INSTITUTO SUPERIOR DE ENGENHARIA DO PORTO
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Os Três Pilares da Sustentabilidade e Gestão Ágil de Projectos: Como é que eles se influenciam

MARIA CAROLINA CONCEIÇÃO CANCELA NOGUEIRA
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AGILE PROJECT MANAGEMENT AND HOW IT INFLUENCES THE THREE PILARS OF SUSTAINTABILITY

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Dissertation presented to ISEP – School of Engineering to fulfill the requirements necessary to obtain a Masters degree in Mechanical Engineering, carried out under the guidance of Professor Francisco Silva from the Department of Mechanical Engineering, ISEP – School of Engineering, Polytechnic of Porto and Professor Konstantinos Kirytopoulos from the Section of Industrial Management and Operational Research, NTUA – National Technical University of Athens.

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KEYWORDS

Keywords: Agile Project Management; Agility; Agile Methodologies; Scrum; Kanban; Project Management; Sustainability, Sustainable Development; Triple Bottom Line

ABSTRACT

The industrial world is becoming more competitive with each passing day. Companies face new challenges and to survive, they need to find ways to stand out from the rest. One way for companies to do this is to improve the quality of the products, this can be achieved by improving production planning.

The goal of this thesis is to investigate a novel perspective within the theoretical area of agile project management and sustainability. The goal of the study is to prove that there are links between Agile Project Management and Sustainability, as well as to learn how Agile Project Management affects organization's social, environmental, and economical dynamics from the triple bottom line standpoint.

The research examines how agile project management ideas are connected to concepts from the three pillars of the triple bottom line using many case studies.

The analysis task consisted of analyzing these concepts and relationships qualitatively to create a network diagram that graphically reproduced the existing links.

The findings reveal that implementing Agile Project Management has a variety of effects on an organization's social, economic, and environmental dynamics. When the bulk of these interactions were examined, it was discovered that there is a favorable effect on all of them.

This work also aims to explore the concepts related to Agile Project Management. In doing so, the author explores the questions of what the need for Project Management is, where did Project Management begin, what are the different approaches that a project can take, why the need for Agile Project Management, which methodologies exist within the Agile Project Management and what tools can help Agile Project Management to achieve results faster.

PALAVRAS-CHAVE

Palavras-chave: Gestão Ágil de Projetos; Agilidade; Metodologias Ágeis; Scrum; Kanban; Gestão de Projetos; Sustentabilidade; Desenvolvimento Sustentável; Tripé da Sustentabilidade

RESUMO

O mundo industrial está a ficar mais competitivo a cada dia que passa. As empresas enfrentam novos desafios e para conseguirem sobreviver precisam, de encontrar maneiras de se destacarem das demais. Uma forma de as empresas fazerem isso é melhorar a qualidade dos produtos, o que pode ser alcançado, melhorando o planeamento da produção. Por esta razão, ter uma boa gestão de projetos torna-se crucial.

O objetivo desta tese é investigar uma nova perspetiva dentro da área teórica da sustentabilidade em gestão de projetos. O objetivo do estudo é provar que existem ligações entre a gestão ágil de projetos e a sustentabilidade, bem como aprender como a gestão ágil de projetos afeta a dinâmica social, ambiental e económica das organizações, do ponto de vista do tripé da sustentabilidade.

A pesquisa examina como as ideias de gestão de projetos ágeis estão conectadas aos conceitos dos três pilares do tripé da sustentabilidade, por meio do uso de vários estudos de caso.

A tarefa de análise consistiu em avaliar qualitativamente esses conceitos e relações, a fim de criar um diagrama de rede que reproduzisse graficamente as relações existentes.

Os resultados revelam que a implementação da gestão ágil de projetos tem vários efeitos na dinâmica social, económica e ambiental de uma organização. Quando estas interações são examinadas, os resultados mostram que este método de gestão tem um efeito positivo.

Este trabalho tem também como objetivo explorar os conceitos relacionados com a gestão ágil de projetos. Para tal, o autor explora as questões sobre qual a necessidade da gestão de projetos, onde começou a gestão de projetos, quais são as diferentes abordagens que um projeto pode tomar, o porquê da necessidade de uma gestão de projetos ágil, quais as que existem dentro da gestão ágil de projetos e quais as ferramentas que podem ajudar a gestão ágil de projetos a alcançar resultados mais rapidamente.

LIST OF SYMBOLS AND ABBREVIATIONS

List of abbreviations

AM	Agile Manufacturing
APM	Agile Project Management
CPM	Critical Path Method
DAD	Disciplined Agile Delivery
DEF	Design for Environment
DSDM	Dynamic Systems Development Method
EMS	Environmental Management Systems
FDD	Feature Driven Development
ISO	International Organization for Standardization
IT	Information Technology
LCA	Life Cycle Assessment
NASA	National Aeronautics and Space Administration
PERT	Program Evolution Review Technique
PM	Project Management
PMI	Project Management Institute
PPC	Production Planning and Control
ROI	Return on Investment
SAFe	Scaled Agile Framework
SPM	Sustainable Project Management
TBL	Triple Bottom Line
US	United States
WBS	Work Breakdown Structure
XP	eXtreme Programming

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INTRODUCTION

1 INTRODUCTION

1.1 Contextualization

A project is something singular, something that is connected to a goal, and when you achieve what you aim, it means that the project ceases to exist (Harold Kerzner, 2017). But to accomplish this goal and to have a successful project it is necessary to do a well-structured plan, and with that comes controlling and monetarizing all the involving aspects of it (Papke-Shields & Boyer-Wright, 2017).

Nowadays, the industrial world appears as very competitive, forcing companies to show new ways of thinking in order to set apart from the rest (Balaji *et al*., 2015). Many times, this changes can be found in the quality of the products, but also in the quality of its confection processes, and it is possible to state that in most cases, improving the quality of project planning is key to achieve success, here is when Project Management (PM) is really necessary (Freitas *et al*., 2020).

Another relevant aspect is that customers are searching for customized products and in smaller quantities or even single products (Günther Schuh *et al*., 2018), making the market volatile and uncertain. It is necessary to find effective strategies to attract and retain individuals, and this seems to be a challenge for organizations (Jan & C., 2020).

To move forward, it is necessary to give to the companies methods and solutions to overcome these adversities, and bearing this in mind comes the Lean philosophy, for being innovative, it presents the necessary potential to allow companies to progress and minimize costs (Tayal & Singh Kalsi, 2020).

The existing environment, focused only on optimization around the process production and associated costs, changed direction to a more demanding and broad market, where customers demand products/services customized and appropriate to their needs. Accompanied by the inability to respond and adapt by part of the companies, a new paradigm emerged, the agile production accompanied with Agile Project Management (APM), which implies adaptability and speed of response and also follows the market, in a way it deals with the aggressiveness of current consumers in the search for new products and services (Shewchuk, 1998).

Because of their emphasis on business benefit, solid stakeholder involvement and quick incorporation of changing requirements, agile methodologies are becoming more and more important in the current context (Kasauli *et al*., 2021; Kussunga & Ribeiro, 2019).

Even though, when using agile methodologies there is an upgrade on companies' production system and, with that, the products improve. It is not yet possible for companies to achieve perfection, and so they try to upgrade in other areas like sustainability. The sustainability subject is a reality and a necessity for everyone in all areas, as environmental aggressions that cause climate change keep on growing, and due to the necessity to take measures to resolve such situations. The application of sustainability in management has been considered of great importance for the success

of the business, so much so that a series of studies have identified positive correlations between sustainability, the company's success and company's image (Hansen *et al*., 2011). This reason, combined with the goals set by the United Nations (*Sustainable Development Goals | Unfoundation.Org*, n.d.), can explain the reason why sustainability and sustainable, development have become the focus for many companies. For a company to be considered sustainable it is necessary to consider the impact of its activities on the environment, trying to reduce them and, consequently, developing social actions that benefit both its employees and the society.

It is important to refer that sustainable development is an evolutionary and systematic process. It is expected that when incorporated with the management techniques from the company, it will be possible to generate profit and simultaneously contribute for the achievement of social and environmental goals. These is achieved through the integration of social responsibility, as a strategic investment, at the core of its business strategy, in its management instruments and their operations, also adding value to their products.

Considering what was mentioned above, the goal of this paper is to carry out a structured analysis of the literature to make an overview on the necessity of PM and the several approaches a project can take, followed by some of the existing frameworks of APM and the values and principles of agile. It will also be explored the significance of APM and when companies should pursue this kind of management over the traditional approach. Furthermore, this work will also focus on the three pillars of sustainability (environmental, economic, and social) and how agile practices influence them in companies.

1.2 Main Goals

The present master dissertation has as main goal finding the best approach for companies that employ APM to become more sustainable and pointing out the positive and negative APM concepts that influence sustainability aspects, to create a new framework that can interconnect APM practices with the tree pillars of sustainability. To do so, the following specific objectives have been defined:

- Research in the literature works done on Agile Project Management;
- Research in the literature works done on sustainability;
- Research in the literature works done on Agile Project Management supported by sustainable practices to have a continuous improvement;
- Seek for future possible improvements on the methodology to promote a good insight to the Agile Project Management and sustainability inside companies.

1.3 Utilized Methodology

The first phase was the selection of the subject, trying to understand the importance of APM and sustainability, what benefits these approaches brings to companies, and then, how we can combine both to improve production and the company's success. In this

way, the author tried to analyze information available in various platforms (Web of Science, ScienceDirect, Google Scholar, etc.) that provide sources for scientific and technical research. Then, after a thorough research across 150 journals, books and articles were reached, 107 articles have been found, corresponding to 71% of the documents. 15% are related to editorial material, while only 7% are conference proceedings and the remaining 7% are reports, as shown in Figure 1.

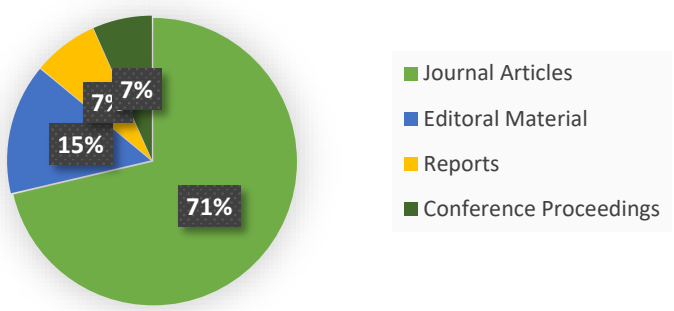


Figure 1 - Type of publications found and used in this work

Regarding the analysis carried out, the articles have also been categorized according to ten research topics: APM, agile, hybrid methodology, Kanban, Lean, PM, Scrum, Scrumban, sustainability and sustainable development. This categorization allowed to assess which topics were most addressed. According to Table 1, Agile was the topic that received more attention, followed by Sustainability.

Table 1 - Categorization of the analyzed articles

Research topic	N.o of articles	%
Agile	53	35,33
Sustainability	27	18,36
APM	22	14,66
PM	17	11,33
Research methodology	9	6
Scrum	8	5
Kanban	7	4,66
Hybrid approach	3	2
Scrumban	2	1,33
Lean	2	1,33
Total:	150	100%

In the last stage of this work, a communication proposal, that best adequate to the goals set, was created.

1.4 Dissertation Structure

The thesis structure was developed within the intention that the reader follows a story line. Thus, this thesis is divided in four chapters.

In the first chapter is presented the introduction of the work. Here, it is possibly to find the contextualization of the project in function of the goals that are intended to reach, the main goals, the utilized methodology and the dissertation structure.

The second chapter shows the literature review related to the main topics of this work. It is demonstrated the research to support the development of this thesis, and several case studies relevant for the work.

The third chapter, while bearing in mind the case studies previously analyzed, ideas are aggregated and a critical analysis is carried out, which highlights the main APM concepts, and the aspects of sustainability found in the case studies. Then, a new model is developed that includes these same points to know how they connect and influence each other.

In chapter 4, the main conclusions of the work are presented.

LITERATURE REVIEW

2.1 Agile Manufacturing

2.2 Agile Project Management Framework

2.3 Sustainability

2.4 Sustainability in Agile Project Management

2 LITERATURE REVIEW

2.1 Agile Manufacturing

In the early 1990s, the European industry had a huge growth, taking the lead of worldwide commerce (de Castro, 2018). Manufacturing companies started to operate in fast-moving commercial environments where unanticipated threats and opportunities are the order of the day (Sharifi *et al*., 2001). The necessity to work in a fast pace and to respond to stakeholders requests quicker, increasing the product value even before the final product, is one of the main reasons why agile practices are being implemented (Antlova, 2014; Nijssen & Paauwe, 2012).

In the book "21st Century Manufacturing Strategy: An Industry-led View", it is possible to see the concept of agile appearing as a new paradigm, introduced by Iacocca Institute at Lehigh University, saying that agile is the capacity in which the physical resources and the workers are capable to reconfigure themselves in order to cope and adapt changes that have not been scheduled (Plonka, 1997). At first, when searching for proposals of how to deal with an uncertain and unpredictable environment, the most predominant and popular notions were of ''adaptive organization'', ''flexible organization'', and ''agile enterprise''. And even though these may appear with different definitions, all concepts were considered as retaining the ability to adjust and respond to change. AM emerged as strategy to respond and adapt to complexity and unpredictable environments (Sherehiy *et al*., 2007; Stettina & Hörz, 2015).

The management of AM has a variety of approaches that use a wide range of tools. In Figure 2, it is possible to see the enablers of agile manufacturing coming together to implement an agile manufacturing systems (AMS) (Gunasekaran, 1998).

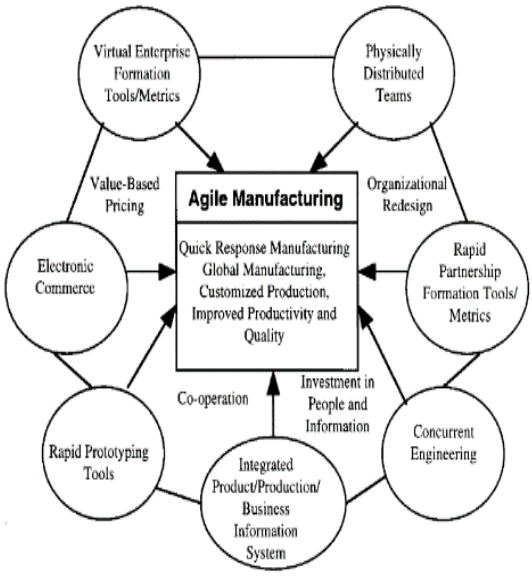


Figure 2 - A conceptual model to illustrate the concept and enablers of agile manufacturing (Gunasekaran, 1998)

2.1.1 Values and principles of agile

The existence of a massive time lag between business requirements and the delivery of technology in the 1990s lead to a frustration in the industry world. Projects were being canceled and, in some cases, the final product did not meet the actual need. The Waterfall model was the basis for the software development models of the day; however, these were not meeting the fast requirements changes. The Agile Manifesto and the Twelve Principles of Agile Software were the outcomes of these problems (Bermejo *et al*., 2014).

Even though they first originated in the software industry, the principles of APM practices have already shown favorable results when applied not only to software projects (*AGILE Practice Guide*, 2017; H. Kerzner, 2019).

The four values of the Agile Manifesto, that guide the staff who integrates the work teams that work daily in the development of projects and in fast and effective delivery are:

1. Individuals and interactions over processes and tools.

Valuing people is more important than processes or tools, because these people are the ones who respond to business needs and drive the development process. When tools and process drive development, then the team is less responsive to change and less likely to meet customer needs. Communication is important and in case of individuals, it is fluid and happens when a need arises. In the case of process, communication is scheduled and requires a specific content (Beck *et al*., 2013).

2. Working software over comprehensive documentation.

Historically, enormous amounts of time were spent on documenting the product for development and ultimate delivery. Agile does not eliminate documentation, but does it in a way that provides the developer what is needed to do the work without getting bogged down in minutiae (Beck *et al*., 2013).

3. Customer collaboration over contract negotiation.

Negotiation is the period when the customer and the product manager work out the details of a delivery, with points along the way where the details may be negotiated. On the waterfall approach, the requirements are negotiated with the customer in detail, prior to any work starting. This means that the costumer is involved in the process of development before the beginning of the actual work and after it is completed, but not during the process. The Agile Manifesto describes a customer who is engaged and collaborates throughout the development process. This makes it easier for development to meet the needs and desires of the customer (Beck *et al*., 2013).

4. Responding to change over following a plan.

Traditional methods considered change as an expense, so they had to be avoided. The intention was to develop detailed, elaborate plans, with a defined set of features with everything. With Agile, the small-time iteration means that priorities can be shifted from iteration to iteration and new features can be added into the next

iteration. Agile point of view is that changes will always provide additional value, which will improve the project (Beck *et al*., 2013).

The twelve principles behind the Agile Manifesto, that are fundamental to an agile management are as follows (Stellman & Greene, 2015):

1. Customer satisfaction through early and continuous software delivery.
2. Accommodate changing requirements throughout the development process.
3. Frequent delivery of working software.
4. Collaboration between the business stakeholders and developers throughout the project.
5. Support, trust, and motivate the people involved.
6. Enable face-to-face interactions.
7. Working software is the primary measure of progress.
8. Agile processes to support a consistent development pace.
9. Attention to technical detail and design enhances agility.
10. Simplicity.
11. Self-organizing teams encourage great architectures, requirements, and designs.
12. Regular reflections on how to become more effective.

Figure 3 shows that agile is a mindset defined by the relationship between the Agile Manifesto values, principles, and common practices.

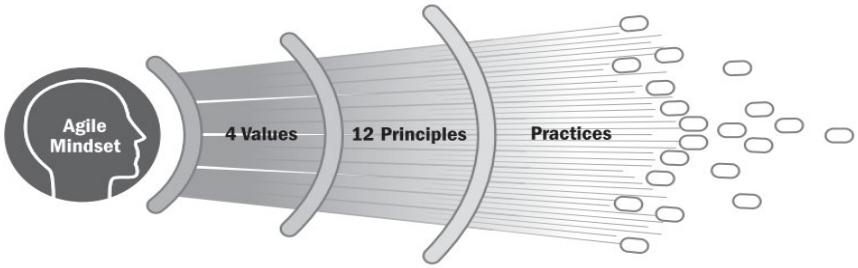


Figure 3 - Relationship between the Agile Manifesto values, principles and common practices (*AGILE Practice Guide*, 2017)

2.1.2 The necessity of Agile Project Management

PM has two types of methodologies: traditional and agile. Agile methodologies were born to fill some gaps in the traditional approach. A lot of projects have a high uncertainty, are very complex and have many risks which are the opposite of the requirements of upfront and control changes, through a change request process, that the traditional more predictive methodology presents. On the other hand, agile approaches were created to explore practicability in short cycles and quickly adapt based on evaluation and feedback (*AGILE Practice Guide*, 2017; Alqudah & Razali, 2017).

The main differences of the traditional and agile approach can be classified in four groups: requirements and specifications (the level of detail at the beginning of the project), project scheduling (iterations and a rough schedule at the planning phase),

team work (self-organized teams, daily meetings), and the costumer collaboration (the representative of the costumer is a regular team member) (Stare, 2014). Table 2 shows how we can identify if it is necessary to use, or not, the agile PM approach by observing six specific characteristics, among the practices adopted by the organization (Tomás, 2009).

Table 2 - Characteristics for identifying the PM approach used by an organization (Eder *et al.*, 2013)

Characteristics	Traditional PM approach	APM approach
1) How to prepare the project plan	There is a single project plan, which covers the total project time and contains the products, deliveries, work packages and activities.	There are two project plans: a) a general plan that considers the total duration of the project, but which contains only the main products of the project; b) a short-term plan (iteration) that contains only deliverables and activities for a fraction of the project's time.
2) The way in which the scale of the project is described	Exact description of the result through text, with contractual standards, objective numbers, and performance indicators.	Description of the result in a comprehensive, challenging, ambiguous and metaphorical way.
3) The level of detail and standardization with which each project activity is defined	The activities are described in a standardized way and organized in a Work Breakdown Structure (WBS) type lists. They contain codes and are classified into sets of work packages, deliveries, and project products.	There is no standard for describing activities, which can be written in the form of stories, problems, actions, or deliverables. And there is no attempt at organization, just prioritizing what needs to be done now.
4) The planning horizon of the project team's activities	The activity lists are valid for the total project horizon.	Activity lists are valid for an iteration, which is defined as a fraction of the total project time.
5) The strategy used to control the project time	Use of reports with performance indicators, written documents, audits, and analysis of	Visual devices are used to indicate physical deliveries of the result (posters, self-adhesive, etc.). The

	phase transitions are used. Team meetings are sporadic.	meetings are short and frequent.
6) The strategy used to achieve the project goal	The project manager evaluates, prioritizes, adds, or changes the activities of the project, so that the results are in accordance with the scope of the project signed with the costumer.	The costumer evaluates, prioritizes, adds, or changes the final product of the project, according to the experience with the results achieved. The team changes the activities to obtain the results proposed by the costumer.

Typically the Project Management Office activity is connected to the management and coordination of plan-driven projects, also known as waterfall or traditional projects (Pinto & Ribeiro, 2018). This methodology is normally used for projects with a well understood scale and permitted using proven technologies (Collyer & Warren, 2009).

The waterfall model is designed so that the life cycle stages occur sequentially, thus, until the preceding phase is complete, the project cannot move on to the next phase of development (Mccormick, 2012). Figure 4 shows an example of the waterfall model.

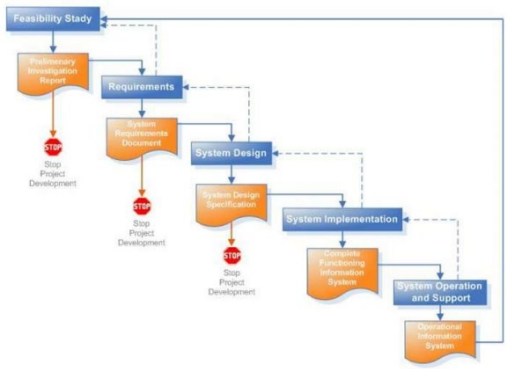


Figure 4 - Waterfall model (Mccormick, 2012)

APM has as focus managing customer needs and evolving their needs by using short development cycles (iterations) and continuous change and adaptation all the way through the project life cycle (Barlow *et al.*, 2011).

The main change during the implementation of agility in a company is at the organizational structure level. For some decades, companies have adopted a hierarchical organizational structure that, with the new reality of the industrial world, needed to be changed and revised to adapt to the new landscape existing in the 90s (*AGILE Practice Guide*, 2017). People present a key role in the company development

and in their own projects, so it is essential to form teams to prevent obstacle to the company's agility (Ventura, 2007). According to agile production practices, tasks can be sorted into fields or departments and then cross-functional teams are formed to perform the activities of each area (Cabral *et al.*, 2012; Diebold *et al.*, 2019).

In 2015, according to the Chaos Report Standish Group (Hastie & Wojewoda, 2015) 39% of the agile projects were successfully completed, while only 11% of the waterfall projects achieved the same outcome.

2.1.3 Agile and hybrid methodologies for Project Management

"A project is a temporary effort taken to create a product, service, or an exclusive result" (*PMBOK ® Guide*, 2013). Projects and operations are different, as showed in Figure 5, projects on its core are temporary and exclusive as for operations, these are continuous and repetitive (Osman & Al Hinai, 2018; Stackpole, 2010).

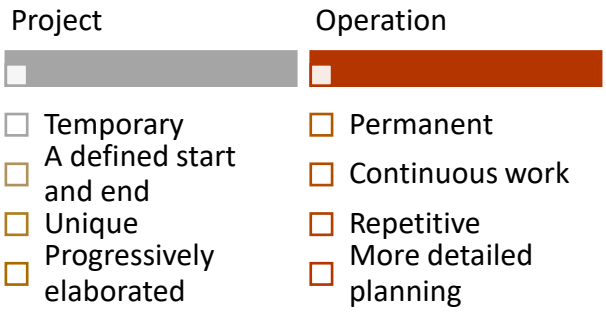


Figure 5 - Project vs operation (Osman & Al Hinai, 2018)

Nowadays, it is almost impossible to find a company that does not have projects undergoing (John, 2010; Varajão *et al.*, 2021), which makes PM essential to organizations.

PM is an activity that requires the application of knowledge from different areas, and so projects may appear in many shapes and there are a variety of ways to undertake them (Fernandes *et al.*, 2018). Fortunately, to get around this challenge and achieve the proposed objectives, it is possible to count on the help of PM methodologies, which make this process more practical, organized, and efficient. Nonetheless, it is necessary to pass the knowledge of the different characteristics and approaches, so teams can select the approach that is most likely to be successful to the job (*AGILE Practice Guide*, 2017; Ahern *et al.*, 2014).

Projects may have a large sliding scale of unknowns like methods to achieve it, the objective, and even the environment it must operate. Figure 6 illustrates this sliding (Collyer & Warren, 2009).

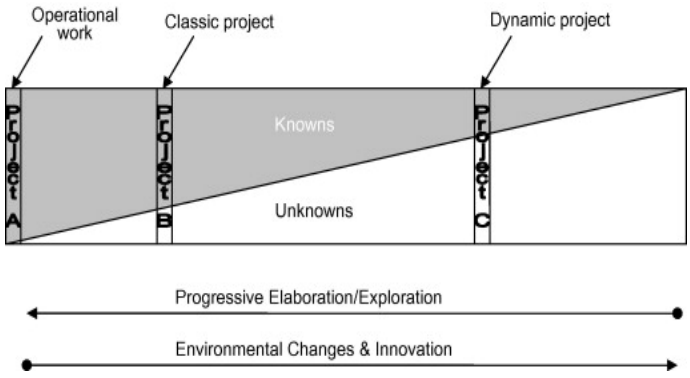


Figure 6 - The race to resolve project unknowns (Collyer & Warren, 2009)

There are four types of approaches: predictive, iterative, incremental, and agile. In Table 3 are presented their characteristics.

Table 3 - Characteristics of Four Categories of Approaches (*AGILE Practice Guide*, 2017)

	Characteristics			
Approach	Requirements	Activities	Delivery	Goal
Predictive	Fixed	Performed once for the entire project	Single delivery	Manage Cost
Iterative	Dynamic	Repeated until correct	Single delivery	Correctness of solution
Incremental	Dynamic	Performed once for a given increment	Frequent smaller deliveries	Speed
Agile	Dynamic	Repeated until correct	Frequent smaller deliveries	Customer value via frequent deliveries and feedback

Perfection is almost impossible to obtain when comes to choosing the right approach for the project. As an alternative each project can look for a position on the continuum that gives the perfect balance for its framework. Figure 7 shows the continuum approaches, illustrating that the frequency of delivery and degree of change are the main factors when comes to picking the right approach for the project.

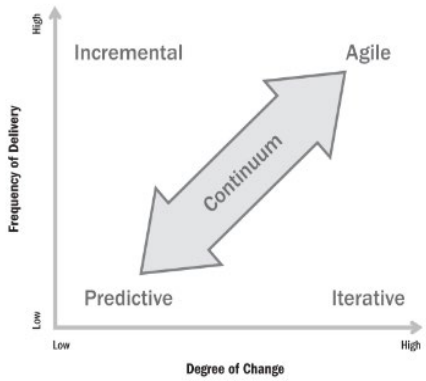


Figure 7 - The Continuum of Approaches (*AGILE Practice Guide*, 2017)

Hybrid Approach

What happens several times, is that projects use more than one approach, they combine different elements from different approaches to attain certain goals. This mix is called a hybrid approach, and this needs to be specially developed for the project.

The hybrid approach allows certain approaches to have a piece of the other approaches, using the best elements of each and, at the same time, replacing the weak spots of one approach for an element from another that confronts that weakness (Burggräf *et al*., 2020).

Figure 8 shows that the hybrid approach can be explained by a network of seven interrelated systems, containing the hybrid process system as the central element and this is surrounded by auxiliary systems as enablers (Brandl *et al*., 2018).

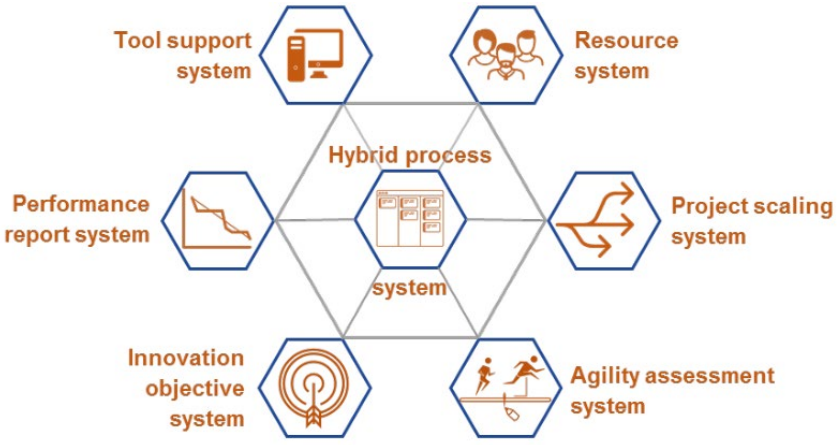


Figure 8 - Hybrid Framework (Brandl *et al*., 2018)

Hybrid infrastructure projects are defined as triads of on-site/coordination/off-site project dimensions (Arashpour *et al*., 2017). Table 4 illustrates examples of different hybrid approaches.

Table 4 - Examples of hybrid approaches (*AGILE Practice Guide*, 2017)

This hybrid approach utilizes an agile development cycle, followed by a predictive rollout phase. This method can be employed when there is indecision, difficulty, and risk in the growth part of the project, which would profit from an agile approach, followed by a defined, repeatable rollout, phase which is appropriate to be carried out in a predictive way (*AGILE Practice Guide*, 2017).

Figure 9 - Agile Development Followed by a Predictive Rollout (*AGILE Practice Guide*, 2017)

In this configuration exists a combination of agile and predictive approach. The project uses an agile approach to things that are still not clear and the predictive approach on things that are known during the planning and execution phase (*AGILE Practice Guide*, 2017).

Figure 10 - A Combined Agile and Predictive Approach Used Simultaneously (*AGILE Practice Guide*, 2017)

This example shows a predominantly predictive approach with some small agile elements (*AGILE Practice Guide*, 2017).

Figure 11 - A largely predictive approach with Agile components (*AGILE Practice Guide*, 2017)

Here, it is possible to see a largely agile approach with predictive components (*AGILE Practice Guide*, 2017).

Figure 12 - A Largely Agile Approach with a Predictive Component (*AGILE Practice Guide*, 2017)

Agile Methodologies

Agility is conceptualized to include and go beyond both flexibility and leanness (Dingsøyr *et al*., 2012). According to Conboy (Conboy, 2009), flexibility relates to the ability of a systems development method to *"create change, or proactively, reactively, or inherently embrace change in a timely manner, through its internal components and its relationships with its environment"*. Moreover, leanness captures the "*contribution to perceived customer value through economy, quality, and simplicity."*

This methodology, like all others, has advantages and disadvantages, whose are listed below (Patanakul & Rufo-McCarron, 2018; Petersen & Wohlin, 2009).

Advantages:

- Changes are made and accepted with normality.

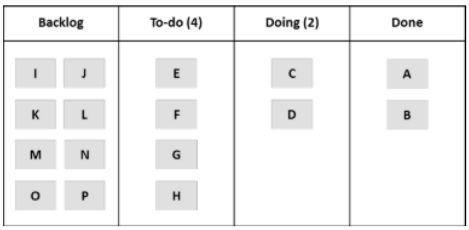
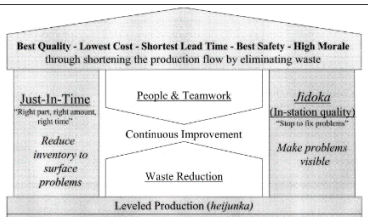
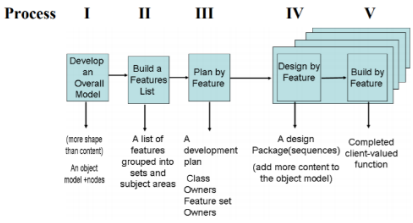
- The end goal is flexible and can be changed throughout the process.
- Faster final product delivery.
- Encouraging greater communication between the teams.
- Development process can be accompanied by the costumer.
- Continuous improvement.

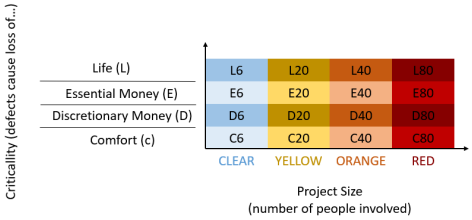
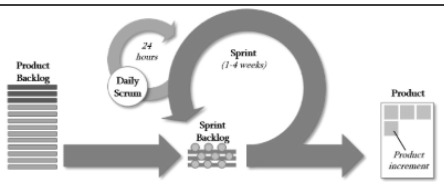
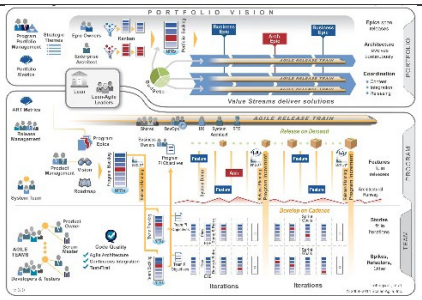
Disadvantages:

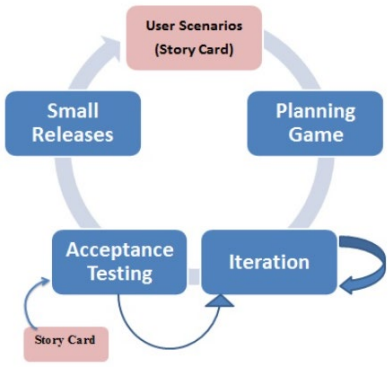
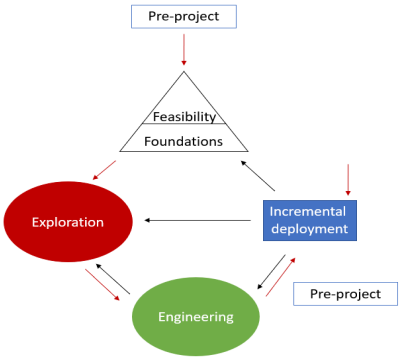
- Less concrete planning.
- Team members can have more than that just one role.
- A great dedication from teams.
- The final product may be different than was expected.
- Less cost control.

In Table 5 is presented some of the most known agile methodologies.

Table 5 - Agile methodologies

Method	Description	Scheme
Kanban	Improves flow and induces system improvement through visualization and controlling work in progress (David J. Anderson, 2010).	 Figure 13 - Kanban board (David J. Anderson,
Lean	Focuses on improving processes by maximizing value through eliminating wastes (achieve more with less) (H. Castro *et al*., 2012; Sohi *et al*., 2016).	 Figure 14 - Lean Manufacturing House (Liker & Morgan, 2006)
Feature Driven Developme nt (FDD)	A light agile method. Uses a set of PM practices. Has five basic processes: development of the comprehensive model (object-oriented analysis); construction of a list of functionalities (functional decomposition); planning by functionality (incremental planning); detail by functionality (drawing object-oriented); construction by functionality (programming and test oriented	 Figure 15 - The five processes of FDD with their outputs (Goyal & Schiller, 2007)

	to objects) (Firdaus *et al.*, 2014; Mishra & Mishra, 2011).	
Crystal	Shapes a project from two parameters: team size and critical level. The main features are continuous delivery, feedback and communication, high levels of focus, security and access to the customer, automation of tests and integrations (Cockburn, 2004).	 Figure 16 - Crystal methodology (Solomon & Young, 2015)
SCRUM	An iterative timeboxed approach to product delivery. A framework within which people can address complex adaptive problems, while productively and creatively delivering products of the highest possible value (Matharu *et al.*, 2015).	 Figure 17 - Overall procedure of Scrum (G. Schuh *et al.*, 2018)
SAFe (Scaled Agile Framework)	Large-scale application of agile across an organization. SAFe synchronizes alignment, collaboration, and delivery. It is scalable and modular (Beecham *et al.*, 2021; Leffingwell *et al.*, 2017).	 Figure 18 - Scaled Agile Framework (Turetken *et al.*, 2017)

Xp (eXtreme Programming)	For small/ medium teams. Work is based on vague and fickle requirements. Tries to add maximum value to the customer based on their feedback. Some of the practices of this methodology are: having the customer always present; working on the requirements and priorities with the development team; daily meetings and simplicity in project (Ghani & Yasin, 2013; Soares, 2004).	 Figure 19 - Extreme Programming approach (Tuli *et al.*, 2014)
Dynamic Systems Development Method (DSDM)	Focuses on the iterative delivery of business systems using timeboxing and continual business involvement. Has a defined process and corresponding set of products, as set of roles that operate at all levels of a project, eight guiding principles and a collection of key techniques that can be used throughout project (Sani *et al.*, 2013).	 Figure 20 – DSDM (Solomon & Young, 2015)

The choice of methodology is a complex and important process, making the wrong choice can mean the failure of the project, or consequences such as increased costs, late deliveries, team, and customer discontent, among others. Figure 21 shows the most used methodologies (VersionOne, 2013).

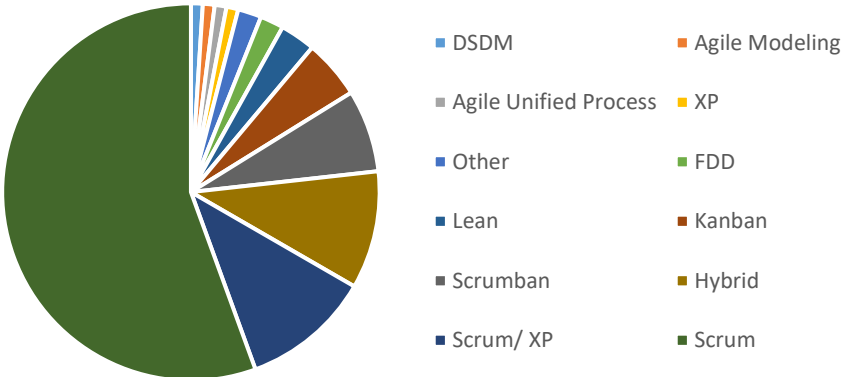


Figure 21 - Agile methodology used (VersionOne, 2013)

2.1.3.1 Scrum

Scrum is a framework for delivering, developing, and sustaining complex products. It is a single-team process outline used to manage product development that runs on time-boxes with consistent durations, sprints, where a potentially releasable increment of product is produced. It consists of Scrum roles, artifacts, and rules (Lei *et al*., 2017; Schwaber & Sutherland, 2017).

Scrum itself is not a strictly described method. It is instead a set of general procedures within which it is possible to use different types of processes and techniques (Rola *et al*., 2016).

Scrum consists of a team composed by three scrum roles: Product Owner, Development Team, and the Scrum Master.

The Product Owner is responsible for maximizing the value of the product, resulting from work of the development team, and is the sole representation of the costumer. The Product Owner oversees creating, updating, prioritizing the product backlog items, and the optimization of the work performance of the Development Team, to ensure that the product backlog items are clear, transparent, and understood by everyone. The Product Owner is, as well, the one who represents the entire stakeholder community, internal and external (Streule *et al*., 2016).

The Development Team consists of professionals that do the actual work. All the members are equal and are seen as a whole, even though each person has their field of expertise (Streule *et al*., 2016).

They also deliver a potentially releasable increment of "Done" product at the end of each sprint. The team is cross-functional, with all the skills inside the team necessary to create the product Increment, there are not sub-teams in the development team, and only the development team members can create the increment (Schwaber & Sutherland, 2017).

The Scrum Master is responsible for promoting and supporting Scrum. The Scrum Master role changes while the team matures, but initially plays nine leadership roles (Cervone, 2011; Spiegler *et al*., 2019):

- Method champion - organizes meetings, teaches the method, and discusses how to adapt the method during the retrospective;
- Discipliner on equal terms - supports the team to keep to the rules, ensures that the team is focus and makes sure that team members attend the meetings;
- Coach - observes team members, provides feedback, and helps teams to find out what they wish to change and how to do so;
- Change agent – the Scrum Master is a role model, changes habits, and guides newly established project teams of the agile way of working;
- Helicopter - knows who possess the right skill for a certain task, to include relevant stakeholders and to structure work;

- Moderator – the Scrum Master moderates meetings and builds a bridge between viewpoints and different fields;
- Networker - connects the team with relevant people from within and outside the organization;
- Knowledge enabler - realizes which kind of knowledge the team needs and supports team members to acquire that knowledge;
- Protector - shields teams from improper requests from the Product Owner, managers, disciplinary leaders, and other departments.

Some of the Scrum events and artifacts are summarized in Table 6.

Table 6 - Scrum Events and Artifacts

Scrum events	
Sprint planning	The team discusses and plans what can be delivered in the Sprint period (Bissi, 2007).
Sprint execution	The Scrum Master and the team analyze what was done since the last daily meeting, what they intend to do and what will be done on the following day (James & Walter, 2010).
Daily scrum	Informal meeting between the team and the stakeholders to demonstrate and inspect what was done in the Sprint and discuss about the problems that occurred (James & Walter, 2010).
Sprint review	The team reviews the work and outlines a plan for improvements to be applied in the next Sprint (Khan *et al*., 2019).
Sprint retrospective	The Scrum Team reflects on its own process and creates a plan for improvements to be applied during the next sprint. This activity occurs after the Sprint Review and prior to the next Sprint Planning (James & Walter, 2010).
Scrum artifacts	
Product backlog	List of requirements requested by the product owner with everything that might be needed in the product (Schwaber & Sutherland, 2012).
Sprint backlog	It is a set of items from the product backlog selected for the sprint. It is a forecast made by the development team, to determine the work needed and what functionality will be in the next increment, to accomplish a goal (Schwaber & Sutherland, 2012).
Burndown chart	The sprint burndown chart is a displayed chart showing the work that still needs to be done in the sprint backlog. It is updated every day, providing a simple view of the sprint progress (Mahalakshmi & Sundararajan, 2008).

Then, it is important to address the topic of Done. This is an essential point for when the team decides to attribute a task as "Done". In order to do so, the product owner and the team need to have a clear definition of "Done" (Kniberg, 2015).

In the Agile Practice Guide (*AGILE Practice Guide*, 2017), Done is also defined as a team checklist of all the criteria required to be met, so that a deliverable can be considered ready for customer use. It is used to do an evaluation when work is completed on the product increment (Schwaber & Sutherland, 2017).

2.1.3.2 Kanban

The Kanban System was developed by Mr. Taiichi Ohno, Vice-President of Toyota Motor Company (Aguilar-Escobar *et al*., 2015; Sugimori *et al*., 2007). It is a powerful tool that allows to improve the sustainability and the control of stock (Pombal *et al*., 2019). According to Anderson and Carmichael (Anderson & Carmichael, 2016), Kanban is a method for defining, managing and improving services that deliver knowledge work, such as professional services and creative endeavors.

Kanban provides smooth and continuous approach to deliver high-quality value to the customers, on time and budget. It, carefully controls, the flow and quality of work to discover and resolve issues immediately. It limits the work, so that, it does not build up and, the team and product can adjust to market shifts daily (Brechner, 2015).

Kanban has been used as a work-visualization mechanism and has three principal features, achieving these enables successful and accelerated coordination and control of the workflow. The three key focus of Kanban can be descried as (Fuior, 2019; Powell, 2018):

1. Materialization of information flow;
2. Visualization of workflow;
3. Restriction of work-in-process (WIP).

Based on the constant work-in-process principle, the number of tasks that can be assigned are limited. By having set a limit for WIP, a pull mechanism is created, which means that the start of a new task only begins when the current task is done (Powell, 2018; *The Kanban Guide for Scrum Teams*, 2018).

Kanban should be used when a team or an organization needs flexibility (teams are not limited by sprints and will work on the highest priority item in the backlog), focus on continuous delivery (teams are focused on flowing work through the system to completion and not beginning new work until the work in progress is completed) and increasing productivity and quality (*AGILE Practice Guide*, 2017).

2.1.3.3 Scrumban

Scrum and Kanban are both Lean and Agile processes that use pull scheduling, limit WIP, use transparency to drive process improvement, focus on delivering releasable software early and often, are based on self-organizing teams, require breaking the work into

pieces and the release plan is continuously optimized based on empirical data (velocity/ lead time) (Kniberg & Skarin, 2010).

Nevertheless, they show some differences. These are presented in Table 7 (Ellis, 2016).

Table 7 - Differences between Scrum and Kanban (Ellis, 2016)

Scrum	Kanban
More perspective	More adaptive
Timeboxed iterations	Timeboxes are not prescribed
Has three roles	Does not prescribe roles
More rules to follow	Fewer rules to follow
Scrum Master owns the process	Team owns the process
Tracks Velocity	Team owns the process

The similarities between the two agile methodologies and the differentiating aspects motivated the creation of a combined approach, the Scrumban (Figure 22). This is a hybrid approach that calls on technical and methodological "compromises" between the parent methodologies (Stoica, 2016). Scrum provides a framework for iterative and incremental development process, whereas Kanban ensures high visibility of the workflow and quick identification of possible bottlenecks, thus enabling continuous process improvement (Mahnic, 2013).

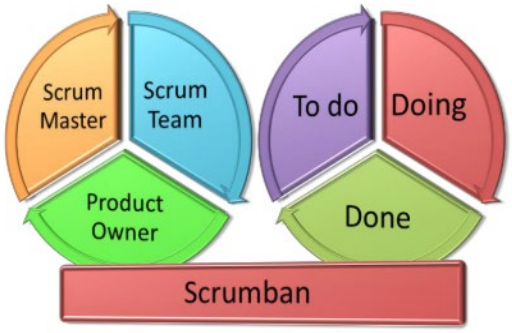


Figure 22 – Scrumban (Stoica, 2016)

2.1.4 Implementing Agile Project Management

To analyze the effects of implanting APM practices in companies, it is necessary to look at the literature regarding some study cases. Table 8 shows relevant studies in the scope of APM practices.

Table 8 - APM research

References	Work description
(Brito *et al.*, 2018)	This article aimed to evidence the benefits of using an integrated operations management approach, following

	lean/agile/ergonomic concepts, to improve the performance and ergonomic aspects of a production system. After the study was done, it was concluded that by using lean and agile principles, there was a reduction of the transportation time and the lead time. Also, the ergonomic risk decreased.
(Conforto & Amaral, 2016)	This study reports an empirical analysis of a hybrid management framework combining APM and stage-gate model implemented in a technology-driven project. The results indicate positive impact on the project and product development performance and suggest that combining these two approaches to balance stability with flexibility is a potential solution for managing innovation projects in high technology-based companies.
(Žužek *et al*., 2020)	This paper presents the implementation of only certain APM practices in a medium-sized manufacturing company. The results showed that communication was improved, faster detection of discrepancies, more effective problem-solving and greater flexibility. The results also suggest that APM practices, even when implemented separately, positively impact project success in terms of both efficiency and stakeholder satisfaction, and can thus help in establishing an economically, socially, and environmentally more sustainable workplace.
(Julian *et al*., 2019)	This paper studies teams which adopted agile practices across a spectrum from taking on a whole methodology to a couple of practices at a time, and then committed to continuous assessment and improvement of their ways of working. This research showed that teams prefer adapting agile-based, team-oriented practices suited to their needs over technical practices and defined methodologies.
(Serrador & Pinto, 2015)	This study uses several projects across multiple industries and countries to test the effect of Agile in the efficiency and overall stakeholder satisfaction in organizations. The findings suggest that Agile methods have a positive impact on both dimensions of project success.
(Laanti *et al*., 2011)	This article aims to study the impacts of agile transformation when it is deployed in a very large software development environment. The results reveal that after implementing agile methods the company presented some benefits. These benefits include higher satisfaction, a feeling of effectiveness, increased quality and transparency, increased autonomy and happiness, and earlier detection of defects.
(Diebold *et al*., 2019)	This work aims to evaluate if an evolutionary transition to agile is suitable for small companies. The transition was based on assessments of improvements and the adoption of Agile practices

was done step-by-step. Positive experiences reported by all the employees during the agile transition indicate that an evolutionary transition is suitable for small companies.

2.2 Agile Project Management Framework

For various goals, various Agile Frameworks have been developed, and each have their one terminology and structure. The framework to utilize will be determined by the business orientation. Many specialized frameworks have a generic structure that can be split into three groups: Roles, Processes, and Products. There are at least four key responsibilities in the majority of frameworks (Valenzuela Musura & Supervisor, n.d.):

- Customer: provides the product's vision and makes judgments on what should be done and in what order. Typically, the product owner. At the end of each sprint, the customer will be responsible for checking off on some stories as "done".
- The team: they are the ones that take the customer's story and break them down into smaller tasks. The team decides on the duration of the project and how the jobs will be distributed among the members. The team decides how to best organize themselves in order to give the most value to the costumer by reviewing the progress made during daily stand-up meetings.
- Agile lead: this person plays a variety of roles. His primary role is to enable the team to self-organize and improve on a continuous basis. The Agile leader should create a welcoming climate where individuals are not scared to try new things and learn from their errors. The team leader should have prior Agile experience and a thorough understanding of the methodology.
- Stakeholders: any individual or group that can assist in delivering value to the costumer is considered a stakeholder in Agile. Stakeholders should verify that the project represents the interests of the group they are a member of.

2.3 Sustainability

The term sustainability, despite not having a concrete definition, became popular after the appearance of the concept of sustainable development in the Brundtland Report in 1987, and after that many definitions have appeared (Gupta *et al.*, 2018; Ruggerio, 2021).

Even though the first things that comes to people minds when talking about sustainability is the environment, nowadays in addition to natural resources, we also need economic and social resources. Sustainability is not just environmentalism; it is also necessary to bear in mind economic development and social equity (Ostrom, 2009). This concept presents a highly positive connotation, and when combined, these three dimensions form what is currently known as the tripod of the sustainability, that is also known as “the triple bottom line” (TBL)(Boyer *et al.*, 2016). As we can see in Figure 23, all the components are interconnected with each other.

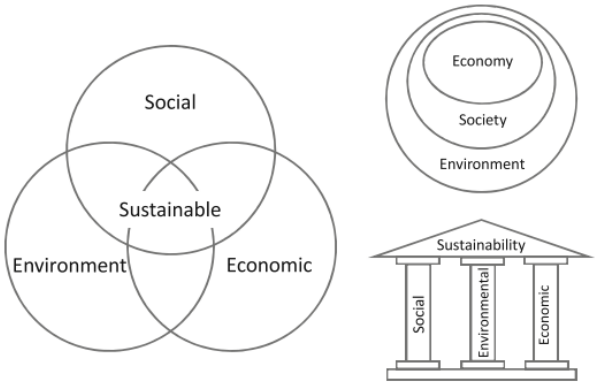


Figure 23 - Left, typical representation of sustainability as three intersecting circles. Right, alternative depictions: literal 'pillars' and a concentric circles approach (Purvis *et al*., 2019)

It is critical that the three pillars of sustainability interact in a harmonic manner, because sustainability cannot exist without these three pillars. One of the pillars depicts an environment in which sustainability is implemented, while each is reliant on the other for survival (Ranjbari *et al*., 2021).

Following this context, emerges, in 1987, with the World Commission on Environment and Development, through the Our common future report, better known as the Brundtland Report, the concept of sustainable development (Ruggerio, 2021). This term means meeting the needs of the current generation without compromising the ability of future generations to meet their own needs (*What Is Sustainability?*, n.d.).

2.3.1 Triple bottom line

The triple bottom line, as said before, is based on the three pillars of sustainability, economical pillar, environmental pillar, and social pillar. The TBL seeks to measure the financial, social, and environmental performance of a company over time. It is one of the best indicators of how sustainable your business is, and how profitable it truly is (Stanitsas & Kirytopoulos, 2021).

It is possible to determine how close or far a firm is to being sustainable using these pillars that evaluate its sustainability. As a result, a sustainable company is one that, at the end of its evaluation, maintained or promoted activities to increase its development level in the three areas (Gimenez *et al*., 2012).

2.3.1.1 Economical pillar

The economical pillar is concerned with the manufacture, distribution, and consumption of commodities and services. Companies cannot benefit from the exploitation of workers or the irresponsible and criminal exploitation of the environment to be sustainable. Sustainable attitudes benefit the financial sector since they limit the consumption of materials, energy, and water, lowering their monthly bill. To put it another way, there is a circular process of advantages that occurs between sustainability and the economy.

In short, it is directly related to the profit, to the positive economic-financial result of a company. When thinking about TBL, it is essential that this pillar bares in mind the aspects of the other two pillars, i.e., there is no point in profiting from deforesting (Bueno & Salvador, 2012; Silva *et al.*, 2012).

2.3.1.2 Environmental pillar

The environmental pillar is based on a variety of approaches to environmental preservation, natural resource conservation, and the reduction of environmental damage over time. At this level, businesses consider how to carry out their operations with the least amount of environmental effect possible.

To adapt to this scale, the corporation must follow environmental regulations when utilizing water and energy, reduce liquid effluent and solid waste emissions, recycle trash, invest in biodiversity, and preserve the environment (Purvis *et al.*, 2019).

2.3.1.3 Social Pillar

The social pillar is related to the development of human capital, such as the production of tools to improve people' quality of life, laws to support population needs, and the development of better politics in areas such as education, leisure and security. This pillar argues that the pursuit of a sustainable society entails a society that is well-cared for and healthy. Furthermore, to promote the personal and collective development of all employees engaged, it is critical to create an environment that encourages real and healthy work relationships (Purvis *et al.*, 2019).

2.3.2 ISO 14000

The ISO 14000 series is a set of international standards, developed by the International Organization for Standardization (ISO) and published for the first time in 1996, through which it is offered to organizations of all types and sizes a set of management tools to control their environmental aspects and improve their environmental performance (Patón-Romero *et al.*, 2019).

The main goal of the ISO 14000 family standards is to provide for environmental protection and pollution prevention, in harmony with socio-economic needs.

To this goal, standardization of environmentally friendly ways to manufacture and deliver services is encouraged, reducing the negative impact that organizational operations can have.

Except for the requirement of commitment to continuous improvement and the responsibility to comply with relevant legislation and regulations, the ISO 14000 set of standards do not specify environmental action obligations.

Among other pollutants, the ISO 14000 does not specify the maximum permissible amount of carbon dioxide (CO2) emission or the maximum level of bacteriological content in wastewater effluent. As a result, the ISO 14000 series of standards is specially designed to provide organizations with all the information they need to create and operate an EMS (Mohamed, 2001; Quazi *et al*., 2001).

2.3.3 Sustainability in companies

A summary of papers containing case studies from the sustainable field is undertaken in this subsection, to assess the topic of adopting sustainability in companies. Table 9 lists studies that are related to this topic.

Table 9 - Sustainability research

References	Work description
(Estoque & Murayama, 2014)	The study evaluates the sustainability of the urbanization process of Baguio City. The paper discusses the implications of the findings for the planning of sustainable development for the city, by determining the relationship between its velocity of urbanization and velocity of urban sustainability based upon various perspectives. The results demonstrated that Baguio City's urbanization has been progressing towards a "sustainable urbanization" from an equal weight perspective and a pro-economic perspective. However, there seems to be a big divergence between socio-economic growth and environmental sustainability.
(Kim *et al*., 2010)	To analyze prospects for decreasing the environmental impacts of forklift manufacturing unit processes and redesigning those unit processes to promote overall sustainability, life cycle assessment (LCA) and design for environment (DFE) approaches were used. Overall, ecotoxicity and human toxicity were the most significant repercussions of the forklift manufacturing process, according to the findings. Cutting, welding, and painting had the highest impact values among the manufacturing unit operations. To reduce environmental effect, a new paint with a higher solid content was developed to replace the present solvent paint used in the painting process.

	As a result, a follow-up LCA revealed that environmental impacts may be reduced by 20%, while volatile organic compound (VOC) and paint usage could be reduced by 30% and 20%, respectively, according to the environmental index.
(Ullah *et al*., 2020)	This paper explores the use of Sustainable Project Management (SPM), with support from the triple bottom line approach, in construction industries. As a result of the findings, it can be concluded that the construct SPM is statistically valid and aids in the formation (Satyro *et al*., 2021) of a parsimonious model for simultaneously assessing the three dimensions of sustainability.
(Carvalho & Rabechini, 2017)	This study uses a PSM model in different industry sectors. The results show a positive and significant impact of PSM on project success dimensions, even though the use of sustainability practice in the surveyed companies is still low. The structural model proposed shows a significant and positive relation between PSM and project success. Both appear as significant factors in reducing the social and environmental negative impact.
(Satyro *et al*., 2021)	In this paper, the author tries to show the importance of o Production Planning and Control (PPC) in the strategy implementation process to assist sustainable industries to be more competitive. The methodology used was multiple case study supported on interviews with production planning and control managers of six renowned Brazilian industries, considered sustainable by their concern with the social and environmental cause, beyond the economic. Results indicate that the role of PPC varied accordingly to the size of the industry, the biggest the company the hardest it was to implement sustainable practices. However, this study shows that companies can use PPC and with that improve and grow.
(Stanitsas *et al*., 2021)	This research looks on incorporating sustainability indicators into building project management procedures. It was possible to identify eighty-two sustainability indicators related to project management practices in construction projects. The research takes a comprehensive look at indicators of sustainable project management, covering the entire spectrum of the triple constraint (TBL). It allows practitioners to select the appropriate combination of indicators, based on the sustainability focus they want to include in their projects.
(Madan Shankar *et al*., 2017)(Diebold *et al*., 2019)	This article examines the most widely utilized sustainable manufacturing strategies in developing nations that may be useful in a certain domain. Manufacturers are being forced to rethink and restructure their old systems as technology advances. The bulk of manufacturing strategies rely on only one or two

	variables. Promoting the 6R ideas (reduce, reuse, recycle, recover, redesign, and remanufacture) has the biggest impact on implementation. Clearly, concentrating on 6R concepts will help the firm execute sustainable manufacturing more efficiently.

2.4 Sustainability in Agile Project Management

In this subsection a brief review of papers covering how sustainability practices interrelate with APM in companies is carried out. Table 10 shows relevant studies in the that are related to this topic.

Table 10 – Sustainability in APM research

References	Work description
(Mathiyazhagan *et al*., 2021)	This study analyses the relationships between lean and agile practices, and how this helps companies to become more sustainable. It uses the best-worst method (BWM) to identify and prioritize the leagile practices that are effective for Indian industrial leaders. Both lean and agile methodologies focus on continuous inspection and adaptation of processes for improvement. Businesses will take less time to embrace new changes and improve existing processes if reaction times are faster. Implementing leagile processes stimulates companies to make significant changes in business operations, along with enhanced sustainability worldwide.
(Anseel, 2017)	"Learning agility has been identified as one of the most important 21st century skills for sustainable careers". Reflection and feed-back behavior are behavioral strategies that have been use in the recent years to learn agile. Both appear to be added value in terms of improving learning, performance, flexibility, and overall well-being. These strategies have positive effects on individual and team performance, so when applied in the correct way it is possible to obtain sustainable careers
(Clark & Eisenberg, 2008)	This article looks at incorporating a sustainable smart lifestyle inside campus. According to the author, schools and communities must be safe, not just in terms of their own energy use and needs, but also in terms of their power's resource demands. Otherwise, the community (or communities) will never be economically or politically secure. The article examines California's and Southern California's total energy condition. Finally, the study explores how a community might become self-sufficient in terms of energy. The emergence of steering groups that meet with political leaders, professors who design new

	courses on sustainable development, and campuses that push public policy with activities are all examples of what happens when a sustainable community is developed.
(Valenzuela Musura & Supervisor, n.d.)	This paper has as purpose to research the existence of connections between APM and Social Sustainability. Through several interviews it was found several relationships between APM concepts and social aspects. The results showed that almost all the interconnections were positive, suggesting the validity of a new stream of research focusing on Agile Project Management as a new project management process through which promote corporate sustainability.
(Dubey, 2016)	This work proposes a six-stage model to fulfill the gaps that have been noted in companies that try to develop an Agile business excellence model to achieve organizational sustainability. Many organizations have used business excellence assessments to identify areas for improvement, such as leadership's role in developing a service-oriented culture, quality, customer orientation, employee involvement, problem solving, staff responsiveness, goal clarification, waste reduction, customer retention, value, market share, and operating costs.
(Ciccullo *et al*., 2018)	This paper develops a comprehensive study of the literature on the integration of lean, agile, and long-term supply chain management paradigms The researchers looked through 73 studies and came up with six different types of integration not only between the lean and sustainable, but also agile and sustainable supply chain concepts. The report addresses probable explanations for these discrepancies and suggests research topics for the future.
(Perera *et al*., 2014)	This article shows how agile and sustainable characteristics interact within a supply chain. This study proposes a conceptual framework describing how agility and sustainability are associated in industrial supply chains, based on the dynamic capability viewpoint, social capital theory, and related literature. It is suggested that agility, as a dynamic capability, increases enterprises' social capital and enables supply chain social, environmental, and economic sustainability. The paper finishes with a description of the proposed study's methodological approach and empirical analysis, as well as its theoretical and practical consequences.
(Miceli *et al*., 2021)	This study intends to investigate how sustainability, digitalization, resilience, and agility interact to assist businesses become strategically resilient by exploiting digitization and agility as enablers from a theoretical perspective, using the building of a

	conceptual model. Communities, networks, and ecosystems, in general, have been defined as having an impact on an organization's resilience. Communities, networks, and ecosystems, in general, have been defined as having an impact on an organization's resilience.

THESIS DEVELOPMENT

3 DISSERTATION RESULTS

3.1 Study Approach

When doing any scientifical research, it is key to define the study objective, it is necessary to draw up an investigation plan and specify the study method and data collected. Therefore, it is fundamental to design an investigation process by delimiting the universe that will be studied (Giangrande *et al*., 2019).

The main concepts when doing a scientifical research, that appear frequently in literature, are the concepts of methodology, method, and technique. Even though all seem very similar, and for that reason are used as synonyms in a lot of occasions, they have different meanings, Figure 24 (C. R. Kothari, 2004).

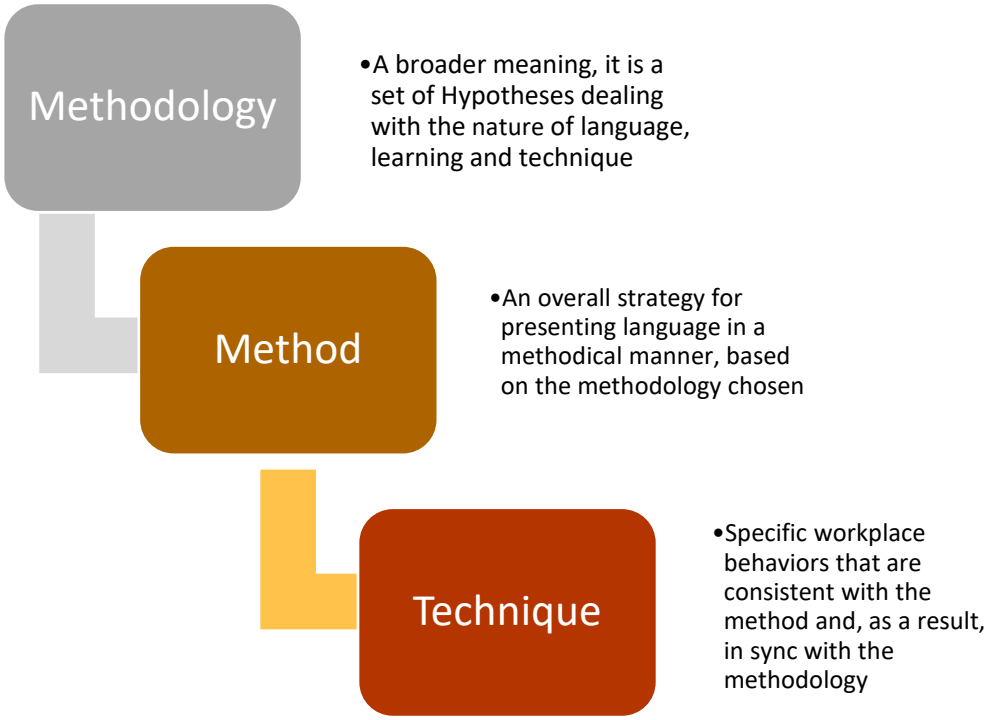


Figure 24 - Hierarchical relationship and meanings between methodologies, methods and techniques (C. R. Kothari, 2004)

After putting together a plan to guide the investigation, it is important to know what type of knowledge one intends to acquire, so differentiate the notions of quantitative and qualitative perspective is essential. One extracts knowledge in a natural and quantifiable reality and can create generalizations that can be applied to various contexts, while on the other is based on a more interpretive and productive, seeking to understand complex interrelationships that happen in real life, respectively. A quantitative investigation focusses on collecting data to confirm the theory, concepts and variables operationalized from theory, problems, and hypothesis and, finally theory and testing. A qualitative investigation centers on data collection, questioning, formation of data categories, theory search and theory construction (Slevitch, 2011).

This document had as its object of study several case studies. From these, it was possible to identify situations or aspects to reflect on their relevance for good running a business, or otherwise finding and recognizing business opportunities, improvements or explore alternative options. Based on the analysis of the relevance of the various topics studied and with a view to building knowledge and contributing to the evolution and growth of organizations in general, it was possible to formulate proposals for improvement (Meirinhos & Osório, 2016). Thus, the research methodology adopted was the case study due to the coexistence of its characteristics as a data collection procedure in the work developed. Case studies as a research strategy have some of the characteristics of qualitative research, and in some cases, they may also include the characteristics of quantitative methodologies. There is a set of research methodologies, but due to the specificity of their characteristics, the case study was the adopted methodology (André, 2013).

The case study has as main goals explore, describe, explain, evaluate a certain situation/phenomenon, obtain knowledge from the studied phenomena, and formulate theories about the situations experienced and understand the event in study. It can be referred to as a tool that allows us to study a particular case or phenomenon in a real context. It can also be considered as an investigation strategy, which requires intensive study of a certain well-defined entity: the case. It seeks to respond in depth to questions such as “how” and “why” and focuses essentially on particular or specific situations, with the aim of obtaining knowledge from them. Furthermore, they can be used for the most diverse purposes and quantitative or qualitative approaches and with various applications in various fields of knowledge (Ventura, 2007).

The next part is to understand the role of the investigator. This should have characteristics such as acumen in asking relevant questions and interpreting them; adaptable and flexible; aware of the issues being studied; be a good listener and impartial to preconceived notions. Then, comes probably the most complex part of the process, outlining a strategy for the study. When designing a case study, four main problems are treated:

- What issues to study?
- What data is relevant?
- What data to collect?
- How to analyze the results?

To raise these issues, the design of the case study as a research methodology encompasses several steps, as it can be seen in Figure 25.

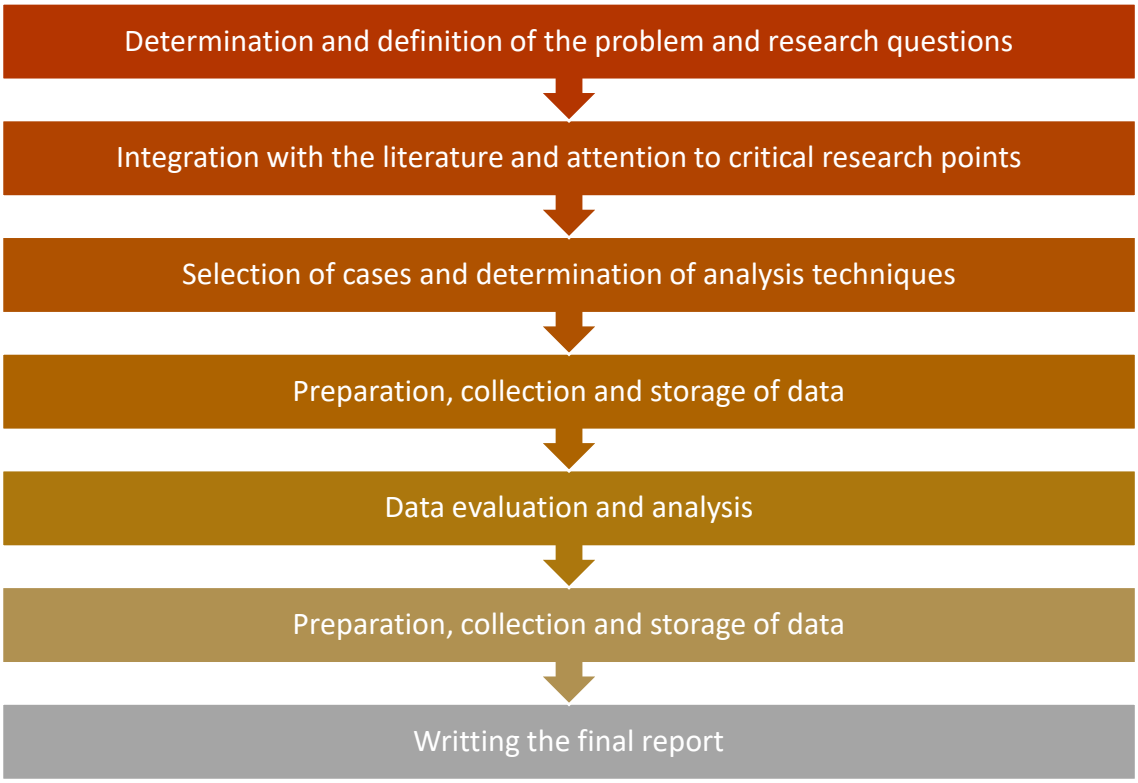


Figure 25 – Study phases

3.2 Developing a novel framework

The needs, conditions, and contents of the framework were derived and collected in the methodological profile through a literature review. This framework was based on the theoretical assumptions underpinning the present research. The basic structure of the developed framework is based on the framework of a matrix based method for ordering and synthesizing data proposed by Bryman & Bell (Bell *et al*., 2012). This matrix is displayed on the form of a spreadsheet in which an index with the central themes and subthemes are displayed. Resulting on what is recommended in the theory, in the present work the index was composed by the main social, economic, and environmental aspects that are related with the use of APM in organizations. These aspects appear to be interconnected, so they were analyzed by using a categorization approach that consists of developing categories that can be related to chunks of information (Saunders *et al*., 2019).

The sources utilized to name the categories were based on the terms collected from the previous theme analysis, in keeping with the exploratory objective and inductive approach of this study (Toljaga-Nikolić *et al*., 2020). The categories were grouped into three main groups: APM related concepts, which are directly related to some APM methodological concept; other elements, which are concepts that cannot be related neither to APM or Sustainability theory; finally, the concepts that can be related to some of the fundamental aspects of this theory mentioned in the theoretical framework.

Table 11, Table 12 and Table 13 present the three main concepts for the three pillars. When the categories were defined, the aim of the assessment changed to find and identify how they were connected (Aarseth *et al*., 2017). These connections were made after reading and analyzing several articles that revolve around APM and sustainability. Each relation connects two concepts, with one of them impacting the second one either positively or negatively. Once all the information was handled, it was possible to use some data presentation techniques, to facilitate the visualization of these relationships. The method selected is the network format suggested by Miles and Huberman (Miles & Huberman, 1994). The network diagram is composed by a series of boxes, representing the concept, that are linked by lines with arrows, showing the connections.

Table 11 – Three main categories of concepts for the social pillar

APM Concepts	Other Social Elements	Social Aspects
Trust	Motivation	Trust
Team leadership	Stress reduction	Self - organization
Constant value delivery	Collaboration/ Communication	Meaning making
Formal methodology	Commitment/ Ownership	Decision making
Written documentation		Learning
Shorter tasks		
Small teams		
Daily meetings		
Iterative process		
Open mindedness		
Creativity		

Table 12 - Three main categories of concepts for the economic pillar

APM Concepts	Other Economic Elements	Economic Aspects
Trust	Company-Customer relationship management	Stakeholders management
Team leadership	Value chain	Political and public management
Constant value delivery	Quality management	Engagement and innovation
Formal methodology	Productivity	Economic performance
Written documentation		
Shorter tasks		
Small teams		
Daily meetings		
Iterative process		
Open mindedness		
Creativity		

Table 13 - Three main categories of concepts for the environmental pillar

APM Concepts	Other Environmental Elements	Environmental Aspects
Trust	Sustainable consumption of environmental resources	Environmental resources
Team leadership	Environmental Policy and Management System	Legislation
Constant value delivery	Commitment, scope, and dissemination of environmental policies and criteria	Environmental involvement
Formal methodology		Certifications and environmental education
Written documentation		
Shorter tasks		
Small teams		
Daily meetings		
Iterative process		
Open mindedness		
Creativity		

3.3 Theorical implementation

3.3.1 Social Pillar

Socially sustainable complex adaptive systems are based on the maintenance of five key elements, according to the framework given in the literature review: trust; capability to self – organization; meaning making; decision making capacity and capability to learn.

Decision making

The decision-making aspect is related to the influence that the individuals must change or have an impact on the system. One of the aspects that have a strong impact on the capacity to make decisions is “Communication/ Collaboration”, as this is the principal process that allows teams to influence decisions on the system around them. In agile everybody’s input is important and is considered, so communication is a crucial part of the process. The other concepts of agile hat appear to influence this aspect are the shorter tasks, small teams, daily meetings/sprints and the iterative process. When teams work with shorter tasks it is easier to make decisions, as while the process evolves there will be tasks already finished and the decisions will be made considered what has already been done. In this approach, developers are more involved in the process, the decisions

pass not only by the project manager but also through the entire team, making them part of the decisions.

The daily meetings/sprints are another relevant aspect that can influence how decisions are made. The topics talked about in these meetings allow the teams to understand what has already been done and what is missing, facilitating the decision making process. Also, in agile teams have fewer members and have a bigger focus on the groups, so people tend to have a bigger influence because there are fewer opinions in the group.

However, it was also found a negative relationship between the shorter tasks (the time to do each task is less than in the normal project management process) and the ability to make decisions. This can be explained by the number of tasks that the sprint has, and, in order to do them, it is hard for developers to have the liberty to do things in their own time.

Learning

The capacity to learn and finding new solutions are essential aspects of the empirical process characterizing APM, and individuals' ability to learn new skills is critical to the system's long-term viability. Reference to the empirical process can be found in the 12th principle of APM: “At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly”.

The APM concepts that seem to influence this aspect are the “creativity”, open mindedness, and the iterative process. In APM, workers are more encouraged to explore and try new things, increasing their creativity, and the iterative process that brings the opportunity for the individual to reflect on himself and improve over time. Also, in Agile it is necessary to keep an open mind, thus, workers can understand and see things from different angles. Another element that influences this aspect is “Collaboration/ Communication”. The capacity of learning is increased in APM and the main reason for this is the improvements that APM brings in “Collaboration/Communication” within teams. The more collaboration and communication the more people learn from each other because people stop working in their own bubble.

Meaning Making

When companies process an agile mindset, the organizations culture is influenced, contributing to meaning creation for individuals operating within the organization.

To ensure the sustainability of a system, it is necessary not to degrade the capacity of individuals and groups to create meaning. The APM concept that influences this aspect is the constant value delivery. When a company performs under the APM ideas, the constant delivery of value is an important factor, so teams are more aware of work delivering for the company and reflecting on the company reputation. Nevertheless, there is also a negative relation between the concept of shorter tasks and this aspect. Working in shorter tasks can limit the capacity of the team to keep in mind the broader

objectives, and the fact that in agile teams are always in a constant cycle that never ends, may reduce the motivation.

Self- organization

Self-organize teams are at the core of the 11th principle of APM: "The best architectures, requirements and designs emerge from self-organizing teams". This aspect has a direct positive relationship between the team leader's coaching endeavor and the ability of the individuals, or the team, to self-organize. This aspect is related to the idea of "being independent", and when the team has a good leadership that coach them, with time they can do their jobs by themselves. Another aspect that also improves self-organization in APM environments is Individuals having the ability to influence the process going on around them.

Trust

In APM practices, trust is a central point to promote employees' motivation, to support employees' self-organization capacities, to improve collaboration between the Agile team roles, customer included, and an indispensable aspect of delivering value frequently. As the quality of a system's connections, trust allows people to stay together despite its underlying complexity. It enables organizations to adjust to the ongoing change brought about by the complex adaptive systems that surround them. Trust is also a key component of the Agile mindset, as evidenced by fifth principle in the Agile manifesto.

3.3.1.1 Other social elements

Collaboration/ Communication

The concepts of collaboration and communication, despite being different and having different meanings, are often confused, and used as synonyms, hence they have been unified in a single category. When analyzing the articles, most present Communication/Collaboration as a central element of the APM methodology, because, in agile teams, individuals, instead of working alone in their own spaces, work together, becoming more efficient. This not only improves the team's efficiency, but also the relationships with customers. Some specific APM concepts that influence this aspect are the daily meetings/sprints, with more frequent meetings the communication improves, and the formal methodology, as it helps keeping a closer interaction with customers, facilitating the communications between them.

Another factor, which is said to strengthen Communication/Collaboration and is, in turn, bolstered by it, is Commitment/Ownership. Agile is characterized by people taking the time to sit down and converse with one another, making a better workplace since everyone is more invested in getting things done and cooperating to share ideas with one another.

Motivation

APM is a well-defined formal approach that can encourage individuals to work more systematically. One other aspect that influences the motivation of the individuals is the iterative nature of APM, and as this has a direct connection with constantly deliver value, this is another concept that influences this aspect, since teams are more empowered to take decision and to be exposed to new challenges in each sprint.

These characteristics of an iterative process and consistent value delivery are linked to a greater sense of responsibility for the process, the self-organization aspect, that seems to be an important aspect of APM that affects the motivation of the individual.

Finally, the last APM concept that influences this aspect is team leadership because it is the person that manages the team that encourages the team members to work.

Stress reduction

Another aspect that was found during the study of the articles, was the difference of the level of stress that individuals may be exposed when using APM compared with the level of stress when using a standard PM approach. By using an Agile methodology, it is expected to only generate the most essential documentation, and this has a positive impact by lowering the stress levels of the team members.

Furthermore, another part of APM that is directly related to stress reduction is the habit of breaking down work into little and short tasks, so the people are not carrying a large burden on your shoulders.

Finally, the members of the Agile team have a certain level of power over the decisions and agreements that govern their work, which helps to reduce stress.

Commitment/ Ownership

It is thought that the concepts of commitment, engagement, and interest could be easily linked, and that the sense of ownership was also employed in a similar way, allowing to bundle them all into one core concept. The use of APM's Iterative processes generates individual commitment/ownership; in Agile, the collaborators can work on one module, then add a new feature in the following sprint, and so on, being exposed to new things, engaging the collaborators more.

3.3.2 Economic Pillar

To maintain an economical sustainable complex adaptive system, the key elements chosen, according to the framework given in the literature review, were: stakeholder management; political and public management; engagement and innovation; and economic performance.

Stakeholders management

Corporate sustainability is related to how companies do business, including their production processes; involvement of parties such as suppliers, customers, and employees; disclosure and public commitments made to society. Related parties to businesses, nowadays, expect to see results from their investments at least once a quarter. This can happen thanks to continuous value delivery. It was also mentioned in several articles the strong connection between the APM concept of trust and this aspect, because trust reduces conflicts and, in the event of a crisis, it provides quicker and more effective responses. Attitudes of showing empathy, acting transparently for the benefit of the other party, and delivering what was promised are seen as initiatives to foster trust.

Another connection found was between the stakeholder management and the aspect of "Company-Customer relationship management". These are interconnected, and as the costumer is part of the stakeholders, what influences one aspect also influences the other.

Sometimes, maybe it will be hard for companies to adapt to certain cultures, which can lead to stakeholder dissatisfaction. For this reason, there is a negative influence between this aspect and the political and public management aspect.

Political and public management

The business environment for stimulating entrepreneurial action can be understood in different ways, including the institutions and public and political organizations installed, access to consumer markets and the culture of a particular region or country. The configuration of these elements can facilitate or hinder the emergence of new businesses, depending on their degree of maturity and the interrelationship between economic, political, and public agents, but these becomes easier when working with teams with an open mind and high creativity, because they can be open to work in every environment and can create solutions for every kind of problem.

Engagement and innovation

This aspect encompasses the indicators of leadership, commitment, productivity and innovation. This corroborates with the new business models, which have emerged with the aim of proposing new, more agile ways to acquire products and services.

The globalized economy has been presenting more demanding consumers and technological changes, which influence the business environment, making it a scenario of competitiveness, uncertainty, and complexity, and encouraging the continuous search for technological development. The creative part of Agile and its iterative process are good solutions to solve this new constant demand.

Productivity is other aspect that influences this topic. Ecosystems, as articulators of entrepreneurship, promote an increase in the level of productivity of entities, influencing the performance of innovation and affecting business processes. When teams are more productive, there is a bigger engagement to the project.

Economic performance

The attainment of economic objectives is frequently used to evaluate an economy's success. These goals can be long-term, such as achieving sustainable growth and development, or short-term, such as restoring economic stability in the face of rapid and unpredictable events known as economic shock. For these reasons, this aspect is directly influenced in a positive way by the APM concept, if constant value delivery is effectively delivered.

When trying to reach a good economic performance, it necessary to keep the customers happy, because they are the ones that pay for the companies' services.

Another aspect that influences the economic performance of a company is the productivity. If the productivity of a working team is improved the economic performance will also improve, as more productivity results in more products/services done.

3.3.2.1 Other economic elements

Company-Customer relationship management

Managing relationships between customers and companies is a key part of any business, as they are the biggest influencers on the company's growth, and they are invited to keep open. As explained above, customers are part of the stakeholders, for this reason all concepts and aspects that influence stakeholders' management, trust and constant value delivery, will also influence customer management. When customers turn to a company to create their product, they expect quality, therefore, it is important to have good quality management.

Another APM concept that influences customer management is creativity, as customers are increasingly looking for different products and work methods, which stand out from the rest.

Finally, the iterative process found in agile, and in the constant exchange of ideas between the work team and customers, is also understood as an influencing concept in customer management.

Value chain

A value chain is a business model that outlines the entire process of creating a product or service. The stages involved in moving a product from conception to distribution, as well as everything in between—such as obtaining raw materials, manufacturing operations, and marketing activities—make up a value chain for organizations that manufacture things. The formality of the APM framework reinforces the value chain, because a good work method helps improving the process of obtaining the product or service, like the small teams and the regular meetings.

However, there seems to be a negative relation between these aspects and the political and public management, as said before, not always companies can relate to the cultural aspects of some regions, so the way they work may not be accepted by the communities, influencing the business model.

Quality management

The act of managing all activities and duties required to achieve a specified degree of perfection is known as quality management. Quality management entails establishing a quality strategy, developing, and implementing quality assurance and planning, as well as quality control and improvement. The team leadership has a big impact in the quality management, if the leader is bad, this can take the team threw the wrong path and impossibilities achieving the result. The formal methodology that agile presents also influences the quality management, keeping the customers up to speed on how the project is going, helps to a better planning to obtain a product just like the costumer wants.

Productivity

The amount of output divided by the volume of inputs is frequently referred to as productivity. In other words, it assesses how effectively a country's production inputs, such as labor and capital, are employed to generate a particular amount of output.

When using APM, the team's productivity improves in a large scale, as it is stated in several articles. The reasons for this are mainly breaking down the work into small and short tasks, the small teams, as it is easier to organize the work and, if someone needs help, it will be easier to assist and the restart working. Also, the daily meetings, that help workers to keep track of the work that has been done, and to show results to present on these same meetings.

Finally, there is a connection between written documentation and the productivity. In APM, it is only generated the most essential documentation, so the team knows what to do and do not waste time on unnecessary tasks.

3.3.3 Environmental Pillar

Industrial leaders have been pressed to acquire more environmental responsibility because of increasing worldwide demand from stakeholders on climate change and its implications for many elements of manufacturing. To maintain an environmentally sustainable complex adaptive system the key elements chosen, according to the framework given in the literature review, were environmental resources; legislation; environmental involvement and certifications and environmental education.

Environmental resource

Environmental resources, also known as natural resources, these are the resources that are available in nature to obtain goods, services, or as human support. Environmental resources are associated with the costs of financial and economic benefits, and this value is estimated by the availability of the resource itself. These resources, in turn, are generally reflected in the price of goods produced with environmental resources, or in the services obtained from their use.

In terms of connections between APM concepts and this aspect, a negative connection was found with the factor of constant value delivery, as when a team is constantly seeking to produce value and present something, it does not always consider the means to achieve its ends, therefore, it can lead to an excess and misuse of environmental resources. However, a positive relationship with the concept of creativity was also found, since, if the team members are creative, they may be able to find methods to solve the problems that are proposed to them by using some resources in an unconventional way and, for this reason, protects them.

Another link found was with the sustainable consumption of environmental resources, as a sustainable use of environmental resources will help to preserve them, and only use what is necessary without waste.

Legislation

In terms of legislation, the ISO 14004 standard helps the company to recognize the legal requirements (laws, decrees, supplementary laws, agreements with environmental inspection bodies, in addition to international standards) applicable to environmental aspects. This series of standards features 138 guidelines for environmental audits, environmental performance assessment, environmental labeling, and product lifecycle analysis. In other words, it specifies the requirements relating to an environmental management system, to allow the organization to formulate policies and objectives that consider legal requirements and information regarding significant environmental impacts.

A direct relationship was found between written documentation and legislation, since by having all the documentation of the production process registered and written, legal problems will be avoided in the future. There is also a connection with the Environmental Policy and Management System, which, like written documentation, positively influences legislation, and by knowing the environmental policies and with a good management system, the teams, as well as the organizations, will be able to keep abreast of legislation and at the same time they try to comply with them.

Environmental involvement

Sustainable development has emerged as an influencing, albeit controversial, aspect for the design of business and policies.

In this sense, this factor is of paramount importance because, for companies to act in a way that makes an expressive contribution to sustainability, they need to promote changes in their production processes. Because, in such a context, the construction of production systems that do not cause negative impacts on nature and society are involved, adopting actions that contribute to the recovery of degraded areas, or providing the market with products and services able to improve their environmental performance, social and economic of their consumers, customers and suppliers.

It should be noted that companies have accepted this pressure, driven mainly by the idea that by transmitting an image of social and environmental responsibility, they can end up generating value and/or advantages compared to other companies in the market. Another concept that influences this aspect is the iterative process. Indeed, during an iterative process, as previously mentioned, there is a constant improvement of the design, product, or project until the team is satisfied with the final project deliverable, which can influence the environmental involvement because, being in constant improvement, it also results in finding environmentally friendly solutions that can bring these same improvements.

Certifications and environmental education

The guidelines of the ISO 14004 standard are applicable to any organization, regardless of size, type, or degree of maturity, that is interested in developing, implementing and/or improving an environmental management system.

An open-minded team is more likely to learn new things. For this reason, the concept of APM open mindedness positively influences this aspect.

Another relationship found was between environmental policy and management system with certificates and environmental education. A company that has an environmental policy will automatically seek to maintain an image that supports it and seeks to keep its company's actions aligned with the environment, and the way to prove this is by having certificates. Also, a good management system can influence employees to want to improve, increasing their education in environmental terms.

3.3.3.1 Other environmental elements

Sustainable consumption of environmental resources

The effective management of natural resources for the benefit of the entire human community is what sustainable environmental resource usage entails. Good team leadership promotes this same responsible use of environmental resources.

Environmental Policy and Management System

An environmental policy is a written declaration, usually signed by the top management, that explains a company's goals and principles for controlling the effects and aspects of its operations on the environment. Although putting one in place is entirely optional, it

is highly recommended, that is why a team, with an open mind at work and with good leadership, will seek to maintain these environmental policies.

Commitment, scope and dissemination of environmental policies and criteria
Protecting the earth's local and global environment, including pollution prevention, responsible use of natural resources, and proper waste management, is a goal that businesses strive for. Inside the company's production teams, there is a team leader that can guide their teams in order to follow these practices and aim to balance environmental protection and conservation of natural resources with other policy goals.

3.4 Authors Overview

From the review of the existing literature, it was possible to find the links described above, however, it is the author's opinion that other links are missing. For this reason, other relationships were considered for the study based on the critical spirit of the author, which will be mentioned in the following paragraphs.

3.4.1 Social Pillar

Decision making
An individual must change or have some impact on the system before they are able to make decisions. In order to make these changes it is necessary to explore and look for new solution to solve problems, this capacity is directly related to the individuals creativity. Therefor creativity can influence the decision-making process.

Learning
Acquiring knowledge is fundamental to improve the work. With the daily meetings, that are provided while working with agile, the agility of the workers increases and the way they work enriches. In these meetings there are exchange of experiences and knowledge from the people in the company.

Trust
Trust can also be written as the feeling of security towards someone or something, this is a crucial component for companies to achieve success and can be influenced by many factors. And just like it is mentioned on the first value of agile, "valuing people is more important that processes".
When working with agile the team leader needs to trust the team that it is working with him, and vice versa.

In agile teams are small, so people interact more with each other, they get to know their coworkers in a deeper way, so it is important that there is trust inside the teams, in order to have a good work environment.
The last relation found was between "Commitment/ Ownership" with trust. Without commitment there is no trust, if the team isn't focus towards the same goal and committed to achieve it in the best conditions, it will be much more difficult reach the final product/ service.

3.4.1.1 Other social elements

Commitment/ Ownership
It is the authors opinion that having an open mind can influence the commitment of a team. It is necessary to have an open mind to embrace change and, the agile point of view is that adding value to a project through changes is always a positive thing.

3.4.2 Economic Pillar

Engagement and innovation and Economic performance
All types of organizations show a strong correlation between engagement and innovation. A culture of innovation involves fostering a sense of adventure in its employees, even if there is no guarantee of success. Organizations that act on innovative ideas benefit even more from engagement.

To be considered economic performance, a taxpayer must have already received or performed the service or product for which the taxpayer is liable. Therefore, a prepayment for goods or services to be delivered in the future will not qualify for a deduction, even if there is an obligation to deliver them.

These two aspects interconnect with each other directly. Each will improve if the other increases, and if one decreases, the other will diminish as well.

3.4.2.1 Other economic elements

Company-Customer relationship management
Like is mentions on the third value of agile, customer collaboration is key to success. One way to keep the costumer up to date to what the team is doing, and how the work is going, is by delivering to the costumer the documentation on how the product/process is being developed. Therefore, in agile it is used written documentation, and this has to be always updated, the quality reports and invoicing are delivered to the clients, and other stakeholders.

Value chain

In business, a value chain describes how products or services are created from start to finish. Therefore there is a direct connection between the value chain and the economic performance of a company, and vice versa. If one increases the other will also improve, and if one decreases, the other will also diminishes.

Productivity

Like was said before, several articles point out that APM increases productivity of teams on a large scale. Another aspect of the agile methodology that can enhance the productivity of a team is the formal methodology of agile. When companies use APM teams have a well-designed methodology, with well-defined objectives and well-defined strategies to achieve them, which improves productivity.

3.4.3 Environmental Pillar

Legislation

A connection was found between trust and legislation, people may not agree with the legislation in force, however it is necessary to have a consensus so that the legislation is passed and that when working, it is possible to trust that the companies will not have future problems. Also, the formal methodology will be influenced by the legislation, as the tasks and how the team will work must follow the legislation.

Environmental involvement

The APM concept of open mindedness will influence the environmental involvement because, only someone who has an open mind is able to be open to new ways of connecting themselves to the environment, otherwise people would say no to every new change.

Certifications and environmental education

In order to obtain the certification, the company will have to undergo audits. If the company has all its documentation written and according to the norms, it will be easier to obtain the certifications.

While working with agile, teams are formed with fewer members, this will make it easier to explain and teach how teams should be involved in environmental terms, as it is easier to reach people.

3.4.3.1 Other environmental elements

Environmental Policy and Management System

Environment policies describe how a corporation intends to control the effects that its operations have on the environment. They are usually signed by top executives. The methodology will only be correct if it is in accordance with the environmental policies

and the management system. The work methodology must be drawn up following the environmental policies and the management system followed by the company

3.5 The Model: A Relations Network Diagram

The resulting concepts are split into three categories: APM characteristics (in grey); Organizational or Individual Factors (in yellow); and the Sustainability's Aspects (in blue). The linkages between the concepts were also classified based on their impact and the "frequency" on which certain causal relationships were discovered among the various articles. While the impact indicates whether the elements under consideration have a positive (green arrows) or negative (red arrows) impact on social features, the frequency is related to the number of times the relationships or connections are mentioned on the articles reviewed. In Figure 26 it is explained the elements used in the diagrams.

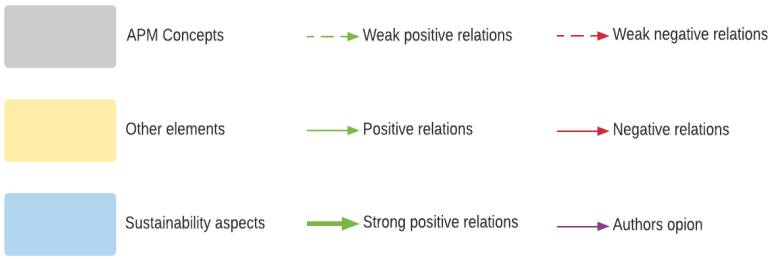


Figure 26 - Explanation of the elements used in the scheme

The network diagrams presented in Figure 27, Figure 29, Figure 28 are the result of the findings obtained from the analysis of the several case studies previously developed and published. This type of model aims to show visually the network of concepts and casual relationships.

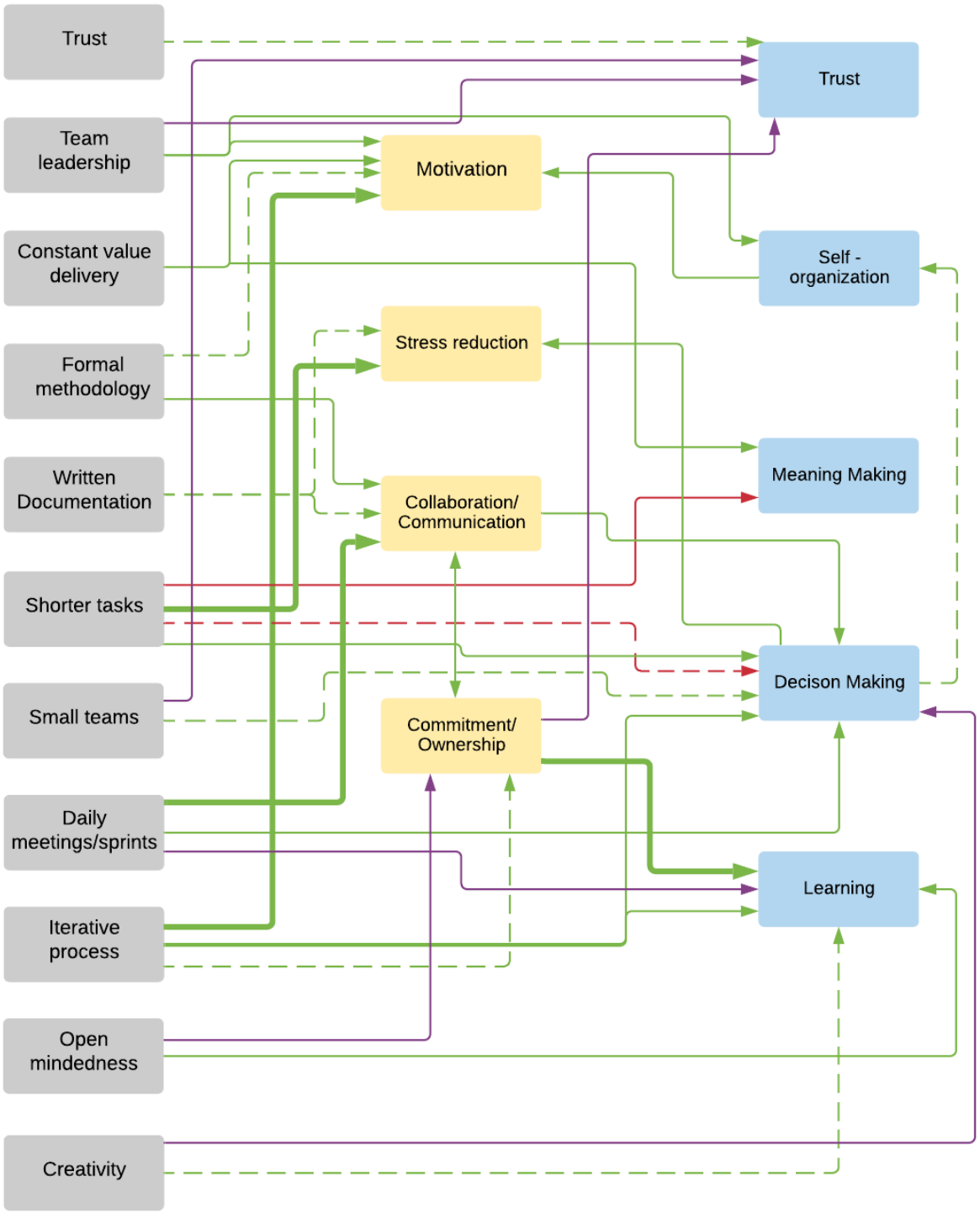


Figure 27 - Complete network diagram of observed social concepts relationships

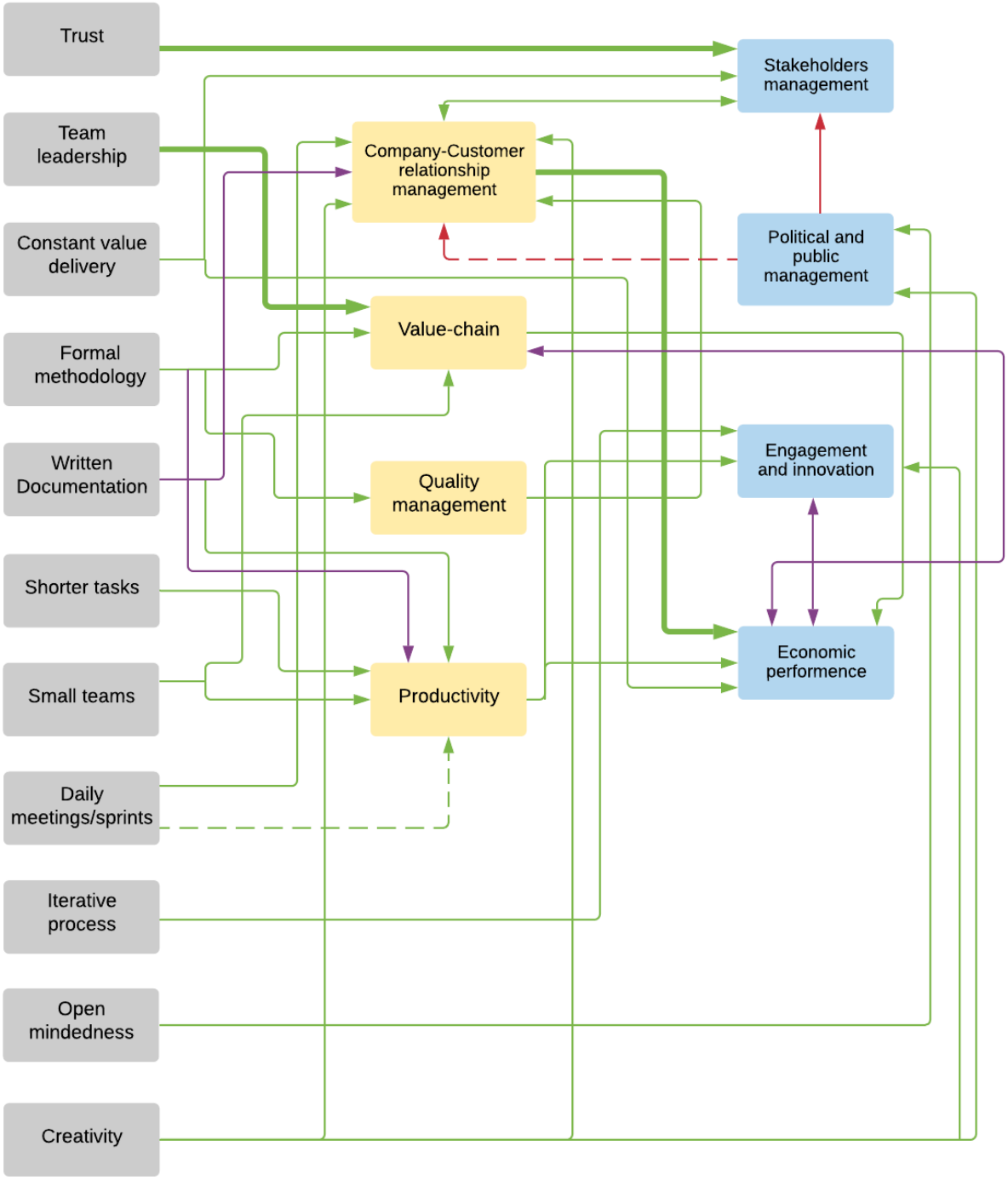


Figure 28 - Complete network diagram of observed economic concepts relationships

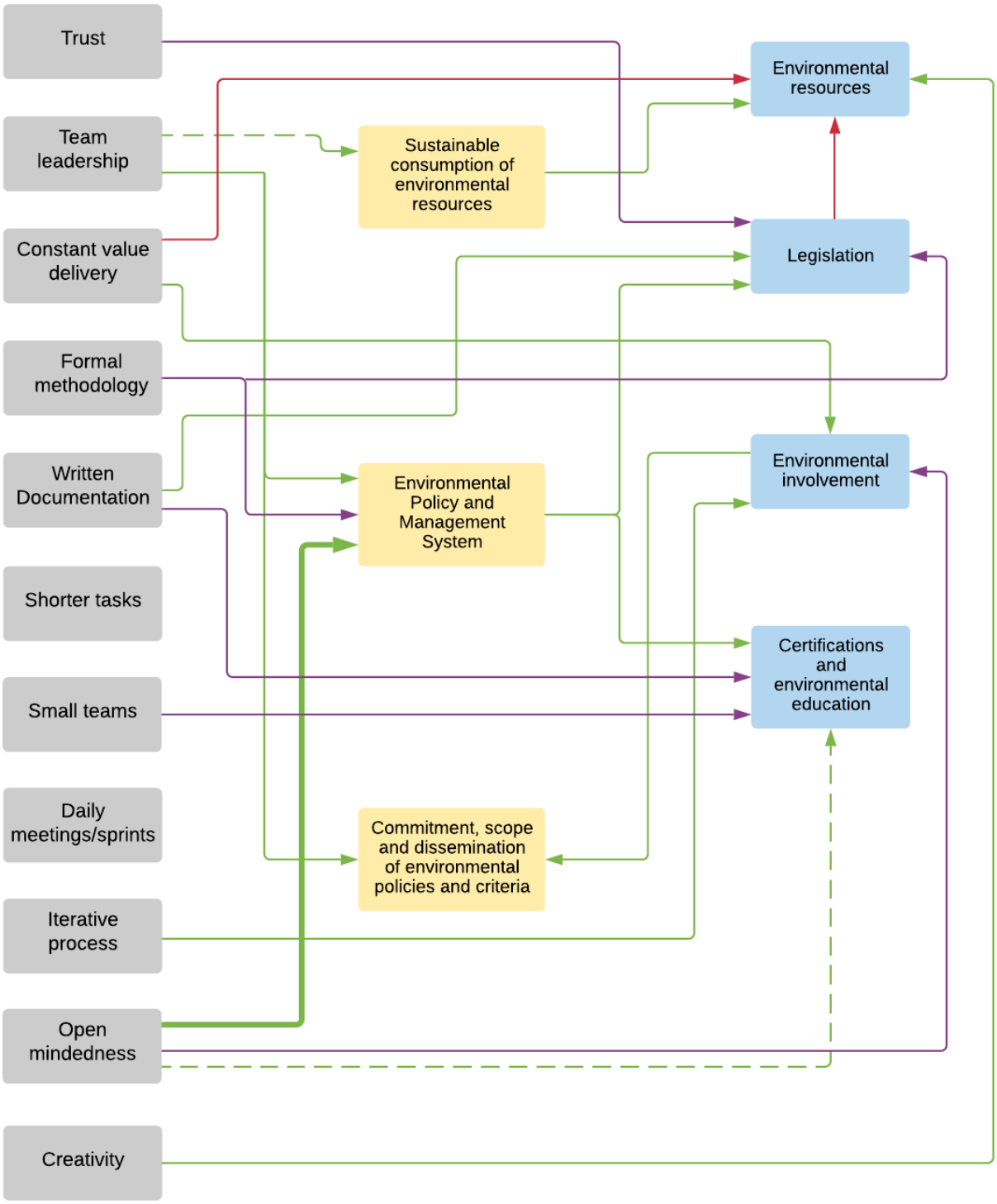


Figure 29 - Complete network diagram of observed environmental concepts relationships

3.6 Critical Review

The goal of this study is to understand if there is a linkage between sustainability (especially the TBL) and APM.

The goals expressed by the TBL are presented from three superimposed ellipses, thus indicating the three pillars of sustainability, which are not exclusive, as they can have reinforced each other. In recent years, the pillars have served as the basis for the creation of various sustainability standards and certification systems that seek to balance the expected results for sustainable development.

Since the creation of the TBL concept, there has been an increase in the tendency of companies to consider the interests of different stakeholders in their management approach.

In the absence of a theoretical framework articulating the impact of APM on these dimensions, this empirical study investigated how APM practitioners describe these relationships. According to the conclusions of this study, APM has an impact on most social, economic, and environmental sustainability maintenance criteria. The empirical findings, their robustness, and attempts to form a synthesis to answer this research's topic will be discussed in the following paragraphs.

To answer this question, application of APM principles and methodological requirements have been analyzed through the study of several case studies and the analysis of qualitative data, on investigating the effects that APM induces on the organizational social, economic and environment dynamics.

The narrative literature review carried out made the research focus, regarding the social pillar, on the aspects: Possibility to Learn; Possibility to Self-Organize; Trust; and Common Meaning. Concerning the economic pillar, the focus is on the aspects: Stakeholders management; Political and public management; Engagement and innovation; and Economic performance. Regarding the environmental pillar, the research focus is on the following aspects: Environmental resources; Legislation; Environmental involvement; and Certifications and environmental education.

The findings obtained from the articles analyzed, with the additional support of academic theory, showed that several APM methodological elements have a direct or indirect causal relation on the improvement or degradation of sustainability fundamental factors. It is thus possible to state that implementing the APM mindset and operational methodologies, has many effects on the organizational social, economic, and environmental dynamics, which are in turn affecting the organizations' social, economic, and environmental sustainability factors.

The theoretical contributions of this study might be interpreted within the topic of project management sustainability, particularly Agile project management. The goal of this study was to look at the sustainability elements of APM approaches with an emphasis on internal processes. As a result, it is anticipated that this contribution will serve as a starting point for future research of the relationship between sustainability

and APM approaches, allowing for the expansion of the topic of sustainability in PM processes.

More particularly, the current study adds to the PM subordinate theory of APM and its relation to sustainability.

As previously stated in the research, the authors were unable to locate any academic literature that refers to or analyzes the APM techniques' sustainability elements. The APM principles, on the other hand, shared certain parallels with a number of sustainability concepts. This link allows for a fresh contribution to the theoretical discussion on project sustainability, proposing that APM is seen as a new and alternative project management technique for promoting sustainability within organizations.

The final addition is to APM theory; according to the Agile manifesto's 8th principle, APM methods "support sustainable development". This claim is made without any explanation of how they define sustainable development.

It is thus concluded that, as the APM framework seems, in the context of the case studies analyzed, to not degrade any fundamental factors of sustainability, APM can be considered as a process model promoting organizational sustainability.

CONCLUSIONS

4 CONCLUSIONS

While developing projects, companies are confronted with multiple setbacks, which have the potential to impact the project success and performance (Unegbu *et al*., 2020). And, as such, these may need to improvise, so that, they can solve their possible problems. PM is complex and, consequently, a fruitful ground for creative, intuitive and spontaneous applications of particular theories to meet the requirements implemented in a constantly changing environment (Klein *et al*., 2015).

The customers' dynamic demands and the ever-increasing intensity of global competition force companies to adopt agile principles (Ramesh & Devadasan, 2007; Günther Schuh *et al*., 2018). APM are based on the agile principles that stipulate an agile behavior among collaborators, that induces the company to deliver products/services according to the customer value, in a pro-active manner and based on a transformed environment that creates opportunities and new Products (Loiro *et al*., 2019). Furthermore adopting an agile development methodology will offer companies a number of ways to evaluate the trend of the project throughout the advancement of the lifecycle (Aziz Butt, 2016).

In a survey on agility preformed in 2019 (*2019 Survey on Agility*, 2019), it is shown that becoming an Agile organization is a priority. And even though the term Agile became popular due to developing methods created especially for the software development (Buganová & Šimíčková, 2019), some researches present evidence that APM can be adopted by other industries and that these even possess APM enablers (Conforto *et al*., 2014).

Coming from the software industry, agile methodologies pursue the target of limiting both time-to-market and resources associated with the realization of innovative products (Günther Schuh *et al*., 2017). Achieving agility differs from organization to organization. Research indicates that relative advantage, team attitude and technical competence, and top management support, are the key factors determining the extent to which agile practices can be assimilated into an organization (Cohn, 2010; Senapathi & Srinivasan, 2012).

Even though it is a hard process, results from several case studies show that becoming agile and adopting the proper agile methodology, presents many advantages to companies, like superior product quality, better customer satisfaction, increase of flexibility and control, improved ROI, and reduced risks. For these reasons, and as this is a relatively recent area, with a lot of room to grow, the future of agile seams promising.

Businesses are constantly being confronted with the challenges posed by changes arising from debates regarding the environmental and social aspects of their organizations, as stakeholders increasingly seek companies that work with the tripod composed of economic, social and environmental aspects.

The implementation of sustainability has been vigorously pursued by the companies around the world. Not only because it is a key factor for the livelihood of companies, but also because it is essential for the survival of future generations.

It is necessary, for the recognition and growth of companies, to act respecting the environment, relating well with customers, suppliers, and employees, as well as acting to meet the needs of the local community. Manufacturers have become more aware of the sustainability issue, in part due to customer demands and government laws, which encompasses not only the environmental, but also the social and economic components.

The environmental pillar seeks to prevent and reduce waste and its reuse, such as recycling, reducing air, water, and soil pollution, protecting, and improving air quality. The social pillar exposes that it is necessary to provide adequate working conditions, promote the professional development of its employees; be concerned about local communities, recognize, and respect cultural diversity and avoid any form of exploitation. The economic pillar deals with developing the activity efficiently, creating and distributing wealth among the different economic agents that contribute to it, as well as including a good relationship with customers and suppliers. Studies show that it is possible to combine environmental measures with improved economic performance when using sustainability practices in manufacturing.

As sustainability and APM are becoming more current in today's industrial world, this dissertation aimed to research how these two concepts can be interconnect. For this type of application, a literature review is rare. As a result, a fresh technique was required for this situation, which demanded a significant amount of effort. To begin with, it is acknowledged that APM has a broad impact on businesses, as successful adoption of APM involves not just the application of new procedures, but also a shift in organizational thinking. APM frameworks also allow firms to adapt to the complex and uncertain environment in which they operate, according to Agile thinking (Loiro *et al*., 2019). With this in mind and presenting the main aspects that involve the different pillars from TBL, it was possible to make some associations between these aspects and some APM concepts and the results show that implementing an agile approach will benefit sustainability inside companies.

All work developed and described here was done based on the literature. The author of this dissertation thinks that future research should be done into the integration of agile and sustainable paradigms in a more practical environment, as well as the impact of integrating the social, economic and environment component when evaluating the integration of established and sustainable paradigms. It is also necessary to discuss the paucity of empirical investigations and the need to consider the integration from an evolutionary standpoint. Finally, future works should conduct a conceptual and empirical research into whether and how paradigm integration is influenced by the strategic importance of sustainability.

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