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Applying lean and agile principles to Portfolio Management

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Table of Contents

Index of Figures

Index of Tables

1 Introduction

1.1 Background

In today's increasingly competitive environment, as global companies with business units are aiming to thrive by standardizing and centralizing their operations, established and well known support functions such as IT are increasing in size and influence. Nevertheless, in a survey conducted by the University of St. Gallen in collaboration with the Harvard Business School, fewer than 10% of the companies declared to be highly satisfied with the services provided by these functions (Kunisch, Müller-Stewens & Campbell 2014). Business units require that functional organizations become a more strategic player and do not restrict themselves to fulfill the day-to-day transactional needs of the business. The pressure on operational excellence while reducing costs, an always increasing competitive intensity and less stable environments are forcing many leaders of functions to change their internal processes in order to emphasize activities that add high value for the company, and get rid of tasks that add little value (Caglar, Kapoor & Ripsam 2012).

In such a volatile business, the IT functions have to manage the uncertainty and be able to quickly respond to emerging opportunities. The organizations able to survive in this turbulent environment are the ones who are driven by business model innovation and embrace the change (Ktata & Lévesque 2009).

Thus, in order to be able to respond to the constant need for further innovation, more unpredictable environments than before and new technologies coming to the market with increased speed, organizations are looking into ways to increase the flexibility and boost their performance. Scaling agility is an attempt to address these problems by leveraging agile mindsets and tools not only at the software development team level, but in all the different layers of the organization (Laanti 2014). Starting this agile journey, any organization should look at the PMO

(Portfolio Management Office) as a guiding body that has the authority to change the governance, the processes and align investments with the business needs (Tengshe & Noble 2007; Thomas & Baker 2008).

1.2 Motivation

This thesis is motivated by the fact that the world around us is characterized by three megatrends nowadays: the broader use of software technology inside various products, the digitalization and the globalization (Laanti, Sirkiä & Kangas 2015). The digital revolution that is going on in this era is putting out of action the organizations that are not able to anticipate the change and to leverage new opportunities (Forrester Consulting 2012).

The Agile Portfolio Management tries to address the questions on how to compete in a continuously changing environment and intensify the rate of innovation (Laanti, Sirkiä & Kangas 2015). And if the portfolio management practices are well explained in the classic project management literature, how to implement the iterative nature of agile approaches in the portfolio processes introduces an interesting challenge that has not been explored in detail yet (Stettina & Hörz 2015). The practice of making the portfolio processes more agile, flexible and close to the stakeholder needs is a relatively new topic in research, and only few papers explain how companies can leverage these practices for their PMO office (Laanti, Sirkiä & Kangas 2015).

1.3 Objectives

The aim of this thesis is to fill the gap in the literature and discuss in detail how the traditional portfolio management can be remodeled accordingly to the agile mindset and tools. This thesis wants to present a model to help clarify how agile software development methodologies could be implemented in the processes of an IT portfolio management office.

1.4 Methodology

The research problem (section 3.1) of this thesis is a topic which is hard to analyze outside of its practical context. For this reason, the methodology used in this thesis is inspired by the action research approach. The action research belongs to a family of research methodologies which has as objective the dual outcome of action and research. The action is translated into a change or improvement within an organization. The research goes on in parallel with the action process and dwells on learning and understanding the problem which has to be solved (Dick 2002).

Action research is an iterative process which defines the path for the change as it converges to a better understanding of the research problem (French 2009). The process is well explained by the spiral of action research cycle in Figure 1 (Zuber-Skerritt 2001). The first step is to create a plan to implement the change or improvement. The following step is acting to implement the plan. Once the action has been implemented, it is necessary to observe the action and collect evidence. The last step is reflecting on the evidence and data collected during the previous phase and, based on that, start the next iteration (French 2009). In action research methodology, it is not requested any specific method of data collection (Holter and Schwartz-Barcott 1993). For this thesis, data have been collected from academic literature, experience reports, review of official documents within the organization, meetings and discussion with the employees.
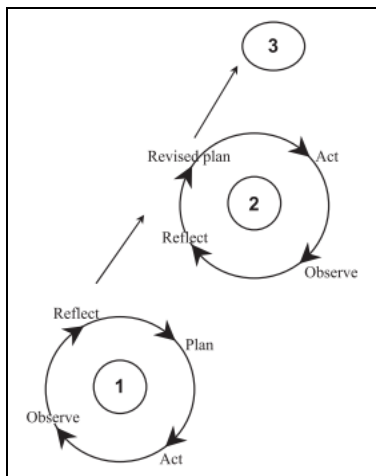
Figure 1. The spiral of action research cycle. Source: Zuber-Skerritt (2001)

1.5 Scope

Due to the characteristics of the case organization (section 4.1), this study is limited to the context of IT corporate functions inside large multinational companies which provide services to their business units, which are already applying agile approaches in at least part of their projects and which are overall open for continuous improvement. The main characteristics of agile software development are speed and flexibility that are achieved thanks to frequent feedback loops, iterative reviews and proximity to the customer. This can be a hard challenge for the large multinational companies like the one in scope of this thesis, since they often have well established practices and structures (Stettina & Hörz 2015).

1.6 Outline

Chapter 2 (*Literature review)* examines existing work related to the topic of this thesis and provides a more accurate definition of the boundaries of the study. Chapter 3 (*Research problem and methodological approach)* defines the research problem, research questions and the approach used for answering the research questions. Chapter 4 (*The case study)* provides the answers to the research questions that can be suitable for the case company in scope. Chapter 5 (*Conclusion)* summarizes the results of this thesis, discusses the limitations and provides possible directions for future research.

2 Literature review

This chapter considers the existing literature related to the topic of this thesis. The first section explains the context in which the research has been conducted and the method that has been followed for the review (section 2.1). In the next chapters, the existing work regarding lean and agile management (section 2.2), and project portfolio management (section 2.3) will be discussed in detail.

2.1 Research space and review method

The literature review has been conducted based on the assumption that a sufficient degree of understanding can be reached exploring the already existing literature in the area of *operations management, software engineering* and *project management.*

According to the definition of Slack (1999), operations management "is the set of tasks which manages the arrangement of resources in an organization which is devoted to the production of goods and services"[1]. In this research space, of particular interest is the literature on **lean management**. This has been the first area explored, since lean management is often perceived as the trigger of agile approaches. It is useful to have a high level understanding of lean principles before moving to the study of agile development.

The Glossary of Software Engineering Terminology defines software engineering as "the application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software"[2]. Since the term **agile** was born in the context of software development, the majority of the existing literature on agile approaches can be found in this research space. Due to the dimension of the case organization in scope, the research space was mainly limited to the study of agile and lean management for large size companies.

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[1] Slack (1999). *The Blackwell Encyclopedic Dictionary of Operations Management.* Blackwell Publishing Ltd.
[2] Electrical, Institute & Engineers, Electronics (1990). *Glossary of Software Engineering Terminology, IEEE Standard 610.12*. 10.1109/IEEESTD.1990.101064.

According to the definition given by the Project Management Institute (2008), "project management is the application of knowledge, skills, tools, and techniques to project activities to meet project requirements"[3]. In this research space, I focused my interest on **project portfolio management** and how the portfolio processes can be adapted to an agile mindset. Indeed, project portfolio management is one of the main areas in this research space, and accordingly to Cantamessa & Montagna (2016) "project portfolio management copes with the strategic decision on which projects and programs should be initiated"[4].

Due to the scarcity of existing literature on the agile portfolio management, and due to the practical nature of the research problem, I looked for academic literature but also for practitioner and experience reports. I consider this approach adequate for facing this topic. The review method is only inspired by the systematic approach described by Khan et al. (2003), but then adapted to fit the time constraints for finishing this thesis.

2.2 Lean and Agile: principles and differences

This chapter discusses the principles of lean and agile methodologies, their implementation in different contexts and highlights the main differences between the two approaches. A deep understanding of these methodologies is the key for the development and comprehension of the entire thesis.

2.2.1 Origins of Lean

The term "lean" was introduced for the first time in the 1988 *MIT Sloan Management Review* article "The triumph of the lean production system" by John Krafcik (Netland & Powell 2016). But the origins of lean production go back around the '50s in a japanese company that had

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[3] Project Management Institute (2008). "What is Project Management?" in *A guide to the project management body of knowledge (PMBOK guide)*. 4th ed., Newton Square, p. 6.
[4] Cantamessa, M., & Montagna, F. (2016). "Innovation Strategy as Project Portfolio Management" in *Management of innovation and product development: Integrating business and technological perspectives.* 1st ed., Springer-Verlag, Ed. London, p.163.

recently decided to expand his scope, from being a textile loom maker to making automobiles: this company was Toyota.

Toyota wanted to design and develop its own cars rather than outsource these activities to foreign companies and was also determined to fund this activity itself without relying on banks. The response to this challenge was the Toyota Development System (TDS): a development and production system able to improve product design and process efficiency in a shorter time and with less resources in order to be competitive in a global automotive industry.

Between the '50s and '70s, Taiichi Ohno led several experiments to achieve the goal of building many different products on the limited equipment that in Japan was available at that time. This challenge led to the creation of a set of practices called the Toyota Production System (TPS), that is considered a major precursor of the current "lean manufacturing" (Womack, Jones & Roos 1990).

2.2.2 Lean principles

The five lean principles are *value*, identifying the *value stream*, *flow*, *pull* and *perfection*. In this section, the details of these principles are discussed.

Value

The first lean thinking principle is value. One of the main aims of lean is avoiding *muda*: this is a japanese word that can be translated with "waste". Taiichi Ohno has identified the seven types of waste*: overproduction* ahead of demand, *waiting* for the next processing step, unnecessary *transport* of materials, *overprocessing* of parts due to poor tool and product design, *inventories* more than the absolute minimum, unnecessary *movement* by employees during the course of their work and production of *defective parts*. Womack and Jones (2003) have added one: producing the wrong product or service in the right way. Consequently, the first critical step to avoid this waste is to define the value from a customer perspective in terms of product or service with specific features offered at specific prices. Thus, a dialogue with the specific customer is key to achieve this goal (Womack & Jones 2003).

Identify the value stream

The value stream is the path that a product follows through the three critical management tasks: the *problem-solving task* that starts with the concept of the idea and finishes with the production launch, the *information management task* going from order taking to delivery, and the *physical transformation task* that involves the transformation of the raw material into a finished product. From the analysis of the value stream will emerge three types of activities: *value adding activities*, *non value adding activities but unavoidable* (at least not in the short term) and *non value adding activities immediately avoidable.* These last activities are the ones that create a waste and should be removed from the stream (Womack & Jones 2003).

Flow

After the definition of a clear value and the removal of wasteful steps, it is important to make the value creating activities flow. The problem here is understanding what *flow* means, and this is counterintuitive. The common mistake is to think that making the value flow means being efficient and keep all the resources (humans and machines) busy running at their maximum capacity (Womack & Jones 2003). This approach leads to resource efficiency but not to flow efficiency. Instead, the objective is to prioritise flow efficiency over resource efficiency and this means minimizing the amount of non value adding activities for the product, as for instance the waiting time for the next processing step (Modig & Åhlström 2012). What the TPS has done is rearranging production activities from batches to continuous flow, by reducing the lot size and learning to quickly change over tools from one product to the next so that all the steps of the manufacturing process could be managed immediately one after the other (Womack & Jones 2003).

Pull

The immediate benefit of continuous flow is that the time needed to move from concept to production, from sale to delivery and from raw material to finished product decreases quickly. This means that is not necessary anymore to plan a long time in advance the production and push the products (maybe the wrong product) onto the customer, but it is possible to let the demand

pull the product as needed. Indeed, one of the main pillars of lean thinking is *just in time*: giving to the customer exactly what he wants and when he wants it. This system can be put in place leveraging *kanban* cards: these cards pull the products through the manufacturing process making the information flow backwards at the same pace products flow forward (Womack & Jones 2003).

Perfection

The fifth and last principle of lean thinking is perfection. Once the first corrections to the processes have been put in place, the pursuit of reducing costs, waste, time, effort and mistakes while offering a product ever closer to the customer needs does not end. This is only the first step toward a lean enterprise. The last principle can be achieved through the practice called *continuous improvement*, a self-explanatory term that refers to the continuous pursuit of perfection (Womack & Jones 2003).

2.2.3 Lean across business units

This section discusses the application of lean principles in the main business units of a generic company.

Lean production

The Toyota Production System is described as a systematic approach to the production planning in order to reduce the waste. This system is the origin of the success of lean applied to manufacturing (Found & Bicheno 2016).

The implementation of lean in the production unit means the implementation of an operating system of production, organization and control. The main goal of this approach is to reduce the operating costs by reducing all forms of waste and avoiding non value added activities. This improvement in the operational processes can be achieved by managers through the application of tools and practices typical of lean methodologies: value stream management, spaghetti chart,

5S (sort, set in order, shine, standardize, sustain) and pull systems through kanban cards (Found & Bicheno 2016).

One of the key requisites to successfully implement a pull system is to have a demand as stable as possible. If the demand is not stable and has high and unpredictable spikes it becomes hard to guarantee a smooth flow of the product through the supply chain and this leads to a high level of inventory with an impact on costs (Found & Bicheno 2016).
For these reasons, in contexts characterized by non standard products and unstable demand it is hard to successfully run a lean production unit.

Lean product and process development
The product and process development greatly differs from production in terms of output. In the production process the initial product is transformed into a visible and known outcome. Product and process development is a completely different activity, driven by uncertainty because at the beginning of the development path the output is unknown. The path is not planned and there are many obstacles to overcome, as problem solving and decision making activities. To overcome these obstacles, many skills are required and, consequently, many actors are involved as for instance engineers, architects, project managers, market consultants (Rossi, Morgan & Shook 2016). For these reasons, the implementation of lean methodologies in product and process development activities is very challenging.

In the traditional product development approach, designers and engineers follow a precise path from point to point seeking for solutions to the problems they face along the process. In this approach, called *point based concurrent engineering*, the decisions are usually taken in the early phases of the development process (Ward et al. 1995).

Conversely, in the lean approach, in order to reduce the errors and consequently the waste, the designers tend to delay the decisions as much as possible. The delaying of decisions, give the designers the time necessary to gather sufficient data and knowledge. To collect a large amount

of data and knowledge in the shortest time, they explore several alternatives sets in parallel. This approach, called *set based concurrent engineering*, shifts the paradigm from design-build-test to test-design-build (Ward et al. 1995).

The benefits of the described lean product and process development are the reduction of late and expensive rework, the avoidance of delays due to changes in the final design phases, the increasing of innovation potential by exploring several solutions and, finally, minimizing the probability of failure as a result of taking into account larger sets of different alternatives (Ward et al. 1995).

Lean logistics

A fundamental function that supports the production and makes the value flowing smoothly along the value chain is the logistics.

The lean logistics has a dual objective: effectiveness, that is about getting done the right thing, and efficiency, that is about doing the right thing without waste. In order to achieve these objectives, the lean approach suggests to minimize the level of stock needed in order to reduce costs. For keeping the amount of stock low, it is important to accurately plan the production to level the consumption rate of each material over time and having a well organized inbound logistics with predictable replenishment lead times. Finally, it is important to have a good recovery strategy with a countermeasure plan in case of problems (Baudin 2016).

One of the most often used concepts in lean logistics is the *milk run*. The milk runs are fixed and predefined routes along which small quantities of a large number of items are moved between and within plants. The benefits of milk runs are short and predictable lead times without multiplying the transportation costs (Baudin 2016).

As we move on with the analysis of lean literature, it becomes more clear the importance of spreading the lean mindset in each business function of the company. Indeed, the final step of a

lean journey is usually the so-called "lean enterprise".

Lean IT

Lean IT consists in the pursuit of a profitable and effective relationship between lean management and the application of information technology (IT) in operations management. This relationship can be complex to manage and the IT department can be seen as an obstacle for the success of lean management (Åhlström, Kosuge & Mähring 2016). Indeed IT systems are easy to shape before their implementation, but once implemented lead to automation of processes and inertia, making the organization frozen in patterns of routines and resistant to change (Allen & Boynton 1991).

Since both lean management and IT are important for the organization, it is essential to find ways to overcome these obstacles and combine IT with lean in a productive relationship (Åhlström, Kosuge & Mähring 2016). Below, three different approaches for a successful achievement of lean IT are discussed.

Evidence-based Lean IT. With this approach, the creation of IT tools always starts with basic and simple solutions in order to experiment and make the necessary process development before starting the real IT project. The "regular" IT project starts only after a proof of concept has been conducted and a feasible and value-adding solution has stabilized (Åhlström, Kosuge & Mähring 2016).

Customer Value-focused Lean IT. Another possible approach is to focus the IT efforts only on the aspects of service delivery that provide a clearly visible benefit for the customer. An easy example of this approach, is a hospital which uses IT tools to improve the experience of patients when they need healthcare services (Åhlström, Kosuge & Mähring 2016).

People-centered Lean IT. This third approach is based on dialogue and collaboration between IT and operational staff to iteratively adapt IT applications in order to increase their fit with

continuously improving processes and to fulfill the end user needs (Åhlström, Kosuge & Mähring 2016).

For these reasons, when starting a lean journey it is important to perceive the IT department as a fellow supporter rather than an obstacle.

2.2.4 Lean across industries

The lean principles have been originally developed in the automotive industry. This section discusses the application of these principles in contexts different from the one for which they have been created.

Lean healthcare

The healthcare industry faces two main problems: always providing high quality to patients otherwise the consequences are unnecessary deaths; at the same time, cutting the costs because the less healthy lifestyle of advanced countries is leading to an increase in demand for healthcare that it is hard to sustain. For these reasons, there is a growing interest in the application of lean management in the healthcare sector (Jones 2016).

To improve the patient experience and to achieve better hospital performance, the initial step is to use value stream maps to understand the flow of patients through different teams and departments. Usually, what emerges is the high number of handoffs necessary to move the patient to the next step in his treatment journey (Jones 2016).

The key to solve the flow problem, like in the manufacturing industry is *visual management*. Showing a central visual board with the status of patients, rather than hiding it on a computer, helps the staff to implement the right action in order to ensure they move to the next step without delays and free up the bed for the next incoming patient. The visual board needs to be created whenever a new patient starts the treatment journey and then needs to be revised and updated on a regular basis. Another benefit of visualization is the ease to identify a problem: a recurring

break of the flow, it is a clear flag of something not working in the process that needs to be diagnosed and solved (Jones 2016).

From the literature, it appears clear that as in the manufacturing industry, the objective of lean healthcare is to prioritise flow efficiency of the "product" over resource efficiency. In the healthcare industry the "product" typical of manufacturing contexts is replaced by the patient.

Lean construction

In the 1990s there was a widespread dissatisfaction with the performance of the construction industry. There was a strong need to reduce costs, defects and accidents while increasing the speed of delivery. For these reasons the construction sector started to try to implement and adapt the lean principles to fit the peculiarities of this industry (Ballard 2016).

Construction artifacts are usually created through a so-called project production systems. There are also other types of project production systems as for instance new product development or software engineering. However, construction has special characteristics that make it different from other forms of project production systems and need to be understood in order to apply lean principles to it (Ballard 2016):

- There are constraints to the design given by the location in which the product will be placed. Examples of these constraints could be availability of materials, laws, culture, meteorological and geological variables;
- Due to the dimensions of assembled components, they cannot be moved through workstations so the workstations need to be moved through the components;
- The customers are individuals and the projects started in response to an order; furthermore, the customer who placed the order cannot be involved in the whole construction process: this means that is very important, more than in other industries, to understand what the particular customer really wants.

The lean vision is to deliver value to the customer without waste. In the case of construction industry, the *value* is instrumental meaning that the value consists of something that enables the customers to achieve their objectives. The *customer* is not only the one who pays or the one who places the order, but there are many project stakeholders involved that have an interest in the success of the construction project (Ballard 2016).

The difference in lean construction can be seen in the different key principles. The first principle that highlights the difference between lean construction and other industries, is *optimize the project, not the piece.* Construction projects are usually complex and uncertain, for this reason it becomes fundamental to link the compensation to the achievement of the owner's desired outcome. In this way, the money and resources are free to move across contractual boundaries in order to find the best project-level investment. In those conditions, fixed price contracts are not useful anymore. The second principle is *target value design.* Due to the customer being a unique individual and not a type, the target costing practice typical of manufacturing has been replaced by target value design. The former makes design driven by cost, the latter makes cost an outcome of design. This principle makes clear that the objective of lean construction is to deliver value to a specific customer where the cost is a constraint rather than value (Ballard 2016).

It is interesting to notice that, even if the industry is very peculiar and different from the others, it is always possible to adapt the lean principles and make them fit for purpose. Indeed, lean is more and more often perceived as a mindset rather than a set of tools and strict rules.

Lean in pharmaceutical industry

Due to the main business of the case organization, it can be interesting to have an overview of the lean practices in the pharmaceutical industry.

In the 1980s and 1990s, the pharmaceutical companies drove their efforts in the R&D investments and marketing activities. Today, given the increasing market rivalry and the declining R&D productivity, the managers are becoming interested in the operational

performance of the pharmaceutical production facilities. Accordingly to the study of Gebauer et al. (2009), it emerges that:

- The size of the plants matters with regard to the implementation of lean practices, indeed large plants implement a higher degree of lean practices than small plants;
- The application of set of lean tools and practices is positively associated with an increase of operational performance in the pharmaceutical industry;
- Even if the pharmaceutical industry is historically a R&D and marketing driven sector, the impact of operational performance on the overall company performance is positive and significant;
- The purpose of lean practices in the pharmaceutical industry is that of guidelines for managers who are seeking to achieve operational excellence.

This study is a further demonstration of the fact that lean practices are nowadays widespread across all types of industries. They can be a support to improve the overall performance of the company even in sectors completely different from the automotive or highly regulated as the pharmaceutical industry.

Lean software development

Given the scope of the thesis, the last case analyzed is the software development industry. In the 1990s the development of software was a slow and arduous process. And while the importance of software increased, the complaints about the old methods grew. Lean software development was introduced as a bundle of principles to pave the way for evolving the agile practices that have been developed with the new millennium. These principles are (Poppendieck 2016):

1. Eliminate waste
2. Amplify learning
3. Decide as late as possible
4. Deliver as fast as possible

5. Empower the team
6. Build quality in
7. See the whole

These principles are consistent with lean manufacturing but the areas of focus and specific practices that emerged were tailored for a software context. Indeed the focus of lean software development came on these areas (Poppendieck 2016):

- *Build the right thing.* Understand what the customer really wants;
- *Build it fast.* Reduce as much as possible the lead time from the customer need to the delivery of the final product;
- *Build the thing right*. Minimize the number of defects and guarantee high quality;
- *Learn through feedback.* Collect frequent end-to-end feedback in order to improve the product accordingly to customer needs.

Lean software development forms an initial theoretical framework for agile practices but lacks the concepts of iterations, test-driven development and continuous integration of small increments that are the distinguishing practices of agile software development which will be discussed in the next chapters.

2.2.5 Limitations of lean management

When starting a lean journey it is important to keep in mind the context in which the lean tools have been developed. These tools have been created within a manufacturing industry which was in that time characterised by high volumes and relatively standardized product's basic design (Modig & Åhlström 2012). Indeed the software industry, which is characterised by a high level of turbulence and specifications not easy to define, has developed the concept of *agile software development* (Cantamessa & Montagna 2016). Being the scope of this thesis an IT organization, the agile concept is taken into account in the following chapters.

2.2.6 Origins of Agile

The primary focus of lean management is *value.* It is an ever going struggle for reducing waste, which reduces value, and continuous improvement, which increases value. Instead, the agile approach emphasizes *customers*. However the lean principles are not in contrast with the inspect and adapt approach of agile (Coplien & Bjørnvig 2010).

In early 2001, software development activity was an ever increasing practice in many corporations and the development teams were facing the risk of being stuck in the processes. For this reason, a group of industry experts felt the need to define the values and principles that would have guided these teams through an adaptive development able to quickly respond to changes (Martin 2003). The group members named themselves the *Agile Alliance*. The outcome was *The Manifesto for Agile Software Development* (Beck et al. 2001):

*"We are uncovering better ways of developing
software by doing it and helping others do it.
Through this work we have come to value:*

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

*That is, while there is value in the items on
the right, we value the items on the left more."*

Kent Beck	James Grenning	Robert C. Martin
Mike Beedle	Jim Highsmith	Steve Mellor
Arie van Bennekum	Andrew Hunt	Ken Schwaber
Alistair Cockburn	Ron Jeffries	Jeff Sutherland
Ward Cunningham	Jon Kern	Dave Thomas
Martin Fowler	Brian Marick	

Individuals and interactions over processes and tools

A common mistake is to build the processes and tools first and then let the team adapt to them automatically. The first value of the agile manifesto focuses on creating the team and then let the team build the environment as needed (Martin 2003).

Working software over comprehensive documentation

Many teams get lost in the creation of documentation instead of focusing on the software. Documentation is important but too much documentation is worse than too little. The faster and more efficient way to transfer knowledge and information is human-to-human interaction. The rule called *Martin's first law of documentation* explains this value clearly: "produce no document unless its need is immediate and significant" (Martin 2003).

Customer collaboration over contract negotiation

One of the pillars of agile methods is customer feedback. To be successful a project has to involve the customer and implement its feedback on a regular basis during the development. The contract should avoid to specify the details of scope and schedule but should rather govern the relationship and the collaboration with the customer (Martin 2003).

Responding to change over following a plan

The business environment is dynamic and the needs change. Furthermore, it is likely that the customers will alter the requirements during the development and implementation of the project. Finally, the human being is not very good in estimations. For these reasons, a good planning strategy should not be based on long term plans but rather on detailed plans for the next few weeks and only rough plans for longer terms that will be adapted to the changing needs and requirements (Martin 2003).

These four values led to the definition of principles that will be discussed in the next section.

2.2.7 Agile software development principles

The values defined in the manifesto inspired 12 principles (Martin 2003):

- *Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.* The focus of the agile approach is on delivering early and often. At the beginning the system delivered is very basic and rudimentary. Then the functionalities increase at each iteration. At each delivery the customer may choose if the product is functional enough to be implemented or if he wants other functionalities to be added or changed.

- *Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.* The change to the requirements is a good thing since it means that the team has understood better what the customer wants.

- *Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter time scale.* The delivery has to be frequent and early, but it has also to deliver a working software. Documents and plans do not count as a true delivery.

- *Business people and developers must work together daily throughout the project.* To be successful, a software project must be continuously guided not only by developers. They need to work in close collaboration with customers and other stakeholders in order to get the job done in the most successful way.

- *Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.* The attention of the agile approach is towards people. People are a critical success factor for an agile project. Team comes first and the environment must be adapted to its needs.

- *The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.* The primary means of communication in an agile project is conversation. Documents can be created as a support if it is needed, but they are not the default practice.

- *Working software is the primary measure of progress.* The fulfillment of customer needs is the measure of progress. The documentation produced or the infrastructure coded are not a measure of progress.

- *Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.* The best way to explain this

principle is through an analogy. Running an agile project is like running a marathon, not like a 100 meter dash. The team has to be able to keep a fast and sustainable pace through the entire project without knowing when the project will come to an end.

- *Continuous attention to technical excellence and good design enhances agility.* The agile team members always strive for the highest quality. If there is an error, it must be fixed within the end of the day.

- *Simplicity - the art of maximizing the amount of work not done - is essential.* Agile teams do not try to anticipate the problems of the future, and they do not try to address all the existing problems of today. Agile teams just do what is consistent with their goals in the simplest and highest quality way.

- *The best architectures, requirements, and designs emerge from self-organizing teams.* One of the other pillars of agile is the concept of self-organizing team. Responsibilities are shared by the team as a whole, and the members work together on all aspects of the project.

- *At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behaviour accordingly.* The environment is continuously mutating, and the agile team knows that has to be flexible and change itself to keep being agile. For this reason, a common practice of the agile approaches is to stop at regular intervals and reflect on what makes sense to continue doing and what should be changed to improve.

These principles serve as guidelines on how to apply an agile approach to any field.

2.2.8 Agile software development practices

The traditional approach to develop software is the so-called *waterfall* method. This approach is a sequential life cycle development that starts with a detailed planning phase where the end product is already clear and documented in every detail. The great advantage of this approach is that it is extremely logical. On the other hand, the weakness is that with this method all the good ideas have to come at the beginning of the process, if they come once the process has already started then it is too late to implement them. Furthermore, humans are not able to plan in detail

far into the future when dealing with the uncertainty typical of the software development processes. For these reasons, agile software development focuses on doing rather than spending effort in planning up front. It emphasizes short iterations based on the customer feedback along the process. It avoids hierarchies and silo mentality empowering self-organized cross functional teams (Larman & Vodde 2008).

In the agile software development context, many methods and frameworks (e.g. Scrum, XP) have been created over the years, but some practices and artifacts are common to all of them. In this section, the key common practices of agile software development have been considered and examined. These practices are a direct consequence of the agile principles.

Customer team member

Customers and developers should work together in order to be aware of each other's issues and be able to solve them together. The best case is when they are co-located in the same building or even better in the same room (Martin 2003).

User stories

Collecting all the requirements in detail long before the system is implemented, will likely result in wasted effort because the requirements are likely to change during the development. The user story avoids the explanation of all the details, but it is only a reminder about the ongoing conversation about the requirements. The customer writes on a card only few words about his needs (As a <role>, I want <goal>, so that <reason>) that will help the developers to remind about the conversation and make a rough plan for the short term (Martin 2003).

Iteration plan and release plan

One of the common practices of agile development is to deliver often. Usually every two weeks there is an *iteration* that delivers a working software partially addressing the needs of the customer. At each iteration the number of needs fulfilled increase. Once a sufficient number of needs have been fulfilled, the goal is to have an output that can be put in production. This is a

major delivery called *release* that is usually the result of 3 months of work corresponding to 6 iterations (Martin 2003).

2.2.9 Differences between Lean and Agile

So far, the principles of Lean and Agile have been discussed and in a certain way how they can fit together due to the many similarities they have. Indeed lean is often cited as a foundation of agile. The lean concept of value stream from a customer perspective recalls the customer focus typical of an agile approach. The focus of lean on reducing waste can be reflected in the agile practice of reducing documentation and delaying decisions (Coplien & Bjørnvig 2010).

Nevertheless, sometimes lean and agile are also contrasting. The Table 1 highlights the major differences between lean and agile:

Lean	Agile
Thinking and doing	Doing
Inspect-plan-do	Do-inspect-plan
Planning and responding	Reacting
Focus on process	Focus on people
Teams (working as a unit)	Individuals (and interactions)
Complicated systems	Complex systems
Embrace standards	Inspect and adapt
Rework in design adds value, rework in making is a waste	Minimize up-front work of any kind and rework code to get quality
Bring decision forward	Defer decisions (to the last responsible moment)

Table 1. Contrast between Lean and Agile. Source: Coplien & Bjørnvig (2010)

All these differences are consequences of the context in which they have been created. Two different worlds: hardware and software. Lean principles have been created to operate in a

predictable and repeatable process, typical of "hardware manufacturing" such as the automotive industry. Agile principles have been defined in a hardly predictable industry, such as software development (Coplien & Bjørnvig 2010).

From the literature analysis done so far on lean management and agile development, it is clear that even if in the practical context there is a lot of confusion on these two practices, they are both excellent tools for improvement but they are also very different. It is necessary to understand how these practices differ in order to implement them in an effective way. The main difference between a lean approach and the agile methodology, is that the former has been shaped around the "hardware" context and the latter has been developed in a "software" environment. Indeed, the lean approach does not require the development of an initial prototype because it would be too expensive for a "hardware" product. On the other hand, the agile approach requires the development of an initial prototype that is later improved through several iterations and releases based on the customer feedback. For this reason, an agile development can be used in a "software" context, in which all the changes and further improvements to the initial prototype require only further man hours but not material costs. The use of agile methodologies in the "hardware" world, has recently started since the new "smart" products send data to the designer while they are used by the customers and this makes possible to design the new version of the product while in use.

For an organization starting a process improvement journey through the implementation of lean and agile concepts, it is extremely important to deeply understand these differences and keep them in mind during the entire journey.

2.3 Project Portfolio: its role in strategy and methods

With the knowledge acquired on lean and agile management in the previous paragraphs, it is now possible to analyse the existing literature on portfolio management and how it can be linked to the agile practices.

Project portfolio management (PPM) is the discipline that "focuses on the selection of the projects that must be initiated, managed, and terminated, for the purpose of achieving the objectives of the organization" (Cantamessa & Montagna 2016). In particular, *portfolio management* can be formally defined as follows (Cooper, Edgett & Kleinschmidt 2002):

> "Portfolio management is a dynamic decision process, whereby a business's list of active new product (and development) projects is constantly up-dated and revised. In this process, new projects are evaluated, selected and prioritized; existing projects may be accelerated, killed or de-prioritized; and resources are allocated and re-allocated to the active projects. The portfolio decision process is characterized by uncertain and changing information, dynamic opportunities, multiple goals and strategic considerations, interdependence among projects, and multiple decision-makers and locations. The portfolio decision process encompasses or overlaps a number of decision-making processes within the business, including periodic reviews of the total portfolio of all projects (looking at all projects holistically, and against each other), making Go/Kill decisions on individual projects on an on-going basis, and developing a new product strategy for the business, complete with strategic resource allocation decisions".

Only with the new millennium, the strategic importance of PPM practices has been recognized. Indeed, a poor portfolio management leads firms to miss a strategic focus when selecting projects (Cantamessa & Montagna 2016). A healthy portfolio management office is key to make efficient Go/Kill decisions and align the project pipeline with the business strategy. Lack of formal prioritization method means that projects are selected based on gut feelings and political aspects rather than on objective criteria (Cooper, Edgett & Kleinschmidt 2001).

Portfolio management can appear as a pure mechanistic problem of decision making under resources constraints. But accordingly to Cooper et al. (2002), it is maybe the most difficult decision-making problem that the modern business has to face. Indeed the goals of portfolio management are unique and hard to achieve (Cooper, Edgett & Kleinschmidt 2002):

maximization of value of the portfolio under budget constraints, *balancing* the projects within the portfolio, *aligning* the portfolio to the company's strategy and achieving the *right number of projects* for the limited resources available.

In order to achieve these goals and being successful, a portfolio management office can use different methods and can apply them with different approaches. These methods and approaches for portfolio management will be discussed in the next sections.

2.3.1 Portfolio management methods

Many methods exist for portfolio management. Some of them are more effective for achieving certain goals, some of them are more effective for other goals. The choice depends on the goals set by the leadership teams. In this section, the methods that are more often used by the companies (Cooper et al. 2001, 2002) will be discussed.

Financial methods

Financial methods take into account financial aspects to select and prioritize projects. These methods are the most popular tool for portfolio management with 77% of the companies using it and 40% relying on it as the dominant method (Cooper, Edgett & Kleinschmidt 2001). Financial methods are particularly suitable to achieve the goal of maximizing the value of the portfolio (Cooper, Edgett & Kleinschmidt 2002).

According to finance theory, the key indicator for assessing the financial value of a project should be the **Net Present Value** (Cantamessa & Montagna 2016). The Net Present Value (NPV) is the sum of future marginal cash flows CF_t discounted to a given interest rate i (Cantamessa & Montagna 2016):

$$NPV = \sum_{t=0}^{T} \frac{CF_t}{(1+i)^t}$$

and the highest the NPV is, the highest is the value of the project. But this indicator ignores probabilities and risk (Cooper, Edgett & Kleinschmidt 2002). To include these aspects, especially for product development projects, an indicator that can be used is the **Expected Commercial**

Value (ECV). After the estimation of the project specific technological risk P_t, the commercial risk P_c, the costs related to technical development DC and the costs for production and launch CP, the ECV can be computed as follows (Cantamessa & Montagna 2016):

$$ECV = (NPV * P_c - CP) * P_t - DC$$

Then to arrive at a prioritized list of projects, the ECV is divided by the resources that are considered scarce, namely the constraining resource (e.g. people measured in terms of money), and the projects are ranked according to this ratio (Cooper, Edgett & Kleinschmidt 2002).

One of the weaknesses of these financial methods is that they require accurate financial estimates for all projects and rely on quantitative data that are often not available. Another relevant weakness is that this method considers a single financial criterion for project selection (Cooper, Edgett & Kleinschmidt 2002). Indeed in a study of Cooper et al. (2001), the outcome is that the most successful organizations rely much less on financial tools, while the poorest results are achieved by organizations which put much emphasis on financial methods.

Optimization methods

Financial indicators are perfect for giving information about the value of individual projects, but provide no information on the relationships between them. The optimization methods can be useful for this purpose. A simple optimization method can be modeled as follows (Cantamessa & Montagna 2016):

Sets:
$i = 1...m$ is the set of resource types;
$j = 1...n$ is the set of candidate projects;
$t = 1...T$ is the set of planning "time buckets" on which planning is performed, up to a horizon T.

Parameters:
r_{ijt} is the use of resources type i by project j at time t;
v_j is the NPV of project j;
d_{it} is the availability of resource type i at time t.

Decision variables:
$x_j = 1$ if project j is started, $= 0$ if it is not.

$$max \sum_j v_j * x_j$$

$$subject\ to$$

$$\sum_j r_{ijt} * x_j \le d_{it} \qquad \forall\ i,\ t$$

$$x_j \in \{0,\ 1\} \qquad \forall\ j$$

Such an optimization model can be hard to implement when the number of projects in the portfolio is high. Furthermore, since the project selection is a strategic decision, managers tend to be suspicious about an algorithm that dictate which are the projects that should start and which are not (Cantamessa & Montagna 2016). For these reasons, other methods are more often used in the project portfolio management practice.

Multicriteria methods

As said before, project portfolio management is not a mechanistic exercise. It has a strategic nature and consequently taking into account only quantitative information based on financial aspects does not lead to the best results. Decision makers need to consider both quantitative and qualitative dimensions as for instance project complexity, effort required, strategic alignment, etc. (Cantamessa & Montagna 2016). The multicriteria methods are a great tool when there is a set of heterogeneous criteria to consider.

One of the many multicriteria methods available is the **Analytical Hierarchy Process** (AHP). This method has the purpose of defining the objectives around a strategic direction. The strength of this method is that the weights of criteria are a direct consequence of the strategy. The evaluation of alternatives is done through pairwise comparison, that from a computational perspective can result too complex and lead to mistakes (Cantamessa & Montagna 2016). For this reason is rarely used by companies, which prefer to use simpler methods as the **Scoring Model**. According to the study of Cooper et al. (2001), 38% of businesses use this tool. Here, projects are scored on a certain number of criteria that can be both qualitative and quantitative. The project score is the weighted sum of the scores on each criterion, and it is the starting point for creating a prioritized list of projects (Cooper, Edgett & Kleinschmidt 2002). The scoring model is an appropriate selection method to achieve a portfolio that is strategically aligned and reflects the business's spending priorities (Cooper, Edgett & Kleinschmidt 2002).

Strategic approaches

There are two different ways to incorporate a strategic alignment into the portfolio: *bottom up* and *top down*. Bottom up means defining strategic criteria into the project selection tool, and this can be done using the **Scoring Model** discussed in the previous section. The top down approach starts with the business strategy as basis for setting the funds for each category of project area (Cooper, Edgett & Kleinschmidt 2002). This approach can be put into action through a **Strategic Buckets method**. With this method, once the business strategy is clear, financial resources are allocated into different buckets and then the projects are ranked within the bucket which they belong to (Cooper, Edgett & Kleinschmidt 2001). In the study of Cooper et al. (2001) this is the second most popular portfolio tool and about 65% of businesses use a strategic approach, while almost 27% report to rely on it as the dominant method.

Mapping methods

The graphical representations of portfolio are great tools when the main goal is to achieve the right mix of projects, in other words a balanced portfolio. This approach comes from financial portfolio in the investment area, in which the portfolio manager wants to achieve the right mix of projects in terms of high risk and uncertainty versus low risk and safe returns (Cooper, Edgett & Kleinschmidt 2002). This approach is widespread but it is important to keep in mind that these tools provide a visual representation of the portfolio and can be a good support for decision making, but do not provide guidance on how to select the projects (Cantamessa & Montagna 2016). A project portfolio map widely used is the **Risk-Reward Bubble Diagram** in which projects are plotted on an XY map just like in the well known BCG Matrix except for the fact that the axes are different: a typical Risk-Reward Bubble Diagram has the reward on the X axis, the probability of technical success on the Y axis and the circle size is given by the resources needed for that project (Cooper, Edgett & Kleinschmidt 2002). Alternatively, other visual maps to display how the budgets are split among the project categories is the well known **pie chart** (Cantamessa & Montagna 2016).

Check list models

Among the least popular portfolio tools can be found the **check lists**, with 18% of companies

using it and only 3% relying on it as the dominant method. This tool is very simple and it is used as a supporting tool together with other more structured tools (Cooper, Edgett & Kleinschmidt 2001). Here, projects are assessed on a set of Yes/No questions. Then the Go/Kill or prioritization decisions are based on how many "Yeses" each project received (Cooper, Edgett & Kleinschmidt 2001).

Resource Capacity-Versus-Demand Analysis

The resource analysis is a valuable tool when achieving the right number of projects in the portfolio is a key goal. The first step to apply this method is to determine the resource demand for the prioritized list of active projects. The scoring model or a financial approach can be used for prioritizing the list. Once the resource demand has been defined, the next step is to analyze the resource capacity. In the example of Figure 2, it is evident that the portfolio has too many projects (Epsilon and Foxtrot). According to Cooper et al. (2002), this exercise can lead to the understanding of the right number of projects for the portfolio, which is the constraining department and finally can help in giving insights on how the departments invest the time of their human resources.

Project	Product Mgmt		Marketing		Research Group A		Research Group B	
	Persondays	Cumulative	Persondays	Cumulative	Persondays	Cumulative	Persondays	Cumulative
Alpha	3	3	2	2	10	10	5	5
Beta	4	7	2	4	10	20	5	10
Gamma	3	10	2	6	15	35	5	15
Delta	5	15	3	9	15	50	8	23
Epsilon	6	21	3	*12*	5	55	8	31
Foxtrot	6	*27*	2	*14*	5	60	5	36
Demand		27		14		60		36
Available Persondays		20		10		60		40
% Utilization		*135.00%*		*140.00%*		100.00%		90.00%

Figure 2. Example of Resource Demand Vs. Capacity Chart. Source: Cooper et al. (2002)

From the analysis of the literature but also from what are the results of the study of Cooper et al. (2001), there is not a single recipe for project selection that works for every company, but it is

important that each business finds the best tool based on its goals. From the study emerged that the most successful organizations do not rely on a single method but tend to use more than one tool in order to achieve the best results. Furthermore, tools are only tools and it is key to avoid using them in a mechanistic way (Cooper, Edgett & Kleinschmidt 2001).

2.3.2 Portfolio management approaches

There can be different approaches to integrate the methods described in the previous section into project portfolio management process. When looking at the **traditional PPM approaches**, the greatest contribution in the literature is the work of Cooper et al. (2002) that will be discussed in detail. Two main different approaches are defined: the *Gates Dominate* approach and the *Portfolio Reviews Dominate* approach. While these traditional approaches are different, the main concept of a linear process to identify, prioritize, allocate, balance and review the projects within a portfolio does not change (Stettina & Hörz 2015). Before describing these approaches, it is important to clarify that both these approaches have been developed in the area of new product development assuming that a traditional gating process similar to the one in Figure 3 is already in place (Cooper, Edgett & Kleinschmidt 2002).
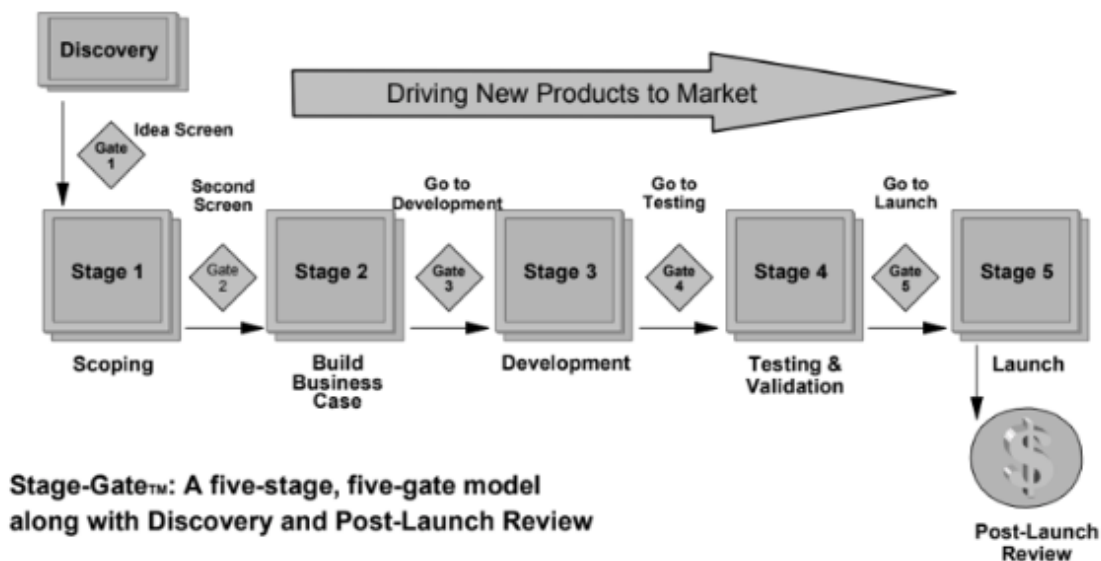

Figure 3. The typical Stage-GateTM Model. Source: Cooper (2001)

The Gates Dominate approach (Cooper, Edgett & Kleinschmidt 2002)

This is the best approach for large companies in a mature business with a portfolio of projects quite static. The focus is on making good decisions on individual projects at each gate. The projects are prioritized at gates and resources are allocated. This means that at each gate there is an in-depth review of the project and the review is for one project at a time. This approach is often added to the Stage-Gate process as a complementary decision process. Therefore, gates are split in two parts: the first part of the gate is a Pass/Kill decision and the second part is the prioritization of the project in question versus all the other projects within the portfolio. In this approach the projects are reviewed all together as a portfolio only twice a year during the Portfolio Reviews: they serve as a check and if the gates are already working well, few corrections and adjustments are needed at the Portfolio Review.

The Portfolio Reviews Dominate approach (Cooper, Edgett & Kleinschmidt 2002)

This approach is fundamentally different in the sense that a single decision point for all the projects within the portfolio replaces the gates of the first approach. This decision point is the Portfolio Review. The gates here are a simple check on the health of each project, and the Go/Kill and prioritization decisions are made at the Portfolio Reviews where all the projects are considered together. The Portfolio Review typically takes place four times a year, this makes the approach more dynamic compared to the previous one. For this reason, this approach is suitable for faster-paced organizations, such as IT and technological companies. On the other hand, this approach requires much more effort for the decision makers who have to review in detail all the projects together and several times in the same year.

At Gate 2 (Figure 3) the project has enough data available to enter the portfolio process and at every Portfolio Review meeting all the new Gate 2 projects, together with all the projects beyond this Gate, are reviewed and ranked against each other. It is also at this recurrent meeting that the resources are allocated and not at gates anymore. In this approach the gates are merely check points rather than decision points.

With the development of agile project management methods, questions on how to leverage these practices outside of individual projects arose. For this reason, some studies tried to understand

how to evolve the traditional waterfall models described above into more **agile PPM approaches**. The substantial difference of these approaches is the iterative nature of agile methods which is translated into a recurrent and frequent reassessment of the projects within the portfolio (Stettina & Hörz 2015). The aim of the next section is to discuss in detail the most important frameworks for agile portfolio management that have been found in the literature.

2.3.3 Existing models for agile portfolio management

In the literature, according to Stettina and Hörz (2015), the main frameworks for the implementation of agile methods in portfolio management are provided by Krebs (2008), Leffingwell (2011) and Vähäniitty (2012). Further authors have provided recommendations and suggestions, based on their experience, to build an agile portfolio and they will be included in this section after the three authors mentioned above.

Krebs (2008)

The proposal of Krebs is a dynamic portfolio managed through agile principles in order to enhance the flexibility. In this model the portfolio management practice is divided into 3 different portfolios: project portfolio, resource portfolio and asset portfolio.

The *project portfolio* can be explained as the vision of the organization. This portfolio is composed of the running projects already in execution and the funnel of ideas that could become active projects. The challenges to overcome, as described by Krebs, are too many active projects and an incorrect mix of projects. Having too many active projects leads to a project switching penalty, this means that if the resources have to switch between different projects, because they are not full time allocated on a single project, their productivity decreases. The estimated waste is about 20 percent if the resource has to switch between 2 projects, 40 percent between 3 projects and 60 percent if there are 4 projects. Theoretically, if the penalty is 60 percent with 4 projects, this means that each project has only 10 percent of productivity because the productivity left is only 40 percent. In order to achieve the correct mix of projects it is essential to have a good project selection tool as a support for assessing and aligning the portfolio with the corporate strategy. The tools and methods for projects selection are fundamentally the ones

described in section 2.3.1. For these reasons the recommendation of Krebs is to always have a healthy funnel of proposals and ideas up-to-date and prioritized.

The funnel starts with an idea which is a very high level description of the potential project and the reason why it should be selected. Then, if the idea is simple and small can go directly into the project funnel, otherwise if it is useful but needs to be better defined it goes through the step of the business case. This document is used to define the scope and the details of the idea before deciding if it is worth the investment. In the case of agile projects, this step is quite different because there is not a clear and defined scope with all the details. For this reason, the business case of an agile project needs to provide enough information to justify the funding of the first iterations and not of the entire project. Since the creation of a business case is very expensive and it requires a lot of effort, with an agile project the organization does not fund the creation of a business case document, but invests in the initial iterations after which a better understanding of the idea will be reached and perhaps a working software too. This is only one of the benefits of having agile projects in the project portfolio.

Another benefit of agile projects is the innovation. With traditionally managed projects it becomes very risky to allocate a great amount of money to one project. In this case it is necessary to wait months or years before seeing a tangible progress and review the benefits of the investment. Instead, with the small cycles of agile projects the financial commitment becomes smaller and the risk related to innovative projects decreases.

In any case, after the completion of the business case or after the initial iterations, if the idea is still a high priority, it will enter the funnel of proposals waiting and competing for the resources. This funnel is extremely dynamic and it is important to constantly assess it and keep it up-to-date.

The active projects need to be constantly reviewed and evaluated. Traditionally managed projects use a status report based on milestones in a master plan which is usually created at the beginning of the project. From this perspective, the advantage of agile projects is that the metrics for the status can be linked to a tested and working software, and after each iteration the system could be potentially deployed. Furthermore, the agile teams provide much different feedback compared to traditional teams. Indeed, just before the retrospective between iterations, the metrics for the

health of the project can be compiled and sent to the portfolio management office removing the need to send an ad hoc status report. They can simply leverage the checkpoint that is already used for project reporting. The suggestion of Krebs is to use metrics such as progress based on the implemented requirements, quality and team morale. The typical action that can be taken after the evaluation are Go, No-Go, Pause and Accelerate.

The final suggestions of Krebs are not to mix agile and traditional projects in the same project portfolio, and to remember that cancelling a project is not negative.

In the model described by Krebs, the second type of portfolio is the *resource portfolio*. The management of resources is important because the highest cost in a project is most often the personnel which is a dynamic and variable element.

In an agile environment, the resource portfolio should be aligned not only with the project portfolio but especially with the funnel of ideas and proposals. This is important because the best time to allocate resources, acquire new skills and train the personnel is the time frame between the proposal entering the funnel and the proposal being converted into an active project. For this reason, Krebs emphasized the fact that agile projects are ideal to get on-the-job-training leveraging the iterative rhythm to transfer the knowledge.

Another challenge identified by Krebs in the resource portfolio is the lack of feedback from the project team. Instead, with agile teams which provide constant feedback about the completion and project reporting between the iterations, the executives can easily assign team members to the upcoming projects. After each iteration, the accuracy of the end date increases and the transition of resources from the finished project to the new one becomes much easier. If the resource portfolio is not transparent and the resource management is not working, the consequence is that resources, close to the end of their project, start a self-advertisement campaign to find a position in a new upcoming project. This campaign makes the resources less productive and it can consequently lead to a delay in the delivery date. This is the reason why it is essential to have a working and healthy resource portfolio in place and the agile environment can help with that.

The last portfolio discussed by Krebs is the *asset portfolio*. The asset captured in this portfolio

are systems, applications and the related hardware investments. An asset can be defined as the outcome after the project is completed. But the asset portfolio is also linked to the resource portfolio because the assets need personnel for maintenance and operation. For their nature, assets are not dynamic as the projects, but still need to be managed and monitored in order to collect ideas for new projects and be able to allocate the potential resources. This third portfolio is enormously relevant because 70 of all costs are in the running systems after the completion of the development projects.

The first challenge of asset management is that legacy systems often become a roadblock. Every company has a system that was a good solution many years ago but then, over the years, the technologies improve and the system becomes outdated. The point where a system becomes a roadblock is when the benefits are lower than the costs to maintain it and operate it. The biggest issue with replacing such a legacy system is that this system could be managing live customers or transactions and can cause a business interruption. It is here that the iterative incremental development of an agile approach can be helpful. The different functionalities of a large system can be grouped into different categories building prioritized units of functionalities. Then, the asset will remain in the asset portfolio while a project proposal for building the new system split into different units is added to the funnel. The resources maintaining the asset can synchronize their effort with the agile team developing the new system in order to build the necessary interfaces between future and existing components and remove the bottleneck functionalities.

Another challenge identified by Krebs in the asset portfolio is to transform the concept of *built to last* into *built to last as long as really needed*. According to a study by the Standish Group, on average 45 percent of functionalities in systems are never used and 19 percent are rarely used. This means that there are many unnecessary features that can be removed in a project and an iterative agile approach can help the team to understand which are the unwanted functions. This can lead to a shorter production time frame and a more dynamic asset portfolio. The smaller investment makes the executives more willing to invest again in a better system that can replace the old one. This increases the rate of innovation, reduces the patchwork solutions and the creation of legacy systems that last for many years and create a roadblock.

The final suggestion proposed by Krebs is to introduce the concepts of Scrum methodology in the portfolio practices. For instance, the concept of Product Backlog can be transformed into Project Portfolio Backlog. The *Product Backlog* is related to a single project and can be seen as a dynamic and prioritized list of requirements, features, items and functionalities that still need to be implemented in the next iterations. The *Project Portfolio Backlog* is the same concept applied to a portfolio of projects and can be seen as a prioritized funnel of active projects and project proposals. The practice of keeping the potential projects in a prioritized backlog has been discussed also by Thomas & Baker (2008).

Scaled Agile Framework SAFe (Leffingwell 2011; Leffingwell & Knaster 2017)

The first version of SAFe has been published in 2011 and provides an agile framework to scale lean principles and an agile way of working to the portfolio and program management levels.

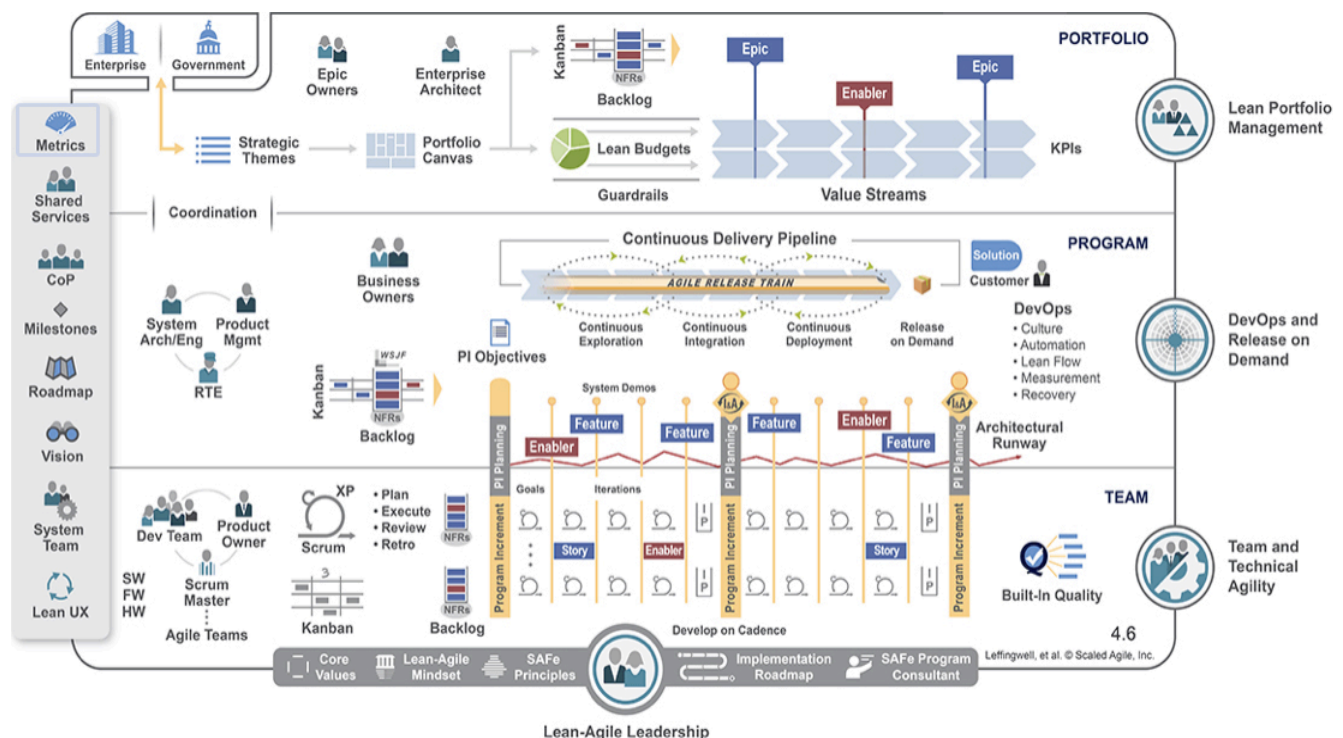The following figure gives a generic overview of Scaled Agile Framework:

Figure 4. Portfolio configuration of SAFe for Lean Enterprises. Source: https://www.scaledagileframework.com

This picture describes the agile framework for the whole enterprise. Leffingwell divides the enterprise into three levels: portfolio, program and team. On portfolio level, the focus is on building the portfolio vision, allocating resources and prioritizing a portfolio backlog. On program level, the focus for the product manager is to collaborate with the portfolio management team in order to prioritize the program backlog. In the lowest level the agile teams are responsible for the implementation and execution of projects using an agile approach which is often the Scrum framework.

Due to the scope of this thesis, only the portfolio layer is presented and further discussed in this study.

Portfolio layer in SAFe

The portfolio layer is described by the Lean Portfolio Management competency which is one of the Five Core Competencies of the Lean Enterprise. The goal of Lean Portfolio Management is to align strategy and execution leveraging the lean approaches to three areas:

- strategy and investment funding;
- agile portfolio operations;
- and governance.

To support the Lean-Agile way of working, it is necessary to change the typical mindset of the traditional approach. The following figure shows how the traditional mindset must evolve:
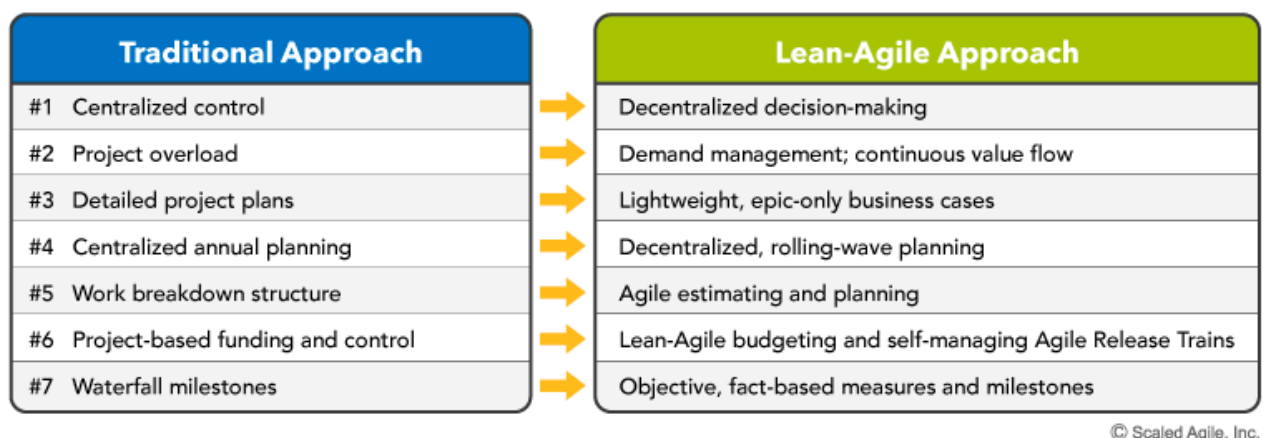
Traditional Approach		Lean-Agile Approach
#1 Centralized control	➡	Decentralized decision-making
#2 Project overload	➡	Demand management; continuous value flow
#3 Detailed project plans	➡	Lightweight, epic-only business cases
#4 Centralized annual planning	➡	Decentralized, rolling-wave planning
#5 Work breakdown structure	➡	Agile estimating and planning
#6 Project-based funding and control	➡	Lean-Agile budgeting and self-managing Agile Release Trains
#7 Waterfall milestones	➡	Objective, fact-based measures and milestones

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Figure 5. Traditional mindset evolves to Lean-Agile approach. Source: https://www.scaledagileframework.com

Portfolio is the highest level of the framework and represents the vision for all the different solutions delivered by the Value Stream of each specific business domain. The vision represents the business strategy of the organization. Thus, the business strategy steers the business objectives which lead the Strategic Themes. These elements tend to remain unchanged for at least one year and are the mechanism to align the business strategy to a portfolio. Strategic Themes influence directly the Portfolio Canvas (Figure 6) which describes how a portfolio creates, delivers and captures value.

Figure 6. The portfolio canvas. Source: https://www.scaledagileframework.com/portfolio-canvas/

The initiatives at an enterprise level are named Epics. An Epic is an initiative large enough to require a financial approval before implementation. The Epic Owners are the ones responsible for defining the epic and managing them through the Portfolio Kanban system:

- *Funnel* - captures all new big ideas from any source and they may be business or technical concepts;

- *Review* - epics that are found to be worth spending more time on defining the epic hypothesis, estimating the value and conducting some preliminary investigation;
- *Analysis* - this stage welcomes the epics that after the previous phase merit more rigorous analysis to understand if the investment can be approved. It is at this step that a Minimum Viable Product is developed. This further analysis is conducted by the Epic Owner together with other key stakeholders as the Enterprise Architects and the Agile Teams;
- *Portfolio backlog* - contains the epics that have been approved. The portfolio backlog is used to maintain the epics by periodically reviewing them and prioritizing them. If enough resources from an Agile Release Train (ART) are available, then the item goes to the *implementation* phase;
- *Implementation* - accordingly to the kanban system, as soon as the capacity is available, epics are pulled into this state. Here the epics are split into smaller items called Capabilities and Features. The responsibility for implementation rests with the development teams, but Epic Owners remain available until the teams have a clear understanding of the work;
- *Done* - this is the last state of the epic once the evaluation of the initial hypothesis has been completed. If the hypothesis was correct, the epic goes to the Program and Team level in the form of features or capabilities. If the hypothesis is refuted, then the epic can be dropped or the portfolio can choose to use another approach for that epic.

The aim of the portfolio kanban is to reduce the batch sizes of work, have visibility and control of the work in process. Indeed, one of the focuses of this framework is on limiting the work in process in order to ensure that the epics are analyzed responsibly. The goal is to achieve flow efficiency rather than resource efficiency.

Value Stream is the process that an organization adopts in order to create a continuous flow of value to a customer. A SAFe portfolio is organized around the different Value Streams of an organization and the role of the portfolio is to fund the set of these streams. Each Value Stream delivers a set of software and solutions that enable the organization to meet the business strategy, either by providing value to the end user or by supporting the business process.

Once the value stream has been defined, the SAFe portfolio creates an Agile Release Train to accomplish the value. The ART is formed of agile development teams which develop and deliver one or more solutions in the same Value Stream.

The Value Streams also make possible the implementation of *Lean Budgets.* Each Value Stream has a budget, and each budget is managed following Lean-Agile budgeting principles in order to make adjustments as the business conditions change. The Guardrails provide the essential governance by defining guidelines and spending policies. The three main steps for the implementation of Lean Budgets are:

1. Funding value streams, not projects - the first step of Lean budgeting is to allocate a budget to each value stream or solution instead of funding the single project;

2. Guiding investments by horizon - it is important to balance the portfolio in terms of horizons of investment. In the short time there will be the initiatives that provide the greatest cash flow and enhance the core businesses. In the middle terms it is important to invest in emerging opportunities which require a relevant budget but are likely to generate substantial profits in the future. The last horizon is the long term and contains initiative for the growth of the organization such as pilot programs;

3. Applying participatory budgeting - in order to allocate the right amount of money in each value stream and have a good prioritization process along the funnel, it is fundamental to involve all the main stakeholders. They have to work all together to make the best investments choices and achieve the best results in the value delivery.

Finally, in order to understand if the organization is achieving the expected benefits, each value stream has a set of KPIs or criteria. The criteria to evaluate the investment are dependent on the type of value stream. For instance, if the value stream provides revenues by delivering end user value directly, then the revenue is a good indicator to assess the investment.

Vähäniitty (2012)

In his doctoral dissertation, Vähäniitty explores how to apply agile product and portfolio management to small software organizations. In his framework, he gives a model to connect business and development decision making leveraging the development portfolio management,

product roadmapping and the release planning process. But what is more interesting for the scope of this thesis is his answer to the question on how to set up portfolio management in an agile context. For him there are three key steps to follow:

- Establishing and keeping up-to-date a public and prioritized list of all ongoing activities;
- Making sure that incentive systems do not lead to a local optimization;
- Designate a group of people to regularly meet in order to make decisions on priorities and resources.

Adaptive Portfolio Investment Management (Kopcho & Apfel 2017)

The Adaptive Portfolio Investment Management (APIM) is a model (Figure 7) proposed by the research and advisory company Gartner to fulfill the speed and agility needs typical of the digital business.

The first step is an ideation phase in which the outcome is a simple and brief explanation of what will be done and why. At this phase the goal of the portfolio is to understand all the different ideas, visions ad concepts and then consolidate them in order to present a global vision back to all requestors. The next step is a Collaborative Business Case which is a meeting with a representative for each group of stakeholders to estimate the value of the idea and determine the willingness to pay of the business to realize the expected benefits. This is not the cost of the proposal but a value based investment limit. The cost of the proposal is estimated only in a following step if the proposal successfully completes this gate. In this case, the proposal goes through a strategic impact review and a more detailed project plan is created. The final steps are the prioritization done by the portfolio office and the approval by the Investment Board. The goal at each phase of this process is to naturally weed out proposals along their lifecycle.

In this process, a fundamental part of what makes it adaptive and flexible is that people are empowered to do their job without any senior manager to supervise all their decisions.

All these practices rely on 5 fundamental principles:

*"1. Create a shared understanding of the strategic **vision** as well as the goals for the current operating model by building a culture of networked communication.*

*2. Build a portfolio process that embraces strategic **value** by de-emphasizing financial return and developing leading indicators to measure if value is truly being delivered.*

*3. Build a culture of **decisiveness** by keeping everyone actively involved in the adaptive portfolio investment management process via direct phone or face-to-face conversation aimed at maximizing value.*

*4. Keep **people** at the heart of APIM by not calling them resources and by encouraging them to tell the truth.*

*5. Use **results** as a driver by continuously looping results back into the process."*
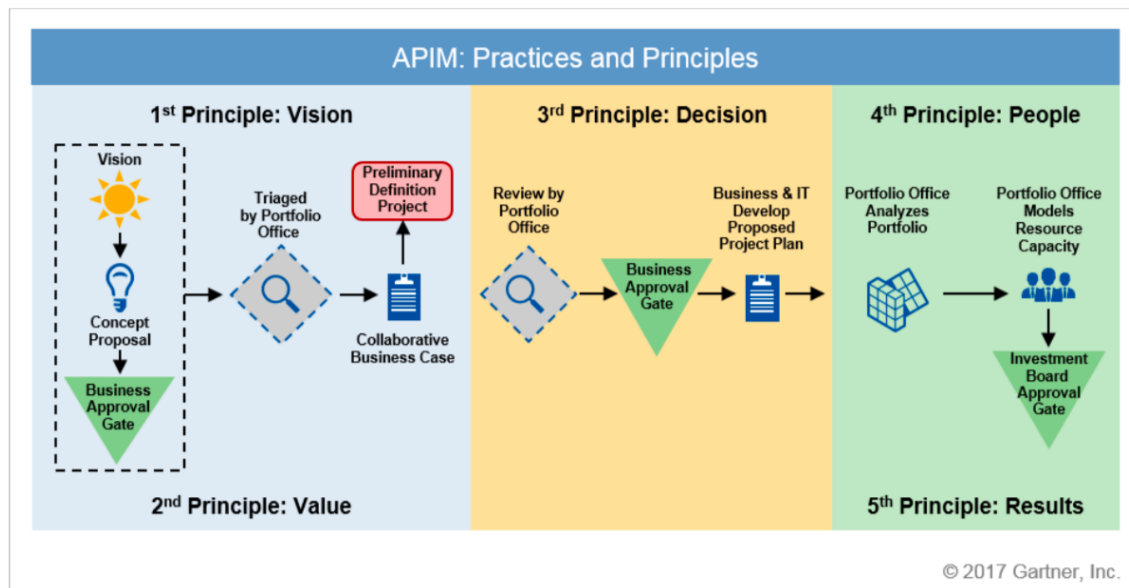

Figure 7. Principles and Practices of APIM. Source: Kopcho & Apfel for Gartner (2017)

The practice of deferring the creation of a formal business case until the confidence on the value of the proposal becomes high is a common practice in the agile portfolio management and it has also been discussed by Thomas & Baker (2008). They highlight the fact that the impulse to go deep into the details is one of the most prevalent legacy mindsets and that it must be defeated in order to embrace an agile and flexible portfolio.

Rolling Fund Allocation Model (Laanti, Sirkiä & Kangas 2015)

Laanti et al. (2015) described how a Finnish broadcasting company adopted agile portfolio management. The most interesting part of their approach is the Rolling Fund Allocation Model. This model consists in the allocation of 100% of first quarter available budget, and in the second

quarter only 80% of the budget is allocated and the remaining 20% is allocated based on the increments and demos of the first quarter. In the third quarter the allocation is only 60% of the expected budget and in the last quarter is 40%. This approach leaves the freedom for the management to allocate funds in a flexible manner in case priorities change and new needs emerge later during the year. Furthermore, this model promotes faster increments and demos because creates a competition between teams who want to attract the remaining funds for their project. Another benefit of this approach is that it reduces the importance of a detailed annual planning and fosters continuous planning. The rationale of this model is that you first fund the initial idea and then you keep funding only the ones that give the best results.

The concept of funding only three months at a time can be found also in Thomas & Baker (2008).

At the end of this literature review, it can be said that all the existing frameworks, even if different, share some common characteristics (Stettina & Hörz 2015):

"1. Transparency of resources and work items, improving trust, decision making, and resource allocation.

2. Collaboration, close collaboration based on routinized interaction and artifacts enabling frequent feedback-loops across the domains.

3. Commitment, to strategically managed portfolios.

4. Team orientation, removing unrest in resource allocation and building capabilities in teams."

3 Research problem and methodological approach

In this chapter, the research problem and the research questions to address the research problem are formulated (section 3.1). In the following sections, the steps and the approach undertook for answering each research question are briefly described (section 3.2, section 3.3 and section 3.4).

3.1 Research problem and research questions

Based on the analysis of the existing literature, the research problem for this thesis is described by the following question:

How can lean and agile principles be leveraged for project portfolio management?

The aim of this study is to address the research problem through the answers to the following research questions:

RQ1. What are the key practices in portfolio management?

RQ2. How can agile and lean principles be applied to the demand management practice?

RQ3. How could a portfolio management office facilitate and coordinate the execution of agile projects through an agile governance and monitoring?

These questions are considered adequate and sufficiently wide to give a fulfilling answer to the research problem. The goal is to address the research problem through proposing a model for agile portfolio management.

3.2 Approach and method for answering RQ1

The steps taken to answer RQ1 (*What are the key practices in portfolio management?*) were:

1) Conducting a literature review to have a deep understanding of the portfolio management practices and processes;

2) Analysing the case organization to understand which are the processes implemented in that context;

3) Defining a framework to illustrate which are the main practices of portfolio management.

The first step has been reviewing the existing literature on the topic and explore which are the most common practices of portfolio management. For this purpose, both academic research and experience reports have been taken into account. The academic research has been useful to get a theoretical knowledge about portfolio management, while the experience reports provided useful insights on what other companies are doing.

Once the external knowledge was acquired, the following step has been looking at what the case organization is doing and get a deep understanding of its processes and potential problems. This analysis has been conducted through collection of data based on internal documents and face to face meetings with the members of the portfolio management office (PMO). The first evident problem that emerged during the analysis was the lack of a formal and working project selection method for the demand management phase (see section 4.2.1).

The final step has been defining an easy to understand framework to identify the key most common practices of portfolio management.

The results corresponding to RQ1 are presented in section 4.2.

3.3 Approach and method for answering RQ2

The steps taken to answer RQ2 (*How can agile and lean principles be applied to the demand management practice?*) were:

1) Conducting a literature review to have a deep understanding of lean and agile practices and the differences between them;

2) Unstructured interviews with people in different roles in the case organization to understand their needs regarding the demand management;

3) Conducting an analysis of the literature to understand how lean and agile principles can be implemented in the demand management practice;

4) Developing an initial framework for managing the demand;

5) Iteratively refining the framework to better fulfill the needs of the case organization.

Talking to different people within the organization, clearly emerged a widespread confusion on the concepts of lean and agile. For this reason, the first step, in order to understand how lean and agile can support portfolio management, was clearly defining the two approaches and highlighting the differences (section 2.2). Once acquired the necessary knowledge about agile and lean management, the following step has been meeting the main actors involved in the organizational change to understand their needs and their desired outcome. From these meetings emerged a strong need of adapting the portfolio to the changing circumstances within the organization and delivering value faster. They had a portfolio based on an annual planning which made the portfolio too static. An agile approach can provide a great support for increasing the speed and flexibility of processes, while lean thinking can help in removing non value adding activities.

Before developing a framework shaped around the case study, I conducted a wide analysis on the already existing frameworks for implementing lean and agile practices into portfolio management. More than one model has been reviewed for this analysis but, for the scope of this thesis, the most valuable has been SAFe framework (section 2.3.3). This step has been a fundamental starting point for developing an agile demand management process fitting their needs. The process has been then iteratively adjusted over a period of 1 month.

The demand management is the initial phase of the portfolio creation and it is also the most effort

requiring practice. For these reasons, I have chosen to start the re-design of portfolio practices from this phase.

The results corresponding to RQ2 are presented in section 4.3.

3.4 Approach and method for answering RQ3

The steps taken to answer RQ3 (*How could a portfolio management office facilitate and coordinate the execution of agile projects through an agile governance and monitoring?*) were:

1) Conducting an analysis of the existing models for agile portfolio management to understand how governance can be adapted to fit the needs of an agile environment;

2) Analysing the governance and monitoring model of the case organization to understand what creates an obstacle in the execution of agile projects and reduces the flexibility of portfolio;

3) Proposing adjustments to the aspects of traditional governance in order to facilitate the execution of agile projects.

The models analysed in the first step are the same models analysed in the third step of the RQ2 (section 2.3.3), and the generic principles of lean and agile management previously analysed have provided the building foundation for answering RQ3. The term *governance* can be defined as the essential guidelines to ensure that the right decisions are made. In particular, the scope of this question is the governance at a portfolio level for agile projects. It is already known that governance is about rules, control and documentation. Agile is about self-organized teams, decentralized decision-making and reducing documentation. It becomes suddenly clear the reason why governance in agile contexts is such a challenging question that needs to be addressed in order to be successful in the agile journey.

Once the external knowledge on the topic was acquired, the following step has been analysing the current governance and monitoring model of the case organization in order to understand the most urgent issues that needed to be solved. The model in use was a typical linear model that can also be found in the literature and in other organizations:
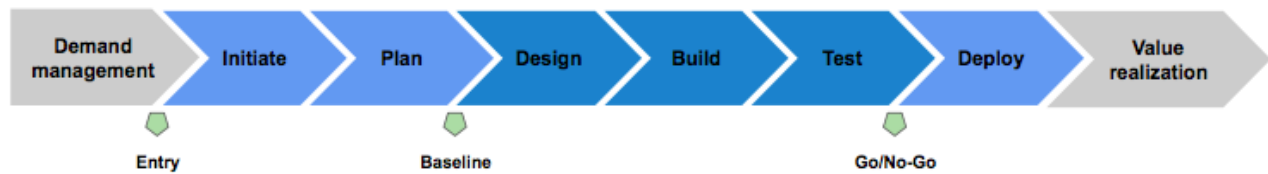
Figure 8. Traditional model for waterfall projects

In the traditional model used by the case organization, the first checkpoint is the Entry point. At Entry, the main deliverable is a business case with a detailed forecast of monthly budget and resources from the start date of the project until the end date. If the business case is approved, the entire planned budget is allocated and the project can start. In the initial phases the project team has to work on the analysis of the requirements and the detailed project schedule. These deliverables must be ready for the Baseline gate and they are mandatory to start the design, build and test phase. If the design, build and test phase is considered successful by the stakeholders, the solution can be deployed and implemented. Along its entire lifecycle, the health of the project is checked against four main indicators that are finance, schedule, resources and scope. The focus of the analysis conducted in the section 4.4 is on understanding which of the earlier mentioned characteristics can be an obstacle in the execution of agile projects, and propose a solution to avoid them.

In the following chapter (Chapter 4), the research questions will be addressed according to the characteristics of the case study and the proposed framework will be presented in detail.

4 The case study

4.1 Case company

The case organization is an organization within the IT corporate function of a global healthcare company. The whole company has about 100.000 employees and annual revenues exceeding 50 billion Euros. The whole IT function has approximately 3.000 employees and the amount of annual costs is above 1 billion Euros. The organization in scope manages a €50 million annual budget for a project portfolio that provides IT services to the different functions and enables them to efficiently run their business. The business of the company is split in two core businesses that are pharmaceuticals division and diagnostics. The organizational structure is a matrix with multiple decision makers and different stakeholders.

This is considered the relevant and essential information to give the reader the context in which the study has been developed.

4.2 What are the key practices in portfolio management (RQ1)?

Based on the literature and the case organization, the practices can slightly differ from one organization to another but 3 common and recurring phases have been identified: *demand management, execution management* and *value realization.*
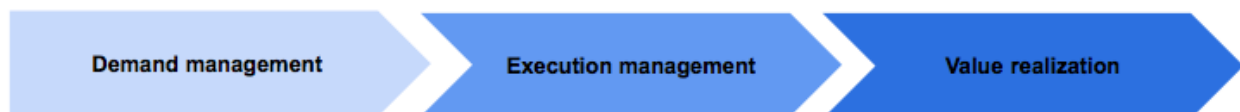

Figure 9. Key practices of portfolio management

4.2.1 Demand management

Demand management represents the period before the effective start of a project. Usually, it is the biggest part of portfolio management practice because during this period the portfolio manager is the one who manages the potential project. In this phase the PMO has to gather the

new ideas and needs coming from the customers and then prioritize them. Here, the portfolio manager is responsible for the whole life cycle from the idea generation until the idea is converted into a real project.

In order to be successful in this phase and to design a healthy process, it is important to have a structured and working project selection tool. To have a working project selection tool, the first step is to understand which are the goals of the organization. After a brief analysis, it emerged that the goals of the organization in scope are fundamentally two:

- *Aligning* the portfolio to the company's strategy;
- *Maximizing the value* of the portfolio for the organization and for the customer (business unit).

To achieve these goals, it is necessary to take into account different criteria, both qualitative and quantitative. For this reason and for its simplicity, the chosen method has been the *multicriteria method* and in particular the following scoring model:

	Reliability	Customer Request	Productivity	New Business Capabilities	Compliance and Security	Customer Experience	*SCORE*
Project A	1	4	2	3	4	3	2.55
Project B	4	2	3	2	2	1	2.65
WEIGHT (Normalized)	0.3	0.05	0.15	0.15	0.25	0.1	

Table 2. Example of the Scoring Model implemented

Weights and criteria have been chosen accordingly to the company's strategy and the PMO goals. The recommendation for the range of the qualitative scale of scores is to use an even number (in this case from 1 to 4) because with an odd number the evaluator tends to stay in the middle in case of uncertainty. Instead, for the number of criteria the recommendation is not to exceed 5-6 criteria because the human brain is not able to take into account more variables and assign a realistic value to each of them. The reasoning behind the criteria is the following:

- *Reliability* - takes into account the criticality of the technology for the business, the

number of recent incidents and the importance of the solution to maintain the current level of service for the customer. This criterion is the main KPI for assessing the performance of the organization and for this reason has the highest weight;

- *Customer Request* - takes into account if the project is a clear need coming from the customer or not. Certain projects are internal ideas, others are clearly requested by the customers. One of the goals of the case organization is to maximize the value for the customer and this criterion responds to this need;

- *Productivity* - takes into account the economic value of the project in terms of savings and returns. This criterion is necessary to maximize the value of the portfolio for the organization;

- *New Business Capabilities* - takes into account if the project enhances new business capabilities. 70% of the portfolio spends in this organization are for lifecycle projects. Year by year the goal is to reduce the amount of money for lifecycle projects and increase the money spent for developing new business capabilities.

- *Compliance and Security* - due to the highly regulated environment, certain projects are required to ensure security and maintain the systems compliant in order to meet industry regulations;

- *Service Experience* - takes into account if the project improves the service experience for the consumer since this helps to increase the value for the customer which is one of the main goals of the analyzed PMO.

It should be now clear the heterogeneity of the criteria and the reason why the recommended method has been the scoring model.

The final recommendation related to the selection process is that tools are only tools, and the project score is not meant to be used mechanistically. The outcome of the tool serves as an initial step for starting a structured and fact based discussion.

4.2.2 Execution management

Execution management is the process that involves the management of all the initiatives in the portfolio from when they start until their closure. In this phase the project manager becomes accountable for the outcome of the project, but at a portfolio level the portfolio manager is still responsible for the project governance practices, for monitoring the execution of the initiatives and for reporting.

The project governance practices purpose is to define clear rules to ensure that the right decisions are made and that money is invested in the best initiatives. The largest the organization, the more important is the role of governance but it can also become an obstacle if there is excessive control. This is particularly true in agile contexts which require a high degree of flexibility and a rapid adaptation to unexpected changes. This problem will be further discussed in the section 4.4.

The execution monitoring is a practice consequent to the governance. This practice requires a choice on the metrics that need to be measured. When choosing these metrics, it is fundamental to bear in mind that "you improve what you measure". In the analyzed case organization, the tracked metrics are scope, schedule, resources and finance.

Once these metrics have been collected, the role of PMO is to create sound reports on these data in order to enable the executives to make effective decisions and increase the transparency of portfolio.

4.2.3 Value realization

Value realization is the last practice and it starts once the project is completed. This practice involves the tracking of the expected benefits and their achievements. This activity is the smallest part of portfolio management process but it is fundamental to communicate to the relevant stakeholders the realized benefits. Another deliverable of the value realization practice is the lessons learned which are useful for the project team in order to improve in the next project what went wrong in the last one. This practice is not in the scope of this thesis.

4.3 How can agile and lean principles be applied to the demand management practice (RQ2)?

The aims of implementing agile and lean principles in demand management and prioritization of activities in the portfolio are multiple:

- Reducing the lead time from the generation of an idea until the moment that idea becomes a real project;
- Improving the visibility of portfolio projects within all the phases of the funnel;
- Reducing waste in terms of time and errors according to agile decision procedures;
- Increasing the flexibility of portfolio to adapt it to the changing needs of a dynamic context;
- Better fulfilling the customer needs through a frequent re-prioritization of projects based on customer feedback;
- Avoiding detailed analysis in the early phases of an idea generation and delaying the decisions.

The case organization in scope was using a traditional approach for demand management with a portfolio planning done on an annual basis a year in advance (e.g. the whole portfolio for 2018 was planned in 2017) which led to a quite static portfolio with limited flexibility. On an average, it took 3 years from the idea generation to the delivery of value. If an idea came in the middle of the year, it had to wait the beginning of the new year to enter the portfolio funnel. Furthermore, the initial step of the traditional approach was the creation of a detailed business case which required a great effort (approximately 10 hours of work). This practice has a double disadvantage: first, the time spent on the creation of a business case that does not advance to the project phase is a waste; second, the high effort required by the creation of a detailed business case is an investment that discourages a No-Go decision. The result was a portfolio which started with the creation of a detailed business case for the proposal and then, in the vast majority of cases, the proposal was converted into a project.

The new framework for the demand management practice can be explained by the following figure:
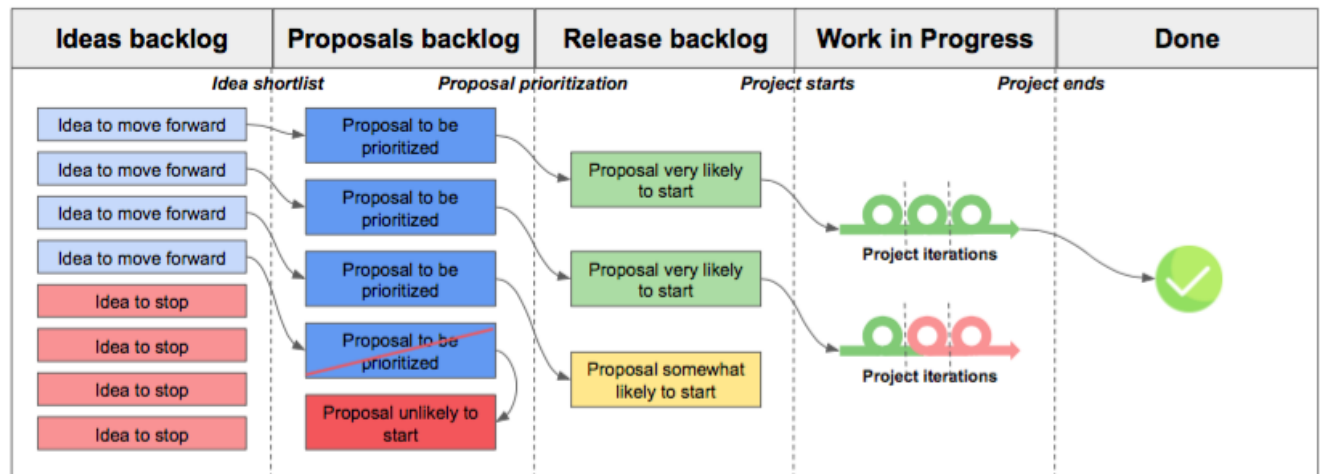

Figure 10. Portfolio kanban for demand management

The process starts with the creation of an idea. The idea can be generated by everyone in the company in order not to limit the potential innovation. In this *ideas backlog* stage, few details are required and the time spent on the creation of the idea has to be very short:

-   Name of the idea
-   Brief description
-   Benefits of the idea
-   Rough estimation of budget needed
-   Rough estimation of duration

It has been calculated that the time required to submit an idea with this level of detail is less than 20 minutes and the persons needed are only 1 or 2. The ideas are then shortlisted based on the criteria defined in the scoring model of section 4.2.1. Due to the small effort required for creating an idea, if the idea is not shortlisted, the wasted time is not that much as it was before when the initial assessment was based on a detailed business case. The shortlist of ideas is made on a monthly basis to be able to start the potential projects as soon as possible.

The ideas that are shortlisted go to the *proposals backlog* phase of the kanban, where more details are required to do a further assessment. Here the idea becomes a real proposal through the development of a business case with more details on financial forecasting, time required and resources. With these data, it is possible to do a formal prioritization against the criteria defined in the scoring model (section 4.2.1) and rank the proposals.

The proposals that are more likely to start enter the *release backlog*, the other remain in the proposal backlog and compete with the new proposals that are coming in. The proposals that are now in the release backlog are ranked against the prioritization criteria previously defined and as soon as there are enough available resources (human and financial), the proposal with the highest priority is chosen and it is converted into a real project. The proposals are formally ranked all together on a quarterly basis, but small adjustments to the priority of individual proposals are done continuously as needed in order to have a backlog always up-to-date and ready to be implemented.

The proposals converted into projects move to the *work in progress* state. This is the phase where all the running projects can be found. On a quarterly basis, all the projects are ranked together with the proposals, and the running projects (e.g. project Y in figure 11) with a priority lower than a proposal (e.g. proposal D in figure 11) can be stopped or cancelled to free up resources and let the proposal enter the work in progress stage to fulfill the new needs of the company. Obviously, the prioritization criteria are a support to decision making. In particular, when taking a Go/No Go decision for an already started project, it is essential to take into account the amount of money already invested in that project and not rely only on the score given by the selection tool. A project should never be stopped in its last iterations.

The projects that make it to last iteration and are completed go to the *done* phase. This is the last phase of the portfolio kanban where the value is delivered and the benefits are reviewed.

With this approach and such a continuous re-prioritization of the entire portfolio kanban, it becomes clear the importance of having a formal and structured tool for project selection.
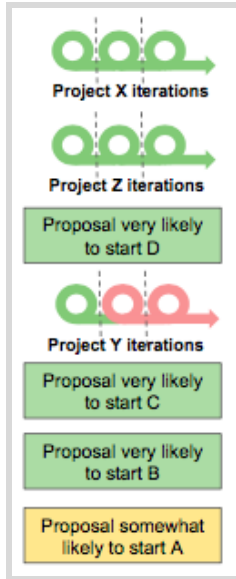
Figure 11. Ranking of running projects and proposals

Furthermore, to better fulfill the needs of customers and company, it is key to build a close relationship with all the involved stakeholders and take into account their feedback when re-prioritizing the portfolio.

The decision for starting a project is now delayed until the very last moment and the effort required in the early stages of the idea creation, when the likelihood to convert that idea into a project is still unclear, is much lower. Finally, a portfolio kanban improves the visibility on all the activities, big and small, that are competing in the portfolio. If the portfolio kanban is public, it also improves the level of transparency of the organization.

A final recommendation is related to the amount of projects in the work in progress phase. The traditional approach is to split the resources between projects that are done in parallel. This behaviour leads to a project switching penalty that decreases the productivity and the result is that all the projects are delivered later. With an agile mindset, the focus should be on finishing a project before starting the next one. Even if in the real world this is not always possible, this should be the guideline to keep in mind when creating a portfolio. The difference between these two approaches is well explained by the following figure, with the assumption that the duration of each project is 1 unit of time if the resources are full time allocated to the project:
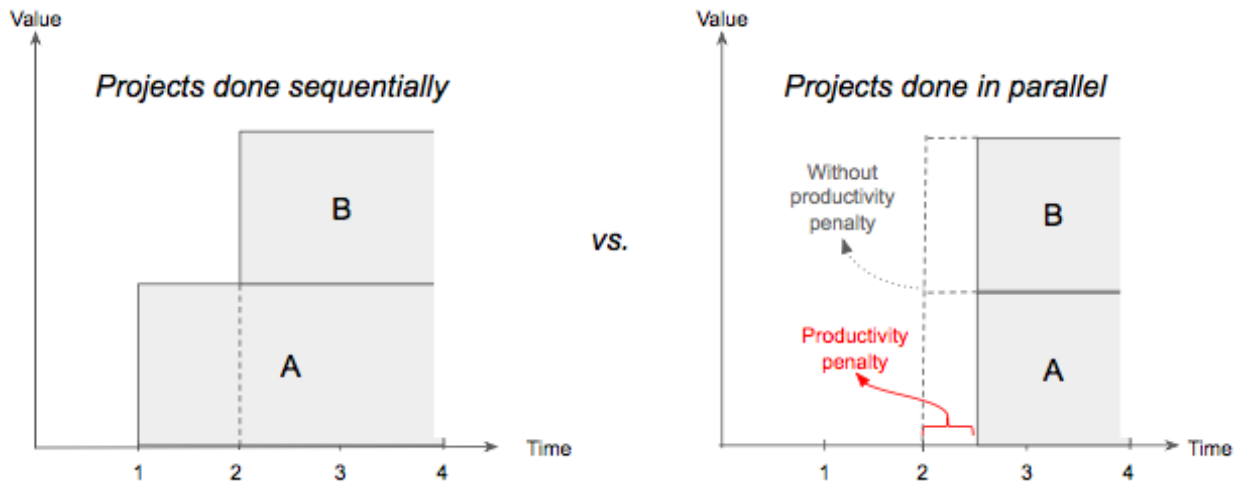
Figure 12. Projects done sequentially vs. projects done in parallel

With the projects done sequentially, the resources that are fully allocated to a single project have a higher productivity, the value is delivered faster and the requirements are fresher. Accordingly to lean principles, the focus should be on flow efficiency rather than keeping the resources always busy to achieve the maximum resource efficiency. Giving idle time to resources is a great opportunity to let them think about innovative ideas and improving their skills through training sessions.

4.4 How could a portfolio management office facilitate and coordinate the execution of agile projects through an agile governance and monitoring (RQ3)?

The aim of this section is to make a proposal for an agile model of governance and monitoring of projects which enable faster decision making. The largest the organization is, the greatest is the need of governance. But in an agile environment, this is a very thorny topic because the need of having a sort of control and well defined decision making processes, which can be applied in the whole organization, often contrasts with the need for flexibility required by an agile business. An excessive level of governance can become an obstacle to success in the agile journey. The challenge is to find that "just enough" level of governance with a focus on collaboration rather

than control, while still providing to senior managers the information they need in order to make fact-based decisions.

In the case organization, the following obstacles have been identified:

- Business case and governance for agile projects;
- Funding model;
- Measures to track the progress of projects.

In the next sections, these aspects will be analyzed and a proposal for facilitating the execution of agile projects will be made.

4.4.1 Business case and governance for agile projects

A business case is an artifact that describes the initiative and it is needed to justify the expenditure of the project. The business case template used by the case organization is a traditional one which includes:

- Name;
- Description;
- Scope;
- Consequences of not doing it;
- Monthly human and financial resources required from the start date to the end date of the initiative;
- Impact of the initiative on other functions;
- Dependencies of the initiative with other initiatives;
- Operating costs expected once the initiative is completed;
- Financial and non-financial expected benefits and when they will be realized.

Filling out this template requires a detailed planning and forecasts for the entire duration of the initiative. The effort required just for filling out the template is approximately 10 hours of work. Furthermore, this calculation does not take into account the time spent previously for gathering and capturing the information required in the template.

All the required details slow down the delivery of value and even if they can have a meaning in a waterfall approach, they lose importance in an agile project. The business case for an agile project should be a lightweight business case with enough information to justify the funding of the initial iterations. These first iterations are fundamental to have a better understanding of the value of the initiative and build a more detailed planning to justify the funding of the following iterations. The focus should be on the vision and the value statement rather than the scheduling and long term forecasts of financials and resources.

In the proposed model, the initial step is the Entry point. At this point, the owner of the initiative should provide the following information in an artifact called "Entry deck":

- *Definitive name of the initiative,* this means confirming the name provided in the initial phases of demand management or making minor adjustments to the initial name;
- *Vision,* this includes the goal of the initiative, who will use the outcome of the initiative, the needs of the customer that this initiative will address and also the critical success factors;
- *Mission,* what the organization wants to do with the solution delivered;
- *Strategic theme* which triggered this initiative;
- *Value statement*, what is the value for the customer and stakeholders of the initiative;
- *Team,* name and role of the members of the team involved in the development of the business case in the "sprint 0";
- *Planned start date for the first iteration,* this means the date of the first "Funding approval" checkpoint.

The time frame between the Entry point and the first Funding approval checkpoint is called "sprint 0". This time frame is when the Entry deck developed for the Entry point is enriched and the real business case with all the details needed for approving the funding of the first iterations is built. The business case includes all the information provided in the Entry deck with the possible updates, plus the following:

- *Human resources,* a detailed planning of the resources required for delivering the features of the first iterations, and only a rough estimation of the resources that will be required for delivering the planned epics in the following iterations;
- *Financial resources*, a detailed forecast of the budget required for delivering the features of the first iterations (this is the budget to be approved), and only a rough estimation of the budget that will be required for delivering the planned epics in the following iterations and for which further financial approvals will be required;
- *Initial product backlog*, this includes the minimally marketable features which will be delivered in the first iterations, and only the high level deliverables (epics) which could be delivered in the following iterations;
- *Release plan,* this requires the release dates of each feature planned to be delivered in the first iterations for which the funds are required at this step, but also a very high level plan for the release of the following epics;
- *Success criteria,* the definition of success and goals to be achieved in the first iterations against which performance is evaluated.

Ideally, the first iterations should be completed within a quarter. This means that the detailed planning is required just for the next 3 months, and the planning of the following releases should be understood as a rough estimation which will be adjusted release after release. This is the resulting model of governance for agile projects, in which the concept of baseline loses relevance:
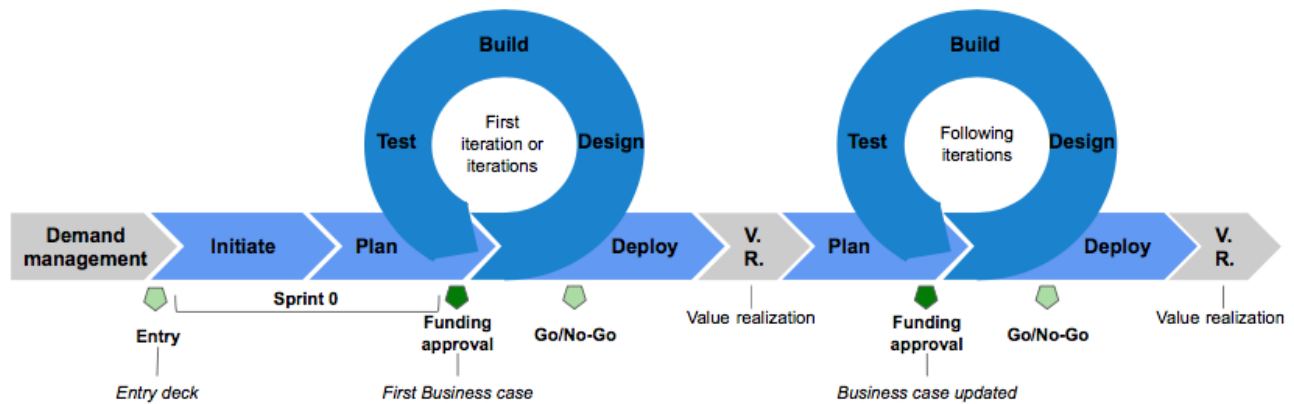
Figure 13. Agile project governance

After the first release, the performance and deliverables are measured against the success criteria previously defined. If the outcome is successful, the deliverables are deployed, the value delivered by the release is assessed and a new planning begins. In this phase, the team will update the initial business case with the information needed to go through the next Funding approval checkpoint and, if successful, start the new iteration.

This model has various benefits. A detailed planning is required only for the short term, this makes the planning phase faster, lighter and more realistic. As a consequence, the decisions can be made quicker because the whole process is lighter. The level of detail is kept as low as possible in order not to create an obstacle to the delivery of value with unnecessary artifacts. Also, in this way there is room for changes along the way which enables the flexibility of agile projects. Finally, this approach defers the creation of a structured business case until the confidence on the expected deliverables of the initiative is high. The consequence is that the probability of delivering the committed value increases, and the risk of delivering something different from what the customer desires decreases.

4.4.2 Funding model

The funding model is a direct consequence of the governance model. In the analyzed case organization, the tendency is to fund the entire project or nothing. It is a "black or white" approach. The financial approval happens before the beginning of the project and then, if the

project is not cancelled, no further approval is required. This approach can be suitable for a portfolio with traditional projects, but not for an agile context. First of all, since the business case for agile projects does not require a detailed planning for the long term (section 4.4.1), the funding of the entire project from the start date to the end date can be a very risky practice. Secondly, this practice leaves less freedom to flexibly allocate funds in case new needs emerge during the year. From a political perspective, deallocating funds from an initiative to fund a new one requires more effort than allocating free funds that have not been committed to anyone yet.

With the model of governance discussed in the previous section (section 4.4.1), an incremental funding model is just a logical consequence. At every Funding approval checkpoint (Figure 13), only the following iterations, for which a detailed planning is required in the business case, are funded. The remaining funds for the remaining iterations will be approved only if the previous iterations have proven successful. In this way, only the initiatives that show tangible benefits will continue to attract funds and the other will be easily stopped, so that the remaining funds will be quickly reallocated to better opportunities. The need for a detailed long term planning decreases as well as the risk that derives from allocating money to a lightweight business case (section 4.4.1). The management is incentivized to explore by funding innovative and more risky ideas since the budget committed is smaller. Finally, the project teams are motivated to deliver immediate value and be more efficient in order to attract the funds for the following iterations.

4.4.3 Measures to track the progress of projects

Regularly monitoring the health and progress of the projects within the organization is a fundamental practice for an effective governance. This practice is necessary to track the team progress and make informed and fact-based decisions on whether to stop a project or not.

In the traditional governance approach used by the case organization, the progress of projects and the value created is measured through the completion of documents such as user requirements, functional specifications or solution architecture. The creation of these artifacts is a great investment in terms of time and it does not add any value to the project and to the decision

bodies, because the documents do not reflect the reality and they can have many flaws that can not be identified until you have built and tested the solution. Indeed, in the IT world, according to the agile manifesto ("*Working software over comprehensive documentation*") cited in section 2.2.6, the best measure to track the progress of a project is the delivered working software.

In this traditional model, every project has to submit a status report every two weeks to communicate how the project is doing in terms of schedule, budget, scope and resources. These reports are crafted by the team and not only they can reflect a picture different from the reality, but they are also a waste of time for the project team which could be invested in creating real value for the business.

Useful metrics for agile projects should take into account the value created, quality and budget. It is essential to make the collection of these metrics as automated as possible, so that data are more accurate and the team can focus on the project delivery. Another aspect to bear in mind when choosing the right metrics is that usually "you improve what you measure". Finally, when thinking about implementing an agile approach for governance and monitoring, the focus should always be on shifting from control and documentation to collaboration and communication.

To make the collection of data as automated as possible and to increase the level of transparency, the idea is that the tool used by the project team should track all the relevant events and share them with all the stakeholders through a project dashboard. In this way, the team does not need to submit a status report on a bi-weekly basis and the stakeholders can simply have a look at the progress of the project whenever they want. Furthermore, these data are always up-to-date and it is very hard to show a picture different from the reality.

The value should be always measured from a customer perspective. In each release, a possible objective measure of the created value is the percentage of fulfilled user stories. A fulfilled user story means that the specific functionality, requested by the user, has been implemented, tested and it is working. Another possible measure of value from a customer perspective is how much of the business problem has been solved after each release. The purpose of every IT project is to provide a solution for a business problem of an internal customer. This metric does not take into

account the number of fulfilled user stories because there could be user stories that are more important and can be labeled as a "must have" and others that are only "nice to have". This metric is even more objective and it simply takes into account whether the business problem is being solved or not.

The quality can be simply measured as number of not successful tests. Furthermore, due to the objective of being more customer oriented, the quality could be also measured by the customer as the number of features implemented that do not reflect what the customer wanted or are not adding value to the customer.

A metric covering the budget area is important to keep track of costs in order to make informed decisions on whether to cancel a project or not. For this reason, it is key to always have an up-to-date release planning in order to compare the actual costs and roadmap against the "baseline" (i.e. the way the initial planning in waterfall projects is typically called).

Finally, also in the agile context, one of the best ways to understand the status of the project is the communication. Promoting an active participation and involving the stakeholders in the project team meetings is the most effective way to monitor the progress of the project. The metrics are an effective way to detect problems, but being involved in the team discussions is the best way to find out what the real root cause of the problem is.

5 Conclusion

This chapter concludes this thesis. The answers to the research questions are summarized and the research problem is addressed (section 5.1). Then, the limitations which can affect this study are discussed (section 5.2). Based on these limitations, the chapter finishes with providing possible directions for future studies (section 5.3).

5.1 Answering the research problem

In order to answer the research problem, it is fundamental to have a clear picture of the answers to the research questions. These answers are summarized in the table below.

Research question	Answer
RQ1. What are the key practices in portfolio management?	The key practices in portfolio management are *demand management, execution management* and *value realization*.
	The biggest and most complex practice is the *demand management*. In order to be successful in this phase it is fundamental to have a structured and easy to use project selection method.
RQ2. How can agile and lean principles be applied to the demand management practice?	Agile and lean principles require the demand management practice to be more flexible, transparent, fast, light, customer oriented and to reduce waste.
	These principles can be achieved through a *frequent re-prioritization* of the demand (e.g. on a quarterly basis) based on customer feedback, by *delaying the decisions* and *avoiding a detailed analysis* in the early phases of the idea generation, and by implementing a *portfolio kanban* which can be visible to everyone in the company. When prioritizing the projects the focus should always be on *flow efficiency* (flow of value delivered by the projects, projects in sequence) rather than resource efficiency (reducing idle time of resources, projects in parallel).
RQ3. How could a portfolio management office facilitate and coordinate the execution of agile projects through an agile governance and monitoring?	The challenge is to find that "just enough" level of governance with a focus on collaboration rather than control, while still providing to senior managers the information they need in order to make fact-based decisions.
	The *agile governance model* should have a funding approval before each cycle of iterations followed by a Go/No-Go decision afterwards. In order to get the funding approval, the business case should be a *light-weight template* with a detailed forecast only for the following iterations and the focus should be on value rather than detailed schedule. The *funding model* should be incremental and the *metrics* for tracking the progress of projects should take into account objective deliverables rather than documentation.

Table 3. Summary of the answers to the research questions

Based on the answers to the research questions, the research problem (*How can lean and agile principles be leveraged for project portfolio management?*) is answered as follows:

Applying lean and agile principles to portfolio management requires changes in the traditional portfolio practices. To be successful in this journey, the changes have to be done incrementally otherwise there could be resistance that can lead to failure.

The main changes happen in the project selection method and in the demand management. Rather than a static portfolio planning done once per year, the prioritization of demand and projects should be done at least on a quarterly basis in order to increase the flexibility and adapt the portfolio to the changing needs. The frequent re-prioritization requires a project selection method that is structured and easy to use, otherwise the practice needs a lot of effort and it is not effective anymore.

The model of governance needs to be re-designed as well. The traditional governance model does not work in an agile world because it is focused on control rather than collaboration. In order to have a portfolio more agile and lean, the governance model should facilitate the execution of projects and remove all the impediments and obstacles that slow down the delivery of value to the customer.

5.2 Limitations of this study

The first key limitation that can affect this study is the fact that the model has been designed for the needs of a single case organization. The case organization is an IT support function of a highly regulated multinational healthcare company. For this reason, the model and suggestions created during this study could be not effective for organizations which possess completely different characteristics from the case organization described above, as for instance startups or small companies with few decision makers. Nevertheless, the results of this study can still be effective for the majority of the project portfolio management offices because they have been strongly based on the analysis of the academic literature and the experience reports of other

organizations different from the one in scope, trying to avoid going into the details of the case organization.

The other key limitation lies in the lack of data to quantify and verify the effectiveness of the framework proposed. The case organization has started to implement the proposed model only towards the end of this study and the expected benefits will be visible in the following months. The only tangible benefit that has been observed is the amount of time to submit an idea. This time has decreased from about 10 hours to less than 20 minutes. Due to time constraints, it has not been possible to wait for the framework to be fully implemented and to observe all the expected improvements in the process. Nevertheless, based on the literature review and the experience reports analysed during this study, I am confident that the expected benefits will be visible 6 to 12 months after the framework has been implemented.

5.3 Directions for future research

Based on the identified limitations of this thesis, a possible direction for future research could be the frequency of portfolio re-prioritization. In this model, the decision to do a quarterly portfolio planning is based on both the literature recommendations and the characteristics of the case organization. Once the model is fully implemented, it would be interesting to study the effectiveness of the re-prioritization on a quarterly basis and understand how this frequency should be fixed in order to get the best results.

Furthermore, the measures to track the progress of projects have just been introduced in this study. Once the agile governance model is operative, the topic of how to measure the value of agile projects and their progress should be further explored.

Finally, the practice of value realization and more in general the value management practice were out of scope in this thesis. The value management practice aims to maximize the value that is delivered by the project. As the portfolio practices will shift to an increasingly customer oriented approach, ensuring the continuous maximization of the value delivered to the customer along the whole project will be one of the keys to success in the agile journey. In the literature, this is a topic that is not as popular as project and portfolio management and it could pave the way for future frameworks of portfolio management practices.

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...”Lui vive in te”...e forsi sta volta rivo a ficartela!