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ANALYSIS OF THE MOST SUITABLE PROJECT MANAGEMENT APPROACH FOR PROJECTS WITH PARALLEL PLANNING AND EXECUTION PHASES

FÁBIO ANDRÉ VELOSO FREITAS
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KEYWORDS

Project Management; Agile; Scrum; Hybrid Project Management Approach; Project Planning

ABSTRACT

Planning projects is a key for success. In the case of projects with major investments like in aircraft maintenance related projects, it is even more indispensable. It is imperative to have total control of all variables and requirements due the enormous complexity and investment associated, which can lead to huge losses if a reliable plan is not established.

This work was developed in a multinational military aviation company on the Airborne Warning and Control System Depot Level Maintenance (DLM) project. This project is characterized by parallel planning and execution phases which shows to be difficult tasks for a traditional project management approach as currently in use. The team faces issues on performing both phases at the same time, which can compromise compliance with project requirements and may decrease customer satisfaction.

In order to overcome this problem, after assessing different approaches from the literature, a new approach has been developed to solve the issue that the DLM project was facing.

As conclusion, the new approach turned the planning phase much more effective, which allowed to use less resources than before to perform it without interfering on the execution phase. This increased the planning performance, which will provide updated plans to the execution phase, ensuring by that way the compliance with project requirements.

LIST OF ABBREVIATIONS

List of abbreviations

A/C	Aircraft
AEW&C	Airborne Early Warning and Control
AWACS	Airborne Warning And Control System
CPM	Critical Path Method
DLM	Depot Level Maintenance
DSDM	Dynamic System Development Method
EADS	European Aeronautic Defense and Space
MRO	Maintenance, Repair & Overhaul
PERT	Program Evaluation Review Technique
PPS	Project Planning and Scheduling
U.S.	United States

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1 INTRODUCTION

1 INTRODUCTION

1.1 Contextualization

In order to be successful in any project it is necessary to plan, monitor and control all aspects of it. In the case of projects like aircraft maintenance, it is imperative to have total control of all variables and requirements due the enormous complexity and investment associated, which can lead to huge losses if a reliable plan is not established. To support the project team in such complex projects, a set of rules and processes are required to be followed in order to create a standardized route to make sure that all steps are taken, and that the project is reviewed by various people in their area of expertise.

Aircraft maintenance is key to keep a fleet flying safely complying at the same time with the evolving airworthiness directives. It is important for the commercial aviation airlines to have a low maintenance turnaround time without compromising its reliability. However, in the case of military aircraft it is more important to have a plannability of the turnaround time to ensure the availability of a fleet with a fixed number of aircrafts, that can be needed at any moment to perform defense and surveillance missions.

In the military sector, there are three different levels of maintenance: organizational level, intermediate level and depot level maintenance.

Organizational level maintenance is performed by the operational squadron and it consists of the preparation of aircraft for flight, which includes activities like pre-flight inspection, aircraft servicing and operation, aircraft ground handling, etc.

Intermediate level maintenance is performed by the maintenance squadron and both scheduled and unscheduled maintenance is carried out. Scheduled maintenance are periodic and phase inspections those are carried out on mechanical systems. Unscheduled maintenance is carried out for example after a special occurrence or necessity of upgrades.

Depot Level Maintenance (DLM) includes extensive modification or overhaul to major components. It is intended to restore equipment and spare parts to a serviceable condition and to support field level maintenance activities, using more extensive resources in addition to those available at lower levels of maintenance. It may imply repairs, overhaul, complete rebuilt of parts, modification, testing, calibration and engineering services supporting the above DLM activities.

Airbus Defense and Space has the responsibility of performing the DLM of the NATO Airborne Early Warning and Control (AEW&C) aircraft developed by Boeing, derived from the Boeing 707. This aircraft operates at an altitude around 10 km. From this altitude can constantly monitor the airspace within a radius of more than 400 km. It is easily identifiable from the distinctive radar dome mounted on the fuselage.

1.2 Main Goals

The main goal of this work is to find the best approach for projects that have parallel planning and execution phases, like the AWACS DLM project. To do so, the following specific objectives have been defined:

- Characterize the project problem and assess why the current approach is not efficient;
- Perform a first analysis of existing project management approaches, those are used currently on similar cases;
- Perform a suitability analysis of the approaches found on the literature and assess if they are suitable for the targeted project;
- Develop a new approach if the ones found on the literature don't fit to the target project.

1.3 Utilized Methodology

The development of this work was performed on a period between February and May of 2019 and it used a tailored Action-Research principle (Lewin, 1946). The reason of the tailoring was because the pure action research methodology consists of a three cycle of four phases (Diagnosing, Planning, Taking action and Evaluating) and in this case not all the phases could be applied.

The new methodology starts with the Diagnosing phase where the problem is identified and characterized. The next step consists of a loop with two phases, research and evaluating. The research phase consists of searching for solutions in the literature that have solved similar problems. These solutions will be then tested on the next phase (evaluating) to assess if they can solve the target problem. This loop has been performed until all solutions found on the literature have been tested.

After the evaluation of all the literature solutions none could solve the targeted problem, therefore a new phase has been performed. The developing phase consist of evolving the own solution to solve the target problem. After developing the solution, it had to be evaluated if it would meet the requirements that would enable to solve the problem.

Out of the scope of this work are the check in work context and improving phase. These two phases will test the developed solution in a real context, and improvements will be made in the future.

Figure 1 shows a diagram of the utilized methodology based on the Action-Research methodology developed by Lewin in 1946.

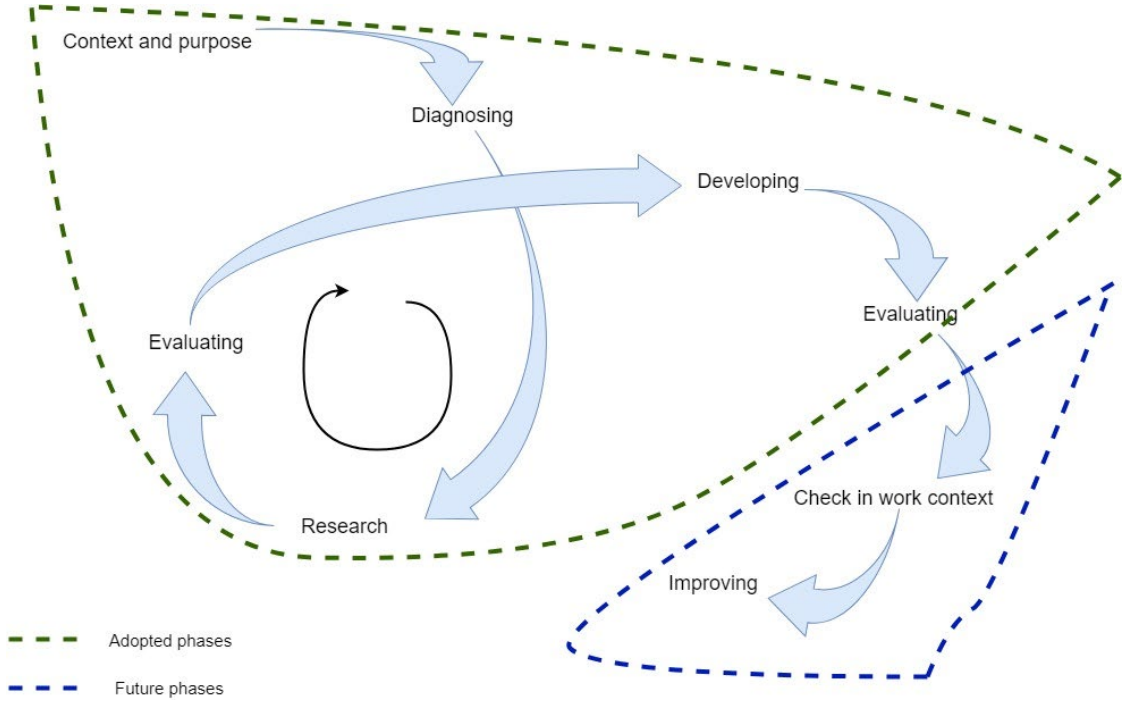

Figure 1 - Diagram of the utilized methodology

1.4 Thesis Structure

This work is divided in four chapters. The first one is called “Introduction” and here is made the contextualization of the project in function of the goals that are pretended to reach. A brief presentation of the company is also presented in this chapter.

In Chapter 2, the literature review of the work subject has been performed.

In Chapter 3, the company and the project have been presented with more depth, followed by the description of the problem, moving further to the required analyzes and developments in order to reach the solution that will solve the problem.

In chapter 4 are presented the conclusions of the work.

1.5 Brief Presentation of Airbus

This work has been developed at Airbus Defense and Space in Manching, Germany (Figure 2). First, an internship of three months has been made on the Depot Level Maintenance (DLM) project of the NATO Airborne Warning And Control System (AWACS). After the internship, this work has been started.

AD&S is a division of Airbus Group, responsible for defense and aerospace products and services, and one of the top ten defense companies in the world. It was formed in January 2014 during the corporate restructuring of European Aeronautic Defense and Space (EADS), and comprises the former Airbus Military, Astrium, and EADS Defense & Security divisions. It has its corporate headquarters in Ottobrunn, Germany. The company has four program lines: Military Aircraft, Space Systems, Communication-Intelligence-Security, and Unmanned Aerial Systems.

The site of Manching, where this Master Thesis was developed, represents the center of competence for military air systems, where approximatively 4500 employees work. The site hosts the Eurofighter program, and all other aircraft operated by German Forces and NATO are serviced here. It also accomplishes Maintenance, Repair and Overhaul (MRO) activities.

Figure 2 - Aerial View of Manching Site

The NATO AWACS program comprises four different projects: two modernization projects, the ongoing DLM and the NATO AWACS DLM Follow-On Contract Acquisition Project. The internship has been carried out on the last one, although the problem is common to both DLM projects which means that the developed solution can be used on both.

BIBLIOGRAPHIC WORK

2 Literature Review

2.1 The Evolution of Project Management

According to Azzopardi (2019), since the Egyptian epoch, project management has been used. It was within the mid-1950s that organizations started to apply formal project management tools and techniques to complex projects. Modern project management methods had their origins in two parallel, however different, issues of planning and control in projects in the United States. The first case involved the U.S. Navy, which at that point was involved with the management of contracts for its Polaris Missile project. These contracts consisted of research, development work and manufacturing of components that were unique and had never been previously undertaken. This particular project was characterized by high uncertainty, since neither cost nor time could be accurately estimated. Hence, completion times were based on probabilities. Time estimates were based on optimistic, pessimistic and most likely. These three time scenarios were mathematically assessed to determine the probable completion date. This process was called Program Evaluation Review Technique (PERT). Initially, the PERT technique did not take into account the price. However, the cost feature was later enclosed using the same estimating approach as with time. Due to the three estimation scenarios, PERT was found to be best suited for projects with a high degree of uncertainty which reflects their level of uniqueness. The second case, involved the private sector, namely, E.I. du Pont de Nemours Company, that had undertaken to construct major chemical plants in U.S. Unlike the Navy Polaris project, these construction undertakings needed accurate time and cost estimates. The methodology created by this company was at the beginning referred to as project planning and scheduling (PPS). PPS required realistic estimates of cost and time and is therefore a more definitive approach than PERT. The PPS technique was later developed into the Critical Path Method (CPM) that became extremely popular with the construction industry. During the 1960s and 1970s, both PERT and CPM increased their popularity within the private and public sectors. Defense Departments of various countries and large engineering and construction companies from all over the world applied project management principles and tools to manage giant budgets, schedule-driven projects. The popularity in the use of these project management tools during this period overlapped with the advance of computers technology and the associated packages specialized in project management. However, initially these computer packages were very expensive and were executed solely on mainframe or mini computers. The use of project management techniques and tools in the 1980s was simplified with the start of the personal computer and associated low cost project management software. During this period, the manufacturing and software development sectors started also to adopt and implement sophisticated project management practices. By the 1990s, project management theories, tools and techniques were extensively established by different industries and organizations (Azzopardi, 2019)

2.2 Project Management

A project is a "temporary endeavor undertaken to create a unique product, service or result" (Stackpole, 2010). It will not last indefinitely, but it has time constraints and has the goal of generating something that is distinctive to the organization.

One of the most known persons on the project management world is Henry Gannt. He was an engineer from the twentieth century who worked on tools to facilitate his team of engineers on managing projects for large companies. His more famous development was the Gannt Chart. This chart started as a daily balance chart which depicted the daily process of work. It allowed engineers and managers to have another point of view of how to check their projects focusing around timeliness, attention to detail and productivity.

Project management is nowadays important for companies. Edmonds (2010) refereed that it is virtually impossible to find a business today where there are no projects being employed unlike the middle of late twentieth century where projects were growing and were something new to the organization landscape.

Project management is at the moment a rapidly growing field and is defined as "the ability to define a goal, plan to reach it, and execute the plan with accountability and control" (Samid, 1995). When undertaking any tasks, whether temporary or ongoing, researchers agree that outlining the overall objective is vital to achievement and it only seems practical to devise a plan to get from start to finish (McClinton, n.d.). With temporary tasks, it is even more important that the time invested in this endeavor is utilized in the most efficient way because this costs the organization less money and time allocated to resources used to the project (McClinton, n.d.).

Since the time of Gantt, managers have become more dedicated to the skill of project management and associations have been established to help project management professionals understand the worldwide standards that make project management successful in today's businesses (McClinton, n.d.).

2.3 Approaches

Projects come in many shapes and there are a variety of ways to undertake them. In order to be successful projects, teams need awareness of the characteristics and options available to select the approach that most likely to be successful to the situation.

There are four types of approaches, defined as follows (*Agile Practice Guide*, 2017):

Predictive approach: A more traditional approach with the bulk of planning occurring upfront, then executing in a single pass; a sequential process.

Iterative approach: An approach that allows feedback for unfinished work to improve and modify that work.

Incremental approach: An approach that provides finished deliverables that the customer may be able to use immediately.

Agile approach: An approach that is both iterative and incremental to refine work items and deliver frequently.

In Table 1 are presented the characteristics of the four approaches.

Table 1 - Characteristics of Four Categories Approaches (Adapted from Agile Practice Guide, 2017)

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

All projects have the characteristics presented in Table 1 and no project can rule them out of consideration. A project's characteristics will determine which approach best fits that project.

In Figure 3 is represented the continuum of approaches in a two dimensional square, which ranges from predictive approach on one end to agile cycle on the other end, with more iterative or incremental cycles in the middle, where it is possible to have a clear view of which approach may be better, regarding the frequency of delivery and the degree of change of a specific project.

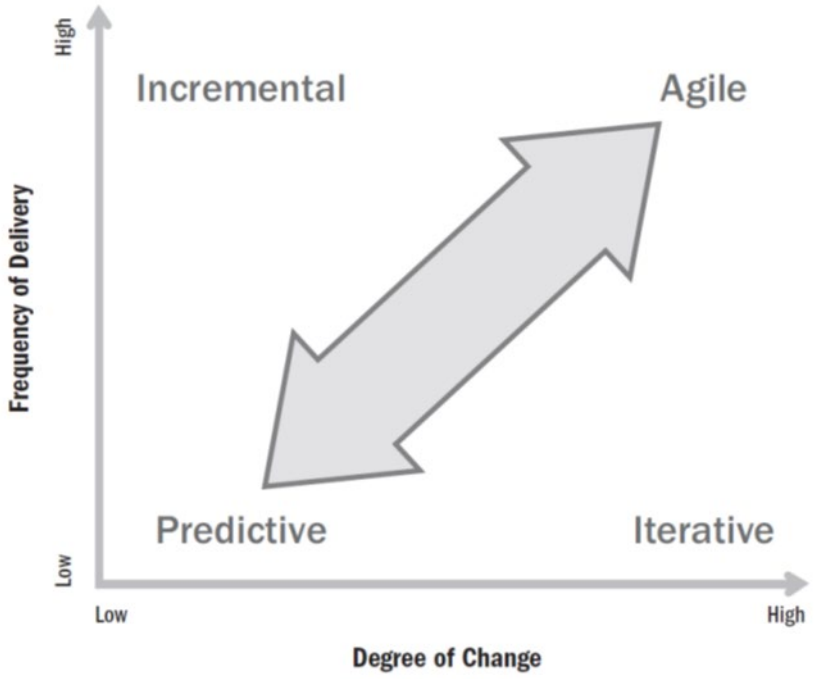

Figure 3 - The Continuum of Approaches (Agile Practice Guide, 2017)

A perfect approach does not exist, which means that no approach will ever fit to all projects. Each project needs to find a spot on the continuum that provides the perfect balance of characteristics for its context.

2.3.1 Predictive

Predictive approach, also known as fully plan-driven take advantage of high certainty around firm requirements and things that are known and proven. The reduced uncertainty and complexity allow teams to segment work into a sequence of predictable groupings.

Projects that use this predictive approach normally have a stable team which requires detailed plans to know what to deliver. Such plans are created at the beginning of the project. In order to be successful, these projects have restricted changes. When the team creates detailed requirements and plans at the beginning of the project, they can articulate the constraints. The team can then use those constraints to manage risk and

cost. As the team progresses through the detailed plan, they monitor and control changes that might affect the scope, schedule, or budget. These projects succeed when other potential changes are restricted like requirements changes.

Because this approach follows a serialized sequence of work, predictive projects do not typically deliver business value until the end of the project. If the predictive projects encounter changes or disagreements with the requirements, the project will incur unanticipated costs.

In Figure 4, the predictive approach is depicted.

Figure 4 - Predictive Approach (Adapted from Agile Practice Guide, 2017)

2.3.2 Iterative

The iterative approach improves the product through successive prototypes or proofs of concept. A high-level vision is developed for the overall undertaking, but the detailed scope is only elaborated for one iteration at a time. After each iteration, the prototype gets stakeholder feedback. This new information provided by the stakeholders is then used on the next iteration, in order to improve the product in compliance with stakeholder's expectation.

Projects benefit from iterative approach when complexity is high, when the project incurs frequent changes, or when the scope is subject to differing stakeholders' views of the desired final product.

In Figure 5, the iterative approach is depicted.

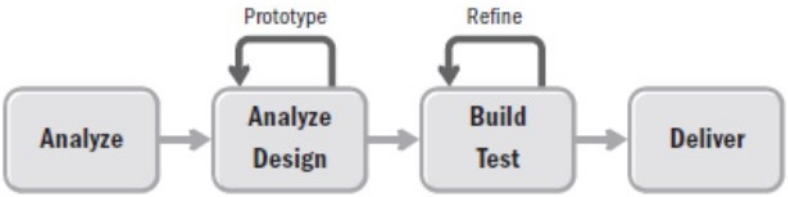

Figure 5 - Iterative approach (Adapted from Agile Practice Guide, 2017)

2.3.3 Incremental

Incremental approaches optimize work for delivering value to customers more often than a single, final product. This means that it provides deliverables that the customer may be able to use immediately. The initial deliverables are planned before the work begins.

As the project continues, the team may deviate from the original vision. Deviations are easy to manage because the team delivers value sooner. The degree of change and variation is less important than ensuring customers get value sooner at the end of the project. Because many businesses cannot afford to wait for everything to be completed, so the customers are willing to receive a subset of the overall solution.

In Figure 6, the incremental approach is depicted.

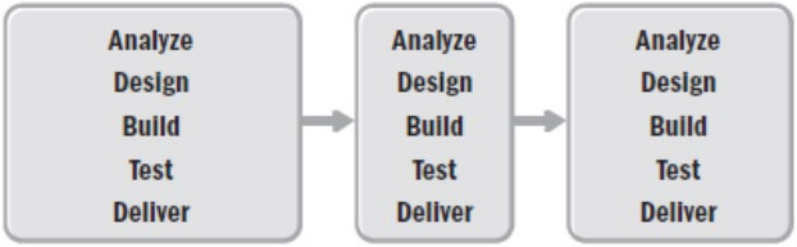

Figure 6 - Incremental approach (Adapted from Agile Practice Guide, 2017)

2.3.4 Agile

In the 1990s, the industry had enormous time lag between business requirements and the delivery of technology. That led to the cancelation of many projects. At that time, projects were led by the waterfall model that was not meeting the demand for speed and could not keep going with the rapid requirements changes. To address that, an Agile manifesto and twelve principles were developed in 2000 by a group of seventeen "thought leaders" ("Comprehensive Guide to the Agile Manifesto," 2016).

Although originating in the software industry, the principles have since spread to many other industries (*Agile Practice Guide*, 2017). This origin is the reason that the values and principles quoted bellow are referring to software industry.

Agile Values of the Agile Manifesto:

1. Individuals and interactions over processes and tools

Valuing people is more important than processes or tools because are these people who respond to business needs and drive the development process. When tools and process drive development, then the team is less responsive to change and less likely to meet customer needs. Communication is important and in case of individuals, it is fluid and happens when a need arises. In the case of process, communication is scheduled and requires a specific content ("Comprehensive Guide to the Agile Manifesto," 2016).

2. Working software over comprehensive documentation

Historically, enormous amounts of time were spent on documenting the product for development and ultimate delivery. Agile does not eliminate documentation, but does

it in a way that provides the developer what is needed to do the work without getting bogged down in minutiae ("Comprehensive Guide to the Agile Manifesto," 2016).

3. Customer collaboration over contract negotiation

Negotiation is the period when the customer and the product manager work out the details of a delivery, with points along the way where the details may be negotiated. On the waterfall approach, the requirements are negotiated with the customer in great detail, prior to any work starting. This means that he is involved in the process of development before the beginning of the actual work and after it is completed, but not during the process. The Agile Manifesto describes a customer who is engaged and collaborates throughout the development process. This makes it easier for development to meet the needs and desires of the customer ("Comprehensive Guide to the Agile Manifesto," 2016).

4. Responding to change over following a plan

Traditional approaches regarded change as an expense, so they had to be avoided. The intention was to develop detailed, elaborate plans, with a defined set of features with everything. With Agile, the small time iteration means that priorities can be shifted from iteration to iteration and new features can be added into the next iteration. Agile point of view is that changes will always provide additional value, which will improve the project ("Comprehensive Guide to the Agile Manifesto," 2016).

According with the Agile Practice Guide (*Agile Practice Guide*, 2017) **the Agile principles that should be followed are:**

1 - Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.

2 - Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.

3 - Deliver working software frequently, from a couple of weeks to a couple of months,

with a preference to the shorter timescale.

4 - Business people and developers must work together daily throughout the project.

5 - Build projects around motivated individuals. Give them the environment and support they need and trust them to get the job done.

6 - The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.

7 - Working software is the primary measure of progress.

8 - Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.

9 - Continuous attention to technical excellence and good design enhances agility.

10 - Simplicity—the art of maximizing the amount of work not done—is essential.

11 - The best architectures, requirements, and designs emerge from self-organizing teams.

12 - At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.

In Figure 7, the relationship between the Agile Manifesto Vales, Principles and common practices is presented.

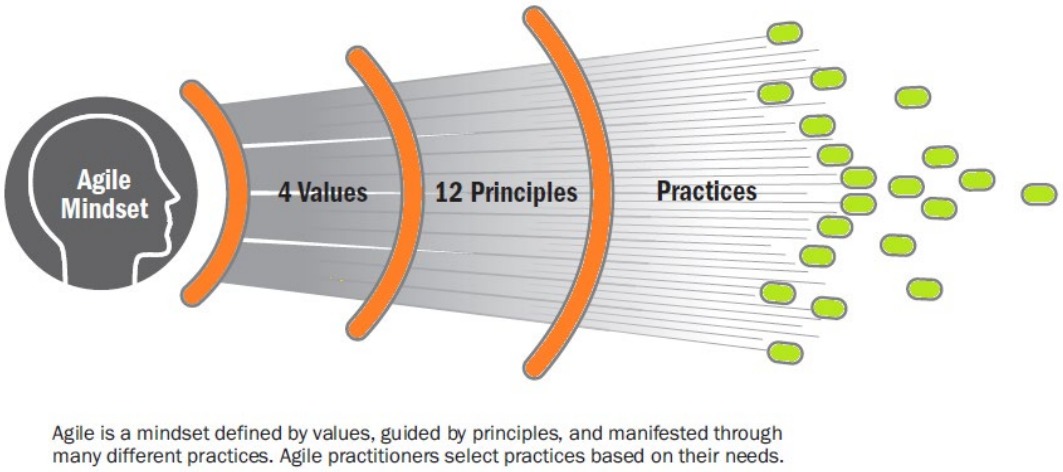

Figure 7 - Relationship between the Agile Manifesto Values, principles and common practices (Adapted from Agile Practice Guide, 2017)

An Agile approach leverages both the aspects of iterative and incremental characteristics. When teams use agile approaches, they iterate over the product to create finished deliverables. The team gains early feedback and provides customer visibility, confidence, and control of the product. Because the team can release earlier, the project may provide an earlier return on investment, because the team delivers the highest value work first.

A project that have high rates of change, complexity and risk can present problems for a traditional predictive approach, which tries to determine the bulk of requirements upfront and to control changes. In an Agile approach team expect requirements to change, thus, instead of avoiding them, the feasibility is explored in short cycles and quickly adapted based on evaluation and feedback.

Agile approaches cover a variety of frameworks and methods. In Figure 8, some methodologies that fulfill the values and principles of the Agile Manifesto are presented.

In the context of this work, only Scrum, Kanban and Scrumban will be assessed as these methodologies are also suitable for projects outside the software industry.

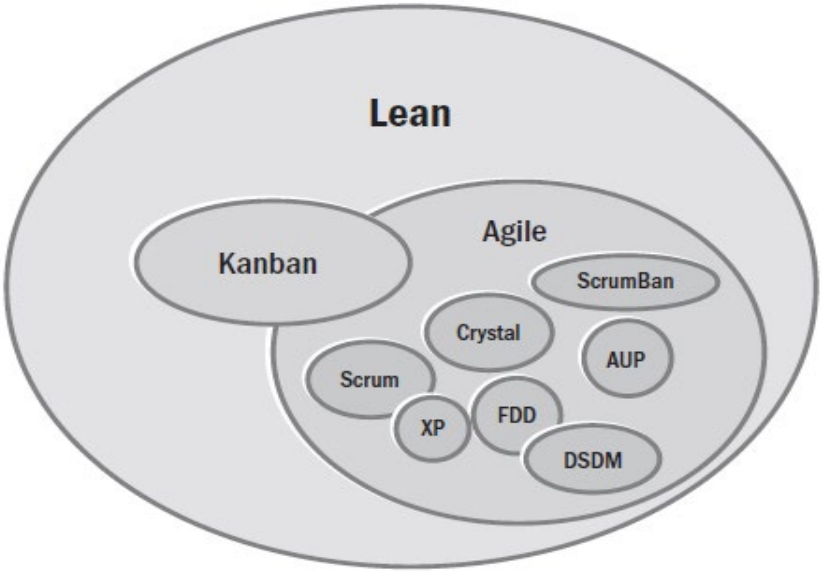

Figure 8 - Agile Methodologies

2.3.4.1 Scrum

Scrum is a single-team process framework used to manage product development. The framework consists of Scrum roles, artifacts, and rules. Scrum runs on time-boxes with consistent durations called sprints, where a potentially releasable increment of product is produced.

2.3.4.1.1 Scrum Roles

Scrum consists on a team made up of three scrum roles: Product Owner, Scrum Master and the Development Team.

Product Owner

According with the Scrum Guide developed by Ken Schwaber and Jeff Sutherland (2017), the Product Owner is someone that is responsible for maximizing the value of the product resulting from work of the development team. He is also the single voice of the entire stakeholder community, internal and external. He is the responsible for managing the product backlog. The product owner also oversees the grooming of the product backlog, which includes creating, refining and estimating product backlog items. Defining the acceptance criteria for each product backlog item is also one of the product owner tasks.

During sprint planning, the product owner works with the development team to define a sprint goal by providing a valuable input that enables the development team to select a set of product backlog items that the team can realistically deliver by the end of the sprint. He collaborates closely with the development team on a frequent basis to ensure that they understand the items in the product backlog.

Development Team

According with the Scrum Guide developed by Ken Schwaber and Jeff Sutherland (2017), the development team consists of professionals who do the work of delivering a potentially releasable increment of "Done" product at the end of each sprint. Only members of the development team can create the increment.

Development teams have the following characteristics:

- They are self-organizing. All members are equal;
- Development Teams are cross-functional, with all the skills inside the team necessary to create the product Increment;
- There are not sub-teams in the development team, regardless of domains that need to be addressed, like architecture, testing, operations or business analysis
- Individual Development Team members may have specialized skills and areas of focus, but accountability belongs to the Development Team as a whole.

Scrum Master

According with the Scrum Guide developed by Ken Schwaber and Jeff Sutherland (2017), the Scrum Master is responsible for promoting and supporting Scrum as defined in the Scrum Guide. He is a servant-leader for the scrum team

There are different services of the Scrum Master, depending on the team member that he is serving.

Scrum Master Service to the Product Owner (Schwaber & Sutherland, 2017)

- Ensuring that goals, scope, and product domain are understood by everyone on the Scrum Team as well as possible;
- Finding techniques for effective Product Backlog management;
- Ensuring the Product Owner knows how to arrange the Product Backlog to maximize value;
- Understand and practicing agility;
- Facilitating Scrum event as requested or needed.

Scrum Master Service to the Development Team (Schwaber & Sutherland, 2017)

- Coaching the Development Team in self-organization and cross-functionality;
- Helping the Development Team to create high-value products;
- Removing impediments to the Development Team's progress;
- Facilitating Scrum events as requested or needed.

2.3.4.1.2 Product Backlog

Product Backlog is an artifact from Scrum. It is an ordered list of everything that is known to be needed in the product. As aforementioned, the product owner is the person responsible for its content, availability and ordering, and to collaborate with internal and external stakeholders to gather and define the product backlog items in a way that the development team has all the information they need. The product backlog is a constantly evolving artifact which means that items can be added, deleted and revised by the product owner as business conditions change, or as the Scrum Team's understanding of the product grows.

2.3.4.1.3 Backlog Grooming

Backlog grooming is the act of adding detail, estimates and to break it down the product backlog into tasks. Only product backlogs items foreseen for the next sprint are broken down into tasks. The grooming is performed by the product owner and development team. Higher priority product backlog items are usually clearer and more detailed than lower priority ones. The product backlog items that can be performed by the development team within one sprint are deemed as "ready" for selection in the sprint planning.

2.3.4.1.4 Sprint Planning

The work to be performed in the Sprint is planned at the Sprint Planning. This plan is created by the collaborative work of the entire Scrum Team. Scrum Master ensures that the event takes place and that attendants understand its purpose. The input to this meeting is the Product Backlog, the latest product increment, projected capacity of the Development Team during the Sprint, and past performance of the Development Team. Items from the product backlog are selected and then broken down into tasks. These tasks will be selected to be performed during the sprint. The groomed product backlog items selected for this Sprint are collected on the Sprint Backlog. The number of items selected for the Sprint is solely up to the Development Team. Only the Development Team can assess what it can accomplish over the upcoming sprint.

2.3.4.1.5 Sprint Execution

After the Scrum Team, the sprint planning finishes and agrees the content of the next sprint. The development team, guided by the Scrum Master's coaching, performs all of the tasks necessary to get the features done. Nobody tells the development team in what order or how to do the task-level work in the sprint backlog.

2.3.4.1.6 Daily Scrum

It is characterized by a 15 minutes daily time-boxed event and is used to inspect progress towards the Sprint Goal and to inspect how progress is trending toward completing the work from the Sprint Backlog.

This event optimizes the probability that the development team will meet the sprint goal and keep them engaged.

Usually, three questions are answered in order to enable that everyone understands the big picture of what is occurring. In Figure 9 those three questions are presented.

Figure 9 - Questions regarding the Daily Scrum (Airbus, 2019)

Daily Scrum is not a problem-solving event. An extra meeting should be scheduled for such purpose.

2.3.4.1.7 Sprint Review

Sprint Review is held at the end of the Sprint to inspect the increment and adapt the product backlog if needed. According to the Scrum Guide, the sprint review includes the following elements:

- The Development Team discusses what went well during the Sprint, what problems it ran into, and how those problems were solved;
- The Development Team demonstrates the work that it has "Done" and answers questions about the Increment;
- The Product Owner discusses the Product Backlog as it stands;
- The entire group collaborates on what to do next, so that the Sprint Review provides valuable input to subsequent Sprint Planning.

2.3.4.1.8 Sprint Retrospective

It is an opportunity for the Scrum Team to inspect itself and create a plan for improvements to be applied during the next sprint. This activity occurs after the Sprint Review and prior to the next Sprint Planning. The Scrum Master ensures that the event takes place and that attendants understand its purpose

According to the Scrum Guide, the main purpose of the Sprint Retrospective is to:

- Inspect how the last Sprint went with regards to people, relationships, process, and tools;
- Identify and order the major items that went well and potential improvements;

- Create a plan for implementing improvements to the way the Scrum Team does its work.

It is also important to discuss what should be started, stopped or continue (Figure 10)

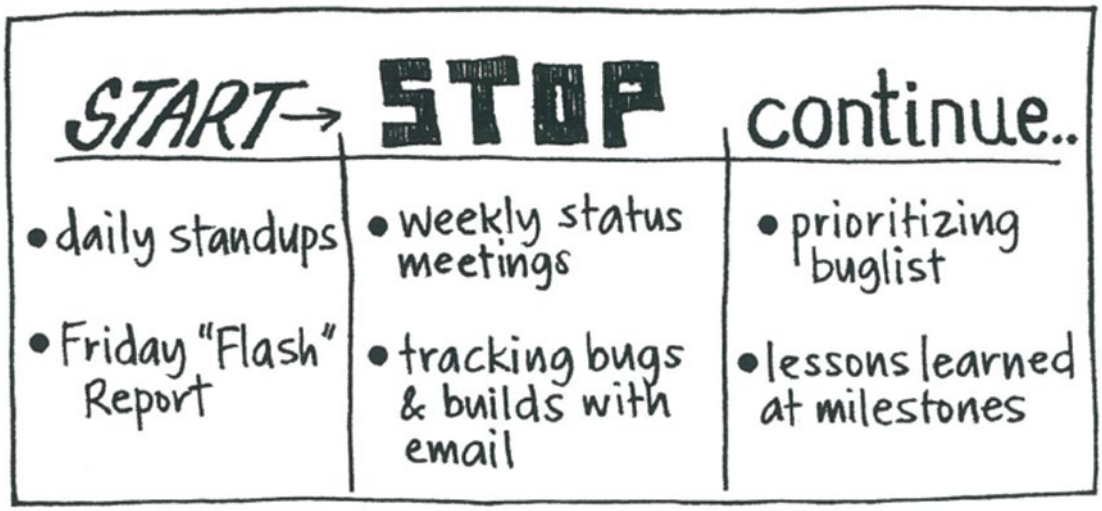

Figure 10 - Example of an outcome of a sprint retrospective

2.3.4.1.9 Done

It is important that every team understands what "Done" means. The definition of "Done" for the Scrum Team is used to assess when tasks are completed on the product increment. In the Table 2 is presented the research regarding Scrum.

Table 2-Research regarding Scrum

Bibliographic References	Work Description
(Streule, Miserini, Bartlomé, Klippel, & de Soto, 2016)	On this work, the authors refer that constructions companies are enhancing the performance of their project teams to improve their competitiveness and increase added value to their clients and themselves. This work is focused on assessing if scrum can be implemented in the design phase of the construction industry and what adaptions may be required. The results showed that a successful application of Scrum in the construction industry is possible and no significant adjustments are needed to be original Scrum framework however some points should be considered like getting a good understanding how scrum works are getting all parties involved from the beginning and take enough time to create clear and comprehensive Product Backlog with items and Tasks.

2.3.4.2 Kanban

The Kanban model is known to have originated from Toyota Production System. Kanban is a Japanese word and literally means “signboard”. According to Anderson and Carmichael (2016), Kanban is a method for defining, managing and improving services that deliver knowledge work, such as professional services and creative endeavors.

The Kanban Method is based on making visible what is otherwise intangible knowledge work to ensure that the service works on the right amount of work, providing a balance between the work that is requested and needed by the customer and the work that the service has the capability to deliver.

In typical Scrum, the product backlog items are chosen for each sprint and an initial planning is made in the beginning of each sprint. The reason of estimating is to enable assessing the appropriate workload during the sprint. In Kanban, there are no sprints and therefore estimating is optional. Another way to achieve predictability is to make sure that all items have the same size (Singla, 2017).

2.3.4.2.1 Kanban Roles

Kanban is and remains the “start with what you do now” method, where initially no one receives new roles, responsibilities, or job titles. There are no required roles in Kanban and the method does not create new positions in the organization (Anderson & Carmichael, 2016), however two roles have emerged from common practice. These roles do not need to be formally assigned. But their responsibilities should be covered within the team:

- Service Request Manager: is someone that is responsible for understanding the needs and expectations of customers. This role can also be called Product Manager, Product Owner and Service Manager (Anderson & Carmichael, 2016).
- Service Delivery Manager: is someone responsible for the flow of work in delivering selected items to customers. This role can also be called by Flow Manager, Delivery Manager or Flow Master (D. J. Anderson & Carmichael, 2016).

2.3.4.2.2 Kanban Practices

The following practices are activities essential to manage a Kanban system (D. J. Anderson & Carmichael, 2016):

Visualize Workflow

- Kanban encourages the visualization of a workflow (Power & Conboy, 2015) by using physical or virtual boards and cards;
- Visualization helps the team to know the progress of each task;
- Tasks are moved through different states;

- If some stage of the work flow becomes a bottleneck, it prompts the development team to handle it immediately (Mahnic, 2013).

Limit Work in progress

- In Kanban, a maximum limit of tasks is defined for the Work In Progress (WIP).
- WIP limits are set up in order to manage the quantity of work-in-progress at any given stage in the workflow (Power, 2014);
- If no WIP limit and no signaling to pull new work through the system exists, it is not a Kanban System (Anderson, 2010);
- This pull based system ensures sustainable pace without overloading different stages of the workflow (Mahnic, 2013);
- Having WIP limit makes sure that team focus on finishing the tasks instead of pull a new one without the other being finished. This will contribute for a smooth workflow and prevent overloads by keeping an optimal pace of work without exceeding the teamwork capacity (Mahnic, 2013).

Measure and manage flow

The workflow should maximize value delivery, minimize lead times and be as predictable as possible. Teams use empirical control through transparency, inspection and adaption in order to balance these potentially conflicting goals. A key aspect of managing flow is identifying and addressing bottlenecks and blockers (Agile Alliance, 2017).

Make process policies explicit

Because work is always moving through different states on the Kanban board, it is important to establish policies that define the “entry” and “exit” criteria, to determine when a work item can be pulled from one state to another (Power, 2014).

Making team policies explicit will help team members manage themselves, make quicker decisions without putting much effort into thinking. These policies can be:

- Defining the WIP constraints;
- Define how the tasks will be added to the backlog and how they will be pulled out of the Backlog to be processed;
- Rules for reversing a task If an experienced team member has advanced it improperly;
- Someone into the team has decision making authority;
- Establish a small group that can override team members’ decisions, if required.

Feedback Loops

An evolutionary process cannot work without feedback loops. Feedback loops are an essential and important part of any controlled process and especially important for evolutionary change.

Kanban defines seven feedback opportunities, or cadences. Cadences are the cyclical meetings and reviews that drive evolutionary change and effective service delivery. Improving feedback in all areas of the process is important, mainly in the following areas (Anderson & Carmichael, 2016):

- Strategy alignment;
- Operational coordination;
- Risk management;
- Service improvement;
- Replenishment;
- Flow;
- Customer deliveries.

Improve & Evolve

Kanban is fundamentally an improvement method. Often, transformation programs are started with the aim to change processes to a new, predefined approach. Kanban is introduced in accordance to the definition above and will pursue continuous and incremental improvement.

In Figure 11, it is represented an example of a Kanban Board (Hansen, 2019).

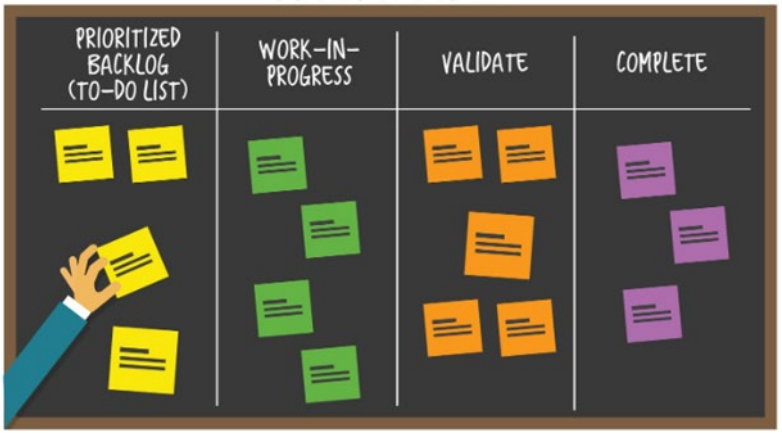

Figure 11 - Example of a Kanban Board

In the Table 3 is presented the research regarding Kanban.

Table 3-Research regarding Kanban

Bibliographic References	Work Description
(Rahman, Sharif, & Esa, 2013)	On this work, the authors refer that Kanban system is not being implemented widely by manufacturing companies in Malasya. The objectives of this work were to determine how the Kanban systems works effectively in a multinational organization, identify the factors hindering small and medium Malaysian enterprises from implementing Kanban. The analysed organization is an automotive manufacturer. The results showed that inventory management, vendo and supplied participation, quality improvement and quality control, employee and top management commitment were the factors that lead to a successful implement of a Kanban system in this organization. On the other side, the factors that impede the implementation of this system are ineffective inventory management, lack of supplier participation, lack of quality improvements and quality control and lack of employee participation.
(Aguilar-Escobar, Bourque, & Godino-Gallego, 2015)	On this work it is studied the implementation of a Kanban System in a Hospital. Literature already shown that the Kanban system can provide significant benefits. This work aims to measure nurses' satisfaction with Kanban systems in logistics of medical consumables. The results showed a high level of satisfaction of each aspect of the Kanban system. This means that hospital managers should promote the implementation of Kanban systems since it increases nurses' satisfaction and provides significant benefits like less work, more order, less space, fewer expired items and increased customer satisfaction.

2.3.4.3 Scrumban

Scrumban is a combination of Scrum and Kanban. It uses features of both methodologies combining the basic features of Scrum and the flexibility of Kanban.

It keeps the daily Scrum meeting and the Kanban board, but eliminates the planning activities and velocity measurement. Scrumban focuses on smooth flow and minimizing WIP.

It often starts as Kanban, with Daily Scrum meetings but, by continuous improvement, it may be modified to include more of the above-mentioned processes, steps or principles.

2.3.5 Hybrid

An entire project does not need to use a single approach. There are projects that combine different elements from different approaches to achieve certain goals.

When a combination or mix of predictive, iterative, incremental and/or agile approaches is used, it is called a hybrid approach.

In the Figures 12 to 14, hybrid approaches which mix agile with predictive elements can be observed.

Figure 12 - Combined Agile and Predictive approaches (Agile Practice Guide, 2017)

Using both predictive and agile approaches is a common scenario, as shows in Figure 12. This approach cannot be called Agile because it does not fully embody the agile mindset, values and principles. However, it would be also wrong to call it predictive since it is a hybrid approach.

There are other hybrid approach combinations. For example, it can be predominantly predictive approach with some agile elements as is depicted in Figure 13, or it can be Largely Agile approach with predictive components, as depicted in Figure 14.

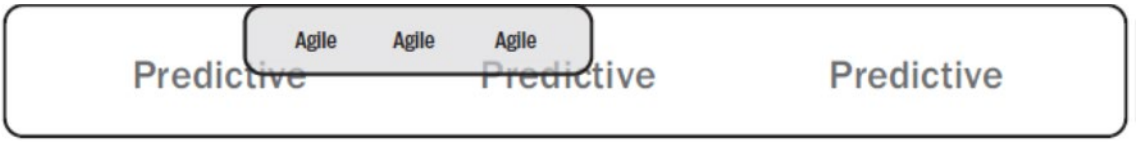

Figure 13 - A Largely Predictive Approach with Agile Components

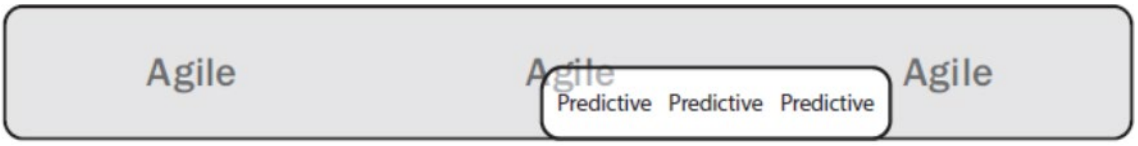

Figure 14 - A Largely Agile Approach with a Predictive Component

Every Hybrid approach needs to be developed for its specific project. There is nothing like a standard hybrid approach that fits to a broad variety of projects.

2.4 SWOT Analysis

SWOT analysis is a tool that is used for strategic planning and strategic management in organizations. It is used to build effectively an organizational and competitive strategy (Gürel, 2017).

The acronym "SWOT" stands for Strengths, Weaknesses, Opportunities and Threats. Each of these elements is now described as follows (Gürel, 2017):

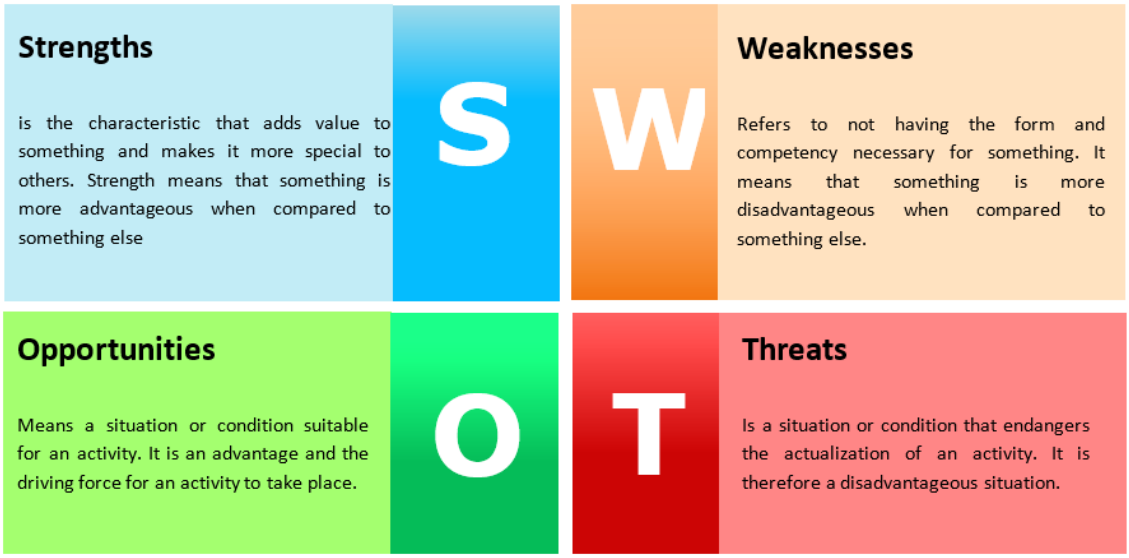

Figure 15- SWOT Analysis

This tool is beneficial because it helps organizations to decide whether or not an objective is possible and therefore enables organizations to set achievable goals. It enables to take visions and produce practical and efficient outcomes.

In the Table 4 is presented the research regarding the SWOT analysis.

Table 4-Research Regarding SWOT Analysis

Bibliographic References	Work Description
(Cui, Allan, & Lin, 2019)	On this work, it is expressed that although a considerable number of underground pedestrian systems (UPS) have been developed in the world, there's a lack of research about the influencing factors of the urban environment within which UPS developments are situated. A SWOT analysis has been performed in order to understand what

	determines the necessity for applying UPS under various circumstances. Due to the fact that UPS is a relatively new topic in urban and transport studies, there is a lack of evidence-based research into the SWOT analysis of UPS.
(Jasiulewicz-Kaczmarek, 2016)	On this work, a SWOT analysis to maintenance system diagnosis and identification of directions of company's strategic action within maintenance area has been performed. The expected result of using this tool was to improve the company "Planned Maintenance" strategy. The results of this tool provided a increase of the efficiency of the maintenance system as action plans to tackle the threats that may arise.
(Dana, 2012)	On this work a SWOT analysis has been performed to improve Quality Management inside a small organization. In order to improve quality management and identify what the organization needs the SWOT analysis tool has been selected because its fast, simple, and can be adapted as an instrument to identify the factors that harm the organization and provide solutions to elaborate a future strategy. With the results of the SWOT analysis it has been possible to find ways to improve quality management in the organization by training the staff, controlling the process and changing the mentality within the organization.

2.5 Agile Suitability Filter Tools

Agile Suitability Filters are tools that can help to assess if different project management approaches can be used within a project. This assessment avoids changing to an approach that is not suitable for a specific project. The decision of changing is to bring more efficiency to a project. However, if the project is not compatible, it can be a disaster.

Changing approaches can bring some risks to the project. They can be rejected by some stakeholders or the project is already well defined and therefore, a plan-driven approach can be more suitable.

These tools are subjective, and the results do not ensure that it will bring project success because the team characteristics play a big role. A smart and motivated team

can do the work with a non-ideal approach, just as a misaligned team can fail with the perfect approach.

2.5.1 Dynamic System Development Method (DSDM) Suitability Filter

In 1994, the DSM Consortium developed a simple Suitability Filter Questionnaire with a list of Yes/No questions. This idea is to check if the project characteristics are suitable to use an agile approach. The following attributes indicate the usability of an agile approach (Griffiths, 2007):

1. **Acceptance of the agile philosophy before starting work**: short cycles, user involvement, iterative development, etc.;
2. **The decision-making power of the users and developers in the development team:** acceptance and support of empowered teams who are allowed to make their own local decisions;
3. **The commitment of senior user management to provide significant end-user involvement:** availability of user resources to participate in the project;
4. **Incremental delivery:** agreement that this is possible and desirable. Stakeholders must agree how to review interim steps and who will be responsible for them.
5. **Easy access by developers to end-users:** a measure of the ease of the development team to access end-users to get feedback;
6. **The stability of the team:** keeping a stable core base to support verbal knowledge sharing rather than requiring documentation;
7. **The development team's skills:** does the development team have all the necessary skills to develop the product or service?
8. **The size of the development team:** small teams to leverage face-to-face communications and minimize communication and documentation costs;
9. **A supportive commercial relationship:** trust and collaboration over contract negotiation;
10. **The development technology:** support incremental delivery, rapid prototyping and refactoring.

2.5.2 Alistair Cockburn's Criticality and Team Size Factors

Alistair Cockburn's Crystal family of methods are foreseen to assess project fit and suitability. It uses the characteristics of a System criticality and team size. Cockburn divided his methods as shown in Figure 16.

On the X axis is the people involved on the project, which starts with small teams of 1-4 people progressing to large project of 500+ people on the right. The Y axis shows the Criticality, that is the potential result of failures to the system.

This methodology has been designed for teams with few elements that want to tackle projects up to a Criticality of Discretionary Funds will not fit to teams with 50-100 people with projects up to Essential Money in Criticality.

Team Size and Criticality are good factors to assess if a project is suitable for an Agile approach. An Agile method can work well on big teams and even on life-critical systems. However, it will require much more effort and skills to implement.

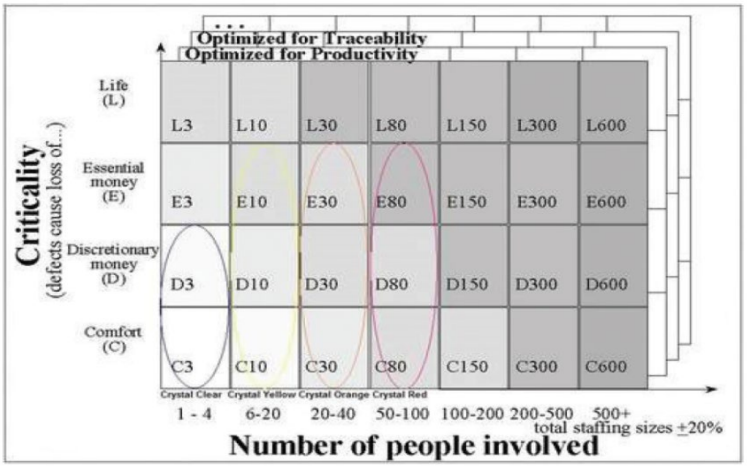

Figure 16 - Cockburn methods (Griffiths, 2007)

2.5.3 Boehm and Turner Radar Chart

In the book, Balancing Agility and Discipline: A Guide for the Perplexed, is described a visual tool for assessing if a project is more suitable to use an agile approach or a more traditional, plan driven one.

This Boehm and Turner's radar shown in the Figure 17, allows to assess a project using five attributes. The scores obtained will be then plotted on the radar diagram. Scores concentrated at the center indicate that the project has a good fit for an agile approach, while scores that are away from that center zone indicate a better fit to a traditional approach. The criteria are:

Personnel: This measures the team experience. Agile projects are more likely to go smoothly with a low proportion of beginner developers and a high proportion of intermediate and expert-level practitioners. If a team has a higher percentage of beginners, then a more traditional approach may be more successful.

Dynamism: This term describes the likelihood of change. It assesses how dynamic the project is and the percentage of requirements that are likely to change during the project.

Culture: This term assesses the temperament of the organization. Is the organization capable to accommodate change or does it rely on the familiarity of order and

tradition? For strict organizations getting buy-in for agile in a very ordered environment can be challenging, which can bring difficulties to adopt.

Team Size: Agile methods are easier to introduce, execute and manage with small teams. Teams of less than ten people are a great fit for agile approaches as they can communicate face-to-face, support unwritten knowledge by conversations and facilitate simple, visible tracking systems. As team sizes grows, supporting agile principles becomes more difficult and requires additional techniques.

Criticality: This element refers to the consequence of a system failure. Agile is more suitable for trivial applications where failure of the system results in a loss of convenience. If it is a mission-critical or life-critical application, agile would be less applicable and a plan-driven approach would be chosen. However, agile can still be applied to test functionality early and often in a life-critical or mission-critical project.

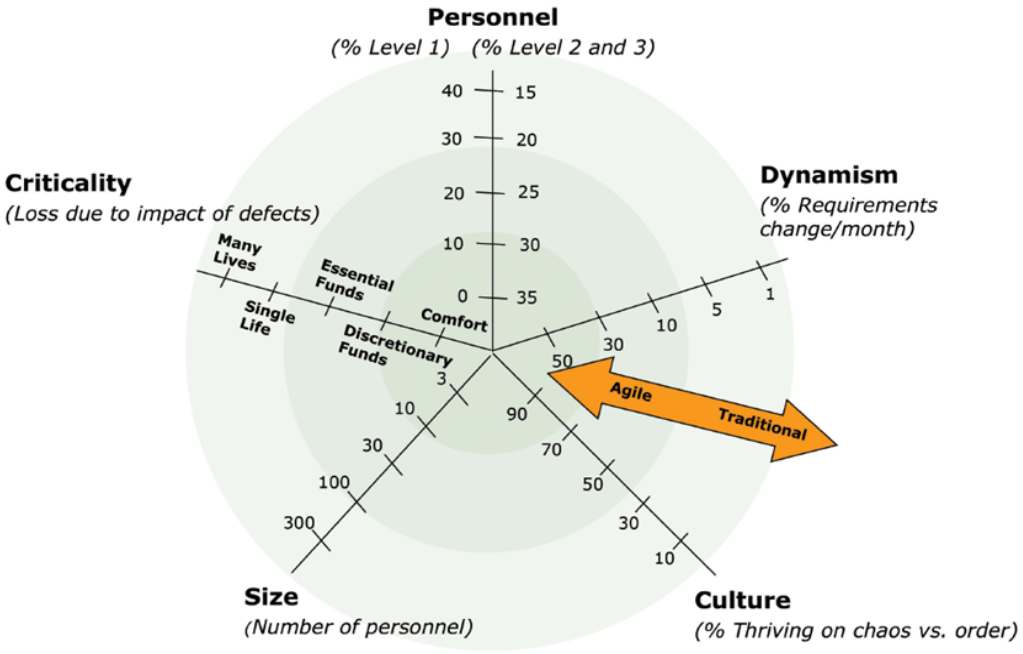

Figure 17 - Boehm and Turner Radar Chart (Boehm & Turner, 2003)

2.5.4 Agile Practice Guide Suitability Radar

Agile literature contains many agile suitability filter tools, like the aforementioned.

Boehm and Turner (2003) used some elements from Dynamic System Development Method (DSDM) and Crystal to develop a new assessment model to help determining if a specific project should adopt an agile or traditional approach.

Based on these previous models, a new model that has been expanded to consider the middle ground of hybrid approaches has been developed by PMI in cooperation with Agile Alliance. It represents a synthesis of several suitability filter attributes to support organizations to assess whether projects should be undertaken using predictive, hybrid or agile approaches.

Organization and project attributes are assessed under three main categories (*Agile Practice Guide*, 2017):

- **Culture:** Is there a supportive environment with buy-in for the approach and trust in the team?
- **Team:** Is the team of a suitable size to be successful in adopting agile? Do its members have the necessary experience and access to business representatives to be successful?
- **Project:** Are there high rates of change? Is incremental delivery possible? How critical is the project?

There will be questions regarding each of these categories. The answers will be then plotted on a radar chart shown in Figure 18.

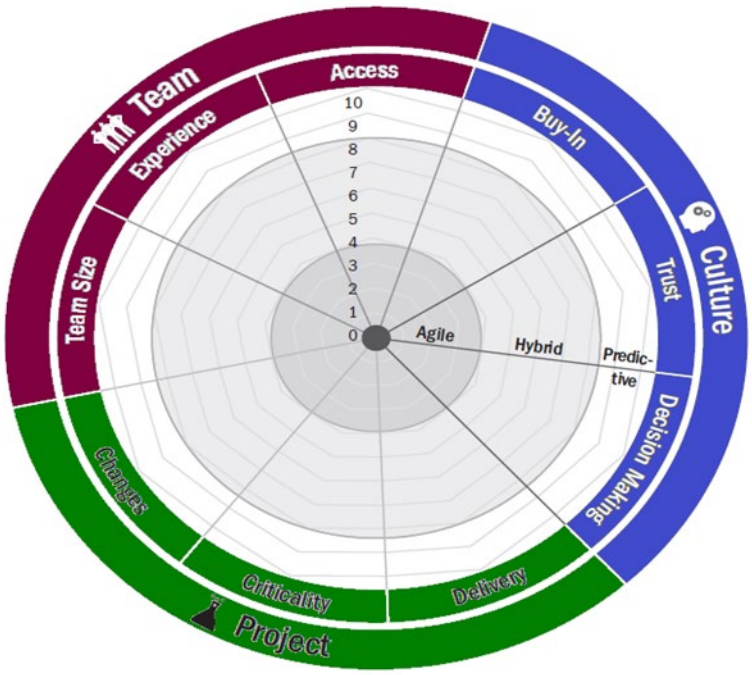

Figure 18 - Suitability Assessment Radar Chart (Agile Practice Guide, 2017)

The respective questionnaire should be completed as a group, which means that for a large project, this may include representatives from the sponsoring group, project execution team, impacted business group(s) and customer community, because a single viewpoint is not enough to make a good assessment.

The questions for this suitability filter are the following:(*Agile Practice Guide*, 2017):

Category: Culture

Buy-in to approach: Is there senior sponsor understanding and support for using an agile approach for this project? The scaling is shown in Figure 19.

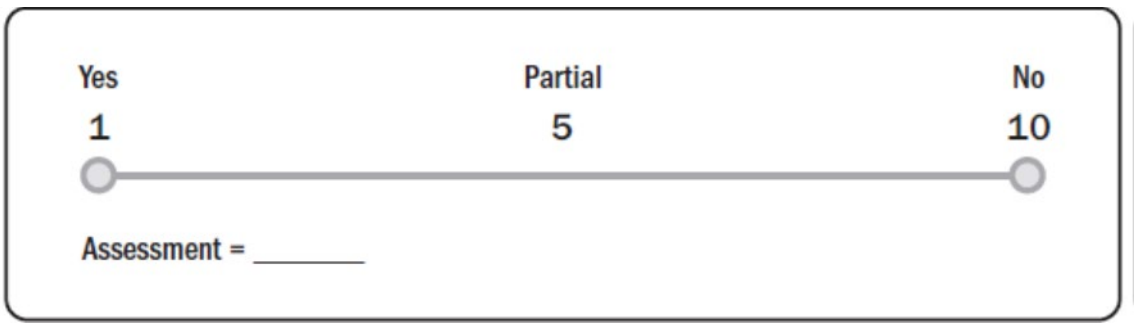

Figure 19 - Buy-In to approach assessment (Agile Practice Guide, 2017)

Trust in Team: Considering the sponsors and the business representatives who will be working with the team, Do these stakeholders have confidence that the team can transform their vision and needs into a successful product or service, with ongoing support and feedback going in both directions? The scaling is shown in Figure 20.

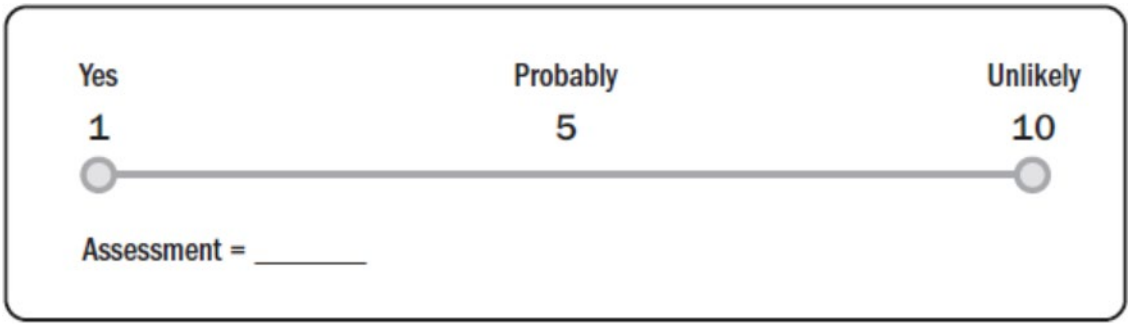

Figure 20 - Trust in team assessment (Agile Practice Guide, 2017)

Decision-making powers of team: Will the team be given autonomy to make their own local decisions about how to undertake work? The scaling is shown in Figure 21.

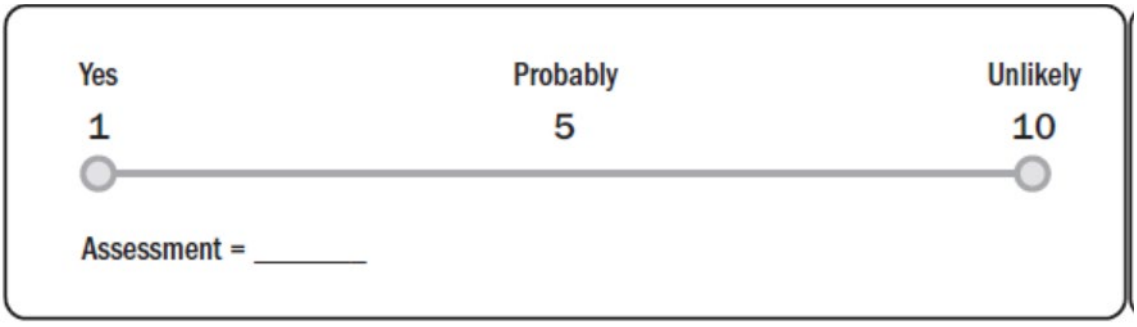

Figure 21 - Assessment for Decision-Making Power of Team (Agile Practice Guide, 2017)

Category: Team

Team size: What is the size of the core team? Use this scale: 1-9=1, 10-20=2, 21-30=3, 31-45=4, 46-60=5, 61-80=6, 81-110=7, 111-150=8, 151-200=9, 201+=10. The scaling is shown in Figure 22.

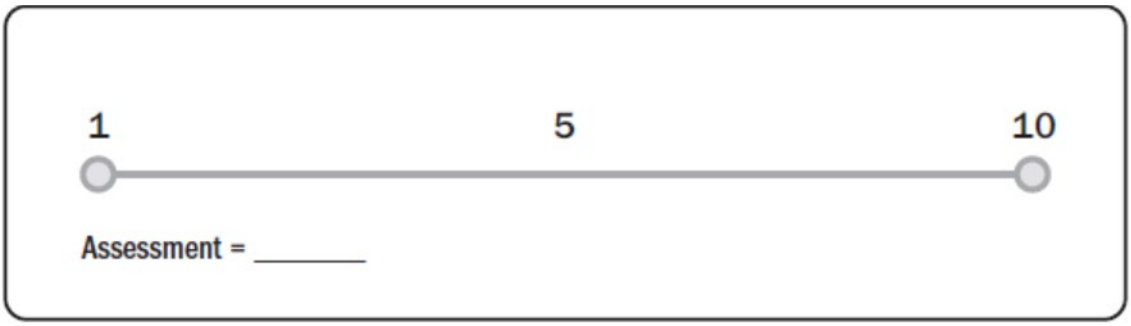

Figure 22 - Team Size Assessment (Agile Practice Guide, 2017)

Experience levels: The experience and skill levels regarding the core team roles must be considered. While it is normal to have a mix of experienced and inexperienced people in roles, for an agile project to go smoothly, it is easier when each role has at least one experienced member. The scaling is shown in Figure 23.

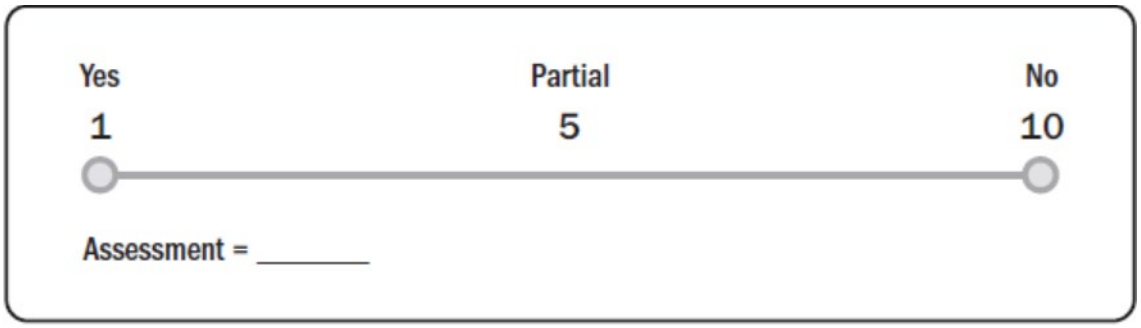

Figure 23 - Experience Level Assessment (Agile Practice Guide, 2017)

Access to the customer/business: Will the team have daily access to at least one business/customer representative to ask questions and get feedback? The scaling is shown in Figure 24.

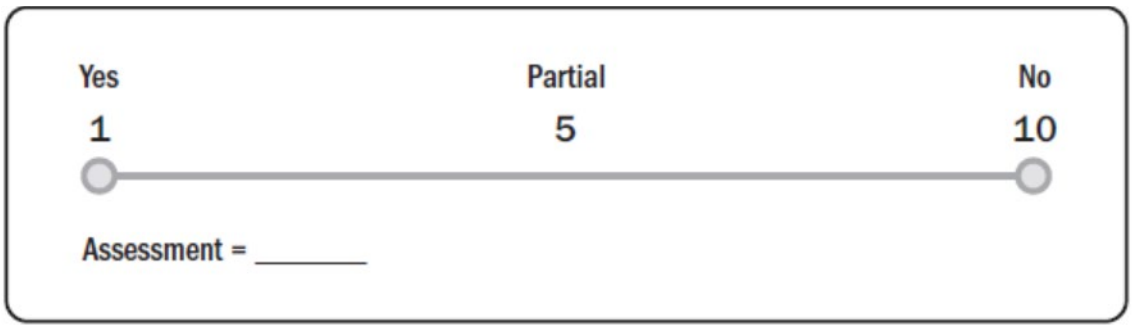

Figure 24 - Assessment for Access to the Customer/Business

Category: Project

Likelihood of change: What percentage of requirements are likely to change or be discovered on a monthly basis? The scaling is shown in Figure 25.

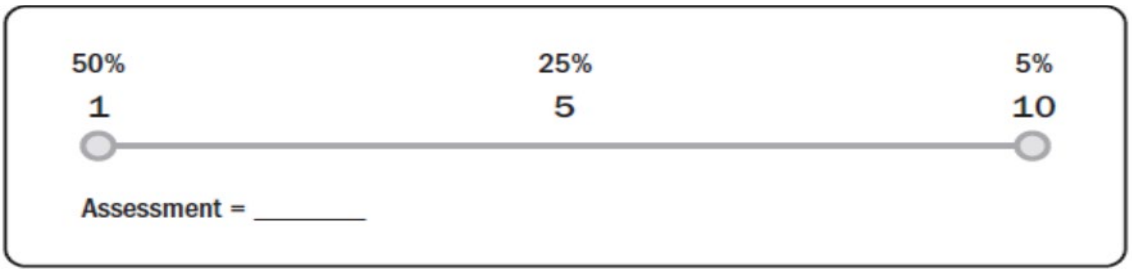

Figure 25 - Likelihood of Change Assessment (Agile Practice Guide)

Criticality of Product or Service: To help to determine likely levels of additional verification and documentation rigor that may be required, assess the criticality of the product or service being built. Using an assessment that considers loss due to possible impact of defects, determine what a failure could result in. The scaling is shown in Figure 26.

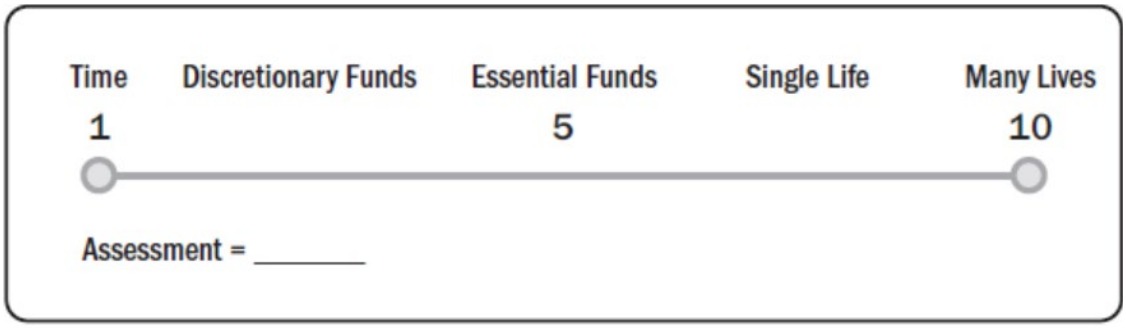

Figure 26 - Assessment for Criticality of Product or Service (Agile Practice Guide, 2017)

Incremental Delivery: Can the product or service be built and evaluated in portions? Also, will business or customer representatives be available to provide timely feedback on increments delivered? The scaling is shown in Figure 27.

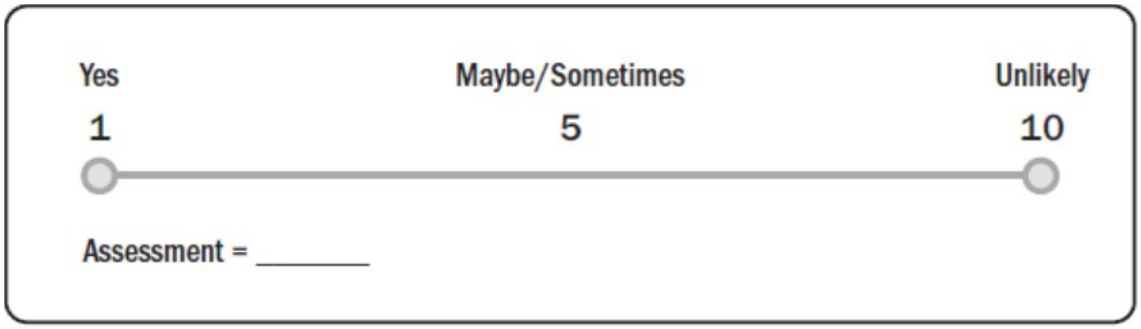

Figure 27 - Incremental Delivery Assessment (Agile Practice Guide, 2017)

The answers to these questions will be plotted on the suitability assessment chart and the points connected. Results clustered around the center in the agile zone indicate a good fit for a purely agile approach.

Results predominantly in the predictive zone indicate that a purely predictive approach may be the best option.

Other results indicate that a combination of agile and predictive approaches might work best.

THESIS DEVELOPMENT

3.1 COMPANY PRESENTATION

3.2 PROBLEM CHARACTERIZATION

3.3 ANALYSIS OF THE EXISTENT APPROACHES

3.4 SUITABILITY ASSESSMENT RADAR

3.5 DEVELOPMENT OF OWN APPROACH

3.6 CASE OF STUDY

3.7 CRITICAL ANALYSIS OF THE OBTAINED RESULTS

3 DEVELOPMENT

3.1 Company presentation

The Airbus Group is represented worldwide in the aerospace sector and related services. Its headquarters is in Leiden, in the Netherlands. At around 180 locations worldwide, 129.442 employees generated a total revenue of 66.8 Billion € in 2017.

Today, the group consists of three divisions: Airbus Commercial Aircraft, Airbus Helicopters and Airbus Defense and Space, as shown in Figure 28.

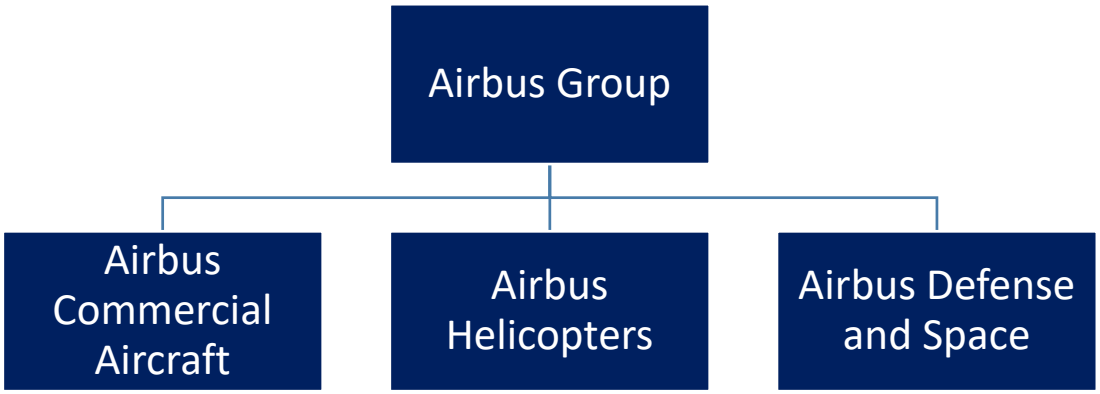

Figure 28 - Airbus Group Structure

Airbus Defense and Space is a division of Airbus Group, responsible for defense and aerospace products and services, and one of the top ten defense companies in the world. It was formed in January 2014 during the corporate restructuring of European Aeronautic Defense and Space (EADS), and comprises the former Airbus Military, Astrium, and EADS Defense & Security divisions. It has its corporate headquarters in Ottobrunn, Germany. The company has four program lines: Military Aircraft, Space Systems, Communication-Intelligence-Security, and Unmanned Aerial Systems, as shown in Figure 29.

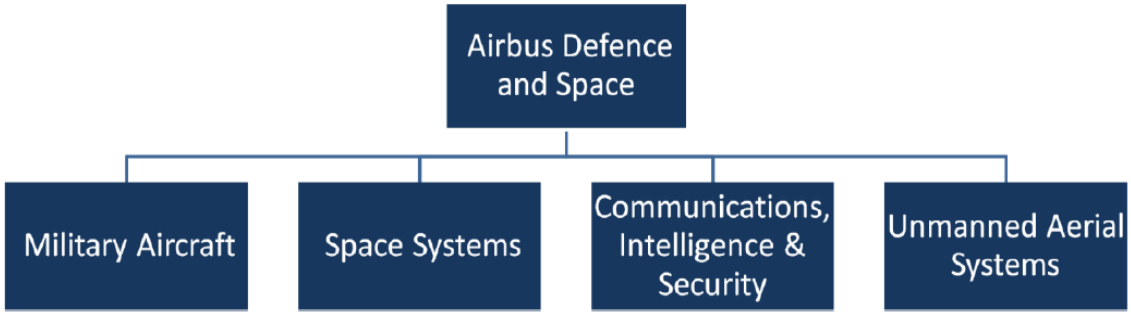

Figure 29 - Airbus Defense and Space Structure

The current work has been developed on the AWACS Program, which belongs to the Military Aircraft division.

3.1.1 AWACS Program Overview

NATO operates a fleet of Boeing E-3A Airborne Warning & Control System (AWACS) aircraft, which provides the Alliance with air surveillance, command and control, battle space management and communications.

The multinational NATO E-3A (NE-3A) Component has 14 NE-3A aircrafts, easily identifiable from the distinctive radar dome mounted on the fuselage (see Figure 2.1 above). The air vehicle is a modified Boeing 707-320, usually operating at an altitude of around 10 km. From this altitude, a single NE-3A can constantly monitor the airspace within a radius of more than 400 km and can exchange information – via digital data links – with ground-based, sea-based and airborne operators.

By using pulse Doppler radar, an NE-3A flying within NATO airspace can distinguish between targets and ground reflections and is therefore able to give early warning of aircraft operating over the territory of a potential aggressor.

In Figure 30 a picture of the aircraft is presented.

Figure 30 - Boeing E-3A AWACS airborne

3.1.2 The AWACS DLM Project

The Depot Level Maintenance (DLM) for the NATO E-3A (NE-3A) fleet has been conducted based on a six-year cycle since the first aircraft entered operation in 1982. The heavy maintenance is currently contracted through a Contracting Agency based in Luxembourg and a Prime Contractor based in Mestre, Italy.

The DLM applies to the air vehicle (Boeing 707-320), with 4 (four) Pratt & Whitney turbojet engines, flight essential avionics and mission avionics (surveillance radar, identification, data processing, communications, navigation and guidance, data display and control).

Depot Level Maintenance (DLM) is understood to mean that maintenance echelon which is intended to restore equipment and spare parts to a serviceable condition and to support field level maintenance activities by the use of more extensive resources, in addition to those available at lower levels of maintenance (intermediate and organizational).

DLM may imply repairs/major repairs, overhaul, complete rebuild of parts, modification, testing, calibration, and engineering services supporting the above DLM activities.

Every 6 years, the fleet of 14 NATO AWACS aircraft comes to Manching for undergoing DLM Maintenance. Some tasks are done in-house, while some of the parts are disassembled here and shipped to other MRO facilities. After the outsourced parts are shipped back to Airbus, they are re-assembled and the Aircraft (A/C) is submitted to the customer, which formally marks the end of the DLM event. Examples of maintenance tasks within one A/C DLM event in Manching are: Analytical Condition Inspection, A/C Structural Integrity Program, Corrosion Prevention & Control, and Interior Refurbishing.

3.2 Problem Characterization

Every project has a project team which has the responsibility for planning and delivering the project in scope, quality and time, as it has been agreed in the contract. To support the project team to achieve that goal, a lot of documents are created in order to record all the project data and to provide guidance throughout the project. The DLM project is complex, therefore it has a lot of documentation that are required to be created in time and always updated to be used when required during the execution phase.

The DLM project has an effectiveness issue in achieving that. The planning and execution phases for this project happen at the same time the project team consists in just a few members and that requires big effort from them for the parallel planning and execution, which can compromise compliance with project requirements and may decrease customer satisfaction.

The AWACS DLM project is using a predictive approach to develop the required documentation, which consists in planning one document at a time. After it is finished, a new one is started. The documentation is connected to each other, what means that if it is required to make an update or change in one document, the others may be needed to be also changed. This requires a big effort from the small project team and is not efficient due to the time pressure and the constant trying to avoid unclear situations due to missing documents. Some changes imply redundant work, which needs still to be done. This is time-consuming and limits resources, which could be applied for other tasks.

Both phases of planning and execution are important for the success of the project and, therefore, any of them cannot be neglected. If the planning is not performed quick enough to follow the execution phase, this execution phase will be performed without a plan. If this happens, a bigger effort will be required in the execution phase to solve related issues by performing firefighting, further limiting the resources available for planning.

In Figure 31 is a scheme with the description of the current approach.

To solve this problem, a new approach needs to be adopted. This new approach needs to be effective in a way that the project team can be able to perform the planning and the execution in an effective way, without wasting time doing redundant work. This work saved in not doing redundant work can be applied to other activities and to make a reliable planning faster available, in order to reduce firefighting effort for the execution.

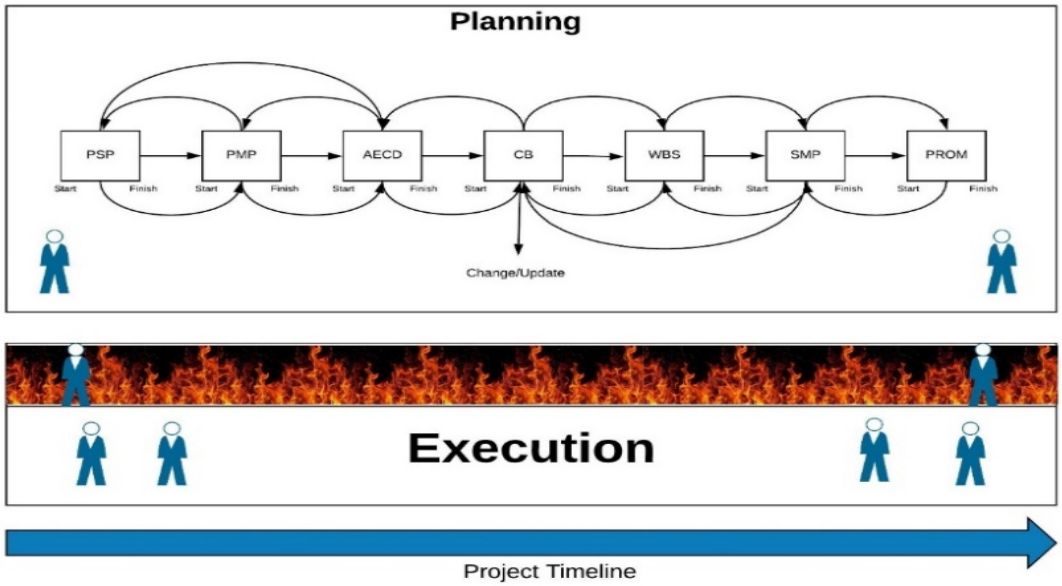

Figure 31 - Scheme of the current approach

3.3 Analysis of the existent Approaches

In order to assess which approach could fit better to the DLM project, a first analysis of each approach mentioned on section 2.3 was made. The core procedures of each of them has been assessed to the DLM Project.

Predictive - In the predictive approach, the documents are prioritized at the beginning and then planned and written one after the other. When one is finished, the next one is started. On the next document, if something changes during the planning, the previous document may need to be updated. As a result of this update, the second document may require also an update. When this is finished, the third one is started with possible implications to the already published documents and so on.

Iterative - This approach consists of planning all the documents first. The first iteration includes only the creation of documents absolutely mandatory at this point of time. During the next iteration, the planning will be more detailed. Those areas, where the planning is completed, will put in text regardless to which documents they belong. These iteration steps will be repeated until the planning is complete. Then, the final documents will be created and released.

Incremental – In this approach, the documents are planned in increments. Each increment consists of a group of documents that need to be created. This approach allows to deliver more often, instead of each whole document just at the end. It is expected that it will be necessary to update the documents in the next increment.

Agile - The Agile approach can be iteration or flow based. It can be combined with an incremental approach. The Agile lifecycles are those that fulfill the principles of the Agile Manifesto. In this approach, the documents will be broken down into specific tasks. These tasks will be allocated to sprints, which are time boxed iterations in Scrum methodology. The way the tasks will be performed is defined and agreed.

3.3.1 SWOT Analysis

In this step, a SWOT Analysis will be performed. This tool will allow to have a clear view of the strengths, weaknesses, opportunities and threats regarding each approach. Its results enable to determine the points that can be improved in case of the necessity of developing a new approach. Figure 31 shows the SWOT analysis regarding the predictive approach.

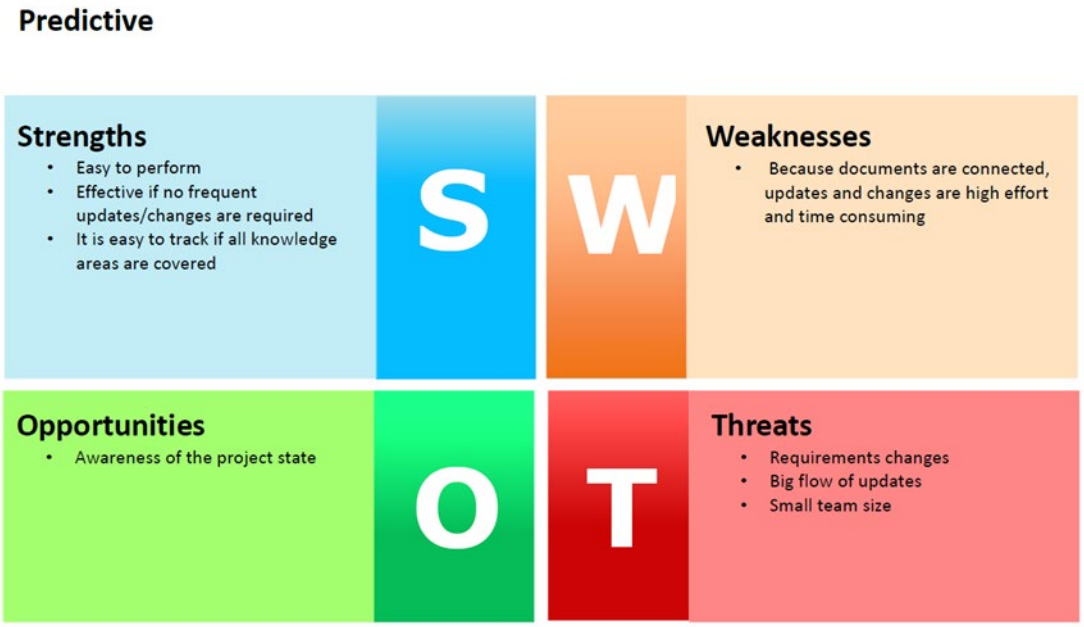

Figure 32 - Predictive approach SWOT analysis

On the strengths field it has elements like 'easy to perform' due the fact that all documents are performed sequentially, allowing to track easily if all knowledge areas are covered turning it effective if no frequent changes or updates are required.

On the weaknesses field is the problem of the necessity of changing a document, which will require high effort and time because the documents are connected, and a change may entail changes in all the other documents.

On the opportunities, it allows to have a complete awareness of the project state because everything is done sequentially, which reduces the risk of overlooking.

On threats, a big flow of updates or requirements combined with a small team size would bring a lot of problems due to the need to change all documents and requires a big team effort to do so.

The SWOT analysis of the iterative approach is shown in Figure 33.

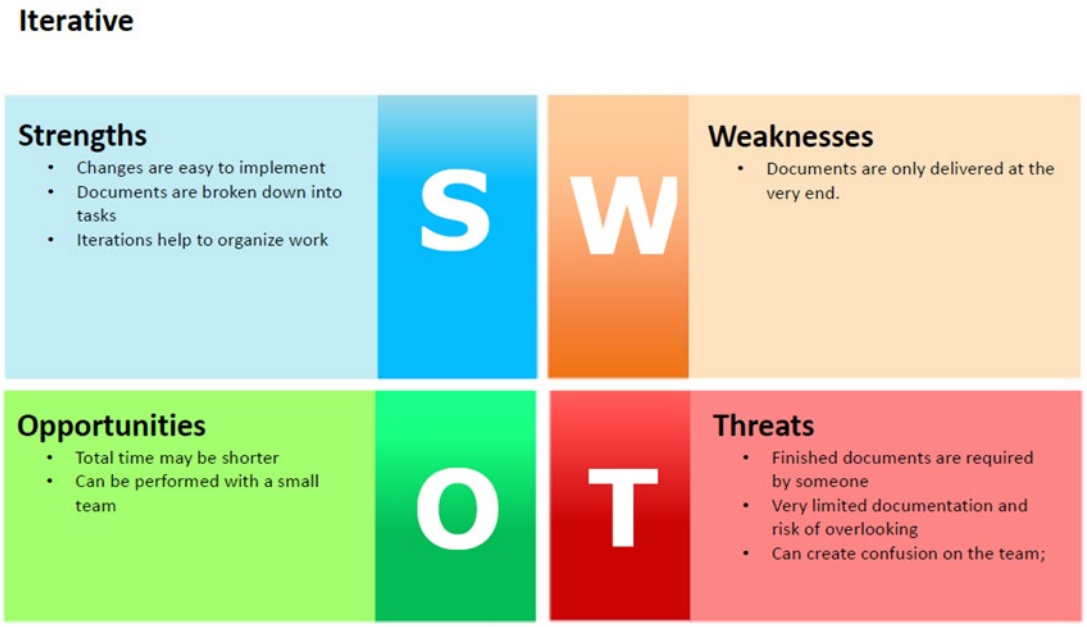

Figure 33 - Iterative approach SWOT analysis

The iterative approach has strengths like the easy way to implement changes because the documents are made in iterations, which means that after each iteration, it is foreseen to change/amend the documents and, therefore, the related effort for changes is small. The documents are broken down into tasks, which allows to manage them easier.

Regarding weaknesses, they are only delivered when they are totally completed.

On the opportunities field, the total time may be shorter than the predictive approach and can also be performed with a small team because the work will be performed in a smoother way and changes will not require so many resources as the predictive approach.

Regarding threats, if someone requires a finished document, it would not be possible because very limited documentation would be available. Additionally, there is a high risk of overlooking. Confusion on the team can also occur due to the lack of documentation.

The SWOT analysis of the Incremental approach is shown in Figure 34.

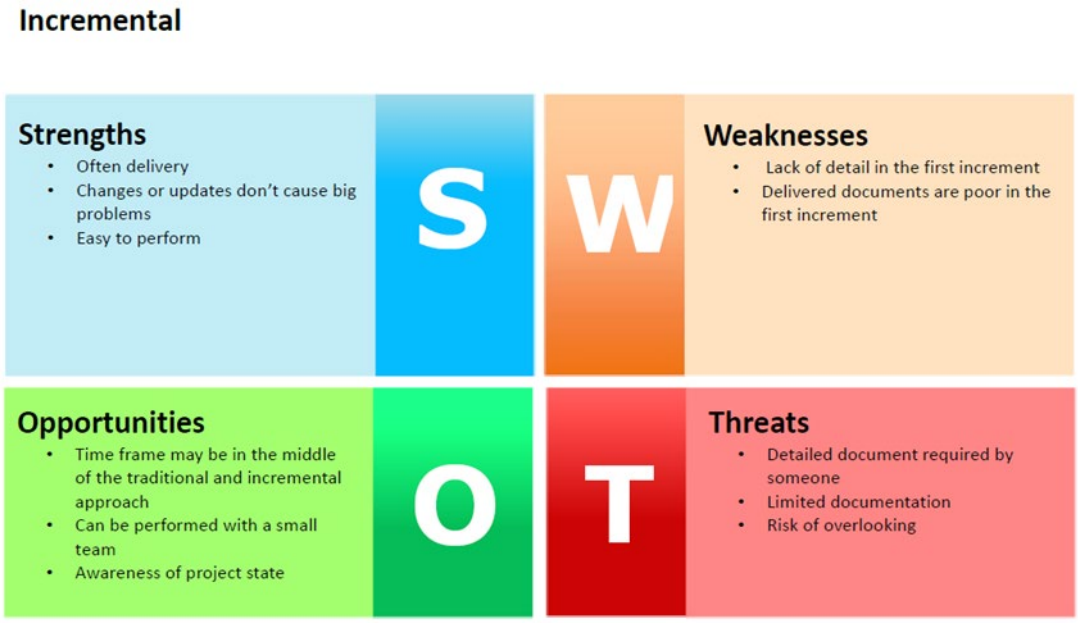

Figure 34 - Incremental approach SWOT analysis

The incremental approach has strengths as often delivery because it allows to deliver in small batches and therefore changes or updates are not a big concern. It is also easy to perform because completed documents are delivered, and it is easy to track.

Regarding weaknesses, the documents will have a lack of detail in the first increments.

On the opportunities field, the time frame may be in the middle of the traditional and incremental approach. It allows to be performed with a small team because the changes or update will not require a big effort of the team. Awareness of the project state is also possible to achieve, due to easiness of tracking.

Regarding threats, if a detailed document is required by someone it will not be available because this approach focuses on plan them iteratively and a detailed one will only available near the end. Therefore, there will be limited documentation. After each increment it is expected that an update will be required. This can increase the risk of overlook a relationship between documents which may lead to not implemented changes in the interconnected documents.

The SWOT analysis of the Agile approach is shown in Figure 36. On the strengths of the Agile approach, it has the possibility to adapt in real time during the project which allows to steer according with the project conditions and resources available. This approach allows also to plan before the sprints enabling a good organization of the work that needs to be done. Changes are not a problem because they can be implemented on different sprints and only what is required is planned instead of the whole document.

Figure 35 - Agile approach SWOT analysis

Regarding weaknesses, it requires a very accurate planning due to the limited progress documentation in an agile approach, information is only available for tasks in work, not for finished or future tasks.

On opportunities, this approach allows being performed with a small team and although careful planning is required, it helps to have a constant awareness of the project state. Priorities can be changed, and reviews can be made due to the existent ceremonies in the Agile methodologies.

Regarding threats, if team members do not follow the agile rules, the approach loses its effectiveness. Because the documents are broken down into tasks and not worked in total, there is a high risk of overlooking.

3.4 Suitability Assessment Radar

Among the different suitability assessment tools, the one developed by PMI and Agile Alliance is the one that is more complete because it assesses not only about the more important aspects of the team, culture and project, but also includes the Hybrid layer that is really important for projects that come from a traditional approach. The DLM project suitability has been assessed using this tool by answering the set of questions already presented on section 2.5.4 and after plotted in the radar chart. The scores and rationales are listed as follows:

- Buy-in: 8 -> The senior sponsor is accustomed to a traditional approach but knows that an agile approach may be important for the project. His understanding of Agile is not enough, but he is willing to support it if good evidences are presented that an agile approach is suitable.
- Trust in team: 1 -> The project team is working with the project for more than 10 years and has already proved to the stakeholders that they are able to transform the customer vision and needs into a successful product. The internal team processes are established and well proven. Due to that reasons, the trust in the team is high in the eyes of all stakeholders (relationship with stakeholders).
- Decision-making powers of team: 2 -> Due to the delivery of successful previous projects and the confidence that all stakeholders have on the team, it has been given high power of decision making in order to turn the processes more efficient. However, some decisions or changes require the project sponsor's approval.
- Team size: 1 -> The team is constituted by five persons.
- Team experience levels: 5 -> The employed project team has a lot of experience in the project. However, it is supported by interns which do not have any or low experience at the beginning. Therefore, it is the experienced project team task to train them. Due to the effort required to train the interns, the efficiency of the team will be lower. Because of this factor, the team experience is "partial", what translates to a 5 score, according with the assessment chart.
- Team access to the customer/business: 1 -> The project team will have daily access to the business/customer representative. This person will be working on the project daily and will be available to answer any questions or to give feedback.
- Project likelihood of change: 5 -> The DLM project has requirements that are likely to change. According with the historic data, around 25% of the requirements may change on a monthly basis.
- Criticality of product or service: 2 -> If documentation is not developed correctly, this can result in an impact on discretionary funds.
- Incremental delivery: 3 -> On this project, the documentation can and should be built and evaluated in portions to allow a better planning and save time with redundant work. The incremental delivery will be ensured always when it is possible. However, to do so, it may be required sometimes to build it in a whole instead of doing it in portions. The business or customer representatives will provide timely feedback on the delivered increments.

The results presented in Figure 37 show that there is no point on the predictive layer, what means that according to the tool, the actual used approach is not the most suitable for this project. A hybrid approach is the one that seems to fit better to this project. It will be developed in the following Chapter.

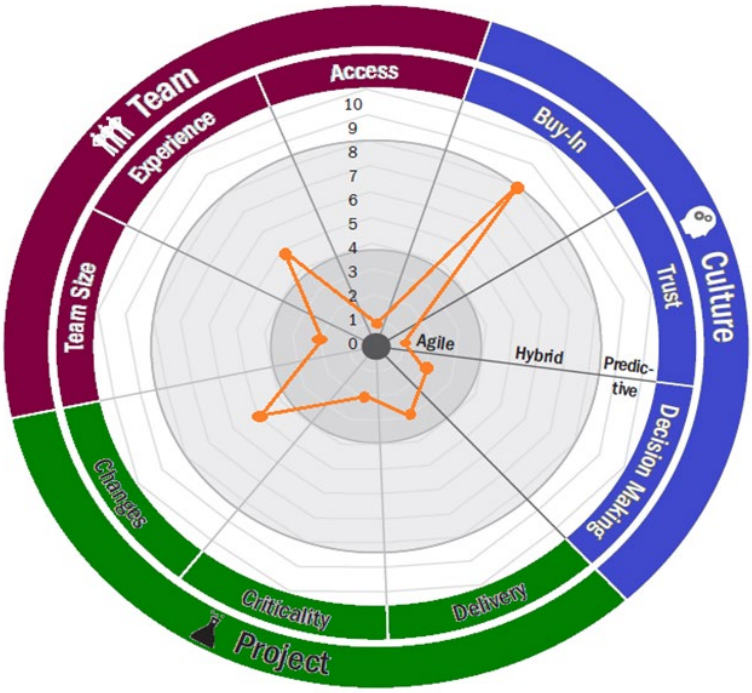

Figure 36 - Results plotted in the Suitability Assessment Radar

3.5 Development of own Approach

As explained in section 2.3.5, a hybrid approach is a mix of Agile with predictive approaches, which can be mostly agile with some predictive elements or vice-versa. As the radar shows, the project has a bigger suitability to a basic agile approach with predictive elements than vice versa. Therefore, it has been decided to start with an analysis of the described Agile methodologies (Scrum, Kanban, Scrumban).

3.5.1 Suitability Assessment of Agile Methodologies

In this section, the suitability of each agile method to the project will be assessed.

The methodologies will not be changed in this part and the assessment will be based on the core rules of each of them. A small description will be made and also a justification of why it fits or not.

3.5.1.1 Scrum

Beginning with the Scrum Roles, they consist of a Product Owner, a Scrum Master and a Development Team. In this project an experienced project manager exists, who can fulfill the responsibilities of Product Owner and Scrum Master. However, due to the small team with some unexperienced members, he needs also to work together with the development team. According to the Scrum guide, the Scrum Master and product owner are not foreseen to work with the development team and, for that reason, it cannot be applied to the DLM project.

The product backlog artifact is an ordered listing of what is known to be produced. In analogy with the DLM project, the ordered listing would be the documents that would be required to be developed.

The next step is the product backlog grooming, which consists of breaking down the product backlog items into smaller elements. This could be also applied to the DLM project. After that, flows the sprint planning, which consist of choosing elements from the list of groomed tasks to perform on the sprint. This could be also used on the DLM project without any constraint.

During the sprint, there is the daily scrum, which is a daily 15 minute meeting. It serves to perform some questions to the development team regarding the work progress and to solve bottlenecks. On DLM project, this meeting would not be enough as it is stated on the Scrum Guide, because it requires some predictive elements to address the lack of team experience.

The next event is the sprint review, which takes place at the end of a sprint with the aim of inspecting and assessing the product that has been built on the sprint. This event could be also applied to the DLM project.

The last event is the sprint retrospective, which is an opportunity for the Scrum Team to inspect and create a plan for improvements to be applied on the next sprint. This event could be also applied to the DLM project.

This methodology shows to be promising. The processes involved, like the sprints, will account the available resources and necessities throughout the project. The ceremonies organize the whole project. Despite these advantages, this methodology is not perfect for the DLM project because it needs some predictive elements to tackle its inherent weaknesses. Some of the events that could fit on the study case, can still be improved with the addition of some predictive elements.

3.5.1.2 Kanban

Kanban is a methodology that has no prescribed roles, that means that the current team on the DLM project can be used without the necessity of learning how to perform a specific role.

As stated in section 2.3.4.2.2, Kanban has the following core principles, whose will be analyzed against the suitability to the project:

- Visualize Work: is about the moving work through different states (Planned, In progress, Done) as it moves through the board. The document tasks can be written in stickers and move along the board as their state change. This would help the team to have a real-time view of the state of each task, what could bring big benefits due to the complexity and number of tasks involved on the DLM project. It can therefore be applied to the DLM project.
- Limit Work in Progress (WIP): this explicit the maximum amount of work in progress at any given stage in the workflow. In the case study, this cannot be

applied because the documents tasks sizes are not linear, what becomes impossible to predict the WIP that should be attributed. An unlimited work in progress is not possible because if there is no explicit WIP limit and no signaling to pull new work through the system. Then, it is not a Kanban system. This WIP also induces a "pull" system meaning that, when an item is finished, another one is drawn to the "on progress" column by the development team. In this case, the tasks need to be assigned because some elements of the team are not experienced enough to know what is better to do at a certain moment.

- Measure and manage flow: this consists on maximize the delivery of value, minimize lead times, and be smooth as possible There are several techniques that are used to manage flow which can be applied to the case study. To measure the queue size flow, throughput rate, cycle time and lead time techniques can be used.
- Make process policies explicit: this refers to the "entry" and "exit" criteria that manage the work moves through different states on the Kanban board (Power, 2014). It is important to have these policies to be able to observe "cause and effect" when some changes are made to the process (Cutter, 2011). These policies refer to the pull principle and, therefore, cannot be applied to the DLM project.
- Feedback Loops: are an important part of the Kanban methodology. It is important to implement them in order to improve quality. This could be also applied to the DLM project because there are team members with enough experience to perform this feedback loops.
- Improve & Evolve: Kanban focus on continuous improvement. It can be applied because there are team members with enough experience to perform this activity.
- This methodology has some advantages because it helps to track the whole project by using the Kanban board and because it provides flexibility. However, there are some elements of it that cannot be applied to the DLM project due to its nature. Another aspect is the team experience, which is not high enough to use a Kanban methodology.

3.5.1.3 Scrumban

Scrumban uses mixed techniques of Scrum and Kanban. To assess if this methodology can be applied to the case study, an analysis to the techniques used on it will be performed.

As stated in the section 2.3.4.3, Scrumban follows the following six core principles of Visualization, Limit work in progress (WIP), manage flow, make policies explicit, implement feedback throughout organization and continuous improvement.

Because the principle of visualization, limit WIP, manage flow and make process explicit policies are the same as the Kanban methodology stated on the section 3.5.1.2, only the remaining ones will be analyzed.

Regarding the implementation feedback throughout organization, it can be applied to the DLM Project. However, because the team is small, it is not required to provide the board to other departments.

It uses also the Daily Scrum as in the Scrum methodology. The assessment of it is already made on the section 3.5.1.1.

3.5.2 Own Approach

In the previous chapter, it was determined that a pure Agile methodology does not fit to the AWACS DLM project, something that was already assessed by the Suitability Assessment Radar.

Scrum methodology is the one that shows more promising suitability; therefore, it will be used as basis. Some elements will be tailored with predictive elements and some other agile elements, as well as total new predictive elements will be added in order to create a methodology that will totally fit the DLM project. The new changes will address the weaknesses found on the SWOT analysis and the areas that are outside the Agile Zone found on the Suitability Assessment Radar. This methodology will still be Hybrid, but overtime become more Agile in order to be even more effective.

Adjustments

As said above, this new methodology will use Scrum as basis and requires adjustments. The duration of each sprint will be one month due to the frequency of changes inherent to the DLM project and the fact of that the low experience of the team may take longer to perform the sprint tasks. The low team experience will also trigger a change on the original scrum roles.

In order to turn the DLM project efficient, it is necessary to maintain a bigger awareness of the status. To achieve that, a Kanban Board will be added to the methodology. This will provide a visualization of the workflow, becoming the work more organized, which will consequently reduce the team confusion and the risk of overlooking. This Kanban Board requires to be adapted in order to comply with the DLM project characteristics. Three more columns will be added to the Kanban Board, which will provide a bigger awareness of the project status and decrease at the same time the risk of overlooking.

Regarding the original Scrum events, they are not sufficient to comply with the DLM project characteristics, and to provide total awareness because of the low team experience. To address that, a new event will be added between the daily scrum and the sprint review.

This new methodology as a whole will give sufficient guidance to the team members to follow the agile rules. It will also support the sponsor`s understanding of Agile, which is one of the points from the Suitability Assessment Radar that was not inside the Agile

circle. The Buy-in will increase when the results appear, after applying this methodology

Developed Approach in Detail

Scrum Roles

The new approach will have a Scrum Master, Product Owner and Development Team, however, instead of being a single person for each role, the project manager will take the responsibilities of Scrum Master and Product Owner. This is only possible because it has a long experience on the project and has knowledge of Agile and is doing training to extend his skills. As Product Owner, he is the only interface between stakeholders and team. He will not only deliver the requirements from stakeholders to the team and vice versa, but also obtain customer approval if required. Due to the lack of experience of some members, and the small team size, he will be also a member of the development team, which means that he is able to perform work along with the others.

Product Backlog

The product backlog (1)* is an Agile element that belongs to the Scrum methodology. It contains the documents that need to be developed. It is a constant evolving artifact, which means that the products can be added, deleted or revised according to the project requirements/constraints in a specific time of the project. These changes will only be made by the Product Owner. This element will be implemented on the Kanban Board.

Sprint Planning

Sprint Planning (2) belongs to Scrum Methodology. On this event, the next sprint is planned. To do so, the product to be delivered is chosen (3) from the product backlog and the backlog grooming is performed, which consists of breaking down (4) the products from the product backlog into tasks (5).

From the groomed backlog (6) the tasks that need be performed on the next sprint are then chosen (8) by the whole team. They are constituting the Sprint Backlog (9). This Sprint Backlog cannot be changed while the sprint is running. The tasks that have not been chosen stay in the Groomed Backlog Column, which is a new column that has been added to the Kanban Board to receive the tasks that are not performed on the sprint but are already foreseen that they will need to be done in future sprints. This is a predictive element because the planning and documentation is made with more depth than in the Agile approach.

* This numbering refers to the Methodology Flow Chart presented bellow in Figure 36

The groomed tasks that do not fulfill the prerequisites to be performed are moved (7) to the “stand-by column”(15), where they remain there until they have the information required to be performed. This new column is a new element of the Kanban Board with the purpose of receiving tasks from the groomed backlog and tasks that cannot be performed during the sprint. It provides a great view of what is able to do and what is not. With this column, the Product owner can easily see which tasks require data/information and work to become them ready to be performed by the team.

Sprint Execution

This event belongs to scrum methodology. It starts after the sprint planning and is where the development team performs the sprint backlog tasks chosen on the previous event. The work is performed in a process step called WIP (10) while the tasks in work are displayed in the Doing Column (11) of the Kanban Board.

Daily Scrum

Daily Scrum (12) is an Agile element that belongs to the Scrum methodology. The purpose of this meeting will be to solve roadblocks but also to address the team experience problem by solving complications that they may have. This meeting will also require the team to answer three questions, which will provide a great indication of sprint status. The questions are:

- What did you do yesterday?
- What will you do today?
- Any blockages in your way?

If during the sprint a task from sprint backlog is discovered (13) that cannot be done, it will be moved to the stand-by column (15). If everything is available to be finished, the task continues to be performed. On this event, the decision is made if a task is ready for approval (14). The team decides together in order to have opinion of more experienced members if a task is ready to be moved to get approval. If the decision is positive, it moves to the Approval column (16) and, if not, it continues to be performed. This additional column was introduced because it was decided to reserve the Done column (28) for the tasks which are already internally and externally approved. On a traditional Kanban Board, such tasks will be removed after approval. To keep these tasks on the board is a predictive element that will reduce confusion and risk of overlooking, and improving easiness of performing.

Therefore, a new element needed to be added in order to separate the already done and approved tasks from the tasks finished by the development team that do not have yet the approval.

This new element is an Approval Column (16). This column will receive the tasks that the development team finishes and are yet waiting for approval.

When a task reaches the Approval Column, the product owner will check such task with the Stakeholders (17), who can be internal or customer.

In order to have the task approved, it needs to be accepted by the internal stakeholders (18) and by the customer (20), if required (19). If both opinions are positive, the task is approved. If some of them does not approve, the task requires a new update (21). The decision of the stakeholders will be given to the development team on the sprint review (22).

Weekly Review

This is a new event that will be added and will occur at the end of every week of a sprint. Because the sprint will have one month of duration, it would be too long to review the tasks only at the end of the Sprint Review. The team`s low experience requires constant alignment with the product owner in order to get directions to the right path, to increase the chance of getting stakeholder approval at the end, when the task is finished. This is a predictive element.

Sprint Review

This is an Agile element that belongs to the Scrum methodology. It takes place at the end of the sprint and it has the purpose of reviewing the tasks that were performed during the sprint. When this event starts, it is expected that the product owner already has the approval from the customer/internal stakeholders to give the result to the team (25). If the tasks have not been approved, they will be moved to the groomed backlog (6), to be updated in future sprints. If they are approved, all finished tasks will be re-evaluated (26), including tasks that are already on the Done column (28). They can also require a new update because the requirements of the DLM project are constantly changing. If any update is required (27), the respective task will be moved to the groomed backlog (6) to be updated in future sprints. If and update is not required, such task is moved to the Done Column (28).

In this event, the tasks that are in the Stand-by column (15) are also assessed (23). If they have already the prerequisites to be performed (24), they will be moved to the groomed backlog (6) to be performed in future sprints, if not, they remain in the column until the next sprint review.

Sprint Retrospective

This event is an opportunity to the team to assess the process and create a plan for improvements for the next sprint. A session of feedback will be performed in order to acknowledge team difficulties and apply changes if necessary. In order to make it easier to get collaboration of the team, three question will be answered as follows:

- What do we want to continue?
- What do we want to stop?
- What do we want to start?

The answer to these questions will provide a great insight about the team opinion regarding the used methodology.

Done

In order to make policies explicit, it is important to give a definition of “Done”. In this new methodology a task is only considered “Done” when the approval of the internal stakeholders or customer is given. When this happens, the tasks can be then moved to the Done column (28) and the sprint ends (29).

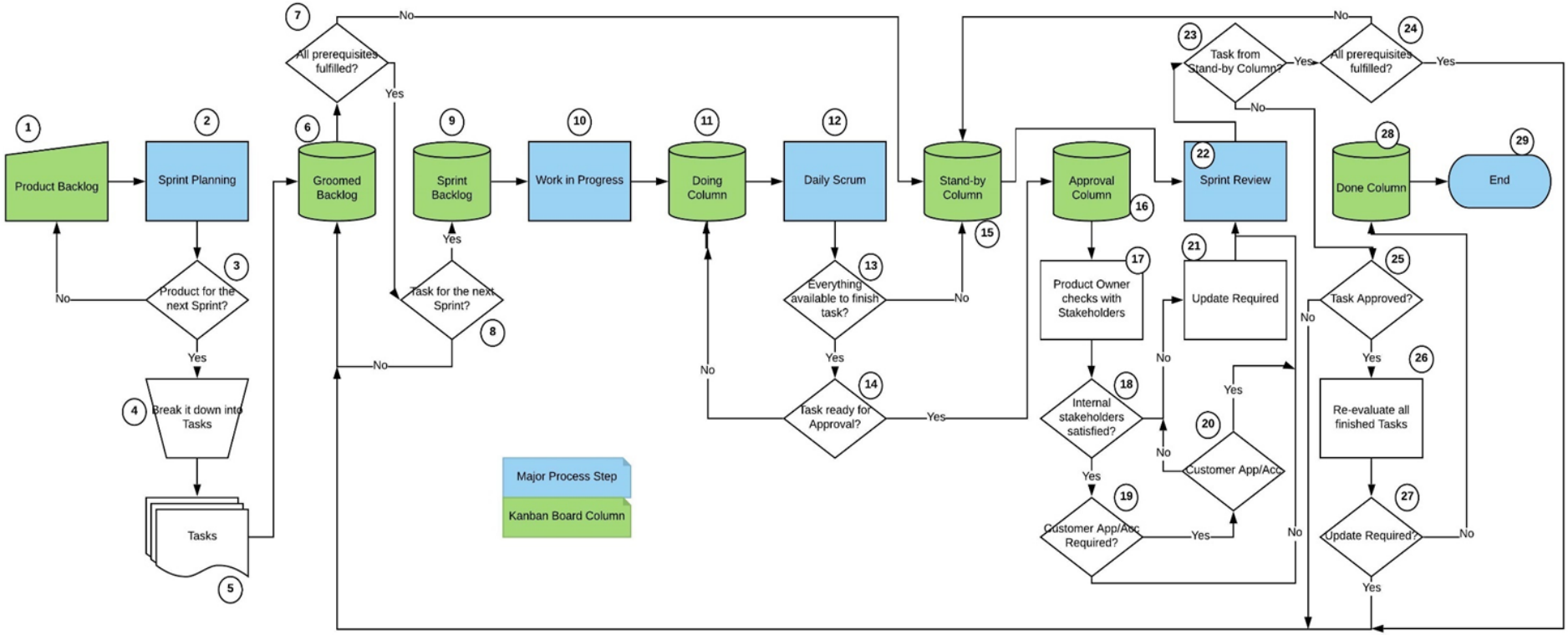

Figure 37 - Flow chart of the new methodology/model

In Figure 39, the adapted Kanban Board for the new methodology is represented. In the figure, all the different ways of possible task flow are depicted.

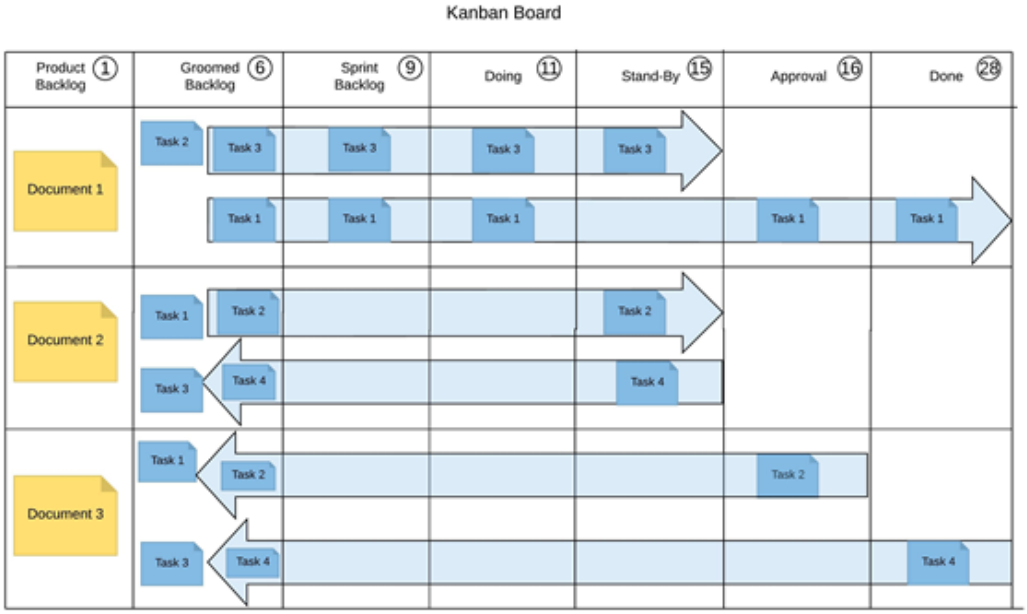

Figure 38 - Adapted Kanban Board

Next it can be find the description of the possible task flows as shown in Figure 39.

Flow 6-9-11-15: Document one has been broken down into three tasks on the sprint planning. Task number three is important and, therefore, it has been decided to be performed on the sprint, so it is moved to the Sprint Backlog. On the Sprint execution, the task is performed throughout the one-month sprint. Everyday occurs the Daily Scrum Event and in this case, it has been discovered that something was missing that does not allow to continue to perform the task number three, therefore, it has been moved to stand-by column where it will remain until the prerequisites are met.

Flow 6-9-11-16-28: The task number three of document one is also important and, therefore, it has been decided to be performed on the sprint, so it was moved to the Sprint Backlog. On the Sprint execution, the task is performed throughout the one-month sprint. When the development team finishes the task, they move it to approval. When the task reaches this column, the product owner checks with the internal stakeholders and customer (if required), if the task meets their requirements. At sprint review, the product owner brings the answer to the team and in this case the task has been accepted because it was moved to the Done column.

Flow 6-15: Document two has been broken down into four tasks on the sprint planning. It was found that the task number two would not have the prerequisites in order to be performed on the next sprint, thus, to avoid confusion on the sprint planning, it has been moved to the Stand-by column, where it will remain until it fulfills

the necessary prerequisites. This task movement has been made on the sprint planning.

Flow 15-6: In analogy with the previous Flow, when a task that have been moved to stand-by column because it did not have the necessary prerequisites will return to the groomed backlog, when it fulfills the necessary prerequisites. In this example task four of document two is affected. The decision to move it back to the groomed backlog is met on the sprint review.

Flow 16-6: Document three has been also broken down into four tasks on the sprint planning. Task number two is one task that has been selected on the sprint planning and performed by the development team. It is on the approval column waiting for approval. The product owner checks with customer and internal stakeholders if the task satisfies their requirements. In this case, the task was not accepted because it was moved back to the Groomed backlog to be reformulated/updated.

Flow 28-6: Task number four of document three is one task which went through the whole process and was classified as “Done”. However, the DLM requirements are always changing and a task that has been already performed and approved may require a new update. This happened in this case and the task has been moved to groomed backlog column to get a new update.

3.6 Case of Study

DLM project uses currently a traditional approach that is not being effective on dealing with a parallel planning and execution phases. This happens because the DLM project has around 25% of requirements changing monthly and due the fact that the documents are connected with each other, a change or update requires a big effort from the team to perform.

As it is possible to see on , there are a lot of documents that require updates and some have never been published, which leads to lack of documentation on the execution phases which requires an extra effort on this phase and will further constrain the resources to perform the planning

Table 5 - List of applicable documents for the DLM project

Data Content Number	Project Document	Abbreviation	Status	Note
00	List of Applicable Documents	LOAP	Published	Update Required
01	Project Charter	---	Published	
02	Project Management Plan	PMP	Published	Update Required
03	Configuration Management Plan	CMP	Published	Update Required
04	Stakeholder Management Plan	SMP	Published	
05	Project Structure Plan	PSP	Published	Update Required
06	Communication Plan	CP	Published	
07	Project Risk and Opportunity Management Plan	PROM	Published	
08	Contract, Change, Claim and Waiver Management	C3WM	Published	Update Required
09	Bid/Proposal Management	BPM	Published	
10	Lessons Learned Management	LL	Published	
11	Project Quality Management Plan	PQMP	DRAFT	
12	Sourcing Plan	SP	Published	Update Required
13	Earned Value Management	EVM	DRAFT	
14	Technical Control Plan	TCP	DRAFT	
15	Scope Management Plan	ScMP	Published	

The documents that require an update and the ones that are still in draft mode will be part of the product backlog. Beyond these, the Quality Management plan has the highest priority and due to this reason, it will be chosen to be developed on the next sprint.

The quality management is still on draft mode, which means that the acceptance criteria for deliverables were not coordinated with and approved by the customer. This led to discussions with the customer about acceptance of the delivered work, which required an extra effort from the team due to rework when the performed work has not been accepted.

The current project management approach requires to have the whole acceptance criteria before they can be presented to the customer to be discussed. This requires a big effort from the team and some acceptance criteria may not be necessary at a specific moment, which means that extra effort has been done without necessity. The feedback from the customer is only given at the very end, when everything is done, which means that if the customer does not accept something, the rework may be much more extensive. Additionally, the discussion with the customer about all acceptance criteria will be more intense compared to discussing a limited number.

The new approach will help to allocate better the available resources and allow to have a real time decision of what should be done first.

In Figure 40, the adapted Kanban board with the quality management plan in the product backlog column is presented, which is the product that the company wants to deliver. It is then broken down into tasks. The tasks consist of Defining Acceptance Criteria, describe how to plan quality for the all different 80 deliverables, defining the Document structure and writing the document.

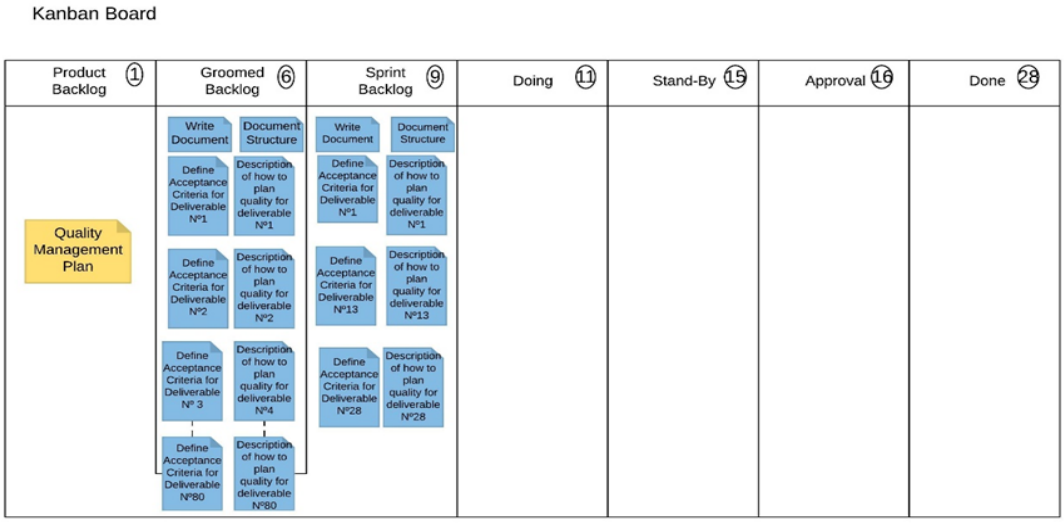

Figure 39 - Kanban Board of the Case of Study

There are some deliverables that are the most important to define early because these are the ones where the project team has more discussions with the customer, and difficulty to reach a consensus, which leads to extra work and use of resources.

In order to solve this problem, instead of planning everything sequentially, only the deliverables that are most important will be developed on the next sprint. The definition of acceptance criteria and the description of how to plan quality will performed for the deliverables 1, 13 and 28 (d1,d13,d28). These are the tasks that are urgent to develop, to relief resources that are normally allocated in order to solve issues that occur due the inexistence of data related to these three deliverables. Therefore, the aforementioned tasks together with the write document and document structure tasks will be performed on the sprint, constituting the sprint backlog. The remaining tasks that have been not selected will continue on the groomed backlog to be performed in future sprints.

The tasks will be then performed throughout the 1-month sprint. As the tasks are getting ready, the development team put them on the Approval Column. The Product Owner takes care of getting approval of the internal stakeholders and customer. On Sprint review, the product owner shall have already the answer for the team. In case of no approval, he has also the feedback of the stakeholders on how they should be developed on future. According with project experts, d1, d13 and d28 may not be accepted on the first iteration and normally three iterations are needed until a consensus with the stakeholders can be reached. When the project team has already the acceptance criteria and how to plan quality for the three deliverables, it will be much easier to the execution phase because no more discussion regarding them will occur, and no extra effort to rework and long discussions will be required. That leads to more resources to the planning phase, turning the planning phase more effective and faster to continue to perform the tasks for the remaining 77 deliverables. This effect cumulates as more acceptance criteria will be agreed, relieving more and more resources for the planning phase. The project experts assessed that the total time span may be half of the traditional timespan.

3.7 Critical Analysis of the Obtained Results

The developed methodology has been approved by the project team. This team is confident that this new hybrid approach will enable to manage effort and time in a way more effective. However there are some points that can be an issue on this approach as follows:

- This methodology has not been yet applied on a context of work on the project, and although the sprint retrospective of the methodology is aimed to tackle problems and provide improvements, there will be necessary some time for the team to get used to the methodology. This means that, at the

beginning, this process may be less productive. Another aspect is that some sprints may be required until the team realizes that something needs to be changed;

- Some elements from the methodology may not be practical or helpful after applying them on a context of work, although they made total sense during the development of the methodology;
- Regarding the Scrum Roles, the developed methodology has a Scrum Master, a Product Owner and a Development Team. The current project manager will have the responsibilities of the Scrum Master and the Product owner and will also be part of the development team. This may imply a conflict of interests. The interest of the project manager is the success of the project, while the Product owner is the voice of the stakeholders and the scrum master is concerned to manage the work of the development team;
- According to the developed methodology during the Sprint planning, the product from the product backlog is totally broken down into tasks and this activity may require a lot of time and effort, especially when the product is not well known. It may be sufficient only to break the product down into tasks those are foreseen for the next sprint;
- When the team finishes a task and moves it to the approval column, the product owner will check with the internal stakeholders and customer to get approval and feedback, and communicate the result to the team on the sprint review event. The time between these two events may not be enough to get the approval from them, especially when a task is finished close to the deadline of the sprint.

According to (Stare, 2014), using agile approaches leads to a increment of the project success. The results showed that when only the important tasks are defined at the beginning of the project, a reduction of the project delay occurred. When tasks that are not so important at the beginning are not planned led to an increase of the overall financial success of the project..

CONCLUSIONS

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The main goals of this work were to characterize the problem that the project was facing and assess why the current approach is not effective. Performing a first analysis of the existent project management approaches that are currently on similar cases, to assess the advantages of them with the help of the SWOT analysis. The ones that seemed to have potential were assessed if they could be applied to the DLM project. The last goal was to develop a new approach if the ones found on the literature do not fit to the target project.

A new approach has been developed in order to solve the problem of the low efficiency of the DLM Project planning phase. Parallel planning and execution phase is really time-consuming and with a small team is difficult to perform with quality, especially when the negligence of one phase will have impacts on the other. The results of the new approach showed that it will be much more effective. The work can be planned in accordance with the available resources. Additionally, prioritization is much easier as do no longer be developed entirely. The feedback from the customer will come much earlier which allows to steer on time in case of something is not going according to customer expectation.

The whole methodology will guarantee that the project is planned more efficiently, resulting in customer satisfaction, reduction of rework, which translates to reduction of costs.

As conclusion, this work allowed the author not only to increase the knowledge about project management and Agile methodologies but also to grow professionally and personally by dealing with a real-problem and by learning everyday with experts from the area.

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