project, it was decided to use the *Mixed Method* methodology, which combines the quantitative and qualitative research techniques. The *Qualitative Approach* is a non-numerical approach to data gathering and analysis, aiming to comprehend the phenomena from the viewpoint of the participants, seeking to investigate the “how” and the “why” behind social phenomena and human behaviors (Hassan, 2024), while the *Quantitative Approach* focuses on data that is easily quantified, compared and analyzed. This kind of approach gathers information from census data and closed-question surveys (Cross, 2024). By utilizing the *Mixed Method Methodology*, benefits would be derived from both the quantitative data’s generalizable, externally valid insights and the qualitative data’s contextualized, in-depth insights. (George, 2021)

The tool “Qualtrics” was used to create personalized questionnaires that were sent to different people who depend on these techniques daily (such as internal auditors, data analysts, IT professionals, pharmacists...) to get feedback on how they impact their day-to-day life. The questionnaires included both open-ended and closed-ended questions, totaling 10 questions, of which three were on the qualitative side, focusing on the strengths, weaknesses and suggested improvements of each methodology chosen by the participants, and the remaining questions were quantitative and focused on aspects like complexity, budget, risk, duration etc.

This research oversaw the collection of individuals' experiences, opinions, and actions, focusing more on providing an answer to the how’s and why’s rather than the how many or how much (Tenny et al., 2022).

As there was going to be a focus on 5 different techniques, it was important to sort out who was going to receive the questionnaires, as it must focus on a technique that they were familiar with. For those

chosen, and to be able to give their true and honest opinion, the questionnaires were made up of open questions to guarantee people's complete freedom to express their point of view concerning what they felt regarding the techniques in question.

The three open questions that were present in the questionnaires were the following:

- Can you identify the main strengths of this project management technique
- How would you describe the weaknesses of this method
- What type of modifications would you suggest to improve this methodology

By resorting to this method, it was possible to identify specific patterns and relationships between variables, since using questionnaires allowed to gather data from a large group of people and increase the generalizability of the results.

Due to the nature of the *qualitative method* and the use of questionnaires, it was necessary to consider different ethical issues to ensure the rights and well-being of everyone involved. Participants were not only provided informed consent, which means they were fully informed about the purpose, procedures, potential risks, and benefits of the study but their participation was entirely voluntary, meaning that the participants could choose to take part or withdraw from the study at any point that they chose. All the answers were confidential, the questionnaires were anonymous, and the data was securely stored and handled to prevent unauthorized access.

Ultimately, and to evaluate the project management methodologies, a comparative analysis was done where it was possible to compare the different techniques and their nuances based on predefined criteria, efficiency, adaptability, stakeholder satisfaction, and overall project success, as it was going to provide a structured understanding of them and their overall impact.

## 4 SURVEY RESULTS

The sample consisted of 100 professionals from various sectors, including Data Analytics, Pharmaceuticals, Cybersecurity, IT, Banking and Auditing, all selected based on their direct involvement with the methodologies under study in their daily professional activities, and given the diversity and importance of this sample, the subsequent section presents the analysis of the data collected through the questionnaire. The results are displayed in a series of graphs designed to offer a clear and accessible visualization of the participants' responses, with the goal to highlight key trends and patterns, with each graphic being accompanied by a brief interpretation to assist in the discussion.

### 4.1 BUDGET

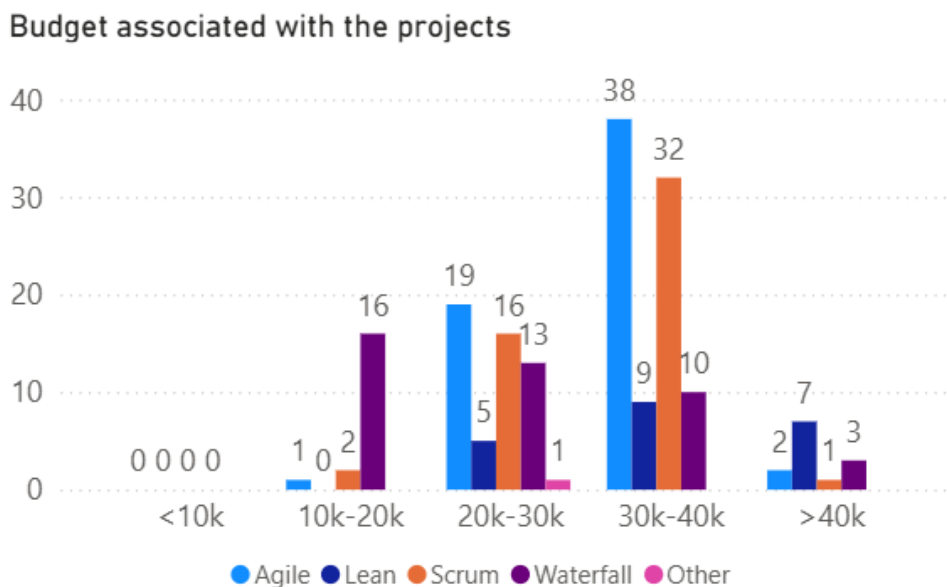


Figure 4-1 - Budget associated with the projects

Figure 4-1 shows the distribution of the different methodologies (Agile, Lean, Scrum, Waterfall and Other) across projects with varying budget ranges (<10k, 10k-20k, 20k-30k, 30k-40k, >40k).

## 4.2 COMPLEXITY

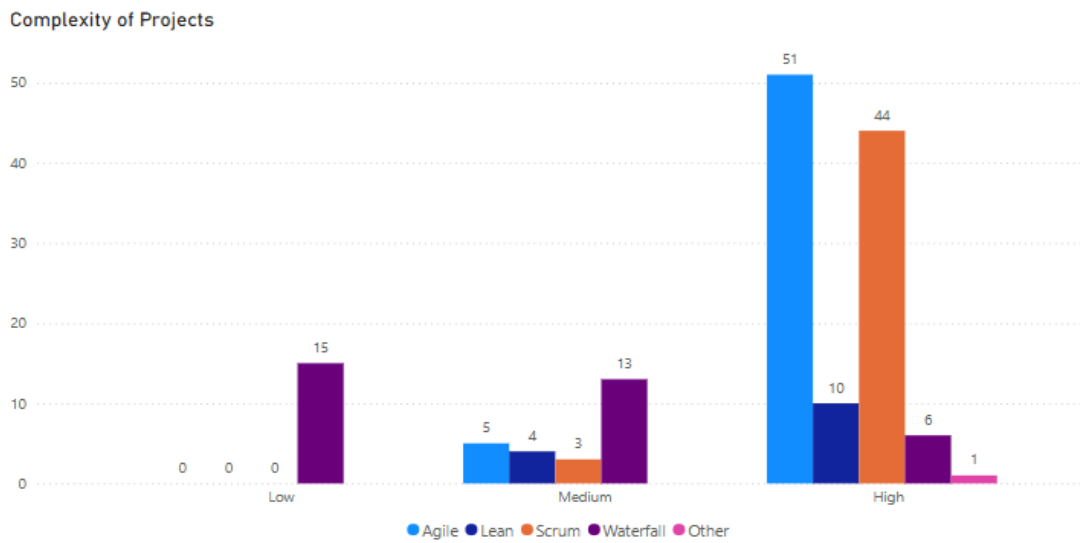


Figure 4-2 - Choice of Project Management Method vs Project Complexity

Figure 4-2 shows how the different project management techniques (Agile, Lean, Scrum, Waterfall and Other) are used across projects of various complexity levels (Low, Medium, High).

## 4.3 FLEXIBILITY AND ADAPTABILITY

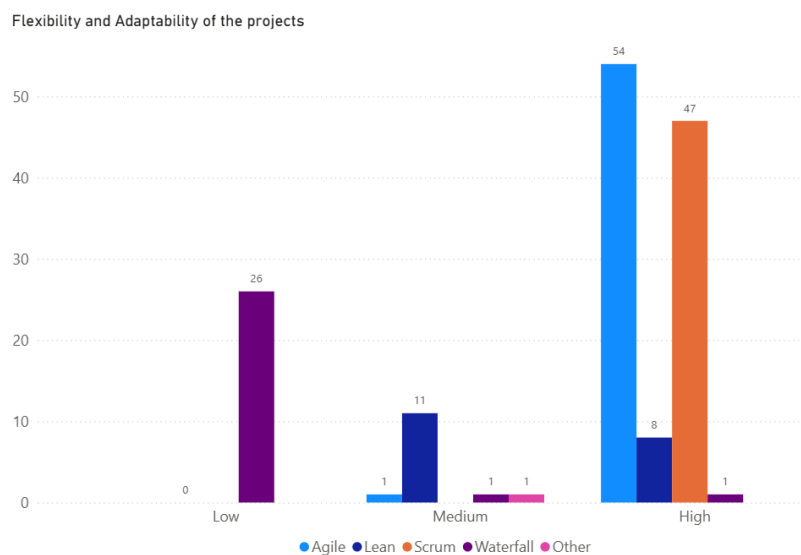


Figure 4-3 - Flexibility and Adaptability

Figure 4-3 shows which project management methodologies (Agile, Lean, Scrum, Waterfall, and Other) are most used in projects categorized by having different levels of flexibility and adaptability (Low, Medium, or High).

#### 4.4 CHOICE OF TECHNIQUE

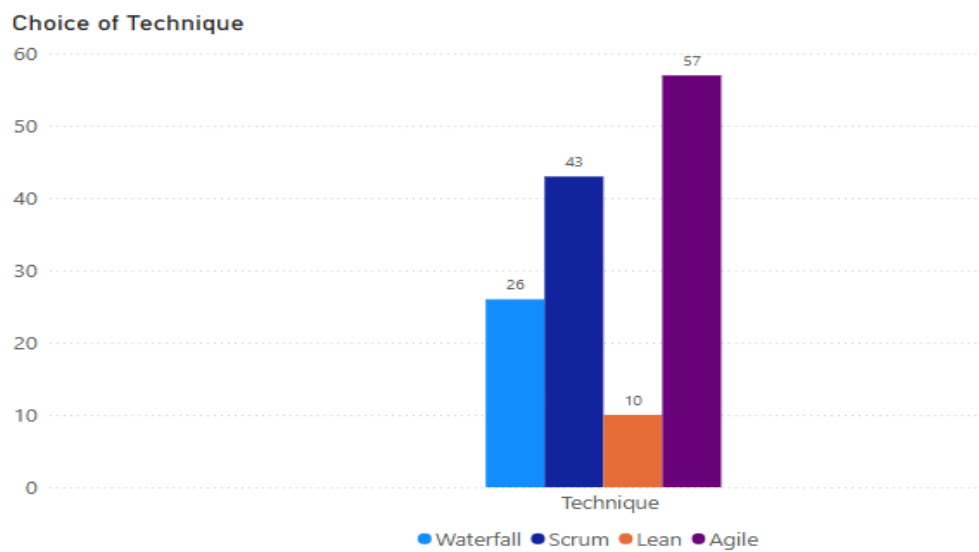


Figure 4-4 - Choice of Technique

Figure 4-4 shows the popularity of four different project management techniques, with the x-axis representing methodologies and the y-axis representing the number of choices.

## 4.5 STAKEHOLDER INVOLVEMENT

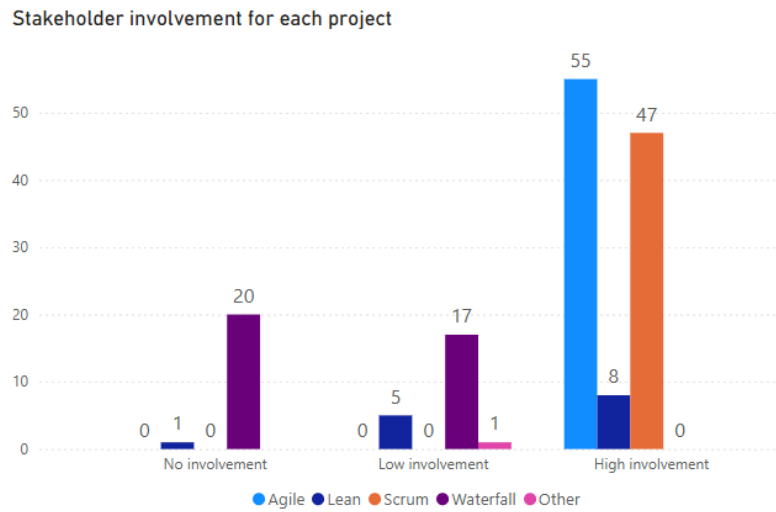


Figure 4-5 - Stakeholder Involvement

Figure 4-5 illustrates how different project management methodologies (Agile, Lean, Scrum, Waterfall, and Other) are used in projects with different levels of stakeholder involvement (No involvement, Low involvement, High involvement).

## 4.6 RISK

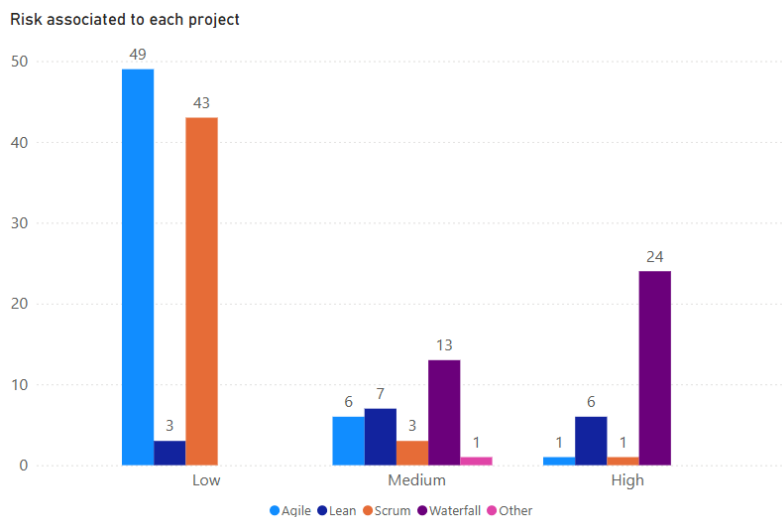


Figure 4-6 - Risk associated with the project

Figure 4-6 shows the distribution of the methodologies (Agile, Lean, Scrum, Waterfall, and Other) across different projects with different risk levels (Low, Medium, High)

#### 4.7 RESOURCE AVAILABILITY

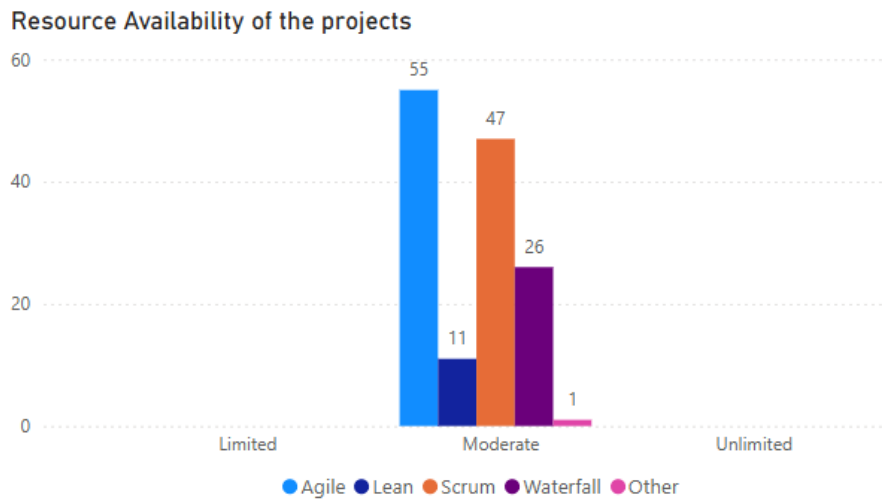


Figure 4-7 - Resource Availability

The figure 4-7 shows the distribution of approaches (Waterfall, Scrum, Lean, Agile, and Others) across various projects with varied resource availability levels (Limited, Moderate, Unlimited).

## 4.8 FIELDS

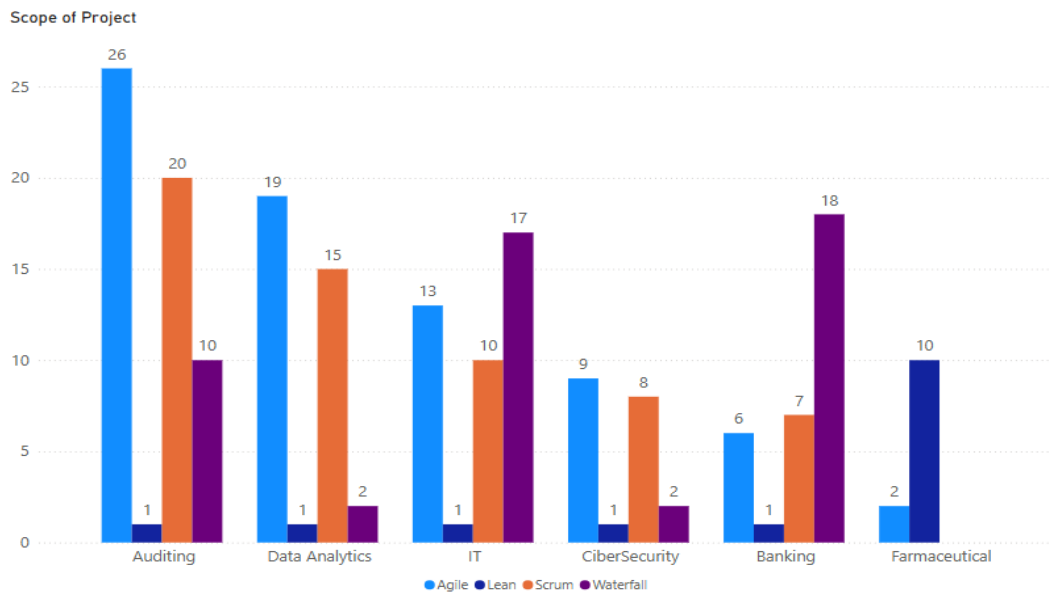


Figure 4-8 - Fields

Figure 4-8 compares the number of projects across different sectors (Auditing, Data Analytics, IT, CyberSecurity, Banking, and Pharmaceutical) using various methodologies (Agile, Lean, Scrum, and Waterfall).

## 4.9 DURATION

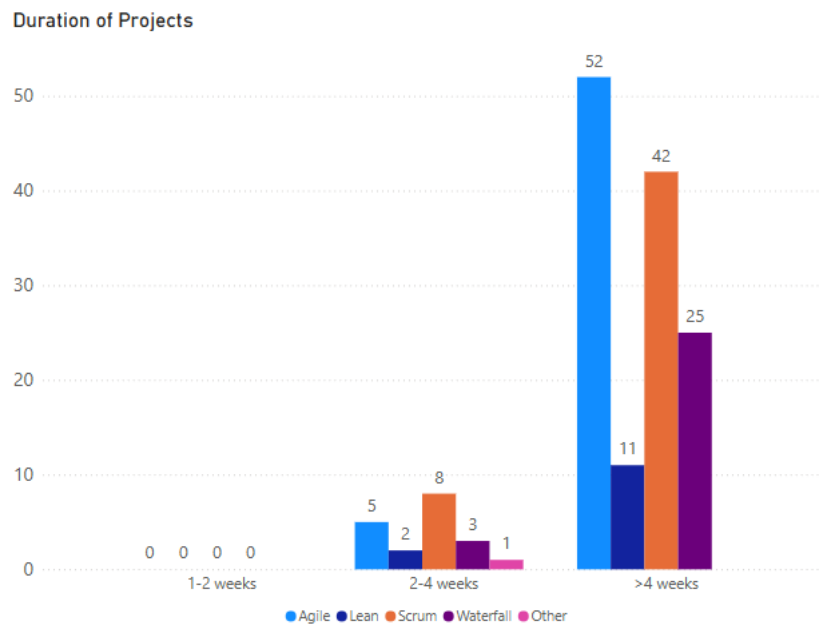


Figure 4-9 - Duration of Projects

Figure 4-9 shows the relationship between the duration of the projects and the project management technique used (Agile, Lean, Scrum and Waterfall) across three-time frames (1–2 weeks, 2–4 weeks, and more than >4 weeks.)

## 4.10 ADVANTAGES, DISADVANTAGES AND MODIFICATIONS

### 4.10.1 AGILE

To determine the Agile methodology's primary benefits, drawbacks and recommended changes, participants were invited to consider their experiences with it, with the goal to gather real-world, experience-based ideas.

Table 4-1- Advantages, Disadvantages and Modifications of Agile

Advantages	Disadvantages	Modifications
Continuous improvement	Culture shift	Combine with other techniques
Flex and Adapt	Scope creep	Safety and compliance
Continuous feedback	Challenges in implementation	Documentation
Collaboration with stakeholders	Lack of documentation	Plan and execute
Adaptable	Dependency on feedback	
Deliver speed	Accurate estimating is hard	

The table 4-1 was created to visually describe the comments, providing a clear summary of how agile is viewed in professional settings. The table's categorization of the data makes comparison easier and assists the analysis on the different aspects of Agile, the advantages, disadvantages and modifications.

### 4.10.2 SCRUM

To evaluate Scrum, participants were asked to list its benefits, disadvantages and recommended modifications based on their prior experience working on projects.

Table 4-2- Advantages, Disadvantages and Modifications of Scrum

Advantages	Disadvantages	Modifications
Reduce risk	Frequent meetings	Combine with other techniques

Improved quality	Requires experienced teams	Training
Frequent deliveries	Lack of documentation	Communication
Collaboration with stakeholders	Dependence on Scrum master	
Continuous improvement		

The table 4-2 was included since it compiles the main perceptions of Scrum, outlining the method's advantages, disadvantages and provides context for potential enhancements.

### 4.10.3 WATERFALL

Based on their practical project execution experience, respondents were asked to provide their opinions on the waterfall methodology's disadvantages, advantages and possible changes.

Table 4-3- Advantages, Disadvantages and Modifications of Waterfall

Advantages	Disadvantages	Modifications
Clear structure	Inflexibility	Combine with other techniques
Proper documentation	Prone to risk	Safety and compliance
Planning established	Delayed Testing	More flexibility
Predictability	No feedback	Communication
Continuous improvement	Long delivery time	

The table 4-3 offers a brief summary of how Waterfall is viewed in practice, making it easier to compare different approaches and encourages more research into its applicability.

### 4.10.4 LEAN

In their organizational context, professionals were asked to assess Lean by determining its advantages, difficulties and potential areas for development.

Table 4-4- Advantages, Disadvantages and Modifications of Lean

<b>Advantages</b>	<b>Disadvantages</b>	<b>Modifications</b>
Cost reduction	Low flexibility	Implementation
Continuous improvement	Overloading colleagues	Training
Waste disposal	Challenges in implementation	Combine with other methodologies
Increase in productivity		
Focus on quality		

The table 4-4 makes it easier to examine how well Lean fits with the project’s objectives and where it could require modifications or integration with other approaches.

#### 4.11 CROSS COMPARISON

To gather insights, those questioned were asked to describe the modifications, disadvantages and advantages of the approaches that they use daily, with their advice being crucial to comprehend how each approach functions.

Table 4-5- Cross comparison between Methodologies

<b>Technique</b>	<b>Used in bigger projects</b>	<b>High Complexity</b>	<b>High Flexibility</b>	<b>High Stakeholder involvement</b>	<b>Low risk</b>	<b>Recomendation</b>
<b>Agile</b>	Yes	Yes	Yes	Yes	Yes	Best employed in dynamic environments
<b>Scrum</b>	Yes	Yes	Yes	Yes	Yes	Good for projects that require frequent deliveries
<b>Waterfall</b>	No	No	No	No	No	Better suited for stable projects

<b>Lean</b>	Partial	Average	Average	Average	Partial	Recommended for industrial/pharmaceutical projects
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Table 4-6- Cross comparison between techniques

<b>Technique</b>	<b>Type of Project</b>	<b>Type of Client</b>	<b>Requirements</b>
<b>Agile</b>	Iterative	Collaborative and participative	Possibly evolutionary
<b>Scrum</b>	Iterative	Collaborative and participative	Possibly changeable
<b>Waterfall</b>	Linear	One-off participation	Fixed
<b>Lean</b>	Repetitive	Focused on efficiency and improvement	Stable

Based on the responses collected, table 4-5 and 4-6 were created to show the differences, similarities and recurrent trends among techniques. A more thorough study was made possible by this table's side-to-side compilation of the feedback, which makes it simpler to see which advantages are most appreciated, any issues with the methodologies and where changes are frequently recommended.

## **5 DISCUSSION OF RESULTS**

Using the questionnaires and following the process of collecting and analyzing 100 responses, it was possible to gain a deeper understanding of the techniques in question. This process not only allowed for the identification of their advantages and disadvantages, but also enabled the recognition of, from the perspective of daily users, the adaptations and modifications that could be made over time to enhance their effectiveness or facilitate their application in real-world settings

### **5.1 QUANTITATIVE ANALYSIS**

#### **5.1.1 BUDGET**

The figure 4-1, titled “Budget” shows the distribution of different project management methodologies across different budget ranges. As we can see, Agile, Scrum and Lean are the most used methods regarding higher budget projects, predominantly from 20k all the way to >40k. On the other hand, waterfall is more prominent in lower budgets, in the 10k-30k mark. This data suggests that methodologies like Agile, Scrum and Lean are the preferred choices when it comes to larger-scale projects, given that projects as such are normally more complex and subject to greater uncertainty so, being the iterative and adaptive methodologies that they are, they are going to allow teams to respond quickly to the changing requirements, making them ideal for bigger and dynamic projects. In contrast, with waterfall having a more linear and rigid structure, it is better suited for projects with properly established scopes, susceptible to minimal changes and of smaller size. The clear, upfront planning and documentation required in Waterfall ensures that all the requirements are understood from the beginning, reducing the risk of unexpected costs

The choice of project management techniques correlates with project complexity and size, with Agile, Scrum and Lean being used for higher-budget projects and waterfall for those with smaller budgets.

#### **5.1.2 COMPLEXITY**

Through the analysis of Figure 4-2, that shows the complexity of each project, we can see the dominance of Waterfall in low-to-medium complexity projects while Agile and Scrum are primarily utilized in high-complexity ones.

In addition to changing requirements, high-complexity projects frequently have significant technical difficulty, such as integrating sophisticated systems, utilizing cutting-edge technologies or dealing with strict security requirements, and because of its iterative nature, adaptability and emphasis on

continuous input, Agile and Scrum are ideal for this, enabling teams to adjust swiftly and better manage risk. However, projects with lower complexity and predictable requirements are better suited for Waterfall, because when there are no well-defined objectives and no need for iteration, its linear structure is suited for it.

### **5.1.3 FLEXIBILITY AND ADAPTABILITY**

The figure 4-3, titled Flexibility and Adaptability, illustrates how various approaches match the degree of flexibility needed for different kinds of projects. High adaptability is necessary for projects that operate in dynamic or unpredictable environments- such as Auditing- and given that Agile and Scrum are built to welcome change and facilitate iterative delivery, they dominate the High category for these types of projects.

At the “Low flexibility” end, we find that Waterfall is the methodology that dominates, depicting initiatives that are stable and in well-defined contexts where there is little change and the requirements are well-established, and since the projects do not need to adapt frequently, that makes waterfall’s linear structure a fitting choice.

Lastly, Lean tends to fit with projects that require a reasonable amount of flexibility, like process improvement, making this technique appropriate for contexts where change is necessary but not constant, since it promotes progressive change via waste reduction and continuous improvement.

All in all, greater flexibility is required in project environments that are more uncertain and dynamic, where Agile and Scrum are the best suited for it, and for projects that are stable and controlled, they tend to align better with Waterfall.

### **5.1.4 CHOICE OF TECHNIQUE**

The graphic 4-4, labeled “Choice of technique”, clearly shows that Agile was the technique that was chosen the most, followed by Scrum, Waterfall and Lean. The data shows the dominance of Agile and Scrum, which indicates a shift towards more adaptive, team-based and customer-focused methodologies, with companies nowadays focusing more on faster delivery of value, adaptability to change and stakeholder involvement when, in contrast, the adoption of waterfall is on a decline, mostly due to its inflexibility in changing environments and the delayed feedback.

Finally, Lean is relatively limited compared to agile and Scrum because it is more process-oriented instead of project-oriented, focusing on eliminating waste and streamlining operations, best suited for supply chains and repetitive processes. When trying to implement Lean in a company, it requires a deep cultural change, demanding a long-term commitment, which is difficult because it requires implementation at all levels.

### **5.1.5 STAKEHOLDER INVESTMENT**

Regarding the figure 4-5, identified as Stakeholder Investment, it demonstrates in detail the differences in stakeholder involvement across projects utilizing various approaches. High stakeholder participation projects, such as software development, require quick adaptation, regular feedback and are characterized by having changing requirements, with said characteristics aligning naturally with Agile and Scrum, designed for continuous stakeholder collaboration. Their framework, that consists of mechanisms like sprint reviews and weekly meetings, is perfect for projects that involve high stakeholder involvement. On the other hand, in projects where the involvement from the stakeholders is low, they tend to lean more for the Waterfall methodology, because these projects are normally defined by having properly established requirements that are acquired at the beginning of these initiatives and little change is anticipated while they are carried out, and due to this characteristics, their engagement diminishes as the project moves forward. This limited interaction is supported by Waterfall's linear structure, which prioritizes documentation and sequential approvals above continuous feedback.

To put it briefly, Agile and Scrum are preferred for projects requiring a high level of stakeholder involvement since they thrive on communication, flexibility and quick iteration, while waterfall is preferred in projects where the stakeholder involvement is low, putting more emphasis on predictability and stability.

### **5.1.6 RESOURCE**

The chart 4-7, labeled Resource Availability, shows that there is a certain homogeneity regarding the level of resources of each technique, and when we talk about "resources", these usually include human resources (such as developers, testers...), the time available for the tasks, the total budget and the tools/infrastructure. Although all the techniques show that they have a moderate level of resources, this does not mean that they all use the same resources, as the graph shows trends, not equalities.

### **5.1.7 RISK**

The figure 4-6, referred to as "Risk", shows how various projects manage risk according to the methodology chose. The scope, requirements and technical difficulties of projects that are inserted in high uncertainty environments are always changing, so methodologies like Agile and Scrum, which control risk through iterative cycles and continuous stakeholder feedback, are advantageous for them. Their structure lowers the probability of project failure by enabling problems to be identified and fixed early, since Agile ensures that risk is communicated and reduced cooperatively throughout a specific project. Agile doesn't fear risk, it welcomes it as an opportunity to improve.

In contrast to this situation, projects that adhere to a more conventional sequential model, like waterfall, are typically classified as low-medium risk, as they often implement the requirements at the beginning of the project and rely on a minimal stakeholder involvement throughout the execution. Because of this, Waterfall is not the best choice for projects that have a high-risk probability and that require a quick reaction.

### **5.1.8 FIELDS**

The figure 4-8, captioned “Fields”, gives a comparative view of which project management techniques are adopted and used by the six different areas. When analyzing the image, we can see that in Auditing, Data analytics and Cybersecurity, the main techniques are Agile and Scrum, followed by Waterfall. We can attribute this to the fact that these areas often require iterative reviews and collaborative feedback, which aligns with Agile/Scrum flexibility. Moreover, it is also needed to any emerging threat that could jeopardize the project.

Regarding IT and Banking, and even though Agile and Scrum are becoming increasingly more popular, Waterfall still plays the main role in both areas due to its nature. When it comes to Banking, it is a highly regulated environment where the projects are forced to meet strict legal and compliance standards, so having in place a methodology that focuses on predictability and traceability, is a plus. Putting so much emphasis on documentation is also important because banks are regularly the targets of audits (internal or external), so having the proper documentation ensures that the whole process happens smoothly.

With IT, the project’s requirements are all established early on and it deals with critical infrastructure – servers, databases... – that require minimal disruption, so having a step-by-step execution is imperative to ensure that the system keeps working as it should. When dealing with data and personal information from the stakeholders/clients, security is a main concern and IT is responsible to enforce those (ex: GDPR, ISO...). By resorting to a technique like waterfall, they are ensuring that audits, documentation and security reviews are built into the process, lowering substantially the risk associated with the project.

Finally, we have the pharmaceutical area where they favor the Lean methodology over Waterfall and Agile. Lean is all about eliminating unnecessary waste and improving the process efficiency, and in the pharma business, it means reducing excess inventory or redundant testing, something crucial, given that this environment is characterized by having high costs and tight margins. The pharmaceutical industry revolves around repeatable processes and standardization, where Lean can assist in optimizing the workflows without putting in jeopardy the quality or compliance, something that

waterfall can't do due to its rigidity and where Agile is too focused on iterative development rather than refine the process.

### **5.1.9 DURATION**

The figure 4-9, labeled "Duration", illustrates how various project lengths correspond with approaches, and the first thing that stands out is that no techniques were applied to projects lasting only 1-2 weeks mostly because the time frame is too short for any structure procedure.

Small, quick-moving projects that last two to four weeks usually benefit from iterative delivery, with Agile and Scrum having more relevance in this timeline due to the structure that they have (short sprints and flexibility), and with Waterfall it's the opposite, it has little presence here, showing that it is probably not well-suited for short-term projects.

When it comes to projects that last more than 4 weeks, all approaches were selected and used. Agile and Scrum have a lot of weight in the category as they are able to facilitate lengthy projects with constant flexibility and iteration, and Waterfall, given its sequential structure, is frequently used in long-term projects where the objectives are already established. Lean is present in both ranges, reflecting its function in ongoing development.

## **5.2 QUALITATIVE ANALYSIS**

After analyzing the answers to the questionnaires, considering the questions related to the advantages, disadvantages and modifications of the techniques, it was clear that the majority of participants were able to correctly identify the characteristics associated with each method. For example, Scrum and Agile were often associated with collaboration, iterative progress and their ability to adapt, while, on the other hand, Waterfall was recognized for its rigid structure and heavy documentation. Lean, on the other hand, was recognized for its dedication to improving efficiency, reducing waste and optimizing processes.

The consistency between the participants responses and the theoretical aspects of the methodologies indicates that the respondents possessed a solid comprehension of the tools they employed but, nonetheless, it points out a limitation since the insights that were obtained merely corroborated existing literature instead of presenting new observations. In other words, the data states that the methodologies are being used according to their intended purpose but offer very limited insights as to how they may evolve. Interestingly, the suggestions for improvement did offer some reflected value and most respondents demonstrated awareness of the limitations that each technique provided

actionable strategies. To strike a balance between flexibility and control, it was commonly suggested the combination of different techniques or the implementation of methods to ensure clear communication between everyone involved in the project.

As a result, and even though the tables themselves mostly reflected the well-established characteristics of the different methodologies, they were also responsible to highlight the broader topic of cross-method integration and ongoing learning as essential to the success of project management, supporting the notion that in today's fast changing project environments, strict adherence to a single methodology is not enough.

### **5.3 ANALYSIS OF CROSS-COMPARISON BETWEEN TECHNIQUES**

Based on the information present on the Cross-Comparison table regarding Complexity and Project Scale, Agile and Scrum are better suited for evolving and complex projects due to their nature of leveraging iteration and waterfall, in contrast, it is best suited for when the predictability of a project is high and the complexity of it is low. On the other hand, Lean occupies a more intermediate space, capable of handling complex projects, more precisely, in structured environments like the pharmaceutical industry.

When thinking about change as an inevitable part of most projects these days, Waterfall, due to its linear and sequential approach, is going to penalize it, making this technique ill-suited for dynamic environments, when alternatively, Scrum and Agile are going to see it as an opportunity and, given that with their iterative and flexible nature, are going to allow for teams to shift priorities without losing progress. When it comes to Lean, the adaptability is a bit different because the main goal is to eliminate waste and improve the processes.

Another factor that has a major impact on a project is Stakeholder Involvement, the influence of which will vary depending on the technique in question. Due to its structure, Agile and Scrum encourage stakeholder involvement and integration through constant feedback, which results in high alignment with the user's needs, reducing the likelihood of scope creep, and regarding Waterfall, it involves stakeholders mainly at the beginning, increasing the chance of misalignment if needs change mid-project. Lean stays, once again, in the middle of the spectrum, where it uses the feedback to increase the value stream and effectiveness.

Lastly, the iterative loops within Scrum and Agile allow for the detection of issues, making sure the teams are focused on fixing them, which significantly reduces the project risk, while Waterfall, due to

its sequential structure, delays the discovery of issues until the later stages, which can result in serious problems for the project.

The comparative analysis presented gives us the necessary information to say that there is no technique superior to others, and the choice behind the selection of a methodology should be based on the specific requirements of a project. For a company, understanding these differences is essential when the expected outcome is the success of the projects.

## **5.4 RESEARCH QUESTIONS**

### **5.4.1 RQ1- CAN THERE BE A UNIVERSAL APPROACH?**

In the world of project management, where each case is different and no two projects are or will be the same, given that their variables will change - including stakeholder involvement, budget, scope, resource availability, duration of projects, complexity of a project, the risk associated with a project- and something as a universal approach has been a dream for project managers, as it would eliminate the need to adapt techniques to each specific situation. Assuming that there is a universal technique, one would expect that this would be reflected in the questionnaires, which was not the case.

According to the information presented in the questionnaire and after processing it, it was possible to see that there is a certain dichotomy between the techniques chosen by the participants, with the main one being the Agile methodology, which was selected by 57% of respondents, followed by the Scrum technique with 43%, the Waterfall methodology with 28% and the lean methodology accounting for 10% of the responses. These results show the influence that the specific variables have when it comes to the choice of a technique, and as represented on the cross-comparison tables, different techniques have different requirements and preferences based on the project variables. Additionally, the decision tree that was elaborated highlights the key points in understanding which key factors come into play when the goal is to pick the right technique, showing that the idea of choosing the appropriate methodology is based on the characteristics of a project.

By analyzing the results, we were able to understand that there is no such thing as a universal approach that can adapt to all projects, because if there were, it would have been chosen by all the participants and the graph would have only one choice, which was not the case. These findings highlight and reinforce the importance of adaptability in the field of project management, where project managers must have extensive knowledge of the different project management techniques to select the one capable of providing the best outcome.

While the hypothesis of a universal approach is enticing, the diverse and changing nature of projects makes this an impractical idea and the search for a universal technique ignores the wide range of different industries, organizational cultures and team structures.

#### **5.4.2 RQ2- HOW CAN THE DIFFERENT TECHNIQUES BE IMPROVED?**

According to the information in the questionnaire, more precisely with the question “What type of modifications would you suggest to improve the methodology?”, it was possible to extrapolate information from the respondents and organize it to understand which different points should be improved. Regarding the professionals who chose Agile as the dominant technique in their day-to-day work, the main changes involved combination with other techniques and improve communication, while on the other hand, those more familiar with Waterfall pointed out that the main improvement measures were also related with combining different frameworks and focusing on the training of the employees.

Although the techniques chosen by the participants were not consistent, a pattern emerged regarding the recommendations, despite the different techniques chosen.

Most professionals assumed that combining different techniques would, ultimately, provide sufficient resilience and mitigate the individual disadvantages of each technique, thus providing professionals with an improved framework that is more adaptable to the project needs. A clear example of this is the suggestion to combine agile and waterfall, where one is described for its ability to adapt to changes in the environment, and the other focuses on the documentary aspect, to create an improved framework. Another recommendation from those interviewed concern ongoing team training, because if professionals have the knowledge to use the techniques optimally, then the benefit that will be gained from them will be maximized, thus allowing projects to have the best possible outcome.

In addition to these propositions, the third most frequently mentioned relates to communication. For the practitioners that use these techniques every day, communication has proven to be an indispensable factor when trying to improve an existing project technique, as a team that is encouraged to share opinions and ideas is a team capable of innovation and to increase the projects value.

#### **5.4.3 RQ3- WHAT ARE THE MOST USED METHODOLOGIES?**

According to the information in the questionnaires, and as mentioned in RQ1, there is a certain dichotomy regarding the methodologies chosen by the participants. The majority ended up choosing the Agile methodology, which received 57% of the responses, followed by the Scrum methodology

with 43% of the responses, the Waterfall technique with 28%, and the Lean methodology with 10% of the choices.

Despite the variety of techniques mentioned by the participants, a deeper analysis reveals an even greater gap between the professionals' preferences. If we group Scrum and Lean as approaches derived from the parent methodology – Agile – we can observe a substantial difference between the predominant choice of the participants regarding traditional techniques and Agile methodologies, with Agile receiving a 72% vote share and Waterfall receiving a 28% vote share. Based on the results and their analysis, it can be concluded that the most used techniques are Agile methodologies, followed by traditional techniques, demonstrating the supremacy of Agile techniques. This is due to the paradigm shift in project management techniques, where strict adherence to a fixed plan was previously more important and sought out, and currently there is a greater demand for techniques capable of adapting to change.

## **5.5 DECISION TREE**

In the world of project management, the choice of a methodology is the main factor in the success or failure of a project, and given the diversity of projects, where each one has its own characteristics and challenges, there is no universal approach for everyone, so the development of a decision tree turns out to be a necessity in terms of helping to select the most appropriate methodology, taking into account factors such as the type of scope, complexity, stakeholder involvement, resources.... By systematically evaluating these factors, Project Managers can make better decisions that not only are going to align with the specific needs of a project but also enhance the likelihood of project success, ensuring that all the resources are used effectively.

The decision tree outlined below, which was independently built and manually constructed as part of this study and based on the data acquired from the questionnaires by converting the patterns found in the gathered data, is intended to assist in the discovery of the best project management methodology.

The purpose of this diagram is to demonstrate, in a simple way, the decision-making process associated with choosing a methodology, considering the main factors analyzed throughout the study. However, it is important to emphasize that the diagram should not be understood as a universal model applicable to all techniques, but rather as an indicative representation that seeks to exemplify the reasoning behind the selection of an approach appropriate to each context.

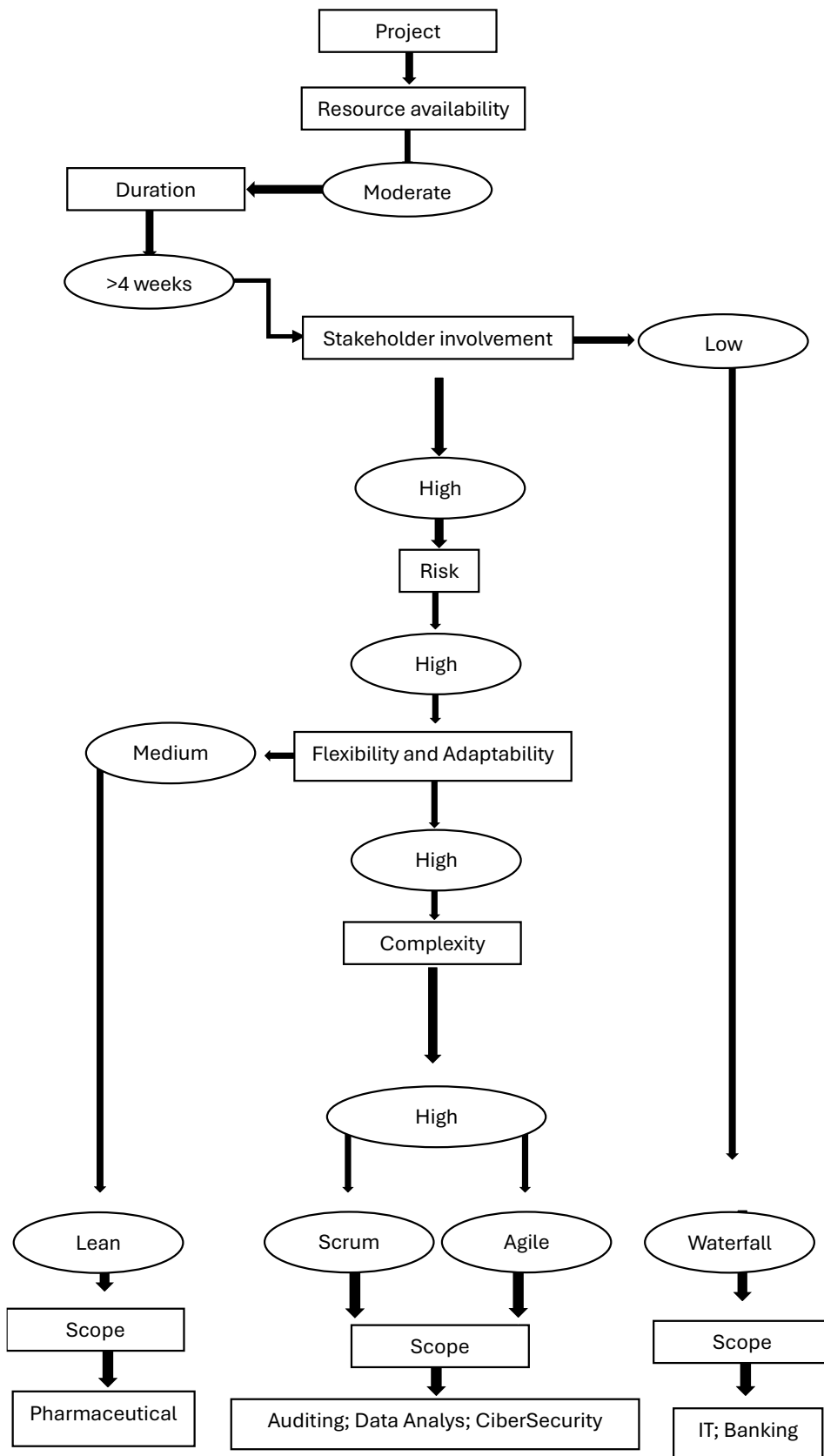


Figure 5-1-Decision Tree for Methodology Selection

This framework helps determine which project management methodology is the most appropriate, based on different factors, with the starting point being the project itself. The first decision point is to assess the availability of resources. If the availability is moderate, the next step is to check the duration of the project and, if the duration is found to be longer than 4 weeks, proceed to assess the stakeholder involvement. If the stakeholder involvement is low, the decision is to use the "Waterfall" methodology, especially for projects in the IT and Banking areas but, in contrast to this situation, if stakeholder involvement is high, the risk assessment is carried out. In a scenario where the risk of a project is assessed as high, it becomes necessary to move on to the next step and assess the flexibility and adaptability of the project. If the flex and adaptability are found to be medium, the decision is now made to use the "Lean" methodology, more specifically in the pharmaceutical area, but if it is high, the complexity assessment is carried out. In this scenario, where complexity is high, the choice between Agile and Scrum methodologies will be based on the scope of the projects, being more used in projects in areas such as Auditing, Data Analysis and Cybersecurity.

## **5.6 RECOMMENDATIONS**

Considering the results obtained from this study, the main recommendation that emerged was all about the adoption of a hybrid project management approach, since no single methodology proved to be universally applicable across all organizations and all projects, so, combining techniques can help mitigate the limitations that each one has. A clear example is the integration of the flexibility of Agile with the structured planning and documentation of the Waterfall model to create a more balanced and effective framework, resulting in a better outcome for the client. However, adopting a hybrid approach alone is not sufficient and its successful implementation depends heavily on the team's ability to understand and apply the different techniques involved, therefore, it is highly recommended that organizations invest in training initiatives for project teams. Many of the weaknesses identified – such as difficulties with implementation, excessive dependence on specialized positions like the Scrum Master and resistance to methodologies - are often connected with the lack of technical knowledge or practical experience, so, by providing regular training to the employees, teams would be better equipped to deal with the chosen methodologies, leading to greater efficiency and improved project outcomes.

In parallel with equipping the teams internally with the proper tools to deliver the best outcome, attention must also be given to how they interact externally, particularly with the stakeholders involved

in the project. The success of any methodology, either traditional or hybrid, relies heavily on maintaining open and consistent communication with all the parties, where the findings revealed that methodologies such as Agile and Scrum benefited immensely from active stakeholder engagement, reducing risk and ensuring that the deliverables align closely with the user expectations. With this said, it is essential that any adopted methodology includes structured mechanisms for ongoing communication to foster alignment and build trust throughout the project lifecycle.

For those who wish to study more about this topic, it is essential to continue exploring frameworks that integrate various project management methodologies, and by doing so, scholars can develop hybrid models that leverage the strengths of each technique, thereby creating more effective and adaptable project management strategies.

Furthermore, this exploration must be complemented by a commitment to ongoing training, as it is important to deepen the knowledge of the techniques of each methodology through tools such as training courses/sessions to gain a practical and theoretical understanding, thus ensuring that you remain at the forefront of the field, always keeping informed of the latest ideas and skills, which is essential for mastering the techniques and ensuring that the models are implemented effectively. Through this commitment to continuous learning, scholars will be able to contribute to the evolution of project management practices and bridge the gap between theory and practice.

## **5.7 LIMITATIONS OF THE STUDY**

Although it is possible to draw different conclusions regarding project management strategies from this study, it still presents certain limitations that should be noted. First off, a bigger sample would have improved the findings generalizability and allowed for more statistical robustness, providing a greater variety of viewpoints and organizational settings. Additionally, the findings are grouped in 3 distinct categories – Banking, IT, Pharmaceutical- which can restrict the extent to which the findings may be used in other fields, and this concentration of data may have been influenced by the unique features of the projects, making the findings less prone to be applicable in other contexts.

In order to address these limitations and offer an organized summary of strategy options that emerged from the study, a decision tree was created. Based on the recurrent topics found in the different sectors, this tool assists in visualizing the available options and shows the possible results connected to each route, providing a clear means of comparing options, even if the sample size restricts the conclusions' generalizability. The tree was manually built using a procedure that involved analyzing the

questionnaires from the interviews and arranging them logically to try and mimic potential project scenarios.

## **6 CONCLUSION AND FUTURE WORK**

This thesis presents a study on how different project management methodologies (Agile, Scrum, Waterfall, and Lean) are applied in practice, focusing on the factors that influence the choice of a methodology depending on the characteristics of each project. For that to happen, a mixed-methods approach was employed, which combined qualitative and quantitative procedures and collected data through questionnaires distributed to professionals across various sectors, including IT, banking, cybersecurity, auditing and pharmaceuticals, with the goal of examine how each methodology is applied in different organizational contexts, focusing on factors such as project complexity, budget, duration, stakeholder involvement, risk, and resource availability. The findings suggested that no single methodology could be universally applied to all project scenarios, instead, the most effective approach often involves adapting or combining different techniques to fit specific project needs. Agile and Scrum are shown to be best suited for complex, high-risk projects requiring flexibility and continuous feedback, while Waterfall is more appropriate for well-defined, stable projects and Lean, on the other hand, excels in process-oriented and repetitive environments, such as pharmaceuticals. Based on the findings, this study recommends the development of hybrid approaches that leverage the strengths of multiple methodologies, the implementation of continuous training programs, and the establishment of strong communication channels within teams and with stakeholders. These strategies can help organizations to better align project management practices with the dynamic demands of modern business environments, ultimately improving project success rates and increase productivity.

### **6.1 FUTURE WORK**

Although this research has provided valuable information about project management techniques within the sectors studied, there are still gaps that could be explored in future work. For starters, a more comprehensive study could be conducted, involving a broader and more diverse set of responses to get a more representative view of the results, thus gaining a greater understanding of the nuances in different organizations. Furthermore, future research could extend the scope of the study by including additional areas besides IT, Banking and Pharmaceuticals, which would allow to draw more complete conclusions about the methodologies, but this time in different business contexts, contributing to a more global perspective on project management practices.

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## APPENDIX A -



This is to certify that

Project No.: **INFSYS2025-7-142012**

Project Title: **Project Management Techniques: how to choose?**

Principal Researcher: **Bruno Correia Nunes**

according to the regulations of the Ethics Committee of NOVA IMS and MagIC Research Center this project was considered to meet the requirements of the NOVA IMS Internal Review Board, being considered **APPROVED** on 7/14/2025.

It is the Principal Researcher's responsibility to ensure that all researchers and stakeholders associated with this project are aware of the conditions of approval and which documents have been approved.

The Principal Researcher is required to notify the Ethics Committee, via amendment or progress report, of

- Any significant change to the project and the reason for that change;
- Any unforeseen events or unexpected developments that merit notification;
- The inability of the Principal Researcher to continue in that role or any other change in research personnel involved in the project.

Lisbon, 7/14/2025

NOVA IMS Ethics Committee  
ethicscommittee@novaims.unl.pt

Figure A 1 - Ethics Committee Report

## APPENDIX B

### Informed Consent Statement

Title of the Study: Project Management Techniques: How to choose

Researcher: Bruno Correia Nunes

Email: 20230637@novaims.unl.pt

Purpose of the Study: This thesis presents a study on how different project management methodologies are applied in practice, focusing on the factors that influence the choice of a methodology depending on the characteristics of each project.

Procedures: You will be asked to complete a questionnaire that will take approximately [3min] to complete.

Confidentiality: All responses will be kept confidential. The questionnaires are anonymous, and the data will be securely stored to prevent unauthorized access.

Voluntary Participation: Your participation is entirely voluntary. You may choose not to participate or withdraw from the study at any time without any penalty.

Consent: By continuing this questionnaire, you indicate that you have read and understood the information provided and agree to participate in this study.

Yes, I understand

---

Question 1 **What type of project management methodology do you use in your day-to-day?**

- Scrum
- (Agile)
- Lean
- Waterfall

Based on the technique(s) you chose before, answer the following questions accordingly

**Question 2 Based on the complexity of your project, which methodology is best suited for it**

	Low	Medium	High
Agile	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Scrum	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lean	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Waterfall	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Question 3 Based on the stakeholder involvement in the project, what technique would you choose**

	No Involvement	Low Involvement	High Involvement
Agile	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Scrum	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lean	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Waterfall	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Question 4 Given the available resources in a specific project, which project management methodology would you choose**

	Limited	Moderate	Unlimited
Agile	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Scrum	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lean	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Waterfall	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Question 5 Based on the scope of a given project, which methodology would you consider most suitable**

	Banking	IT	Auditing	CiberSecurity	Data Analytics	Farmaceutical (6)
Agile	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Scrum	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lean	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Waterfall	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Question 6 Considering the adaptability needs of a specific project, what technique do you select**

	Low	Medium	High
Agile	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Scrum	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lean	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Waterfall	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

---

Question 7 Considering the risk profile of a project, what methodology is best suited

	Low	Medium	High
Agile	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Scrum	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lean	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Waterfall	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

---

Question 8 Based on the duration of the project, which technique would you choose

	1-2 weeks	2-4 weeks	>4 weeks
Agile	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Scrum	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lean	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Waterfall	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

---

Question 9 Considering the budget constraints of your project, which methodology would you apply

	<10k	10k-20k	20k-30k	30k-40k	>40k
Agile	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Scrum	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lean	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Waterfall	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Question 10 How would you describe the advantages of the method chosen at the beginning?

Question 11 How would you describe the weaknesses of the methodology that you chose?

Question 12 What type of modifications would you suggest to improve the methodology?

## APPENDIX C

### Agile

#### Agile Manifesto

As a result of the meeting, the outcome was a significant consensus that included 4 unique values and 12 guiding principles.

Regarding the values, these represent a shift in focus from the traditional project management methodologies to more of a customer-centric approach, flexible and collaborative. According to the Agile Manifesto, “We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value”:

- Individuals and interaction over processes and tools
- Working software over comprehensive documentation
- Customer collaboration over contract negotiation
- Responding to change over following a plan

And even though there is value on the right, we must value more the items on the left

Said values will serve as the foundation for guiding the software development process and define the unique traits of any agile method. This Manifesto emphasizes that when a decision needs to be made, preference should be given to the items listed on the left side of each core value over those on the right (Al-Saqqa et al., 2020b). Nevertheless, we should not dismiss the latter either. While they may be relatively less important, they still hold significance. These values emphasize preferences rather than alternatives, which is a common misconception when it comes to the values of the Agile Manifesto (Croix, 2018).

#### **1. Individuals and interaction over processes and tools**

As stated by Steve Jobs, “Tools are just tools. People make them work”.

What is responsible for creating the product are the people, not the tools. The tools are there just to assist the team regarding their necessities, and not the other way around (Rodríguez et al., 2019). This first value states that to maintain a smooth workflow and deliver a high-quality product, effective teamwork, strong collaboration, and clear communication are essential. These elements ensure that everyone is aligned, issues are addressed promptly and innovative solutions are developed collectively. (Croix, 2018)

## 2. Working software over comprehensive documentation

In the past, a significant amount of time was dedicated to documenting the product throughout its development and final delivery, including requirements and technical specifications, along with obtaining the necessary approvals for each stage. This extensive documentation process had the goal of ensuring clarity and alignment but resulted in delays and inefficiencies (Eby, 2016). Regarding Agile, it is not going to eliminate said documentation; instead, it is going to simplify it by providing the development team with the necessary information without overwhelming it. The requirements from the stakeholders are going to be captured as "user stories", which offer enough connection for the development team to start building new features effectively (Trivedi, 2021). The manifesto emphasizes that true progress in agile methods is gauged by the tested, working software rather than extensive documentation. By utilizing this approach, we are going to reduce ambiguity and provide immediate feedback on whether the software meets the requirements, ensuring that the development process remains focused on delivering functional and valuable outcomes (Al-Saqqa et al., 2020b). The Agile Manifesto values documentation, but it values working software more.

## 3. Customer collaboration over contract negotiation

As Mike Cohn states in the book *Agile Estimating and Planning*, "Customer collaboration is valued over contract negotiation because agile teams would like all parties of the project to be working towards the same set of goals".

In the past, contracts were the primary focus. Businesses would create detailed contracts with their customers, outlining the specifications of the final product. However, this often led to discrepancies between what the contract specified, what the product delivered, and what the customer truly needed. This misalignment frequently resulted in dissatisfaction and the need for adjustments. When it comes to traditional software development methodologies like waterfall, the customers would negotiate and specify the intended requirements before any work had been done, which meant that they were only involved before the development began and after its completion, but not between. In contrast to this approach, a customer in the Agile Manifesto is described as someone actively engaged and collaborating throughout the development process (Trivedi, 2021). The closer a company is to its customers, the better it can understand their needs. This understanding is crucial for agility, as being agile is meeting the client's requirements effectively (Croix, 2018). Establishing a feedback loop with

your customers is essential to continuously ensure that your product meets their needs, since regular communication and feedback helps you make the necessary adjustments and improvements.

#### 4. Responding to change over following a plan

“Requirement change was one of the most common causes of software project failure.” (Robert Glass, 2001)

When we think about being agile, probably the first thing that comes to mind is the ability to respond to changes properly, since it is common for the environment where we are to change (Croix, 2018). In the traditional software development frameworks, change was seen as costly and therefore avoided. This approach is focused on creating highly detailed plans with specific features where every element is given high priority, but this method involves numerous dependencies, requiring tasks to be completed in a specific sequence to allow the team to progress onto the next stage (Trivedi, 2021). On the other hand, in the agile methodology, the brief duration of each iteration allows for priorities to be adjusted between them and new features to be incorporated in the subsequent ones. Agile embraces change, viewing it to enhance the project and deliver added value (Eby, 2016). The fourth value of the Agile Manifesto prioritizes responding to changes throughout the development process over adhering to a rigid plan, with this approach aiming to achieve the final goal of customer satisfaction (Al-Saqqa et al., 2020).

Alongside the 4 values that were mentioned and explained above, the Agile Manifesto is also responsible for establishing 12 guiding principles for the agile methodology, as stated on table below.

Table C 0-1- Agile's Principles

Principle	Description
1. Our highest priority is to satisfy the customer through early and continuous delivery of valuable software	The foremost aim of any Agile team is to deliver a valuable, functional product to their client, and customers prefer receiving functional software regularly instead of waiting long periods between releases.
2. Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.	Agile processes leverage change to enhance the customer's competitive edge and it's the ability to avoid delays when a requirement or feature request changes.
3. Deliver working software frequently, from a couple of weeks to a couple of months, with a preference for the shorter timescale	While P1 emphasizes customer value, P3 highlights the importance of time, stating that delivery iterations should be time-bound.
4. Business people and developers must work together daily throughout the project.	To derive business value from IT, business people need to communicate with and understand developers since better decisions are achieved when the business and technical teams are in sync.
5. Build projects around motivated individuals. Give them the environment and support they need and trust them to get the job done	Motivated teams are more likely to deliver their best work than unhappy teams since team members are the most vital success factors.
6. The most efficient and effective method of conveying information to and within a development team is face-to-face conversation	This principle highlights the importance of direct human communication within the Agile team, rather than relying on written specifications or plans.
7. Working software is the primary measure of progress	The best measure of a product's progress is what the client actually has in their hands. Delivering smaller, incremental pieces of the product early and often provides a more accurate measure of progress, reflecting the true impact through functional code
8. Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely	Teams set a consistent and sustainable pace for delivering working software, which they replicate with each release

9. Continuous attention to technical excellence and good design enhances agility	Having the right skills and a good design enables the team to maintain their pace, continuously enhance the product, and adapt to changes.
10. Simplicity-the art of maximizing the amount of work not done-is essential	The goal is to create a product that is both simple and adaptable to sudden changes, while also meeting customer requirements
11. The best architectures, requirements, and designs emerge from self-organizing teams	This principle is connected with P5. By providing support and assigning responsibilities to self-organizing teams made up of motivated individuals, their performance and architecture will be enhanced.
12. At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly	This final principle is the core of the Agile Framework; it encourages continuous and regular self-improvement in the face of a changing environment.

The twelve principles of Agile expand on the core values to offer more specific guidance, being designed for software development and responsible for fostering a dynamic and responsive development environment (Todd, 2022). These principles place a strong emphasis on delivering functional software and fostering collaboration among the stakeholders, advocating for change as a beneficial opportunity rather than a disruption and emphasizing the importance of maintaining a sustainable work pace, discouraging the reliance on overtime (Zaitsev et al., 2018).

Regarding the principles, it is believed that they are “built” on top of three philosophical beliefs (Kiv et al., 2018):

- Adaptation- The project team must be agile in recognizing and responding swiftly to the demands of the situation, which involves accommodating necessary changes while minimizing disruptions to product specifications. By being adaptable and proactive, the team can ensure that the project remains on track and meets its goals effectively;
- Inspection- Team members tasked with monitoring deviations must conduct regular checks and be adept at identifying any elements that breach specifications. This proactive approach ensures that issues are detected early, allowing for timely corrections and maintaining the integrity of the project;
- Visibility- It's crucial that the elements of the process impacting the outcome are transparent to those managing the process. This visibility allows for better control, timely interventions, and informed decision-making, ensuring the project stays aligned with its objectives.

The key takeaway from the 12 Agile principles is to remember your main purpose as a software development team: creating and releasing software. By keeping this goal at the forefront, you ensure that all other Agile values and principles naturally align.

## **Scrum**

### **Product Owner**

The product owner (PO) has one of the most important roles in Scrum and, in most cases, the hardest one. It is going to be responsible for establishing the requirements and objectives of a project for the team to follow, maximizing their output and the output of each task (Sverrisdottir et al., 2014).

To successfully complete a project and deliver a worthy product to the customer(s), the PO needs to have good communication and negotiation skills. Additionally, he needs the right amount of authority and backing from the executive management to be able to lead the development team and align the interests of the stakeholder(s) (Sverrisdottir et al., 2014).

The Product Owner is going to be responsible for developing the Product Backlog (Sverrisdottir et al., 2014) (it essentially serves as a list of tasks, requirements, and improvements needed for the release of a product and a user story represents a software requirement from the perspective of the end-user (Chakravarty et al., 2023) ), and a PO is an individual, not a team. He acts as a representative for all the stakeholders involved in the project (Peek, 2023). According to the Scrum Guide, this product backlog is going to be used to ensure that the first thing to be developed is the key functionality (Schwaber et al., 2020)

They focus on comprehending how the market evolves and the business, prioritizing tasks for the team to finish accordingly, and in order to be a proper Product Owner, you need: (Sachdeva, 2016)

- Create and oversee the product backlog
- Assign priority to each item in the Product Backlog
- Collaborate closely and maintain clear communication with the business and the team
- Provide the team with clear directions on which features should be delivered next

Not only does the PO have the responsibility of ensuring collaboration with the development team and advocating for the customer, but it also must decide what should or should not be prioritized and accept the consequences of said decision. It is crucial that he (PO) rejects unnecessary new requirements and works alongside the team and stakeholders, rather than adding unnecessary items

to the Product Backlog. Customer involvement is vital in agile methodologies like Scrum and poor cooperation can cause issues for the team (Cho, 2008).

### **Scrum Master**

We can look at the Scrum Master as someone who oversees the Scrum development process and is responsible for conducting daily reunions with the team to ensure that the Scrum rules are properly followed (Peek, 2023), all while being responsible for ensuring the Team's effectiveness (Schwaber et al., 2020). With the view to assist the team in improving its productivity and output capability, the Scrum master needs to have a very specific profile, since all of his characteristics are going to be perceived throughout the assignments that he is going to be responsible for, with the essential aspects of the expected profile being Leadership, empathy, ability to influence others and perception (Schwaber et al., 2020).

The scrum master is not in any shape or form a Product Manager (since there is no place for that in a scrum methodology) (Sachdeva, 2016), it just plays a pivotal role within the Scrum framework, acting as a bridge between the Development Team, the Product Owner, and the organization, promoting Scrum as it is defined in the Scrum Guide.

### **Development team**

The development team is a group of highly skilled professionals tasked with creating/developing and meeting the objectives of the software product, and subsequently, providing it along with all the necessary documentation (Peek, 2023). This team is a cross-functional one, including different people with different backgrounds, ranging from developers to testers, testers to designers, operations engineers etc (Sachdeva, 2016), normally around five to nine people and are going to be guided by the Scrum Master (Sharma et al., 2017).

## **Lean**

While rigorous process thinking in manufacturing can be traced all the way back to the 1450s in Venice, Henry Ford was the first person to fully integrate an entire production process (Lean enterprise institute, 2020). Lean manufacturing starts with Ford and his plant in Highland Park, Michigan, in 1913, where he prioritized creating the best possible product over organizational structure by tirelessly seeking out ways to eliminate waste and enhance employee efficiency. Rather than pushing people to work harder, he aimed for smarter work practices for both individuals and the company as a whole (Six Sigma, 2017). Despite being able to turn over the inventories of the entire company every few days, it still faced one small problem: Variety. The Model T (Ford's universal car) came in only one color and

with only one layout, so when the world asked for variety, Ford seemed to lose its way. (Lean enterprise institute, 2020). Meanwhile, Sakichi Toyoda established Toyoda Automatic Loom Works in 1926, which later became Toyota when it ventured into automobile production. In 1950, Eiji Toyoda, Sakichi's nephew, spent three months at Ford's Rouge plant in Dearborn, Michigan, and after examining Ford's production system, Eiji Toyoda realized that Ford's mass production methods were unsuitable for Toyota since the Japanese market was too small and diverse for mass production (Skhmot, 2017). By revising the method established by Ford, and through a set of modifications to it, they were able to invent the Toyota Production System, also known as Lean Methodology.

The ideas of Muda, Muri, and Mura— the three categories of waste that Lean aims to eradicate to optimize production and increase value —are fundamental to this approach.

### **Muda**

*Muda* signifies inefficiency, futility and lack of value, which equates to giving up on enhancing self-worth. Value-added work is a cycle that boosts the worth of a product or service that the customer is willing to pay for (Shedge et al., 2022). In a nutshell, this type of waste does not benefit the business or the employees, as it increases costs and causes tasks to take longer than they should. We have two types of *Muda*, Type 1 and Type 2. *Muda* type 1 encompasses non-value-added activities in processes that are essential for the end customer (i.e. inspection and safety testing. Don't enhance the product value but crucial for customer safety) and *Muda* type 2, that involves non-value-added activities that are unnecessary for the customer and should be eliminated (Do, 2017b). Within *Muda* type 2, we can categorize waste into seven distinct classifications (Garcés et al., 2023)

- Surplus inventories
- Unneeded transportation
- Delays and defects
- Overproduction
- Inefficient movement of personnel
- Excessive processing

### **Mura**

*Mura* refers to unevenness or irregularity, occurring when a process is inconsistent and leads to variations, (Ishak et al., 2018) more specifically when equipment, facilities, or personnel are pushed beyond their limits, leading to interruptions, errors, postponements, and potentially catastrophic outcomes (Gandhi, 2018).

The presence of any of the seven wastes in *Muda* can be justified by *Mura* and *Mudi* (Smith, 2017). For example, in a production line, items need to go through several workstations during the assembly process and when the capacity of one station is greater than that of others, waste accumulates in the form of overproduction, waiting, and other inefficiencies (Shedge et al., 2022). What is the outcome of this? Well, product defects may occur, leading to customers receiving inconsistent products or services, and said situation is further complicated by *Mura*, which creates *Muri*, thereby undermining efforts to eliminate the seven wastes of *Muda*.

*Mura* involves either overburdening some resources while others wait or alternating between overburdening and underutilizing the same resources over time, but it can be prevented through the use of the Just-in-Time approach (Shedge et al., 2022), since its main goal is to eliminate sources of manufacturing waste by obtaining the correct quantity of raw materials and processing the right amount of products at the right place and time

### **Muri**

The last type of waste identified in the Toyota Production System, alongside *Muda* and *Mura*, is called *Muri*, and it can be characterized as the waste caused by overburdening, which can overwhelm individuals working in stressful or uncertain environments. *Muri* can significantly reduce your team's efficiency and profitability, since excessive workload can negatively impact team morale and disrupt the overall health of the workflow (Smith, 2017)

This excessive workload can stem from various factors, each contributing to a decline in team productivity, and recognizing these factors is essential to maintaining a productive and healthy work environment. Implementing Lean production enables manufacturing the same product with reduced human effort, financial resources, equipment and space (Rifqi, 2021), combining the efforts of the entire organization – from top management to workers and suppliers – to meet market demand, doubling production and quality while reducing costs (Kelendar, 2020). To be able to achieve the expected outcome, Lean follows 5 major principles that influence the approach to increase the productivity and eliminate waste across the entire production system

### **Identify Value**

The first principle, ***Identify Value***, is all about defining value from the customer's perspective (Project Management Institute, 2018) by identifying the specific form, feature, or function that a customer is willing to buy when they can't complete the task themselves or without significant time or cost investment (Smith A, 2015).

In some cases, customers find it hard to express their needs, mostly when it comes to new technologies or products. To understand what it is that they really want, there are methods that can be used, such as surveys, interviews... (Do, 2017a) which will help businesses understand and meet customer needs, even when customers can't clearly articulate them.

### **Map the value stream**

This second principle regards the identification and mapping of the value stream, identifying every step in the stream and remove those that don't add value (waste), whenever possible (Project Management Institute, 2018). The waste can be divided into two categories: necessary but non-value-added, and unnecessary non-value-added. This last one is pure waste and should be eliminated, while the first one should be minimized as much as possible (Do, 2017a).

In Lean management, Kanban boards are used to map this process, since they help track each step of the workflow and visually represent the value stream (Krasteva, 2025).

### **Create Flow**

Once the wastes are removed from the value stream, the next step is to ensure that the remaining steps flow smoothly without any interruptions or delays (Do, 2017a), moving continuously from one station to the next with minimal waiting time, aiming to achieve zero inventories between the value development processes (Smith A, 2015).

“Flow” is about producing parts one at a time from raw materials to finished goods and move them individually to the next workstation without any waiting time in between (Smith, 2017) and to ensure a smooth and effective flow, various strategies and tools are put into practice, like reorganizing the production line layout to cut down on unnecessary movements and streamline the flow of materials and products or adopting simple, cost-effective automation solutions to enhance efficiency without requiring substantial investments.

### **Establish Pull**

Inventory is frequently regarded as a major source of waste in production systems, as it consumes capital, occupies space, and can result in overproduction and obsolescence. This is where the pull system comes in, with it being responsible for reducing inventory and items while ensuring that the necessary materials and information are accessible for a seamless workflow (Do, 2017a).

Lean Manufacturing advocates for demand-driven production rather than forecast-based production as it focuses on producing only what is needed, when requested, and in the required quantity, assuring continuous flow in the production process by associating actual customer orders with the production rate (Smith A, 2015).

### **Seek Perfection**

By rigorously applying the first four principles, enterprises can aim for perfection, as activities within the value stream become more transparent than ever before. (Smith A, 2015) This final principle is the continuous pursuit of perfection, where ongoing improvement becomes ingrained in the company's culture, involving optimizing processes, fostering innovation, and engaging employees in problem-solving.

Originating from the Toyota Production System, these principles emphasize delivering customer value while optimizing resource utilization. Serving as essential directives, Lean principles assist organizations in boosting efficiency, eliminating waste, and improving overall performance (Do, 2017).

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