POLITECNICO DI TORINO

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Hybrid project management: a tailored approach

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Abstract

Enterprises face significant barriers while trying to adopt a fully agile approach. It is demonstrated that an incremental approach is highly appreciated compared to a traditional one especially in the IT sector, but internal and external factors force companies to slow down this transition. This master thesis aims to explore the impact of a tailored hybrid project management approach on a small-sized IT consulting company in order to overcome common drawbacks of adopting a waterfall or purely agile approach, with a particular focus on the monitoring phase by building an ad-hoc project monitoring dashboard.

To understand the benefits of such custom approach, the company's project managers have been interviewed to assess an as-is analysis of the internal project management process, in which it resulted that there was a lack of standardization and each project manager adopted its personal approach. A pilot project has been used to set up a standard and customized hybrid project management approach. A general planning phase has been performed upfront to determine a budget and an estimation of the effort, while a detailed planning has been done with an agile tool at the conclusion of each deliverable, considered as an incremental product delivered to the client. Each deliverable has been divided into sprints to be released inside the company to evaluate potentially shippable product increments and project performances, which have been assessed through the creation of a monitoring dashboard that displayed information about the overall project performance and resources, by using KPIs and graphs coming from the literature and modified such to encounter the needs of project managers. The results showed a wide appreciation of the monitoring tool by the interviewed project managers and suggests that in some settings tailored hybrid approaches can be likely more successful compared to the standard agile and waterfall ones.

1. Project management methodology and approach

A project management methodology is described by PMI (Project Management Institute) as a set of methods, techniques, procedures, rules, templates, and best practices used on a project. Other definitions have been written, but they do not differ too much from the previous one: project management methodology has been often described as set of guidelines and principles that are applied to a specific situation, or as a knowledge set about tasks, roles, tools, techniques, and deliveries used over the course of a project and tailored specifically for it. Cockburn (2003) defines project management methodology in a very broad way, which is any principle project management team relies on in order to deliver successfully project results (Spudnak, 2014).

There are other terms that are used for the same meaning as methodology. For example, the most widely used is "project management method", which is often defined as a structured way to manage projects with rules and directions. Even though project management method is used interchangeably with project management methodology, this last definition can be considered more complete since it includes detailed tools and techniques (Spudnak, 2014).

In addition, PM methodology can be defined by its scope and goals. Its goals are reaching the desired quality of the project result, as well as control and process improvement. From a higher-level perspective, the final goal is to increase the probability of success when delivering a completed project (Spudnak, 2014).

A good and well-defined methodology will guide the project manager through a set of activities that will achieve project results in a managed and controlled way. Characteristics that lead to a good methodology are an appropriate level of details, standardized planning, usage of templates, cost and time management techniques, reporting, flexibility for quick development and usage on most projects, standardized project lifecycle phases. These elements need to be understandable, accepted, usable and based on guidelines and must reflect the business ethic (Spudnak, 2014).

A project management approach is a set of principles and guidelines which define how a specific project is managed. A similar term, comparable to approach, can be the term project management framework, that represents set of rules, methods, templates, and

processes to be used during the project lifecycle (Spudnak, 2014). The distinction among a traditional, or prescriptive, approach and an agile, or adaptive, approach can be helpful to select the best one depending on the project and its characteristics and the competence and knowledge of the organization. Depending on the approach used, there are different success factors to be considered. It is recommended to discuss about the project management approach at the start-up of the project and the relevant success factors are decided accordingly with the approach selected (Rolstadas et al., 2014).

2. Traditional project management approach

The concept of waterfall, or traditional, project management approach has born in 1950 when projects were assumed to be linear, predictable, and simple and all the principles should have been applied to each project in a uniform way, no matter whether the project was small or extremely large. The aim of the traditional project management approach is to have a detailed, efficient, and optimized initial plan, in order to conclude the project within the initial planned time, scope and cost (Spudnak, 2014).

The waterfall approach is composed by five main phases: initiating, planning, executing, monitoring, and controlling, and closing. It is assumed that once a phase has been completed, it will be kept completed for the entire duration of the project without returning on it (Baird, Riggins, 2014).

A waterfall approach implies for the project the use of a predictive lifecycle, which means that the scope, time and cost are determined as early as possible in the project lifecycle. These kinds of projects follow a several sequential phases, each one focusing on a set of determined activities. In each phase, the work performed is different than in any other phase along the lifecycle, therefore each step may need different skills and know how (PMBoK, 2013).

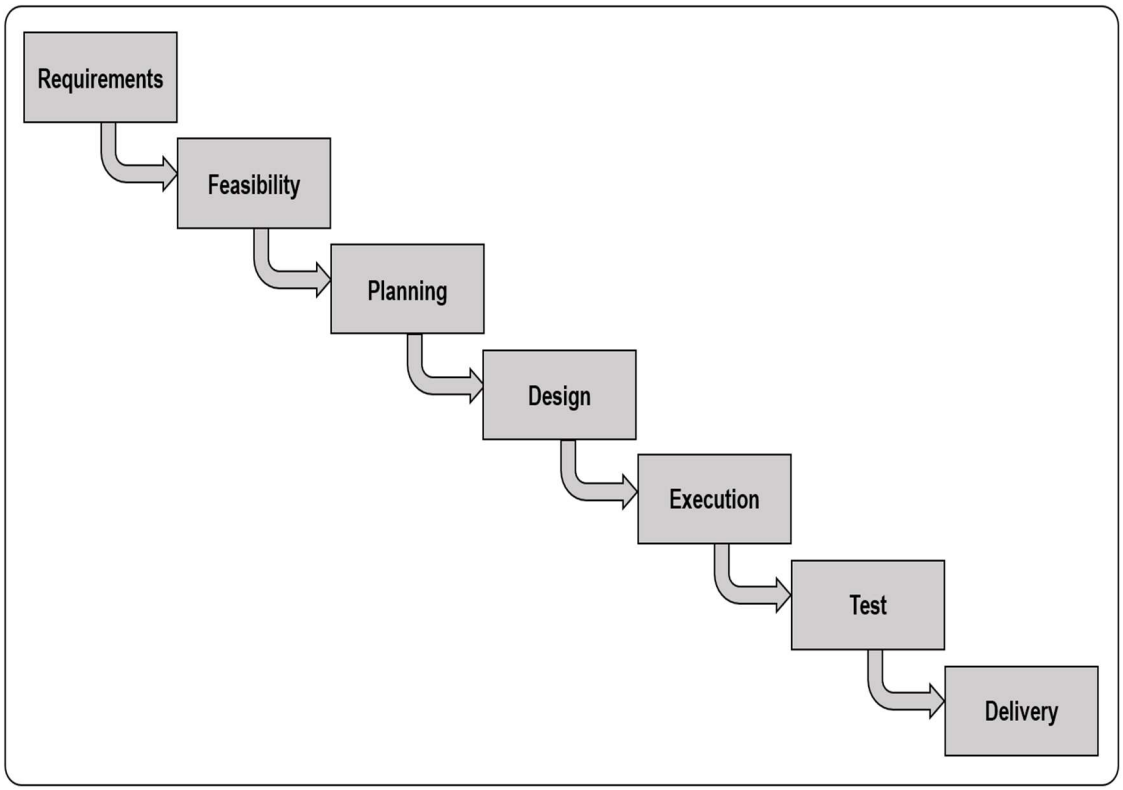

Figure 1 Waterfall scheme

Once the project has started, the team will focus on the general scope, developing a plan in order to deliver the product/service and executing it following the initial plan. If changes occur, there is the need for re-planning and accept the new scope. The project management process is divided into main groups: initiating, planning, executing, monitoring and controlling, and closing (PMBoK, 2013).

The initiating group embraces all those actions that define a new project, in which there will be given an authorization to start the project. The financial resources are found, the initial scope is well defined, as well as the relevant external and internal stakeholders are identified, and the project manager is assigned. All the relevant information is written in the project charter which will be approved and authorized officially. In this way, all the expectations of the stakeholders are aligned with the purpose of the project, having clear scope and goals, and showing participation in the project. Involving them is very important in order to increase the acceptance rate of the deliverable, stakeholder satisfaction and customer satisfaction. This process group is usually performed by the high-level management, at the portfolio or program level, and therefore is generally outside the project control. A procedure of evaluating alternatives among different projects can be performed, and this document may include the scope of the project, deliverables, forecast of resources, project duration, and an investment analysis (PMBoK, 2013).

The planning group of processes is about the establishment of the general scope of the effort, defining objectives and developing the actions in order to achieve those goals. The project management plan is developed and defines the basis of future work, as well as the main documents used to deliver the scope of project. In the planning phase, the strategy and tactics for the completion of the project are set up. The plan defines how the project will be executed, monitored, controlled and closed (PMBoK, 2013). In a pure waterfall approach, planning is used to determined who does what and how, as well as how much the tasks will cost. Once planning has been completed, the scheduling can be performed.

In order to address the “what”, a Work Breakdown Structure (WBS) is developed, it allows to decompose the project in a way that tasks and work packages are well organized using an identification number that will be used to control costs and schedule of the task. The highest level is usually the project itself, whereas going in the next levels the detail

increases until we reach the maximum detail level, which is the single work package or another desired level of detail that is necessary to control the project (De Marco, 2011).

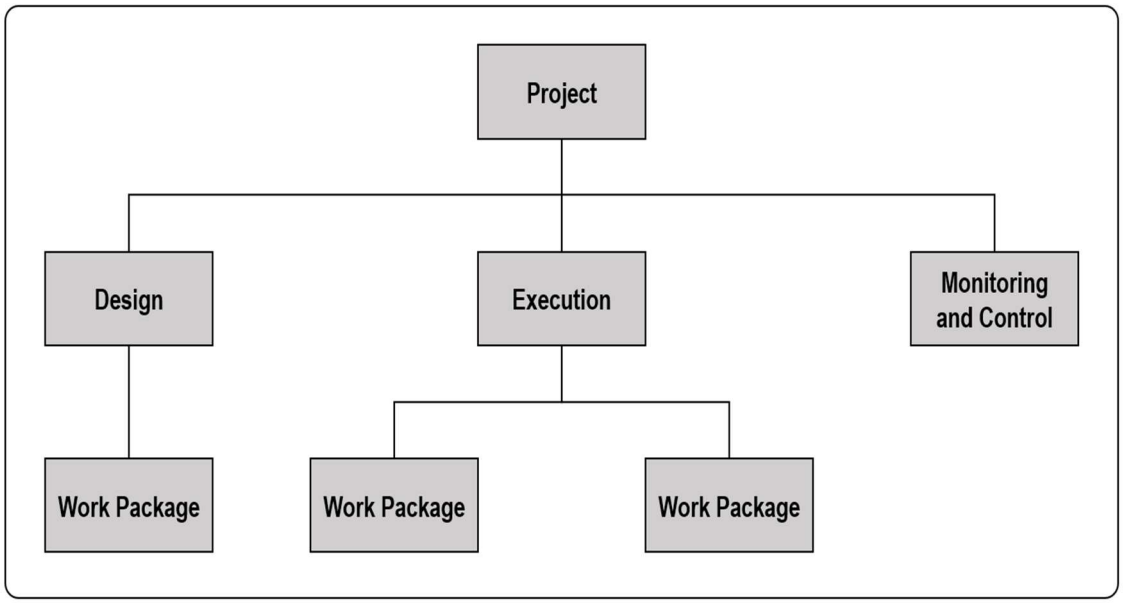

Figure 2 Example of a WBS

To address the problem of the "who" does what, an Organizational Breakdown Structure (OBS) is usually set up. Like the WBS, it is a method to decompose the resources needed to accomplish the task of the project based on competences and skills. The OBS is structured in order to link each WBS task with an estimated effort to one single human resource or more (De Marco, 2011).

Finally, the cost allocation is performed through the CBS (Cost Breakdown Structure), a hierarchical structure that classifies resource in direct costs such as material, labour, and other cost accounts. Combined with the WBS, it allows the project manager to keep track of the expenditures as well as the project progress. The CBS includes the cost of overhead related to the project (design services, insurance fees, project management) and other costs which can be reconducted to the project (De Marco, 2011).

Once the what, how and how much are defined, the scheduling process addresses the problem of the when. It is a crucial part in a waterfall approach, since there is just a very detailed scheduling at the beginning of the project, and it must be performed effectively in order to reduce the chance of delay once it goes into execution. Milestones are set at the beginning throughout the project to allow keeping track of what has gone as planned or what went wrong in terms of cost, quality or schedule. A good schedule gives information about the project progress and can be used as contractual tool to set payment

schemes and incentives to finish on time. It should be a tool that helps both the contractor and the owner (De Marco, 2011).

Once the schedule has been completed, the project can start and during the execution an extensive process of monitoring and control is put in place. For the aim of our research, we will explore later in detail the most adopted traditional monitoring tools. Monitoring includes activities such as measuring, collecting, assessing trends and measurements, and distributing performance information (PMBoK, 2013). Monitoring and control processes work in a feedback system in which the first detects and the second corrects the deviations detected.

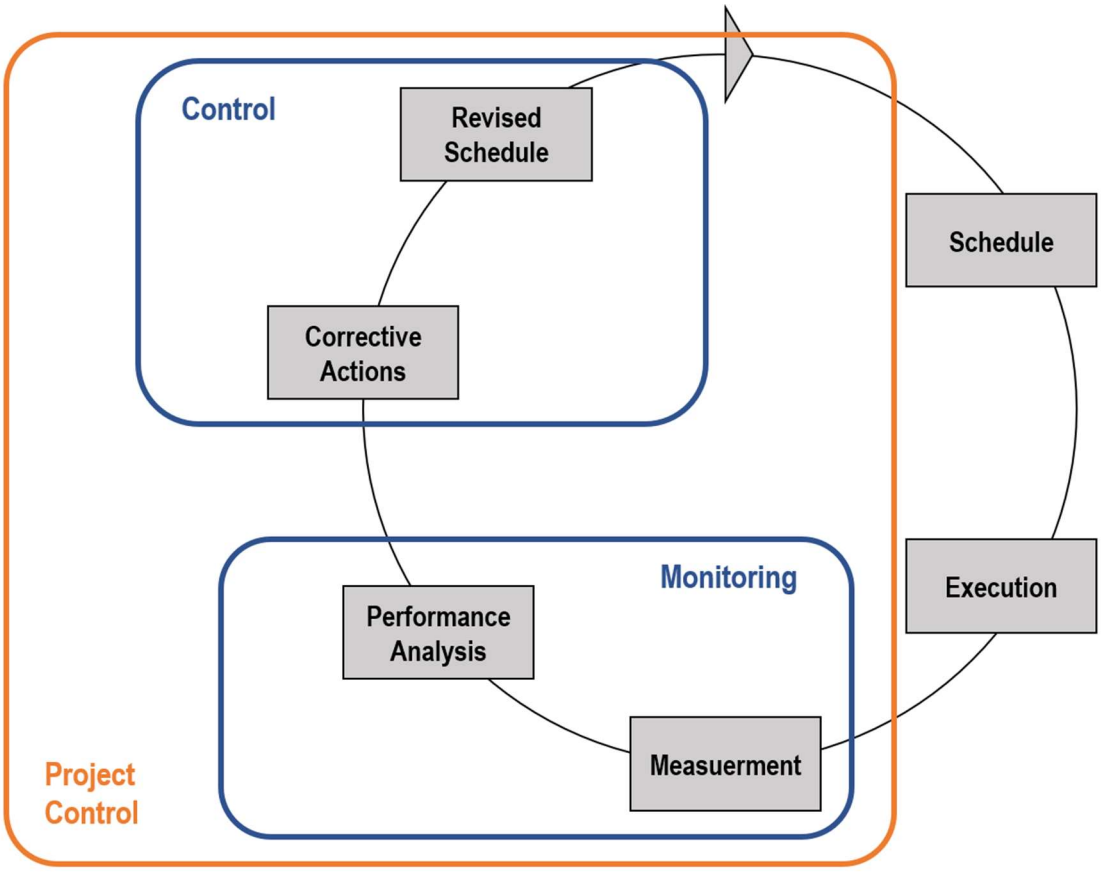

Figure 3 Monitoring and Control processes

It is very likely that in a waterfall setting projects can suffer from cost overruns and delays in schedule, therefore using a monitoring process is very important to track the actual progress in terms of cost and time. The project monitoring process triggers project control, which by comparing actual to scheduled performance enables the use of corrective actions which will adjust the project to the schedule (De Marco, 2011). In a traditional project management approach, the main components of an effective monitoring process are a

schedule and a detailed WBS, the definition of effective performance indicators during the planning phase, a process used to report and identify performances, and the involvement of people with the right knowledge for an appropriate reporting. The monitoring process follows three phases: measurement of schedule progress and actual cost, calculation of the difference among scheduled actual and scheduled progress, calculation of an estimated time at completion and cost of the project (De Marco, 2011).

2.1 Waterfall – visual reporting tools

2.1.1 Gantt chart

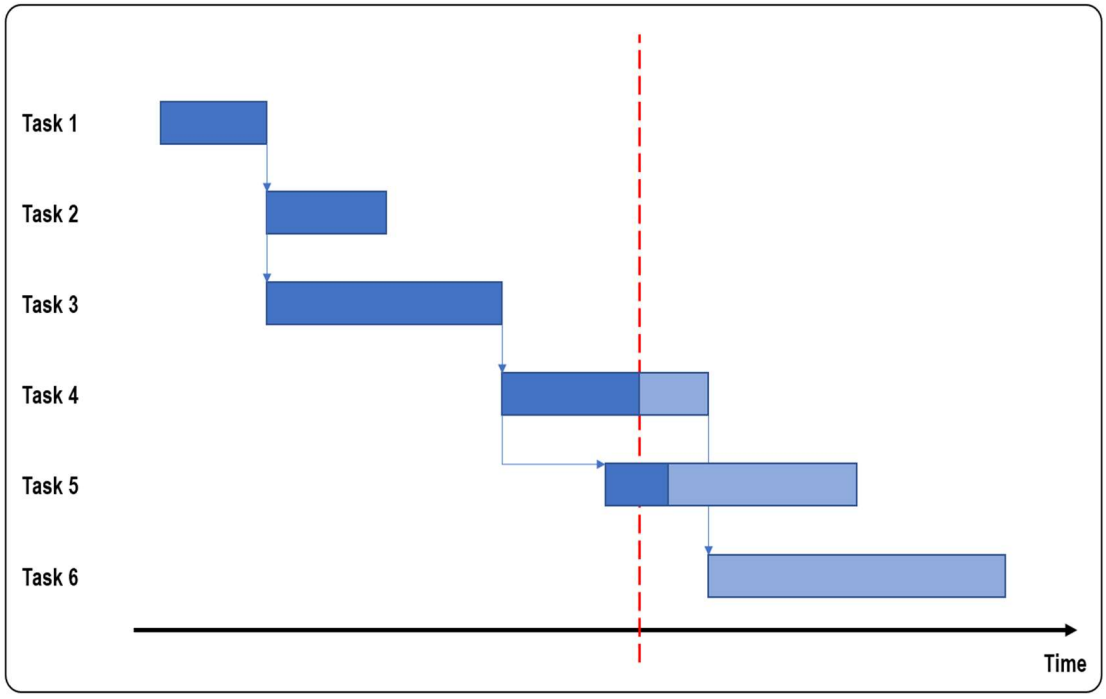

Figure 4 Example of a Gantt chart

Widely adopted chart that shows an intuitive relationship among the project's tasks and their duration. Each bar represents the amount of time that its respective task will take. It is useful to communicate to the stakeholders how the project will proceed. There is an intuition that explains how tasks are related to each other, yet not explicit (De Marco, 2011). The Gantt chart is mainly known as a planning tool but given its flexibility it can also be used to track project's tasks progress with respect to the original plan if the effort is updated and linked with the Gantt, therefore it is used as a monitoring tool as well. In order to use this chart as a planning and monitoring tools, the following inputs are needed: task list, milestone list, task duration estimate, start date of each task, actual duration, or

percentage of completion of each task, resource pool in order to integrate in the Gantt information about resources.

2.1.2 EV analysis

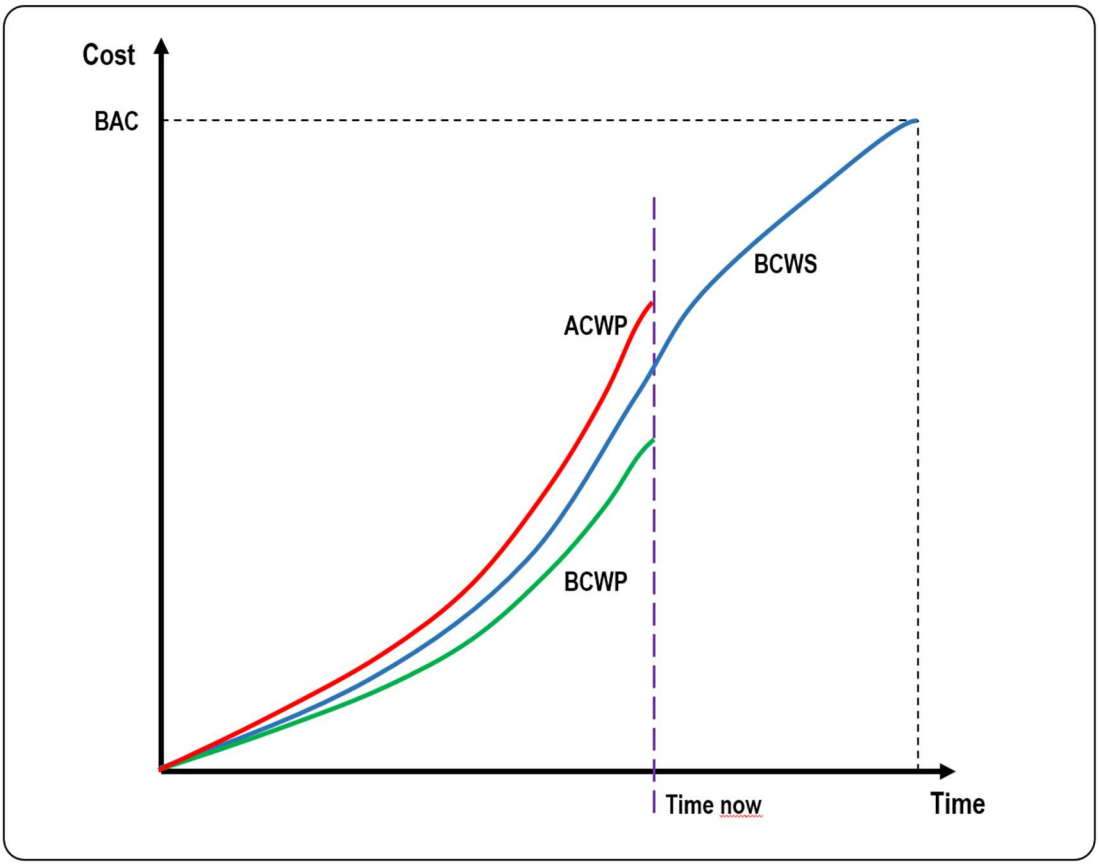

Figure 5 Example of S-curves

Earned value analysis tries to answer the question of how to measure and forecast project performances in terms of time and cost by using monetary information. EVA is the most widely adopted monitoring tool in a waterfall project management approach because it overcomes the problem of not taking into account the progress status of the project by integrating schedule, work performed and cost. The visual output of the EVA analysis over time is the S-curve, it shows cost and schedule variances. This enables a quick and graphical understanding of the project status for suggestion of global corrective actions to the project strategy. Based on the position of each curve with respect to the others, the chart can show whether the project is ahead/in delay in terms of schedule, cost or both variables (De Marco, 2011). The three metrics which are the basis of EVA are: budgeted

cost of work scheduled (or BCWS, that is the planned cost to complete the project), budgeted cost of work performed (or BCWP, is the planned value of the work performed), actual cost of work performed (ACWP, is the actual cost of the work already done). By plotting these metrics on the S-curve chart, it becomes easy to understand the variances against the project plan in terms of cost and time. The schedule variance is the difference among BCWP and BCWS, while the cost variance is calculated as the difference between BCWP and ACWP, and these differences are reflected on the position of the three curves, which can give a quick insight on how the project is performing. The project information to be used as inputs to create an S-curve chart are time information, planned costs, initial schedule and work performance data, which include actual costs and earned value of the project.

2.1.3 CI/SI chart

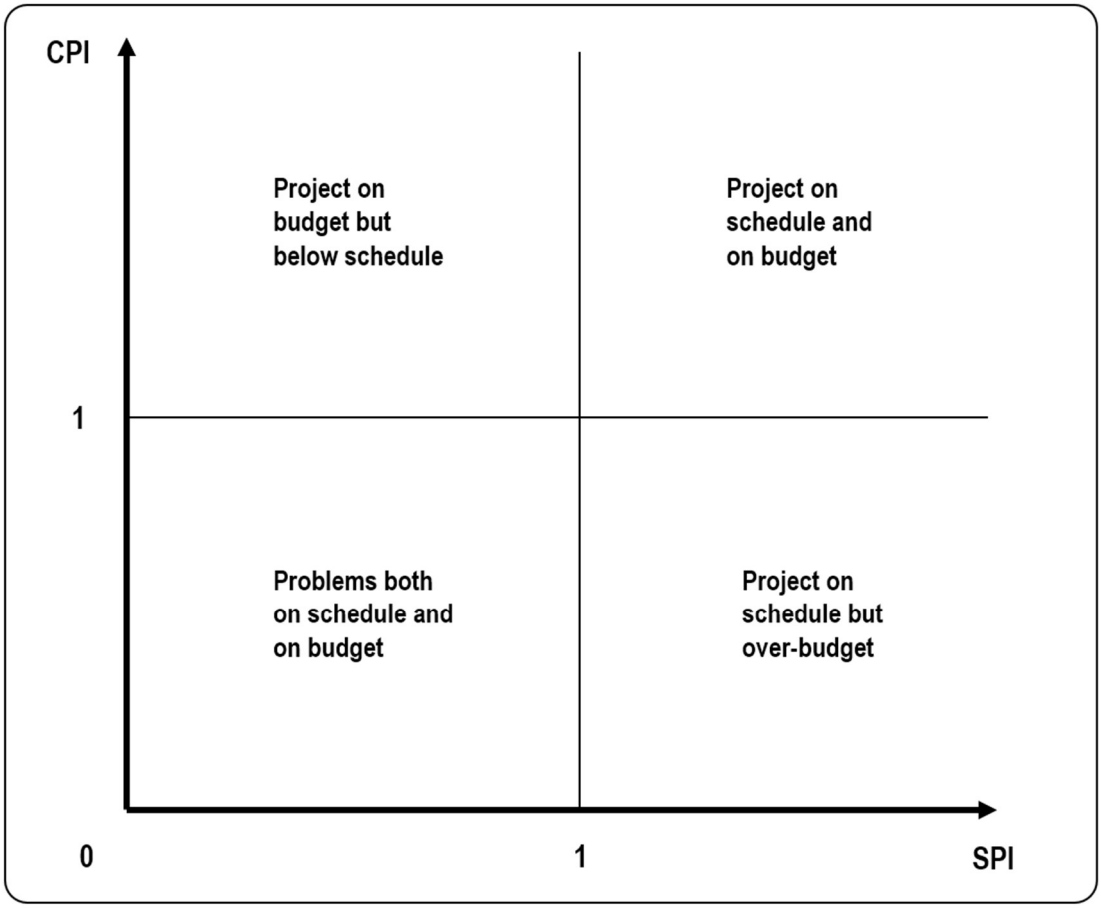

Figure 6 CI/SI chart

The aggregate cost index and schedule index chart shows the overall performance of the project in terms of cost and schedule. There are four scenarios in which the project can be: on schedule and on budget, on schedule with budget problems, on budget with schedule problems, both schedule and budget problems. This chart takes into account the same metrics of the S-chart but in a different way in order to give an overall insight of the project performance. The three metrics used are combined to create an aggregate schedule performance index (BCWP divided by BCWS) and cost index (BCWP divided by ACWP). These indexes are usually shown in an aggregate way but can be displayed also as a trend over time, as shown below.

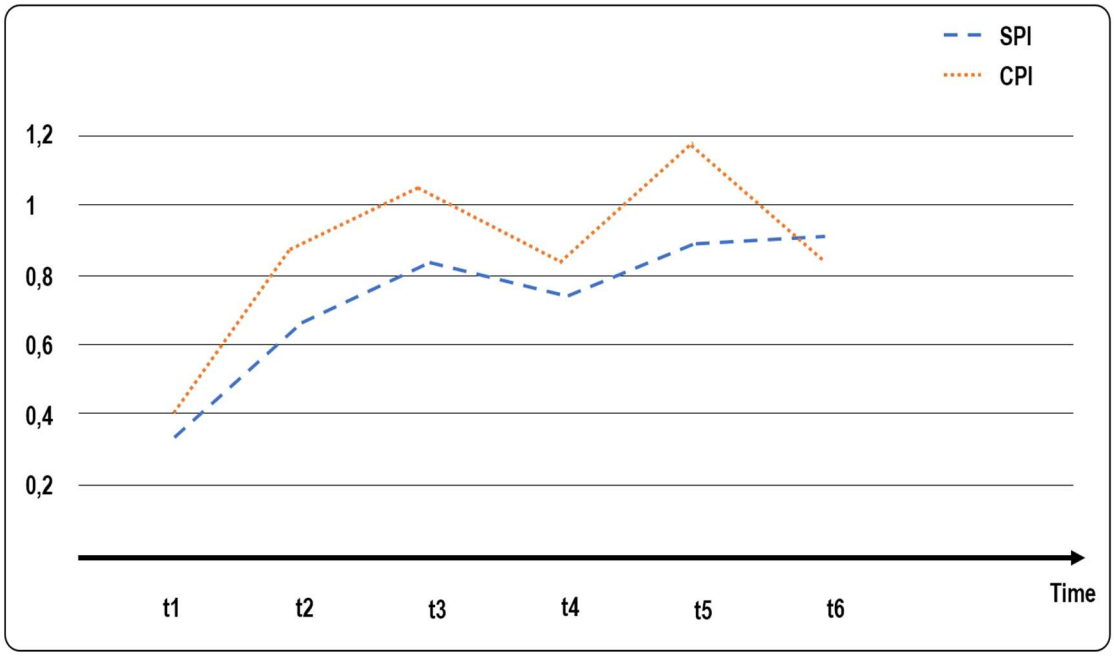

Figure 7 CPI and SPI on a timeline

One of the most important characteristics of the waterfall approach is also one of its main disadvantages: the main bodies of knowledge of the waterfall approach prescribe that the same techniques and methods can be applied to whatever project, no matter its size, sector, or peculiarities. This approach assumes that the relationship among tasks in a project is hierarchical and linear, whereas today's project tasks have different and more complex interrelations, therefore it does not reflect the needs of the latest projects (Spundak, 2014).

In addition, there are many external factors, which are not taken into account by the traditional approach, that contribute to the success of a project. These variables could

change while a project is in progress, and in today's world these changes are becoming even more unpredictable, therefore an initial plan is supposed to be modified many times during the life of the project, due to internal and external factors that will change over time. Sometimes it is also difficult to release an initial plan because the objective of the project has not been defined yet (Spundak, 2014). It is also known that a traditional approach can become costly and risky especially while the project is in progress and if new requests arise (Baird, Riggins, 2014).

3. Agile project management approach

The limits related to the traditional approach have led to a new way of thinking how to manage a project, especially with the advent of software development that has been seen as a totally different project compared to the most traditional ones, for example in the construction field (Spundak, 2014).

This new approach is called agile, and today is widely used because of its adaptability to changes during the lifecycle of the project and it can fit to different projects in general. Agility is defined as "ability to create and respond to change in order to create value in a turbulent business environment" (Highsmith, 2004). An agile environment is characterized by uncertainty and needs a certain knowledge that enables the organization to deliver the project as soon as possible, even in presence of major changes during the project lifecycle.

Predictability was the key for the traditional approach, whereas adaptability is the key feature of agile project management, which is also more important than the previous one. Since changes are inevitable, new approaches need to take them into account by acknowledge that is almost impossible to develop an initial detailed plan which would never change during the whole cycle of the project. these new approaches put more emphasis on the execution, rather than on a detailed initial planning (Spundak, 2014).

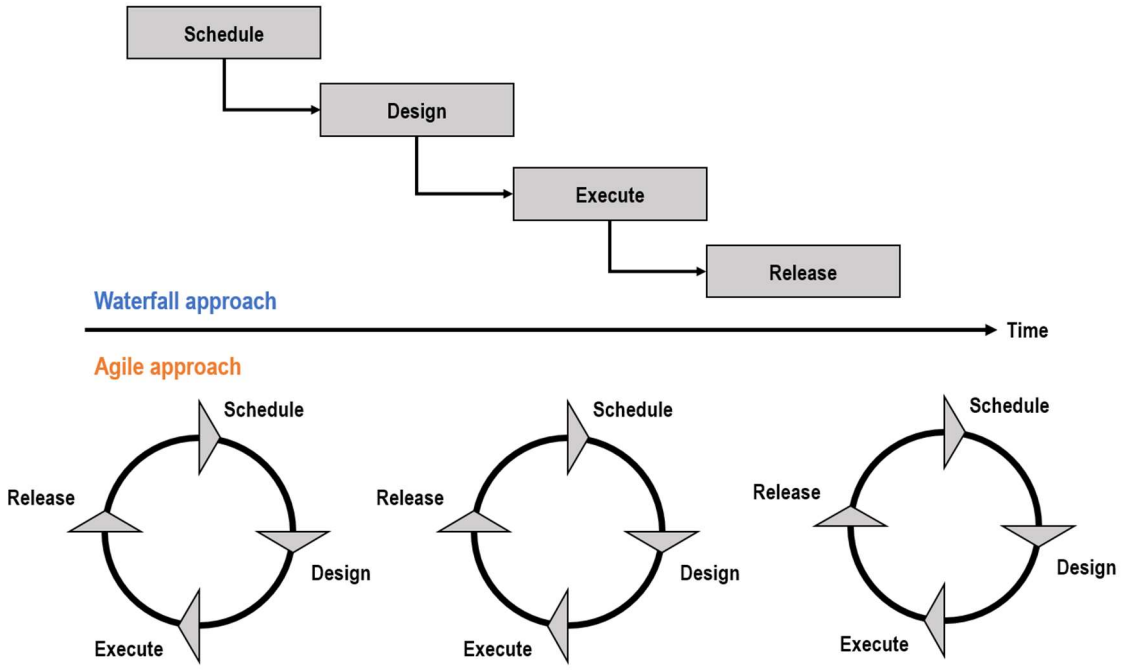

Figure 8 Waterfall vs Agile approach

Another crucial difference between traditional and agile approach is that in the second one emphasizes collaboration and communication over just following the process. Team members are way more included whenever a decision needs to be taken, using both a formal and informal communication. This aspect is important not only internally, but also externally: the client is also involved in order to reach as close as possible the project's goals, and to respond very rapidly to changes and new requests (Spundak, 2014).

An iterative approach has emerged and has been used also before, but through the Agile Manifesto for Software Development written in 2001, the core values of this approach have been set up:

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

Since these principles are totally different and change in a disruptive way the project management approach, many organizations fail in running fully agile because of several aspects. In an iterative approach, it is encouraged to create a lean upfront plan with very few details compared to the traditional initial plan. On the contrary, organization suffer from difficulty in changing with respect to the old culture, this results in creating a very detailed plan at the backlog rather than at the activity level. In terms of risk management, the agile approach suggests developing and deliver as early as possible the product to test its performance and review the risk while the product is working. On the contrary, organizations still refer to the traditional approach in which the risk is documented with problems and solutions, so that it can be signed by the relevant stakeholders. Another aspect is that while agile suggests the project team to work cross-functionally during the project development, organization still fail in doing this by separating people's functions inside the project lifecycle. Going further, agile-like minded companies could lack in establish the requirements while developing the product, keeping separated the two processes, and in an iterative approach it could be very useful to understand the solution in order to define clear requirements (West, 2011).

To create similarity with the traditional approach, Highsmith (2004) has created five phases of the agile approach:

- Envision: define vision, project organization and scope

- Speculate: create a model defined by the features of the product and time constraints, and an iteration plan for the implementation of vision
- Explore: deliver parts tested as soon as possible and search for a wat to decrease uncertainty
- Adapt: verify deliverables, situation, and behaviour of the team to adapt to the environment if needed
- Close: close the project, develop the lessons learned and celebrate.

An agile approach has been preferred with respect to the traditional one mainly because it reduces the risk of uncertainty related to project quality, having better project communication and control, and delivering the project that is coherent with the expectation of the client prioritizing value instead of cost and time. In a traditional setting, the plan creates cost and schedule estimates having the project requirements as constraints, while the agile approach the vision creates future cost and estimates.

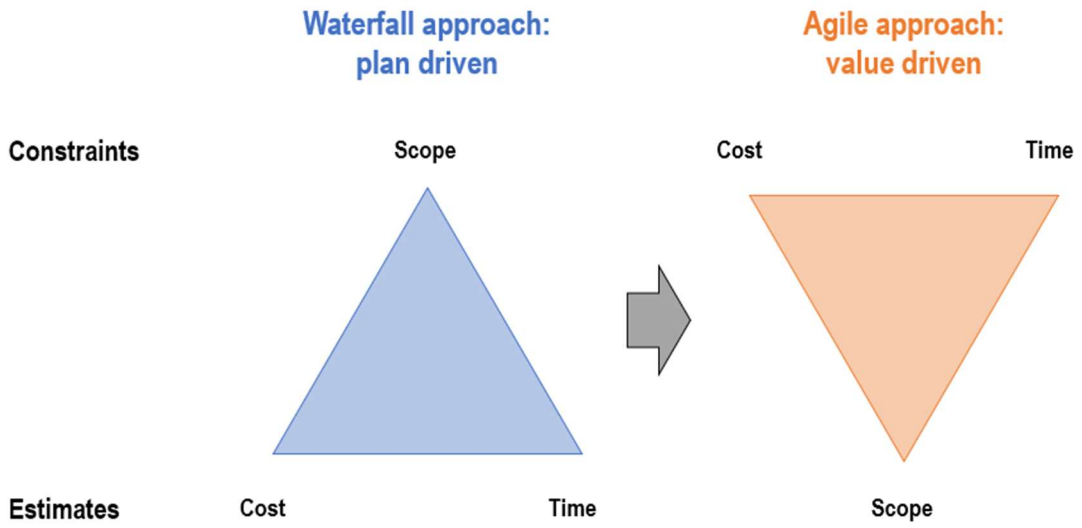

Figure 9 Waterfall vs Agile value triangles

Initially, this new approach had a wide range of opponents who argued that there was no evidence of successful application of an agile project management. Lately, empirical research demonstrated a wide range of successful application of such processes: they success factors that led to its success were an appropriate qualification of the project team, good delivery strategy, good usage of agile methods, whereas factors such as organizational environment, involvement of clients and good management processes are potentially contributors for such success. There are still some organizational barriers that

prevent the right implementation of this approach, but these problems can be overcome by creating an appropriate culture and a good understanding of the difference among a traditional and an agile approach inside the project's organization (Spundak, 2014). One of the most popular Agile methodologies is Scrum.

3.1 Scrum

As stated by the Scrum Body of Knowledge, Scrum is an iterative, adaptive, flexible, effective, and fast framework created to deliver a high amount of value throughout the whole execution of a project. Its goal is to ensure an environment in continuous progress, with collective accountability and a full transparency in communication. The framework of Scrum is defined and developed in a way to be adaptable to every project, no matter the size or the industry in which it is located.

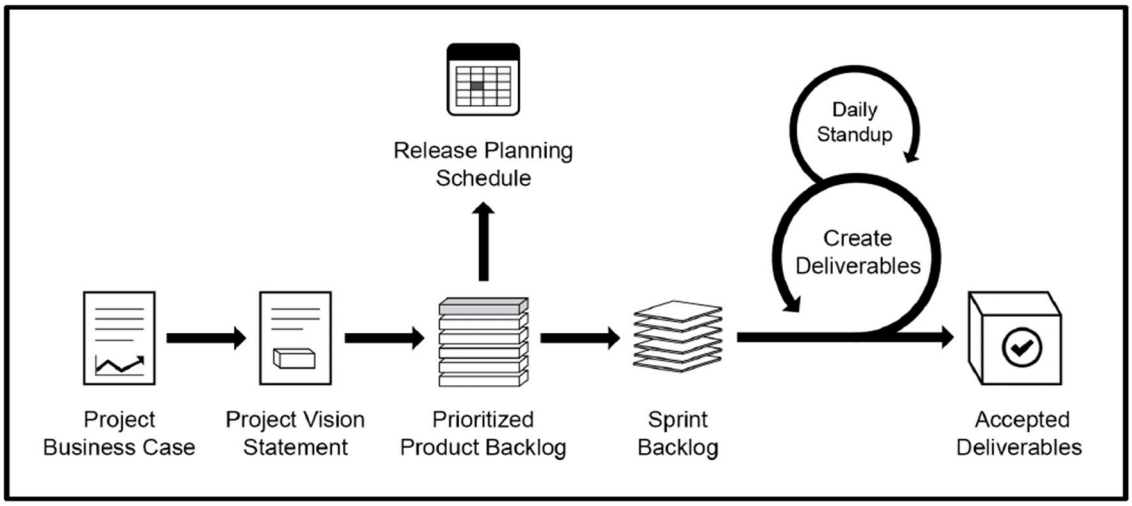

Figure 10 Scrum approach scheme (credits: SBoK, 2017)

The Scrum cycle starts when a vision for the project is created by the stakeholder's meeting. A Prioritized Product Backlog is developed by the Product Owner: this is a list of User Stories, which are the project and business requirements ordered by priority. The Sprint Planning Meeting is the starting point of the Sprint, in which the highest priority requirements are included inside it. A Sprint lasts usually between a time range of one and six weeks, and during this time the Scrum Team works to create a product increment or Deliverable that is potentially shippable to the Product Owner, and possibly every day Daily Standup Meetings are performed in order to analyse the progress. At the conclusion of the Sprint, the Sprint Review Meeting is performed, and a demonstration of the Deliverables is done to be accepted by the Product Owner and other interested Stakeholders, if the Acceptance Criteria are met. The Retrospect Sprint Meeting is done

at the end of the Sprint cycle, in which the team discusses about lessons learned aimed at improving performances and processes for the next Sprints (SBoK, 2017).

Scrum is based on six principles that need to be followed during the execution of each project. First, Empirical Process Control tries to give emphasis on the main ideas of Scrum: adaptation, inspection, and transparency. Self-organization puts a focus on self-organized work that delivers a greater value in this way and helps in improving shared ownership and fosters a creative and innovative environment. Collaboration focuses on appropriation, articulation and awareness and tries to give an idea of project management as a process of shared value creation. Teams work together to deliver a product in a way to maximize its value, and here is where the Value-based Prioritization principle lies. Time-boxing principle helps in understanding time as a constraint used to develop and manage effectively planning and execution of the project. Scrum elements which include a time box are Sprints in their selves, as well as planning meetings, standup meetings and review meetings associated to each Sprint. Last, the Iterative Development principle describes the iterative approach and gives insights in how to manage products that satisfy the needs of customer in a changing environment. The organization's and product owner's responsibilities are delineated in an iterative development approach (SBoK, 2017).

In order to meet the project objectives, a Scrum Core Team is set up. This team consists of three core roles, which are the Scrum Master, the Product Owner, and the Scrum Team and none of these roles have authority over others.

The Scrum Master facilitates, guides, and teaches practices of Scrum, makes sure that Scrum processes are followed and tries to resolve problems inside the team. It ensures the Scrum Team with an adequate environment to successfully deliver the final product. This role is different compared to the waterfall Project Manager, in which he acts as a project leader, while the Scrum Master is not at a higher level compared to the team and acts more as a facilitator. Indeed, the Scrum Master can be appointed at each sprint, therefore every Scrum Team member can be the Scrum Master inside the same project.

The Product Owner reflects the voice of the customer inside the project organization. Its objective is to maximize the perceived value of the product or service, maintaining on track the project while following the customer requirements and the business justification.

The Product Owner specifies the customer requirements, which have to be followed and understood by the Scrum Team, which consists in a group of people accountable for the creation of the deliverables and estimating the User Stories (SBoK, 2017).

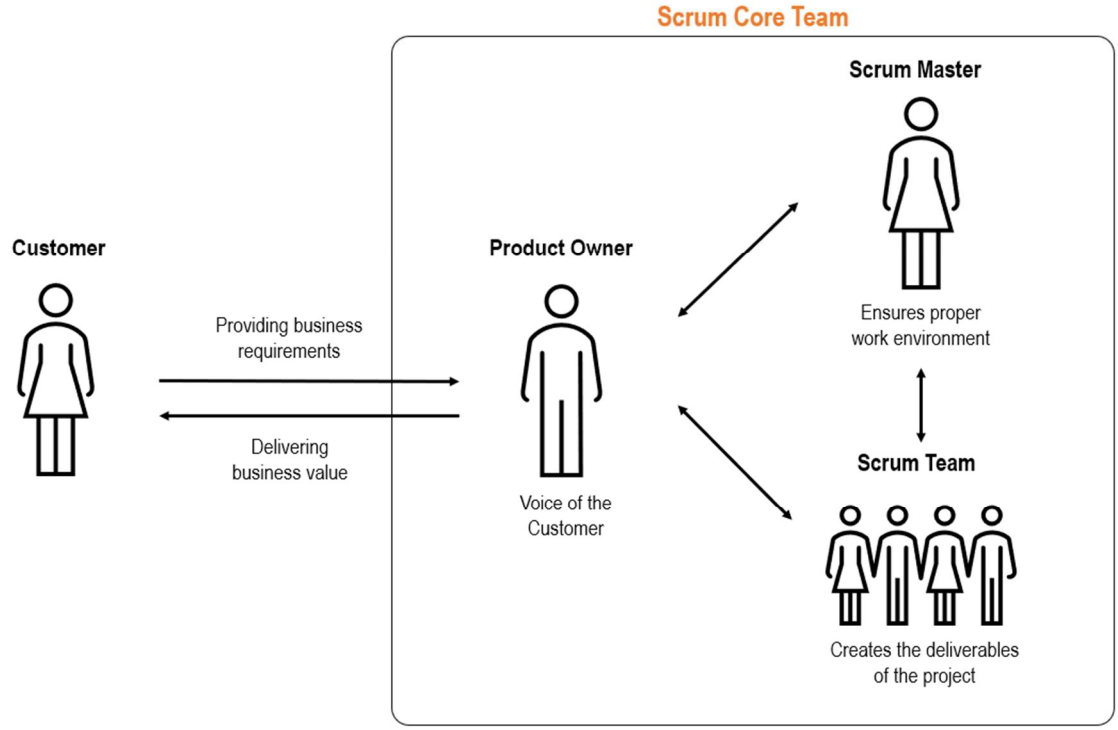

Figure 11 Scrum Core Team

Other roles, which are involved in the project execution without being a core representative of a Scrum methodology, are customers, stakeholders, users, and sponsors.

An important objective of Scrum is to deliver a product which is value driven. This can be done using a prioritized product backlog, in which high value requirements are delivered first by creating potentially shippable products that are incremented once each sprint ends. The business justification needs to be carried out and followed over time, therefore setting up a monitoring and control process is critical. Following, a review of the most important monitoring tools in Scrum methodology is performed. Even if the earned value analysis is accepted by the SBoK, it will not be considered due to the previous review in the traditional project management approach.

3.2 Scrum – Monitoring tools

3.2.1 Sprint burndown and burnup chart

The SBoK defines a sprint burndown chart as "a graph that depicts the amount of work remaining in the ongoing sprint". It displays the work that has been processed by the scrum team, which should be updated at the end of each day or week as work is completed and it also allows for the detection of forecasts that may have been over- or under-estimated. If the scrum team is not on track, the scrum master is accountable for identify impediments or obstacles to successful completion and try to cancel them (SBoK, 2017).

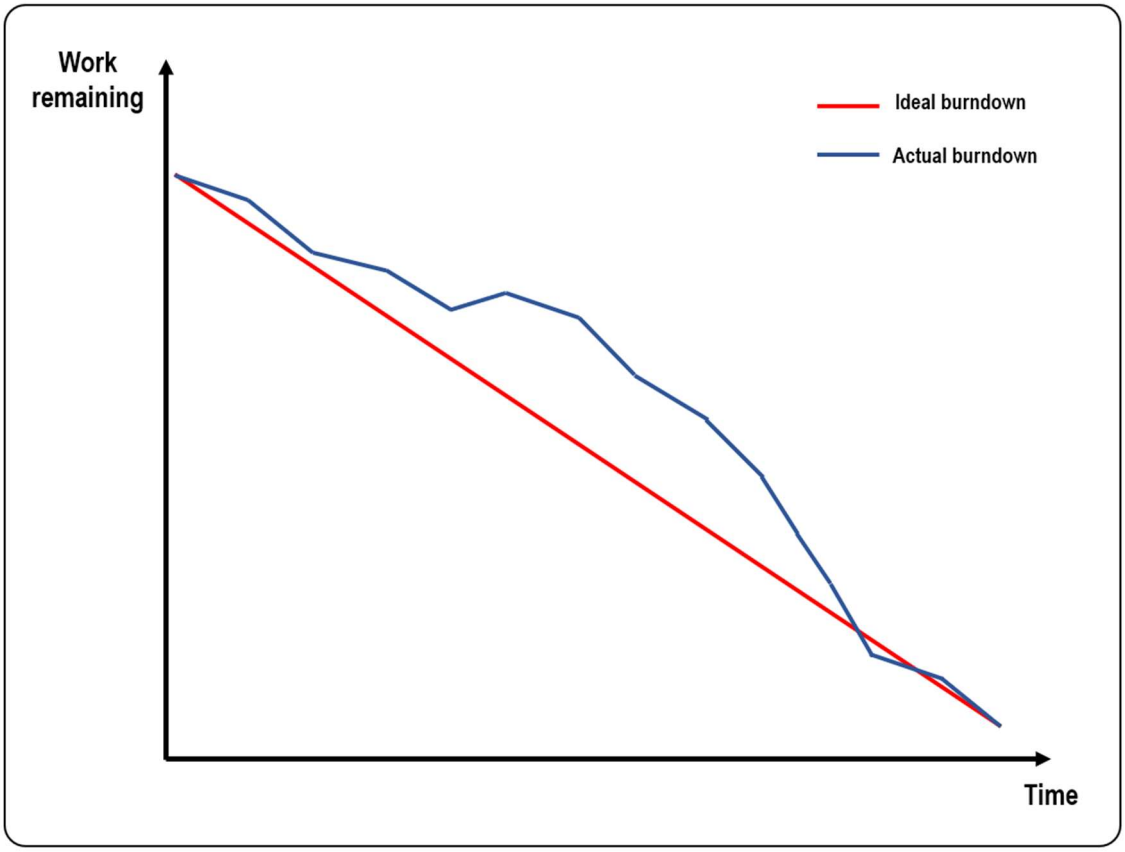

Figure 12 Brundown chart

This chart can be used to show an estimation of the remaining work until the iteration is completed (iteration burndown), otherwise it can represent an estimate of the releases delivered (release burndown). This chart compares the planned work against the actual remaining work to understand whether there is the need to modify the user stories which were planned to be delivered in that sprint (Jadvani et al., 2012).

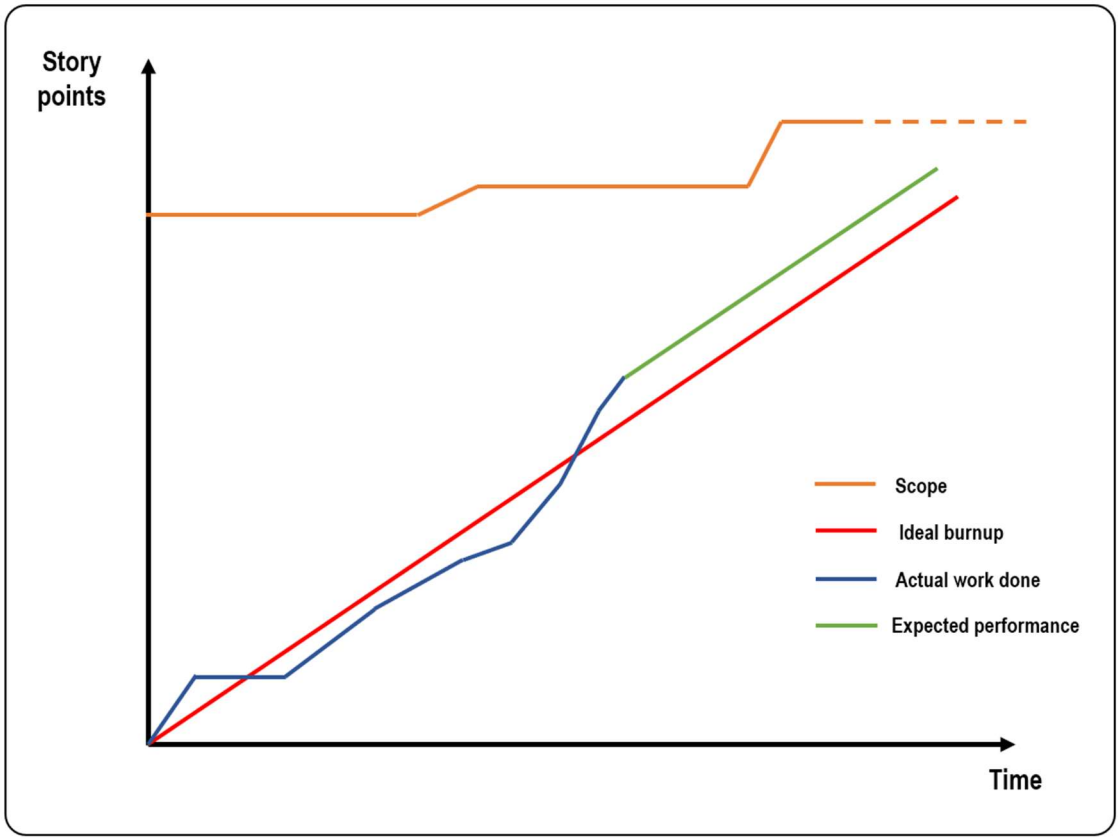

Figure 13 Burnup chart

An alternative to the more used burndown chart is the burnup chart that is similar to the burndown chart, but it depicts the work completed instead of the remaining work. As an agile project does not have a predetermined size, it is used to show the amount of work performed and it eventually allows to perform forecasts based on past performances, keeping fixed the scope.

3.2.2 Velocity chart

Velocity measures progress in terms of number of user story points completed per sprint by the team, and it is useful to estimate the remaining effort until the project is completed. Velocity can be seen as a measure of productivity, it can be used to understand how much work can be done for each sprint assuming that the agile team remains the same across the whole project, otherwise this measure will not be able to give any insight in terms of performance forecast (Jadvani et al., 2012).

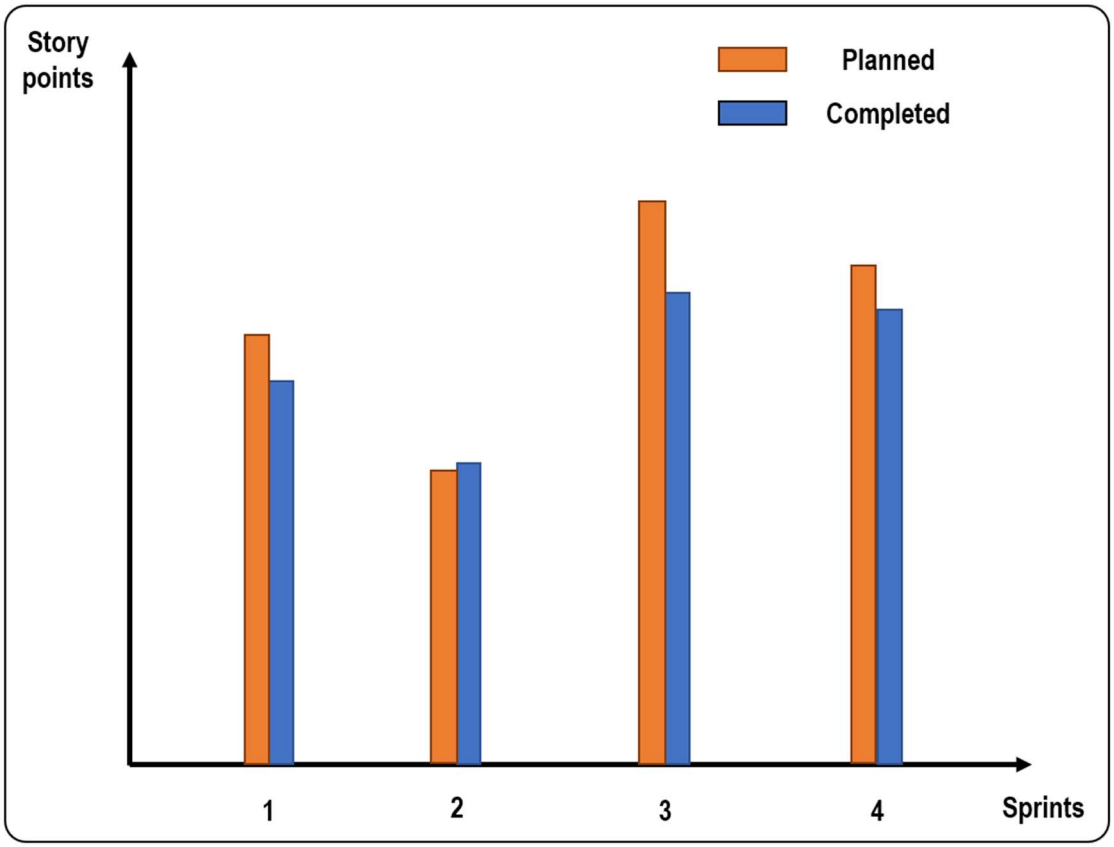

Figure 14 Velocity chart

With this assumption in place, previous velocity is the most important element that will help predicting how much work can be performed by the team in a future sprint, and past performances of each sprint are stored to create reliable velocity forecasts (SBoK, 2017).

3.2.3 Cumulative flow diagram

The cumulative flow diagram, also known as CFD, is a tool used to track the overall project performance and depicts the amount of work in done, in process and to do at a particular time. Unlike the burndown chart that depicts the single sprint status, it is used to monitor the whole project. CFD is also commonly used to detect and remove bottlenecks, as well as reducing lead time while responding to customer requests and keeping track of new requests, which will increase the overall project scope (Jadvani et al., 2012).

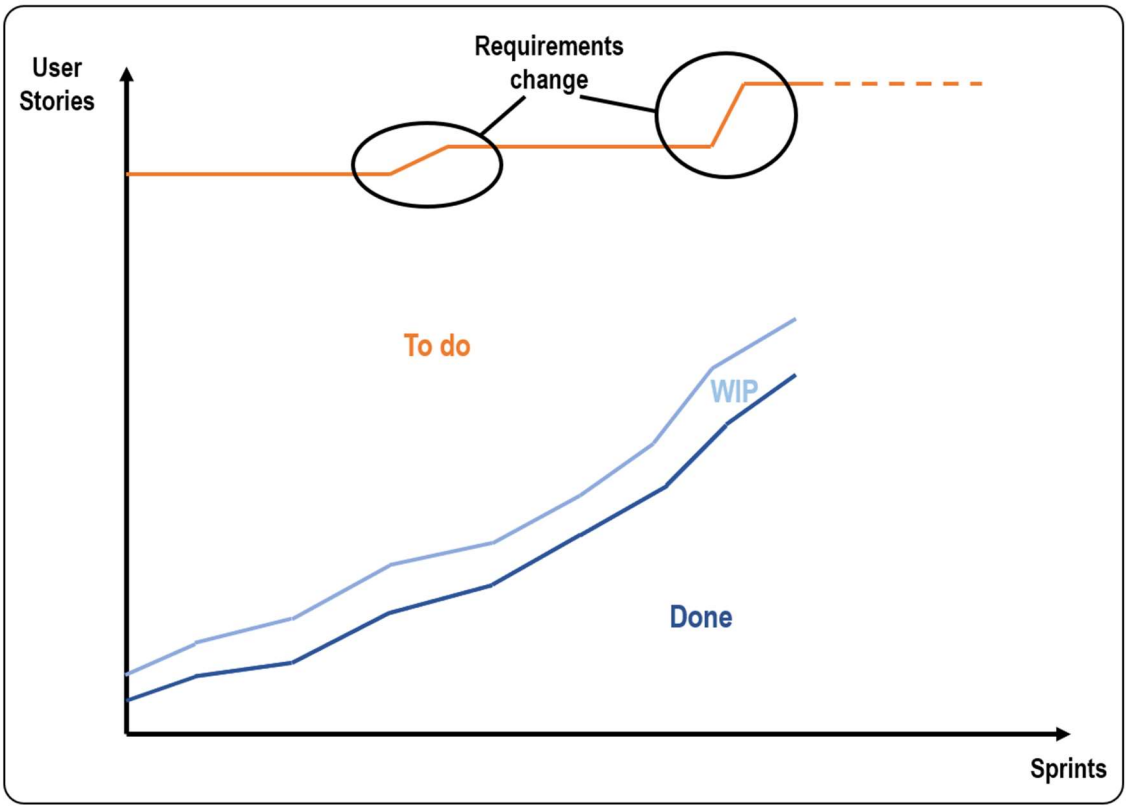

Figure 15 Cumulative flow diagram

The x-axis can show either the timeline in terms of time or the sprints in chronological order, while the y-axis displays the cumulative number of user stories completed in a particular time frame. Usually there are three lines: the one above depicts the overall number of requirements coming from the customer, the middle line shows the work that is in progress while the one below represents the work completed that has been delivered (Petersen, Wohlin, 2009). These requirements should be delivered in accordance with the prioritization given in the product backlog.

The ideal way in which an agile project is carried out is to estimate and plan tasks only for the following iteration, but in real practice a general prediction of the overall project budget is needed. Using the assumption of using the same scrum team for the whole project, and therefore having a constant velocity, previous velocity performances are used to predict an overall effort, if a big number of project elements will not change as well (Jadvani et al., 2012). This method is used just to have an idea of the overall project budget which will not be binding, as many changes can occur during the execution of the project, therefore it is not supposed to provide an accurate measure.

3.3 Additional considerations

Scrum has become the most popular methodology since the agile approach arose, mainly because it puts a strong emphasis on team dynamics compared to the rigid traditional approach that lacks a focus on people, especially in a software development environment. Many companies have tried to fully adopt the Scrum methodology, but there are many discrepancies compared to the guidelines given by the SBoK, as stated by West (2011).

Since the goal of resource management is to maximize each resource utilization, it becomes clear that each team member will work on several projects during a given time frame. The agile approach suggests collaboration and team members need to work together to solve problems. Having team composed by people working on several projects at the same time makes it difficult to coordinate and fulfil the above agile requirement, increasing the risk of losing important information while switching among projects.

Usually business analysts become product owners, and this can create problems since a product owner should own a product, while a person in that role has other priorities such as give information to the customer about the intent of the team. The risk is to have a low perceived authority and credibility which could lead to technical and business decisions that would not be followed.

In a project culture setting, the teams which are formed for a specific project will do most of the work. The agile approach gives recommendations to reduce the cost of working together, while in this culture every time a project team is set, all the learning procedures must be repeated.

Not all the tasks that should be included in a sprint given the agile approach are carried out inside it. This situation can lead to missed activities and lack in the quick feedback that characterizes an agile organization.

4. Hybrid approach

So far, we have discussed about the two most important and widely used project management approaches with a focus on the monitoring phase from two different points of view. Both agile and traditional approach have their pros and cons, therefore it is hard to choose which one is the best fit for an organization. As a consequence, sometimes it can be useful to use both approaches in a combined way, especially in project-oriented companies that are organized on a project portfolio level. In addition, it can happen that one specific project inside the same portfolio need to be managed using a different approach with respect to another, since a misalignment among the project characteristics and the approach adopted can lead to problems during its lifecycle, or even worse to failure (Spundak, 2014).

The table below shows the differences among traditional and agile approach, divided by project's characteristics.

Characteristic	**Traditional approach**	**Agile approach**
Requirements	Clear initial requirements, few changes	Creative, innovative; unclear requirements
Users	Not involved	Frequent and close collaboration
Documentation	Comprehensive formal documentation	Tacit knowledge - Minimal
Project size	Big and complex projects	Small projects
Organizational support	Existing processes, bigger organizations	Prepared to accept the agile approach
Team members	Fluctuation expected, distributed team, not accentuated	Smaller and collocated team
System critically	Serious consequences if system failure	Few critical systems
Project plan	Linear	Iterative
Organization	Managed	Self-organized

A traditional approach is more suitable in projects characterized by a low level of uncertainty, clear initial client's requirements, and well-defined goals. These projects would ideally have a low change rate in terms of requirements, while the emphasis would be on the initial planning and on formal documentation, as well as verified and predictable way how to reach project goals. Usually, this waterfall approach is used for bigger projects, no matter the complexity, duration or size of the project team members. In these kinds of projects, there is the need of a centralized and structured control over human resources, since the project manager is not always in contact with the team members, and these people are likely to be less experienced and there is the possibility to have a high turnover. As there is a likelihood of a system criticality and consequences can be highly impactful, it is recommended to use traditional project management (Spundak, 2014).

An agile approach is more suitable for innovative and creative projects, that are characterized by uncertainty, future requests that are not predictable and unclear goals. These projects are organized in a way such that updates, and new requests occur very likely, and requirements are sorted functionally in order to better respond to an iterative approach used in agile project management and to have a more effective monitoring and controlling. Communication among team members is enhanced in this approach, in fact the best way to exploit an agile way is to work in the same location as well. Knowledge does not reside in documentation, but rather is tacit inside every team member. It becomes necessary for the organization to be prepared to embrace this new way of thought and continuous changes (Spundak, 2014).

The goal of a certain methodology is to increase the chance of successfully deliver a project, as well as having an efficient team. Other benefits are faster time to market, more efficient processes such as decision-making processes and management of quality process, better controls of project scope and goals, reduced risks, better customer satisfaction and an efficient exchange of information among projects to allow more time for value added tasks. Using a methodology does not automatically enable project success, in fact the organization needs to clearly understand the needs, context and scope of the project. But, as a matter of fact, using a methodology which is not appropriate can lead to many problems during the project lifecycle or even worse, in can lead to failure (Spundak, 2014).

In order to adopt a methodology that likely would contribute to project success, there is the need to have a coherence with all the other organization processes, and this is why many companies have started to create and develop their own methodology. For example, we can consider a customized IT project at a small company for a big organization, which is the client. The requirements could be unclear, while a great amount of documentation is required by the client, and the final users are not involved in the development of the project. The project is basically small in terms of workload and duration, a small team is involved using a linear planning with few iterations because of uncertainty of the requirements and the system development is not that critical for the client (Spundak, 2014).

Given this project, the methodology should in turn be coherent and aligned with both the client's organization, with complex and rigid processes, and the small IT company characterized by flexible and light processes. Therefore, given the characteristics described before, both a traditional and an agile approach need to be used. This means that the application of a single methodology cannot be enough, and several methodologies could be applied and merged based on the specific project needs. Other elements that could influence the selection of a methodology are the product criticality, project size, project manager personal decision, priorities, project team experience and size, flexibility of requirements, availability of the customer, time, cost, risks, number and location of stakeholders and the possibility of using an iterative approach (Spundak, 2014).

Looking again at the project and its characteristics in the previous example, it is clear that the best methodology would be the use of a combination of elements coming from agile and traditional approaches, since adopting just one or the other approach will not fit the project at its best. It is important to identify the characteristics that will be used for the selection of certain elements of a project management methodology, and which elements to choose inside a particular methodology (Spundak, 2014).

For these reasons, our aim is to explore these hybrid approaches and to apply these concepts to a case study in the IT sector, which will be discussed lately. A hybrid software development approach is defined by Kuhrmann et al. (2017) as "*any combination of agile and traditional (plan-driven or rich) approaches that an organizational unit adopts and customizes to its own context needs (e.g., application domain, culture, processes, project, organizational structure, techniques, technologies, etc.)*".

Since the beginning of the 2000s, several studies have been performed in order to gather data and information about processes and combined processes. Many analyses demonstrated that a wide range of combined project development approaches are used. Only the 35% of the population use the proper traditional, or waterfall, approach, while most of them use incremental approaches inside some phases of a project. Even more studies recently have demonstrated that traditional approaches are progressively combined with iterative and agile project management approaches. The HELENA (Hybrid dEveLopmENt Appraches in software systems development) study has tried to fill the gap in literature given by the lack of evidence of these combined approaches (Kuhrmann et al., 2017).

The study assumes that the hypothesis of the "Water-Scrum-Fall" (discussed in the following chapter) are valid, and that the hybrid approach is reality and is adopted in the IT software development companies. Given these assumptions, the aim of this research is to understand what a hybrid approach is and if it fulfils the requirements and expectations of the end users inside the organizations. This extensive survey aims to study the project management development approach, the number of development approach used and combined, and whether external standards have influenced companies in adopting hybrid approaches. The questionnaire used includes levels of project, organization, and personal experience (Kuhrmann et al., 2017).

The first result concerns the development approach used by the population, composed mainly of IT, financial and telecommunication organizations, both big and small. It is shown that many different approaches are used, for instance the 53.6% of the population are implementing Scrum and even more are using generic approaches such as code reviews, that means they are adopting a mix of agile and traditional approach. On the other hand, a good amount of the people surveyed, which means the 34.8%, implement the waterfall model as their project management development approach. These results give credit to the "Water-Scrum-Fall" hypothesis and it is very likely that in the future this approach will be widely used (Kuhrmann et al., 2017).

The second result is about how a combination of different project development approaches are implemented in an organization. To do this, two perspectives have been analysed: one is the self-evaluation of how the participants have implemented a cluster of project disciplines, structured following the SWEBoK (SoftWare Engineering Body of

Knowledge), which addresses project lifecycle phases such as requirements engineering, project management, implementation, coding, architecture, and design. The last one concerns the process use related to different company sizes. The participants have been asked through a rating whether they implemented an approach that was more traditional or more agile, divided by the SWEBoK disciplines (Kuhrmann et al., 2017). As a result, the participants responded in a way such that there is a balance among the agile and traditional approach: exceptions are in the configuration and risk management where there is a tendency in the use of a more traditional approach, whereas in the coding and integration sections participants show a preference in the agile processes (Kuhrmann et al., 2017). Another result is that no matter the size and the sector of the industry, companies use to mix different project development approaches based on experience and learnings derived from projects in the past. While the project is in progress, however, the approach could change compared to the one used and planned at the beginning.

The last result of this research demonstrated that the greatest factors which influence the use of a hybrid approach in an organization is the use of standards and eternal norms such as ISO 9001 or ISO 27001, no matter the size of the company (Kuhrmann et al., 2017).

Overall, there is an increasing trend in the implementation of hybrid approaches, and this can be due also because of a certain reluctance of project managers to go fully agile and implementing hybrid processes can help in addressing different challenges which would help combining standards while keeping a high degree of flexibility (Kuhrmann et al., 2017).

One of the main advantages in adopting hybrid approaches is that a project benefits of the flexibility allowed by agile development while new requests or changes occur, whereas at the same time there is still emphasis on the use of proper techniques, tools and supporting documentation which have to be rigorously completed especially in big size companies and in case of external projects. Requirements might change during the project lifecycle, but documentation is still fundamental even in an agile-like context, especially for stakeholders and to keep track of each one's accountabilities, as well as new requirements and changes over time (Adelakun et al., 2017).

Documentation has a communication role as well in hybrid environments where teams are not located in the same place. It can also be important to create an initial blueprint of the requirements and to structure a change request process to ensure the client is aware of

the changes before these are put in place. This documentation, which is not a bullet point inside a purely agile environment, would help to create a timeline of the changes and any variation that affects the initial project plan (Adelakun et al., 2017).

One of the most famous hybrid approaches is the Water-Scrum-Fall developed by West in 2011.

4.1 Water-Scrum-Fall

The Agile Manifesto written in 2001 has been the result of a meeting among experts that asked themselves why projects were not always successful. Over the following years, there have been many investigations which aimed to discover the popularity of a pure agile approach among a wide population of IT professionals. The survey performed by Forrester in 2010 showed that less than 40% of the interviewed population selected a purely agile approach as their adopted methodology, while the majority of the population have been inspired by the Agile Manifesto, but they have developed a mixed traditional-agile approach because of the constraints given by their governance and the organizational culture. Such effect can result in a failure of the realization of the agile organizations benefits (West, 2011).

The water-scrum-fall approach is composed by three main phases: a more traditional and linear approach in the initiating phase of the project, an iterative approach during the execution and again a linear process in the closing phase.

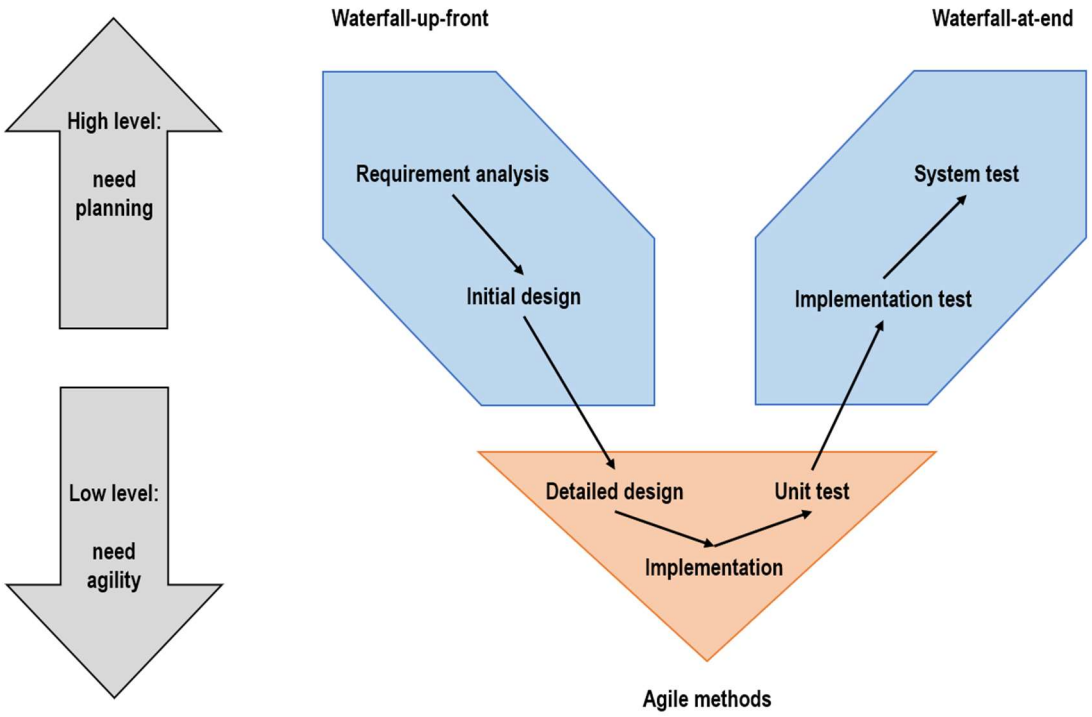

Figure 16 Water-Scrum-Fall scheme

"Water defines the upfront work": requirements definition and a detailed plan are needed by the company's governance rules. These initial plans are sometimes used by the companies to create the key points of the contract, in order to define a budget and an overall time schedule. Customers usually want to know how long it would take and how much will it cost to conclude the project. Moreover, they want to ensure whether the business knows their requirements, but sometimes they do not have clarity over the customer's requests. Putting too much emphasis on the initial planning, however, could lead to several problems: sometimes clients have difficulty in effectively communicate their requests. Another problem is that defining all the requirements in an early phase could lead to have several wrong requirements. Moreover, this implies that requirements definition and development are two separate phases, reducing in turn the project team's ownership of the final product, since there is a lack in continuous communication between the team and the client. An important consequence is that the project team becomes less cross-functional, which is one of the core ideas in the agile process.

"Teams use Scrum to develop software in the middle of the process": while executing the project, the development team should embrace the Scrum methodology, without losing the focus on its basic principles. It is necessary to create a team which is cross-functional, common goal-oriented and able to deliver a working product. Even if there is a scrum-

fall approach, it is still necessary to have testing moments inside each sprint. The release process is complete in this way, and feedback can be given quickly in order to apply the corrective actions needed reducing the impact and cost of defects. Sharing information among the organization and the customer is fundamental during the execution of the project development, as well as having a culture that accepts changes and understands the impact of them.

“Fall means establishing gates to limit software release frequency”: many organizations still fail in deliver frequent releases as requested by Scrum, mainly because of lack in their architecture and due to heavy processes in their governance and documentation. Development and operations should work more closely in order to foster team culture, collaboration and shared goals vision. Once a collaborative and cross-functional team has been built, it is necessary to improve processes that would slow down the product releases. Adding release activities to sprints will increase feedbacks from the customer and will help in create an automatization in the release processes as future implementation. Creating business-driven shared objectives are important to remove conflicting measures, promoting a balanced functionality and quality (West, 2011).

In a future setting, methodologies and standards such as Scrum will be replaced by customized methods using a mix of approaches depending on the organization needs. The goal of this hybridization is to have flexibility and robustness in business processes to be ready to respond in each situation.

5. Mediamente Consulting case study

The previous literature review has been done to put a focus on the main characteristics and differences among traditional and agile approach and exploring the grey area between these two points at the extremes, that is the hybrid approach. Several methodologies have been established both in a traditional and an agile setting with many standards accepted and used worldwide. In a hybrid setting, standards have not yet been set and it is likely that if existing, they would never be widely accepted like the other two approaches. Thus, the way to be followed in a company that wants to implement a hybrid approach is to create "in-house" its custom hybrid approach which best fits inside that environment, as every company has its own characteristics and culture, and an approach like this could be successful in a setting while ruinous in others.

This master thesis focuses its case study research on Mediamente Consulting, a small IT consulting company in which a restructuring of the internal project management process is in process to optimize it through a tailored hybrid approach based on their needs. A particular emphasis is put on the monitoring phase in which a customized project monitoring dashboard is developed and validated through an existing project and through interviewing the company's project managers to evaluate the benefits of using it with respect to the previous monitoring processes.

5.1 Overview

Mediamente Consulting is specialized in advanced business analytics and several technologies such as IBM, Oracle, and Microsoft. Its mission is to guide enterprises into a digital transformation that embraces business analytics, exploiting the advantages of the latest IT innovations and adapting the business to the new challenges of the market. The company invests in R&D activities such as innovative solutions based on big data and statistic models platforms, customer support for applications and technological infrastructures, creation of new frameworks aimed at adopting work standards to speed up implementations and ensure a high-quality deliverable in Data Management, Data Visualization, Data Integration and Corporate Performance Management areas. The company was born in 2012 and has been awarded as start-up of the year in 2016 by the start-up incubator of the Politecnico di Torino. This company has become a controlled company of Var Group, leader in IT services, technologies, applications, and software solutions in Italy.

Mediamente Consulting aims to create a partnership with the client in order to manage and transform data in useful information for decision-making processes. Analytics act as a support for operational and strategic processes and can be applied to a wide variety of clients with very different dimension, both at a national and international level. The company has developed five main core competences, divided into business units: Infrastructure, Data Integration, Business Intelligence, Advanced Analytics, Corporate Performance Management.

The Infrastructure business unit includes activities about data management, monitoring, technological upgrades, engineered systems and architectural consultancy on cloud enterprise infrastructure. The Data Integration area works using frameworks for data transformation, data quality, data enrichment and data streaming using near real time technologies, giving a high level of integration among existing information inside the enterprise. Business Intelligence shares solutions both for business and IT levels, creating reports and dashboards aimed at structuring a clear analysis for the support of the management, as well as configuring self-service analytics used to provide an interactive analysis of the information needed. The business unit related to the Advanced Analytics area is a transversal unit which embraces all the others, and includes topics such as machine learning models, advanced descriptive statistics models used to calculate statistical metrics and indexes, and advanced analytics for the development of forecasts. The Corporate Performance Management (CPM) unit involves tasks such as what-if analysis through an index simulation environment, budget and forecasts, creation of a guided internal workflow system involving different people and closing aimed at the business management in a multidimensional level by using derived information from various sources.

Mediamente Consulting is investing many of its resources for the development of an advanced analytics and business intelligence framework. The objectives of this instrument are to formulate hypotheses and forecasts using predictive algorithms useful to simulate future scenarios, analysing data to extract value hidden insights through advanced clustering and forecasting algorithms, data visualization for decision making using a visual representation of requested data and creating operational and strategic business actions to maximize the client's business objectives.

Another core business of the company is the Application and Systems Management (AMS) process, that supports client's platforms in their ordinary and extraordinary maintenance management. Their objective is to create, support, track and apply machine learning themes to forecast future values of the metrics that describe the systems status.

5.2 As Is Project Management process

Mediamente Consulting operates in three main activities: maintenance (AMS), time and material tasks and fixed price projects. This last activity is increasing its importance in terms of share of revenues, therefore having an appropriate and effective project management process has become necessary.

An AS-IS analysis of the internal project management process has been performed to evaluate the level of standardization and to assess which phases were considered a bottleneck or critical for the successful delivery of a project. Three project managers of different business units and the CEO of the company have been interviewed to have a clear view of the overall process, with different points of view about the critical points.

A new project originates when an opportunity arises, that can be a manifestation of a need from an existing client about a business topic in which it needs to improve, otherwise Mediamente Consulting proposes new solutions directly to it. New clients can be introduced by suppliers or other Var Group partners, otherwise they can be acquired through the participation in public or private announcements and the proposal of an offer. Once the opportunity has been clarified after a preliminary collection of information, a project manager of the interested business unit acts as a technical account for the client and will follow it for the whole life of the project. Subsequently three main evaluations are performed: commercial, technical, and financial.

The technical evaluation produces a technical project charter as an output, in which there is the definition of the requirements, scope, delivery modes and a proof of concept if required, as well as all the technical details that explain what will be done during the execution of the project. The commercial and financial evaluation enable the creation of the second output that is the economic proposal, through which the financial situation of the client is assessed, and the kind of internal activity is defined. The proposal can be binding or not binding, where just an idea of the proposal is sent and there is no constraint for the client. Afterwards, the proposal is submitted to the client that can accept, refuse, or deal. If the client accepts, the project starts with the execution. An initial planning has

already been done for the creation of the project charter, after the client has accepted the project will be planned in detail and executed. These upfront phases are almost standardized, and all project managers use these guidelines to start with the project. All of them are usually divided into milestones and deliverables, which are specified in the project charter with the associated elapsed days to give a general duration to the client.

5.2.1 Survey with PMs – approach

Three project managers of Mediamente Consulting have been interviewed to understand how the project management process was carried out and the criticalities that they are facing, as it has emerged that the process is not standardized and each of them have their method based on their working experience. Another factor that contributes to such variety of method in the same enterprise is the size and duration of the projects, that have a high variance and can last from two weeks up to more than two years. For example, the Infrastructure business unit carries out mostly AMS activities, while fixed-price projects are usually a low share of their revenues, small and short in terms of duration. Much longer and more complex projects are done in the BI, Data Integration and CPM business units, where fixed-price projects are their main source of revenues.

The planning phase for big-sized projects, especially in the BI business unit, are done using a Gantt chart with details about what is needed to be done in order to assess the tasks to be carried out. The type of resource is defined as well as the IT environment and the criticalities, while the estimation of the task duration is done by type of resource appointed even without knowing who exactly will do it. Microsoft Excel is used in each project both for the planning and the execution phases, while Freedcamp has also been used in the past as an agile tool for some projects to track activities done, in progress and to do and to empower every resource to autonomously monitor the progress, allowing the project manager to reduce its workload for non-value adding activities. A monitoring and control process is not put in place, in fact the project manager based on its experience knows whether a project is on track or not before the delivery due date: if a project is behind of schedule, more resources are allocated, and other controls are performed to assess the delay recovery.

For some projects MS Planner is used as it is integrated into MS Teams to allow resources inside the team to know the tasks they need to accomplish, but there is not a feature which allows to understand how much effort a resource has spent. The effort estimation is done

without any link related to the resource allocation, as the starting date of the project is often uncertain. Before the start date is set, a Gantt chart is done to define the macro activities along with the elapsed days to set a duration. A monitoring phase is also done at the end of each week among the project managers to decide about the resource allocation, based on each project performance.

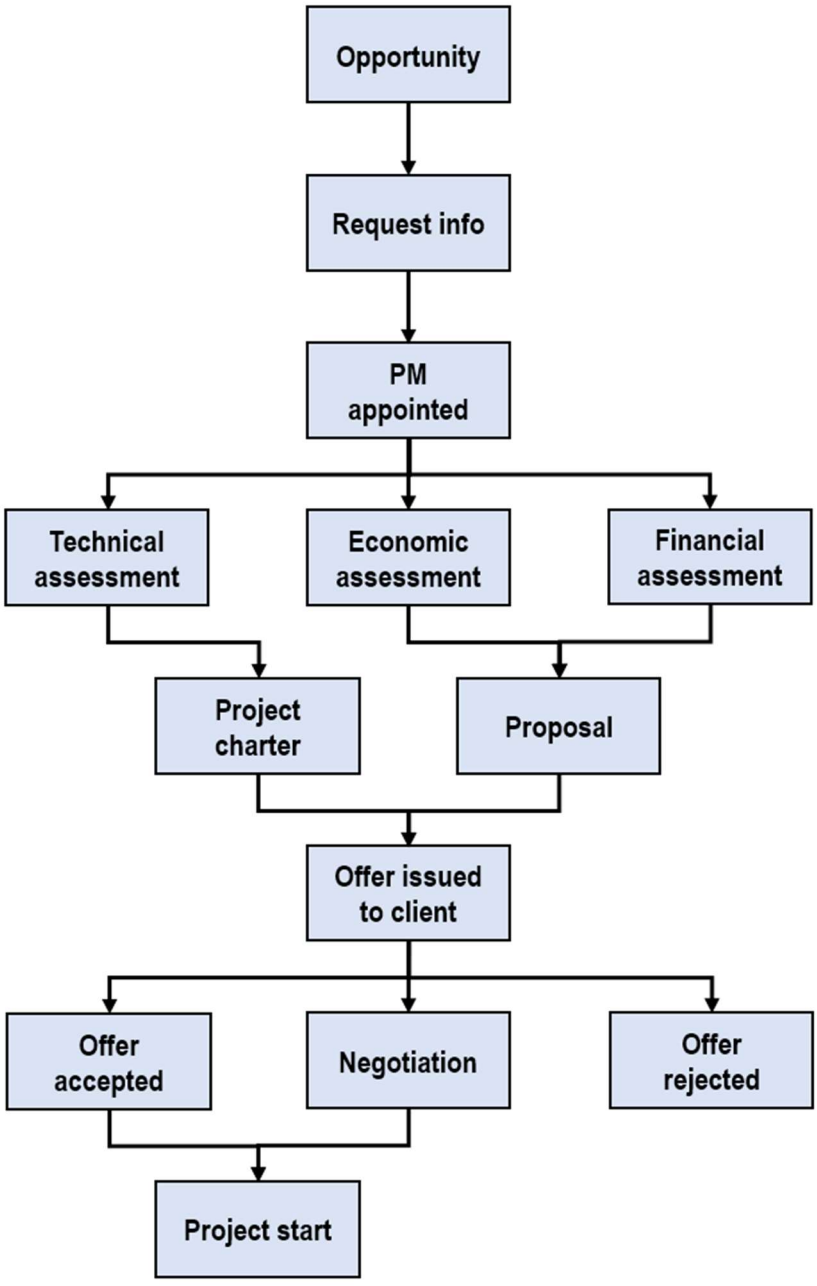

Figure 17 Standardized project management processes

5.2.2 Survey with PMs - criticalities

These surveys with the company's project managers highlighted different improvement points in the internal project management process, depending on their experience and the different style they manage projects.

The first aspect to consider is that in some business units there is a lack of transparency, that is resources working on a specific project do not have a clear vision of other activities that are carried out inside it, while few people know what is going on in the whole business unit. There is not an accurate metric to define whether a resource is efficient or not, and the idle time is not controlled for the single resource, as an informal control is put in place in which there is a continuous feedback between the resource and the project manager. Sometimes this lack of information is a consequence that in some projects there is a mismatch among the planned task and the actual ones that are carried out. Some project managers are more flexible in terms of tasks that a resource must do giving them more autonomy, while others keep their resources more aligned with their initial planned activities.

Even if there is a project manager meeting each week, the actual progress status of projects is done properly just each month, as in the weekly meeting they are mainly discussing about the resource allocation for the following week. The CEO asked about project progress each month and would like to have a clear and instant view instead of asking to each project manager. In some projects there is a lack of information and it is difficult to understand the productivity in terms of revenues of the project. To keep track of the project's progress, project managers use excel files with their own template created based on their experience, but these files are not shared among them, therefore they are different and take into account different aspects.

Another area that should be improved according to the survey is the risk management process. There is a lack of a standardized risk management approach, in fact as each project manager adopt its personal approach based on its experience.

5.3 Tailored hybrid approach

Given all the information above, the need for a standardization using familiar project management practices has become evident. It has been demonstrated by Milosevic and Patanakul (2004) that a standardization in project management may lead to project

success, especially when factors such as tools, project leadership and processes are standardized.

Project managers in Mediamente Consulting already used some agile project management aspects due to the nature of the business, while other constraints have forced them to keep using some traditional practices. Thus, effort during this last year has been spent to create an accepted project management approach that could be used for at least some kind of projects. The approach that has been recognized to be most suitable for a process standardization in the company is a hybrid project management approach which can be applied in medium and large-sized projects.

Usually, given the business of the company, it is recommended to implement a fully agile approach, which could potentially be applicable inside the company, but external barriers prevented this implementation, forcing the company to adopt a hybrid approach which rises from a trade-off with these externalities. The main external factor is the contractual aspect with the client, in which a fully agile approach implies to use a Time and Material contract (T&M), where deadline and budget are not clearly defined as this kind of project management approach is value driven instead of plan driven. By contrast, clients usually require a Fixed-Price contract as they perceive it can give them an assurance than a T&M, as budget and duration are clearly defined before signing the contract. Therefore, the need to structure an agile approach while keeping some traditional elements given by external barriers, resulted in the definition of the following hybrid project management approach.

Once requirements of the client have been clearly agreed and understood, the project charter is created, and high-level milestones and related deliverables are defined. This implies that at the beginning of the project, an initial general planning activity is performed by the appointed project manager, mainly based on its previous experience to set an overall duration and budget for the project to be accepted by the client. If the client accepts, the project will be initiated. Once the project has started, a detailed planning is done at the beginning of each deliverable which will be released to the client when completed. A deliverable into this approach acts as a “macro-sprint”, and this will be the lower project-level that the client will receive as an incremental product.

From the contractor point of view, which is Mediamente Consulting in this case, a detailed planning phase for each deliverable implies the creation of another level, that is the Internal Sprint. The Internal Sprint (it will be called just “Sprint”) is defined while the

detailed planning of the deliverable is performed. As a deliverable might have a high variance in terms of duration, sprints are created to subdivide each deliverable into small pieces which help the organization to keep track of the deliverable status and criticalities if occurred, before releasing the deliverable to the client. Therefore, a deliverable is subdivided into a variable number of sprints which will have fixed duration inside each deliverable and will last no more than two weeks. In this way, an update of the deliverable will be available inside the organization at the end of each sprint, and corrective actions can be taken in time before releasing it. If a deliverable has a duration lower or equal than two weeks, only one sprint will be created, otherwise a higher number of sprints will be necessary in order to have a timely update of the project. At the end of each sprint, a meeting among the team members and the project managers is done to discuss about the lessons learned and improvement actions for the future, as well as understanding whether potentially shippable products might already be released.

The main advantage of this approach is that from the point of view of the client there is a high perceived contractual security as if it was carried out more in a traditional way, and from the contractor point of view there is a high degree of agility that enhances flexibility and increases the chance to deliver a successful product due to the several internal and external reviews of the project.

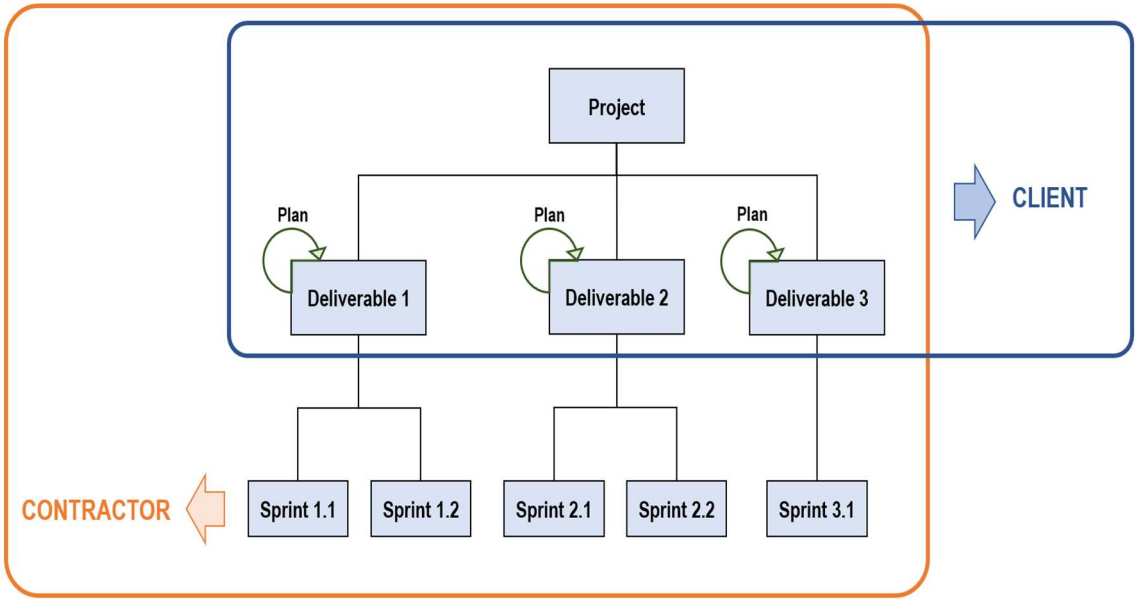

Figure 18 Tailored hybrid project management approach scheme

The detailed plan of each deliverable defines the sprints mentioned above, as well as the activities which will be carried out and the resources allocated to each activity. A product

backlog is set up to create a prioritized bucket containing the main activities which need to be completed in the next deliverables, sorted by priority.

An excel file is created while delivering the low-detailed plan, and it is updated at each deliverable to define the number of sprints and their due date, while the detailed planning phase is performed on an agile planning tool, MS Planner. This tool has been preferred to others mainly because Mediamente Consulting has adopted the MS Office 365 package, therefore it can be easily integrated in other useful tools such as MS Teams so that each team member knows which tasks has been allocated to through the Planner add-on.

MS Planner for a project using this approach is organized as follows: an initial bucket acts as prioritized product backlog, while the subsequent buckets are associated to each sprint. In each bucket, detailed activities are defined, and resources are allocated to each activity.

5.3.1 Pilot project and improvements

To carry out our study and creating a tailored monitoring dashboard, a pilot project has been used to create a demo of the final version of this tool with the aim of being validated and implemented in the daily activities of Mediamente Consulting as part of their project management process. The information provided adopting the approach in the previous chapter were not enough, therefore improvements were necessary to gather all the data needed for the monitoring tool.

The most important lacking element for the creation of a monitoring dashboard was the information about effort. As MS Planner does not provide any specific feature in which to insert the effort, an agreement has been adopted within the company among the team members and the project managers. The “description” field in the MS Planner Task has been filled using the following string: “Effort: resource1 (x)[y], resource2 (x)[y]”, where “resource1” and “resource2” will be substituted using the resources name, there may be a variable number of resources depending on how many team members are involved in the task. A distinction among planned and actual effort has been found using different type of parentheses: “(x)” describes that a resource has planned to spend x number of hours for completing the task, while “[y]” states the actual y effort amount a resource has spent.

Another lacking element was a differentiation among the tasks, which are planned tasks, new requests, and bug. A planned task is an activity which is already planned from the beginning of the deliverable, a new request is treated as a requirements or scope change from the client and generally arises after the release of a deliverable and before the beginning of a new one, therefore it is treated in the same way as a planned task, but it is still important to distinguish them for the sake of the monitoring tool to be set up. The bug task could be an error or a rework during the execution of the project, and for this reason it might arise at any time, therefore there is no planned effort but only an actual effort and is usually the main reason why a project could be delayed. Labels to differentiate the kind of tasks have been introduced: no label indicates a planned activity, yellow label shows a new request whereas a red one allows to distinguish a bug.

The pilot project is composed by 16 deliverables, and at this time the project has gone up until the 12th deliverable. As said above, the first phase of this hybrid approach is the low-detailed planning through an excel file. Three timeframes have been captured to analyse and follow the progress of the project: at the end of the 4th and 8th deliverables, and during the 12th. The images below show how the low-detailed plan of the project changes using this approach, in fact it is clear how the planning per deliverable approach creates the internal sprints and their respective duration which is no more than two weeks.

PROGETTO - X				
Deliverables	**Sprint interni**	**Inizio**	**Fine**	**Effort disponibile/risorsa per sprint**
1.Attivazione flusso da old BI		**13/03/2020**	**15/04/2020**	
	Sprint 1.1	13/03/2020	29/03/2020	88
	Sprint 1.2	30/03/2020	15/04/2020	104
2.Rilascio in produzione		**16/04/2020**	**30/04/2020**	
	Sprint 2.1	16/04/2020	30/04/2020	88
3.Modello Dati		**01/05/2020**	**09/05/2020**	
	Sprint 3.1	01/05/2020	09/05/2020	40
4. Sviluppo ETL		**10/05/2020**	**30/05/2020**	
	Sprint 4.1	10/05/2020	19/05/2020	56
	Sprint 4.2	20/05/2020	30/05/2020	64
5. Attivazione Flusso da OLD BI.2		**31/05/2020**	**06/06/2020**	
6. Analisi valorizzazioni		**07/06/2020**	**14/06/2020**	
7. Dev + Rilascio BICC		**15/06/2020**	**29/06/2020**	
8. Back-end + Rilascio BICC		**30/06/2020**	**01/08/2020**	
9. Analisi funzionale		**02/08/2020**	**25/08/2020**	
10. Data mapping		**26/08/2020**	**30/09/2020**	
11. Dev Backend		**01/10/2020**	**14/11/2020**	
12. Dev Frontend		**15/11/2020**	**05/01/2021**	
13. Cut Off		**06/01/2021**	**10/02/2021**	
14. Warehouse KPI		**11/02/2021**	**18/03/2021**	
15. Maruni		**19/03/2021**	**25/04/2021**	
16. Change request		**26/04/2021**	**03/06/2021**	

Figure 19 End of the 4th deliverable

PROGETTO - X				
Deliverables	**Sprint interni**	**Inizio**	**Fine**	**Effort disponibile/risorsa per sprint**
1.Attivazione flusso da old BI		**13/03/2020**	**15/04/2020**	
	Sprint 1.1	13/03/2020	29/03/2020	88
	Sprint 1.2	30/03/2020	15/04/2020	104
2.Rilascio in produzione		**16/04/2020**	**30/04/2020**	
	Sprint 2.1	16/04/2020	30/04/2020	88
3.Modello Dati		**01/05/2020**	**09/05/2020**	
	Sprint 3.1	01/05/2020	09/05/2020	40
4. Sviluppo ETL		**10/05/2020**	**30/05/2020**	
	Sprint 4.1	10/05/2020	19/05/2020	56
	Sprint 4.2	20/05/2020	30/05/2020	64
5. Attivazione Flusso da OLD BI.2		**31/05/2020**	**06/06/2020**	
	Sprint 5.1	31/05/2020	06/06/2020	40
6. Analisi valorizzazioni		**07/06/2020**	**14/06/2020**	
	Sprint 6.1	07/06/2020	14/06/2020	48
7. Dev + Rilascio BICC		**15/06/2020**	**29/06/2020**	
	Sprint 7.1	15/06/2020	29/06/2020	88
8. Back-end + Rilascio BICC		**30/06/2020**	**01/08/2020**	
	Sprint 8.1	30/06/2020	16/07/2020	104
	Sprint 8.2	17/07/2020	01/08/2020	96
9. Analisi funzionale		**02/08/2020**	**25/08/2020**	
10. Data mapping		**26/08/2020**	**30/09/2020**	
11. Dev Backend		**01/10/2020**	**14/11/2020**	
12. Dev Frontend		**15/11/2020**	**05/01/2021**	
13. Cut Off		**06/01/2021**	**10/02/2021**	
14. Warehouse KPI		**11/02/2021**	**18/03/2021**	
15. Maruni		**19/03/2021**	**25/04/2021**	
16. Change request		**26/04/2021**	**03/06/2021**	

Figure 20 Planning until the 8th deliverable

PROGETTO - X				
Deliverables	**Sprint interni**	**Inizio**	**Fine**	**Effort disponibile/risorsa per sprint**
1.Attivazione flusso da old BI		**13/03/2020**	**15/04/2020**	
	Sprint 1.1	13/03/2020	29/03/2020	88
	Sprint 1.2	30/03/2020	15/04/2020	104
2.Rilascio in produzione		**16/04/2020**	**30/04/2020**	
	Sprint 2.1	16/04/2020	30/04/2020	88
3.Modello Dati		**01/05/2020**	**09/05/2020**	
	Sprint 3.1	01/05/2020	09/05/2020	40
4. Sviluppo ETL		**10/05/2020**	**30/05/2020**	
	Sprint 4.1	10/05/2020	19/05/2020	56
	Sprint 4.2	20/05/2020	30/05/2020	64
5. Attivazione Flusso da OLD BI.2		**31/05/2020**	**06/06/2020**	
	Sprint 5.1	31/05/2020	06/06/2020	40
6. Analisi valorizzazioni		**07/06/2020**	**14/06/2020**	
	Sprint 6.1	07/06/2020	14/06/2020	48
7. Dev + Rilascio BICC		**15/06/2020**	**29/06/2020**	
	Sprint 7.1	15/06/2020	29/06/2020	88
8. Back-end + Rilascio BICC		**30/06/2020**	**01/08/2020**	
	Sprint 8.1	30/06/2020	16/07/2020	104
	Sprint 8.2	17/07/2020	01/08/2020	96
9. Analisi funzionale		**02/08/2020**	**25/08/2020**	
	Sprint 9.1	02/08/2020	13/08/2020	72
	Sprint 9.2	14/08/2020	25/08/2020	64
10. Data mapping		**26/08/2020**	**30/09/2020**	
	Sprint 10.1	26/08/2020	06/09/2020	64
	Sprint 10.2	07/09/2020	18/09/2020	80
	Sprint 10.3	19/09/2020	30/09/2020	64
11. Dev Backend		**01/10/2020**	**14/11/2020**	
	Sprint 11.1	01/10/2020	15/10/2020	88
	Sprint 11.2	16/10/2020	30/10/2020	88
	Sprint 11.3	31/10/2020	14/11/2020	80
12. Dev Frontend		**15/11/2020**	**05/01/2021**	
	Sprint 12.1	15/11/2020	27/11/2020	96
	Sprint 12.2	28/11/2020	10/12/2020	72
	Sprint 12.3	11/12/2020	23/12/2020	
	Sprint 12.4	24/12/2020	05/01/2021	
13. Cut Off		**06/01/2021**	**10/02/2021**	
14. Warehouse KPI		**11/02/2021**	**18/03/2021**	
15. Maruni		**19/03/2021**	**25/04/2021**	
16. Change request		**26/04/2021**	**03/06/2021**	

Figure 21 Planning during the 12th deliverable

The above excel file includes the following fields: Deliverables, Internal Sprints, Start Date, Due Date, and Available effort per sprint for each resource. This last field has been added to have more resource information in the monitoring dashboard.

The detailed plan is created in a new plan in MS Planner, and it is organized as shown below.

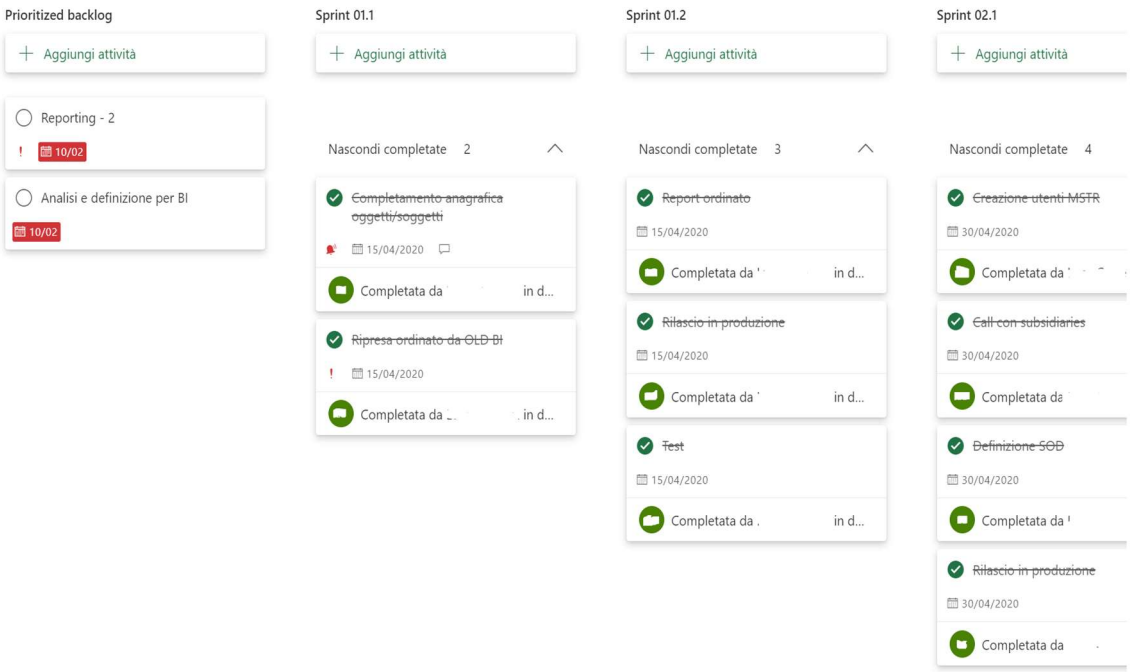

Figure 22 Screenshot of the MS Planner plan

The snapshot shows the prioritized product backlog and the first sprints, where each bucket contains a single sprint. In this image no improvements discussed above are shown, whereas opening a single task details enables to understand the changes in terms of how the template of the task is organized to gather information about effort for each resource. In the Notes field, the planned and actual effort is added for each resource, while each resource with its associated effort is separated with a comma from the other resource, if more than one. This is an important aspect for the back-end implementation of the dashboard.

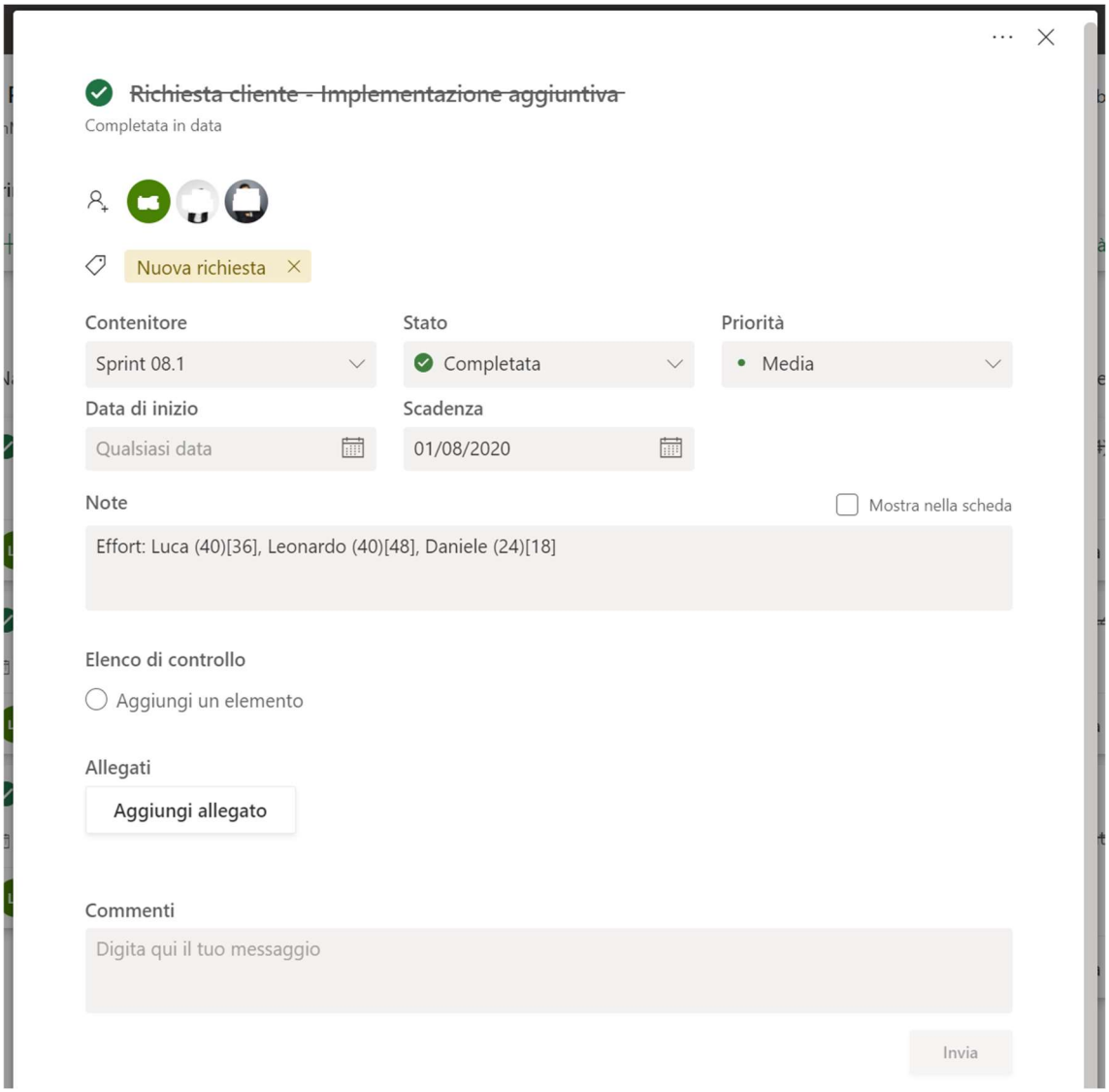

Figure 23 Detail of MS Planner task

The improvement aimed at showing the different kind of activities can be understood with the image below, where no labels are used for planned activities, while a yellow label is created for a new request that has arose from the client, and a red one for internal problems such as reworks or bugs that implied the creation of a new task to keep track of the issue. Planned effort for a red labelled task is zero, while the actual effort is added when the issue has been fixed.

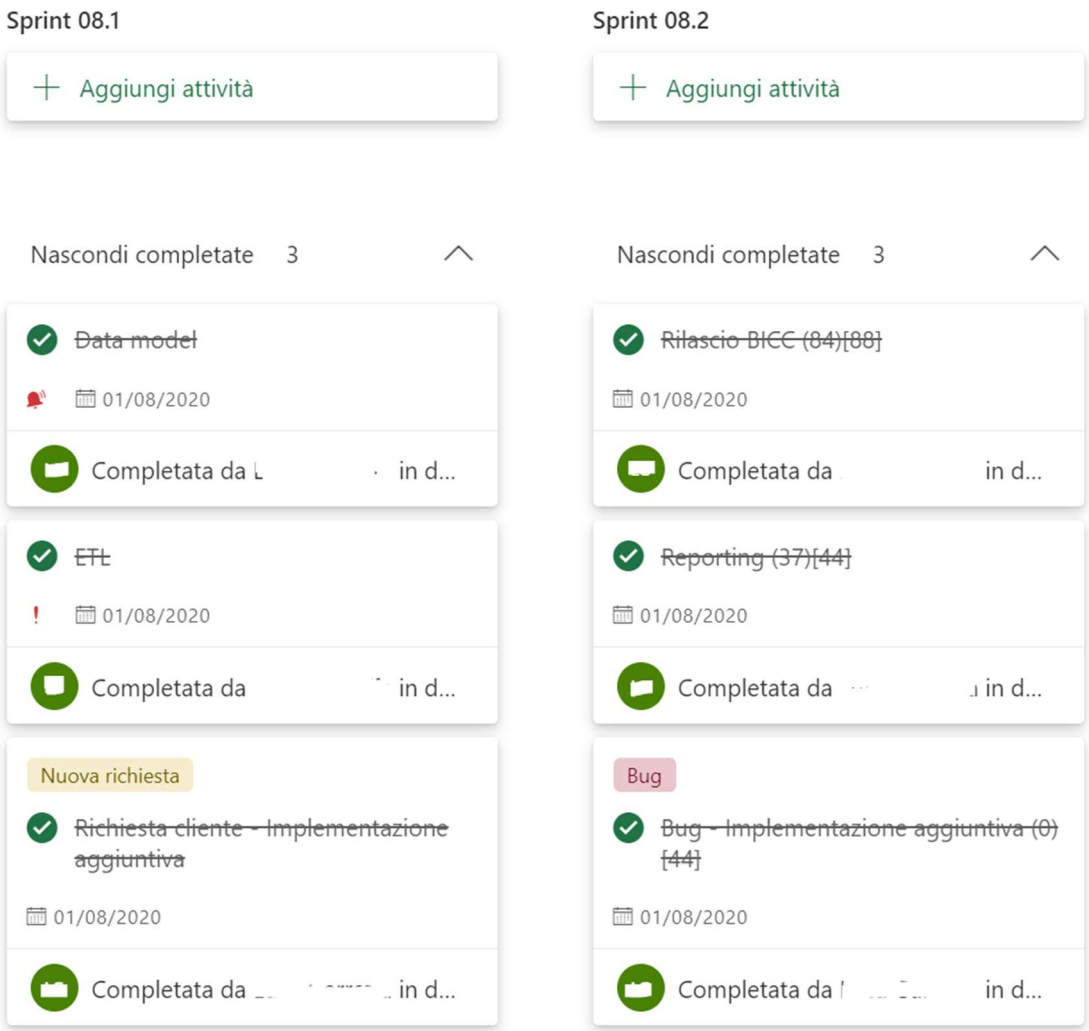

Figure 24 Different kinds of labelled tasks

Once these preliminary steps have been applied to the pilot project, the next step has been the creation of the monitoring dashboard which could allow to keep track of the project progress using a hybrid project management approach.

5.4 Monitoring dashboard

The aim of the creation of a customized monitoring dashboard has been to overcome one of the most stressed criticalities treated in the chapter above. A monitoring dashboard might overcome this issue, moreover it can enhance transparency and communication among resources and the project team, reducing the time spent in having informal discussions about the project progress. It allows to keep track of the project performance over its full lifecycle as well.

As Mediamente Consulting adopts MS Office 365 and it is well known by each member of the company, MS Power BI has been chosen as the reporting and visualization tool for the creation of the monitoring dashboard. It is part of the MS Office environment and it is already used as a reporting tool for some clients especially in the Business Intelligence business unit. Power BI is a collection of apps, connectors and software services that working together allow to create connections among unrelated data sources, turning them into interactive and coherent insights in a visual way. It is a highly flexible tool that allows to connect many of the most used data sources such as excel spreadsheets or on-premises and cloud-based data warehouses. It is intuitive and could be implemented in a high variety of ways, allowing it to be used in a high range of businesses of different dimensions given its adaptability.

The input sources for the monitoring dashboard are the low-detailed Excel plan and the detailed information for each task coming from the plan created in Planner. As there is no direct connection among Planner and Power BI, an Excel spreadsheet is needed to create a relation among the tools. Planner has an export function that allows to create an Excel file containing all the information inside the original plan. Columns are created according to the elements that characterize Planner: Task ID, Task name, Bucket name, Status, Priority, Assigned to, Created by, Creation date, Start date, Due date, Delay, Completed by, Completion date, Description, Control list completed, Control list, Labels.

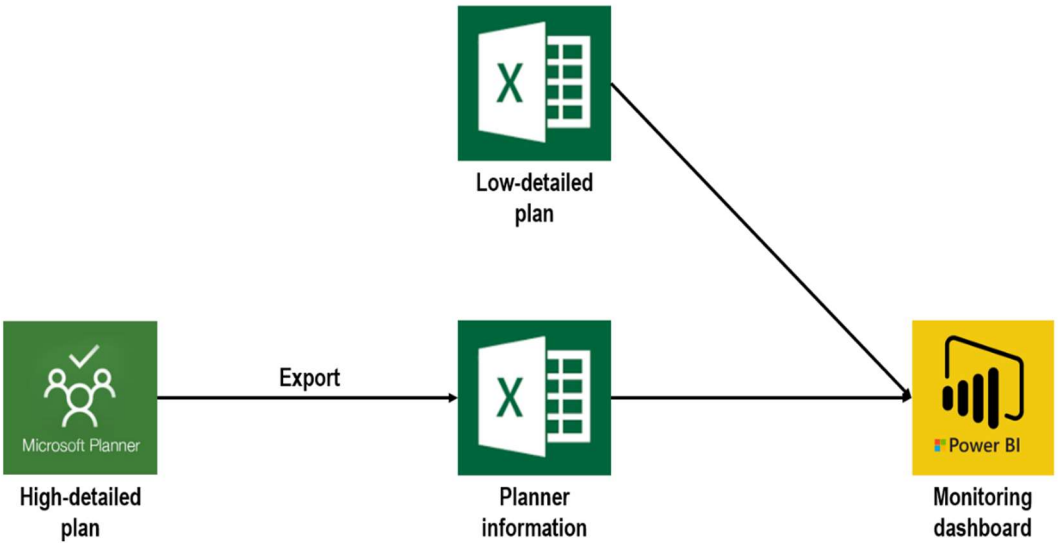

Figure 25 Input-Output scheme

To better understand the feasibility of the dashboard, a Proof of Concept has been developed before starting the real project of the monitoring tool that would be implemented in the company's project management process. A single Excel export has been done in Planner, to have the details of the pilot project at a particular moment in time, while the low-detailed plan has been taken in the same moment of the project progress. As there was the need to understand how to organize data from the input files, no transformation of data in Power BI has been done, because it would have been much more effort consuming compared to transforming data directly from Excel. From the low-detailed plan Excel point of view, a reorganization to have direct correspondence among deliverables and sprints has been done. In the Excel exported file from Planner, it has been necessary to extract different information coming from the description field in the tasks, such as the resources appointed for the tasks, as well as their respective planned effort and actual effort. A first transformation has been to isolate the "Effort: " string, and afterwards a VBA Macro has been created to trim the string whenever a comma was found while adding a new row for each resource inside the original string. Once that each resource with their efforts has been allocated to a single row, two new columns have been created to hold the planned and actual efforts, which have been isolated from the resources through a combination of Excel formulas.

After these data transformation have been performed, the two files have been used as input for Power BI, where graphs and KPIs have been created and developed with the constant feedback of the project managers to create a dashboard that could have been

easily integrated in the already established project management process of the company, adding value and efficiency.

5.4.1 Monitoring dashboard: Back-end implementation

Once the proof of concept has been created and understood, the following step has been the implementation of the back-end part of the tool that will be ideally used by the company.

The first phase of the transition from the proof of concept to the final product has been the need to sync the plan inside Planner with its exported Excel file. Planner is the tool that allows to update the plan, therefore the exported file needs to be always up to date, which is not feasible through always exporting manually the plan. Two ways have been thought to overcome this problem: a built-in Microsoft solution, which consists in using MS Power Automate that allows creating a flow of tasks that updates periodically a single excel file, which in turn can be used as data source for Power BI. The other solution is to insert data into a Database that through a combination of scripts allows to keep the DB up to date. The two solutions are in a phase of study and both feasible and will be implemented in the next future outside the thesis project. In this study, three stages of the project have been exported from Planner to show the progress of the pilot project.

The second phase of the backend implementation is about the transformation of the two data from the Excel sheets to be used in Power BI. The transformation of the low-detailed plan has been done directly in Excel, as it is done for each deliverable and it would be more time consuming using other approaches to transform that spreadsheet. Following it is shown how the Excel sheet has been changed from the structure in the showed in the previous chapter.

Deliverables	Sprint	Inizio preventivato	Fine preventivato	Effort disp per risorsa
01.Attivazione flusso da old BI	Sprint 01.1	13/03/2020	29/03/2020	88
01.Attivazione flusso da old BI	Sprint 01.2	30/03/2020	15/04/2020	104
02.Rilascio in produzione	Sprint 02.1	16/04/2020	30/04/2020	88
03.Modello Dati	Sprint 03.1	01/05/2020	09/05/2020	40
04. Sviluppo ETL	Sprint 04.1	10/05/2020	19/05/2020	56
04. Sviluppo ETL	Sprint 04.2	20/05/2020	30/05/2020	64
05. Attivazione Flusso da OLD BI.2	Sprint 05.1	31/05/2020	06/06/2020	40
06. Analisi valorizzazioni	Sprint 06.1	07/06/2020	14/06/2020	48
07. Dev + Rilascio BICC	Sprint 07.1	15/06/2020	29/06/2020	88
08. Back-end + Rilascio BICC	Sprint 08.1	30/06/2020	16/07/2020	104
08. Back-end + Rilascio BICC	Sprint 08.2	17/07/2020	01/08/2020	96
09. Analisi funzionale	Sprint 09.1	02/08/2020	13/08/2020	72
09. Analisi funzionale	Sprint 09.2	14/08/2020	25/08/2020	64
10. Data mapping	Sprint 10.1	26/08/2020	06/09/2020	64
10. Data mapping	Sprint 10.2	07/09/2020	18/09/2020	80
10. Data mapping	Sprint 10.3	19/09/2020	30/09/2020	64
11. Dev Backend	Sprint 11.1	01/10/2020	15/10/2020	88
11. Dev Backend	Sprint 11.2	16/10/2020	30/10/2020	88
11. Dev Backend	Sprint 11.3	31/10/2020	14/11/2020	80
12. Dev Frontend	Sprint 12.1	15/11/2020	27/11/2020	96
12. Dev Frontend	Sprint 12.2	28/11/2020	10/12/2020	72
12. Dev Frontend	Sprint 12.3	11/12/2020	23/12/2020	104
12. Dev Frontend	Sprint 12.4	24/12/2020	05/01/2021	88
13. Cut Off	Sprint 13.1	06/01/2021	23/01/2021	40
13. Cut Off	Sprint 13.2	24/01/2021	10/02/2021	56
14. Warehouse KPI	Sprint 14.1	11/02/2021	28/02/2021	64
14. Warehouse KPI	Sprint 14.2	01/03/2021	18/03/2021	40
15. Maruni	Sprint 15.1	19/03/2021	31/03/2021	48
15. Maruni	Sprint 15.2	01/04/2021	13/04/2021	88
15. Maruni	Sprint 15.3	14/04/2021	25/04/2021	104
16. Change request	Sprint 16.1	26/04/2021	08/05/2021	96
16. Change request	Sprint 16.2	09/05/2021	21/05/2021	104
16. Change request	Sprint 16.3	22/05/2021	03/06/2021	88

Figure 26 New organization of the low-detailed plan

It has been organized in a way to create a one-to-one correspondence among the deliverables and each sprint, otherwise Power BI does not recognize that there is a hierarchy between the sprint and its associated deliverable.

For what concerns the detailed plan exported from Planner, the main issue of the proof of concept was that all the data needed for Power BI have been transformed by modifying the exported worksheet, therefore it has been a manual operation rather than an automated one. To create an automated process that would have allowed to directly use the raw exported Excel worksheet, it has been necessary to operate through Power BI that enabled an automation of the transformation of the initial aggregated data into analysable ones.

After promoting the headers in the Power Query Editor, the initial data transformation from the raw exported Excel spreadsheet has been to divide the string of the Description field according to how many resources were appointed for each activity. Through the advanced editor using Power Query M, new columns have been created based on how

many resources were involved in the project, and their respective planned effort and actual effort. In this case, three resources have been totally involved in the project, therefore three columns have been created, and six more have been added in total to allocate their planned and actual effort to each separated column. In this table, called "Attività", whenever an activity involved less than three resources, an "ND" field was used in the resource column which was in surplus for that task. For example, if an activity involved two resources, the field in the column of the third resource has been filled with an "ND" string, and the related efforts field have been filled including a "0" string.

The following screenshot shows a section of the Power Query M code used to transform the data as said above.

```
    #"Added Custom" = Table.AddColumn(#"Changed Type1", "Prima risorsa", each try Text.Range([Descrizione],8,Text.PositionOf([Descrizione]
        ,"(",Occurrence.First,Comparer.Ordinal)-8)
otherwise "ND"),
    #"Added Custom1" = Table.AddColumn(#"Added Custom", "Effort Preventivo Prima Risorsa", each try Text.Range([Descrizione],
        Text.PositionOf([Descrizione],"(",Occurrence.First,Comparer.Ordinal) +1,Text.PositionOf([Descrizione],")",Occurrence.First,
        Comparer.Ordinal)-Text.PositionOf([Descrizione],"(",Occurrence.First,Comparer.Ordinal)-1)
otherwise "0"),
    #"Added Custom2" = Table.AddColumn(#"Added Custom1", "Effort Preventivo Seconda Risorsa", each try Text.Range(Text.Range([Descrizione]
        ,Text.PositionOf([Descrizione],",",Occurrence.First,Comparer.Ordinal)),Text.PositionOf(Text.Range([Descrizione],Text.PositionOf(
        [Descrizione],",",Occurrence.First,Comparer.Ordinal)),"(",Occurrence.First, Comparer.Ordinal) +1,Text.PositionOf(Text.Range(
        [Descrizione],Text.PositionOf([Descrizione],",",Occurrence.First,Comparer.Ordinal)),")",  Occurrence.First, Comparer.Ordinal)
        -Text.PositionOf(Text.Range([Descrizione],Text.PositionOf([Descrizione],",",Occurrence.First,Comparer.Ordinal)),"(",
        Occurrence.First, Comparer.Ordinal)-1)
otherwise "0"),
    #"Added Custom3" = Table.AddColumn(#"Added Custom2", "Effort Preventivo terza risorsa", each try if List.Count(Text.PositionOf(
        [Descrizione],",",Occurrence.All )) = 2 then Text.Range(Text.Range([Descrizione],Text.PositionOf([Descrizione],",",
        Occurrence.Last,Comparer.Ordinal)),Text.PositionOf(Text.Range([Descrizione],Text.PositionOf([Descrizione],",",Occurrence.Last,
        Comparer.Ordinal)),"(",Occurrence.First, Comparer.Ordinal) +1,Text.PositionOf(Text.Range([Descrizione],Text.PositionOf(
        [Descrizione],",",Occurrence.Last,Comparer.Ordinal)),")",  Occurrence.First, Comparer.Ordinal)-Text.PositionOf(Text.Range(
        [Descrizione],Text.PositionOf([Descrizione],",",Occurrence.Last,Comparer.Ordinal)),"(", Occurrence.First, Comparer.Ordinal)-1)
        else "0"
otherwise "0"),
    #"Added Custom4" = Table.AddColumn(#"Added Custom3", "Seconda Risorsa", each try Text.Range(Text.Range([Descrizione],Text.PositionOf(
        [Descrizione],",",Occurrence.First,Comparer.Ordinal)),2,Text.PositionOf(Text.Range([Descrizione],Text.PositionOf([Descrizione],",
        ",Occurrence.First,Comparer.Ordinal)),"(",  Occurrence.First, Comparer.Ordinal)-2)
otherwise "ND"),
    #"Added Custom5" = Table.AddColumn(#"Added Custom4", "Terza Risorsa", each try if List.Count(Text.PositionOf([Descrizione],",",
        Occurrence.All )) = 2 then Text.Range(Text.Range([Descrizione],Text.PositionOf([Descrizione],",",Occurrence.Last,Comparer.Ordinal)
        ),2,Text.PositionOf(Text.Range([Descrizione],Text.PositionOf([Descrizione],",",Occurrence.Last,Comparer.Ordinal)),"(",
        Occurrence.Last, Comparer.Ordinal)-2) else "ND"
otherwise "ND"),
    #"Added Custom6" = Table.AddColumn(#"Added Custom5", "Effort Consuntivo Prima Risorsa", each try Text.Range([Descrizione],
        Text.PositionOf([Descrizione],"[",Occurrence.First,Comparer.Ordinal) +1,Text.PositionOf([Descrizione],"]",Occurrence.First,
        Comparer.Ordinal)-Text.PositionOf([Descrizione],"[",Occurrence.First,Comparer.Ordinal)-1)
otherwise "0"),
    #"Added Custom7" = Table.AddColumn(#"Added Custom6", "Effort Consuntivo Seconda Risorsa", each try Text.Range(Text.Range([Descrizione]
        ,Text.PositionOf([Descrizione],",",Occurrence.First,Comparer.Ordinal)),Text.PositionOf(Text.Range([Descrizione],Text.PositionOf(
        [Descrizione],",",Occurrence.First,Comparer.Ordinal)),"[",Occurrence.First, Comparer.Ordinal) +1,Text.PositionOf(Text.Range(
        [Descrizione],Text.PositionOf([Descrizione],",",Occurrence.First,Comparer.Ordinal)),"]",  Occurrence.First, Comparer.Ordinal)
        -Text.PositionOf(Text.Range([Descrizione],Text.PositionOf([Descrizione],",",Occurrence.First,Comparer.Ordinal)),"[",
        Occurrence.First, Comparer.Ordinal)-1)
otherwise "0"),
    #"Added Custom8" = Table.AddColumn(#"Added Custom7", "Effort Consuntivo terza risorsa", each try if List.Count(Text.PositionOf(
        [Descrizione],",",Occurrence.All )) = 2 then Text.Range(Text.Range([Descrizione],Text.PositionOf([Descrizione],",",
        Occurrence.Last,Comparer.Ordinal)),Text.PositionOf(Text.Range([Descrizione],Text.PositionOf([Descrizione],",",Occurrence.Last,
        Comparer.Ordinal)),"[",Occurrence.First, Comparer.Ordinal) +1,Text.PositionOf(Text.Range([Descrizione],Text.PositionOf(
        [Descrizione],",",Occurrence.Last,Comparer.Ordinal)),"]",  Occurrence.First, Comparer.Ordinal)-Text.PositionOf(Text.Range(
```

Figure 27 Part of Power Query M code

The "Prima Risorsa" (first resource) column has been created by isolating from the Description field the string starting from the space after the "Effort:" string, until the first curved parentheses "(", which is indicating the information about the planned effort for the first resource. If these conditions are not met, an "ND" string in the Prima Risorsa

field related to that task is inserted. The fields related to the second and third resource follow the same logic, with the only difference in the starting point used to isolate the string, which is the first comma and the second one, respectively.

The planned effort for each resource is inserted in a custom column by isolating in the Description field the string contained inside each curved parenthesis. As there are more than one open and closed curved parenthesis inside the description field, an order needed to be created to allocate the planned effort to the right resource. Regarding the first resource, its related planned effort has been found by using the Power Query M function that allows to find the first occurrence of the string element we need to find. To find the planned effort related to the second resource, the coding has been created to look at the first curved parenthesis found after the first comma. The same method has been used for the third resource but searching for the curved parenthesis after the second comma. If no parenthesis were found, and "ND" string would have been inserted in the field.

The same method has been applied for the creation of custom columns related to the actual effort for each resource.

As a result of this transformation, this table is organized as follows: each row corresponds to a single task of the project, while new columns are created to isolate in a single column the resources and their related planned and actual efforts for each task. An example is shown below of how the resources and the efforts have been divided starting from an initial string from the Description column.

Prima risorsa	Effort Preventivo Pri...	Effort Consuntivo Prima R...	Seconda Risorsa	Effort Preventivo Seconda Risorsa	Effort Consuntivo Seconda
ND	0	0	ND	0	0
ND	0	0	ND	0	0
ND	0	0	ND	0	0
ND	0	0	ND	0	0
Luca	24	0	ND	0	0
Luca	56	0	ND	0	0
Luca	32	0	ND	0	0
Luca	24	0	Daniele	16	0
Daniele	24	0	Leonardo	24	0
Luca	0	8	Daniele	0	32
Daniele	32	40	Leonardo	40	38
Luca	8	8	Daniele	8	8
Luca	24	20	Leonardo	24	24
Luca	16	18	Leonardo	40	36
Luca	0	32	Leonardo	0	10
Luca	8	8	Leonardo	8	4
Luca	24	20	Leonardo	16	20
Daniele	8	6	Leonardo	8	8
Luca	8	12	Daniele	8	8
Daniele	8	6	ND	0	0
Luca	30	32	Daniele	24	28
Luca	20	24	Daniele	16	20
Luca	8	8	Leonardo	8	8
Leonardo	6	6	ND	0	0
Leonardo	0	44	ND	0	0
Luca	40	36	Leonardo	40	48
Luca	20	24	Daniele	20	16
Leonardo	20	18	ND	0	0
Daniele	24	30	ND	0	0
Daniele	8	6	ND	0	0

Figure 28 Screenshot of how the table is organized after the transformation

The final table to be used as input for the analysis of the information in the Power BI monitoring dashboard needs to be different compared to the one shown above after the transformation, therefore other operations need to be performed. The input table needs to have one single column containing all the three resources, one for all the planned effort and one for all the actual effort. This means that also the tasks need to be duplicated, and the total number of rows will be higher compared than the original one. This is a result given by the fact that each task can be performed by up to three different resources, therefore if a task is done by three resources it will be repeated into three different rows, indicating one single resource with its related effort for each row.

To do this, three new tables have been created. Starting from the original “Attività” table, it has been necessary to create a new table for each resource and its associated information about the planned and actual effort. The first table has been called “Attività Prima Risorsa”, which contained the same information of the original table but the custom columns about the information about the second and the third resource have been removed. The second table has been called “Attività Seconda Risorsa”, in which the custom columns containing the information about the first and the third resource have been removed. Moreover, a filter has been applied to remove the rows containing the “ND” string in the column containing the name of the second resource, in order to eliminate the tasks that did not have any second resource allocated.

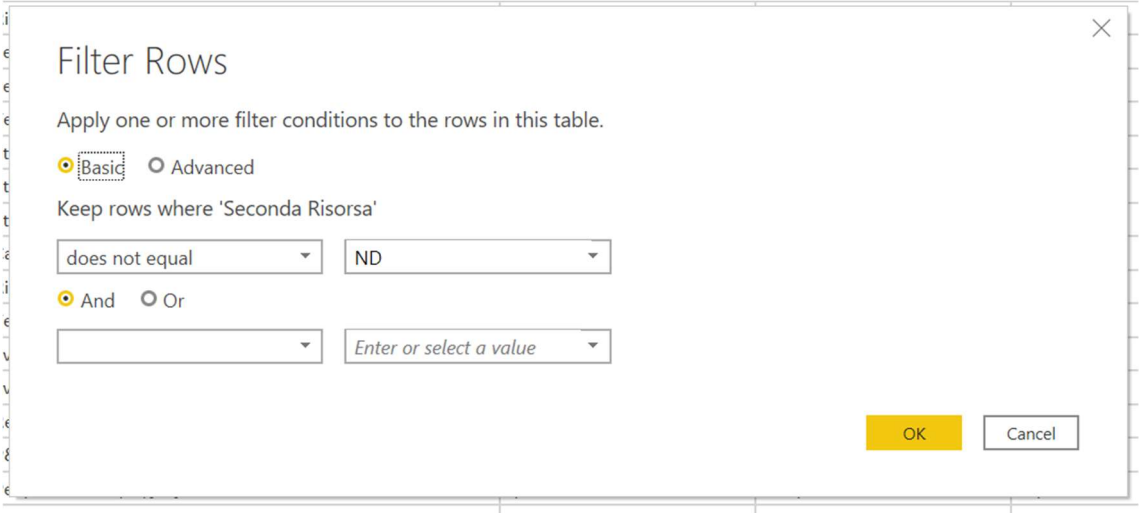

Figure 29 Screenshot of rows filtering by ND

The third table has been called "Attività Terza Risorsa" and, in which the custom column related to the first and second resource have been removed, while all the operations on this table have been the same of the second one. The "Attività Prima Risorsa" table has not been applied this filter because all tasks have at least one resource allocated, moreover it allows to keep track of the tasks in the product backlog which do not have any allocated resource. If this filter would not have been applied in the second and third table, there would have been a redundancy in the information.

The three tables with single resource information have been created, the next and final step for the creation of the input table has been to create a new table called "Attività per Risorsa" which has been the result of the three previous tables joined together. This has been possible through the Append function into Power Query Editor, as shown in the screenshot below.

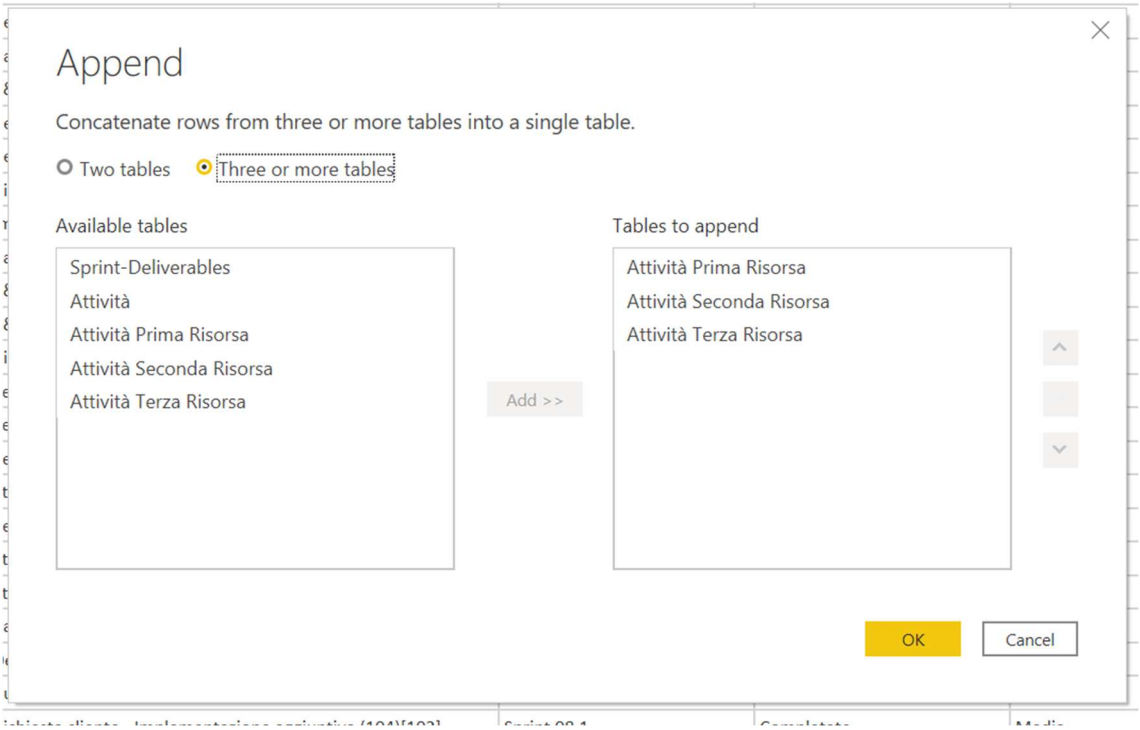

Figure 30 Screenshot about append function in Power Query

The "Attività per Risorsa" table along with the "Sprint-Deliverables" table, which is the low-detailed plan transformed directly through Excel, have been used as the input for the creation of the monitoring dashboard for the pilot project.

The next step in the back-end implementation for the creation of the dashboard has been to create the model which is a fundamental step to define the relationships among the input tables.

Meanwhile, a Calendar table has been created, which is a table of dates and contains one row for every date that might occur in the dataset to be analysed. It allows to create relationships among tables that have a date information in a univocal way.

The model has been created as shown below and consists of three tables that are linked together.

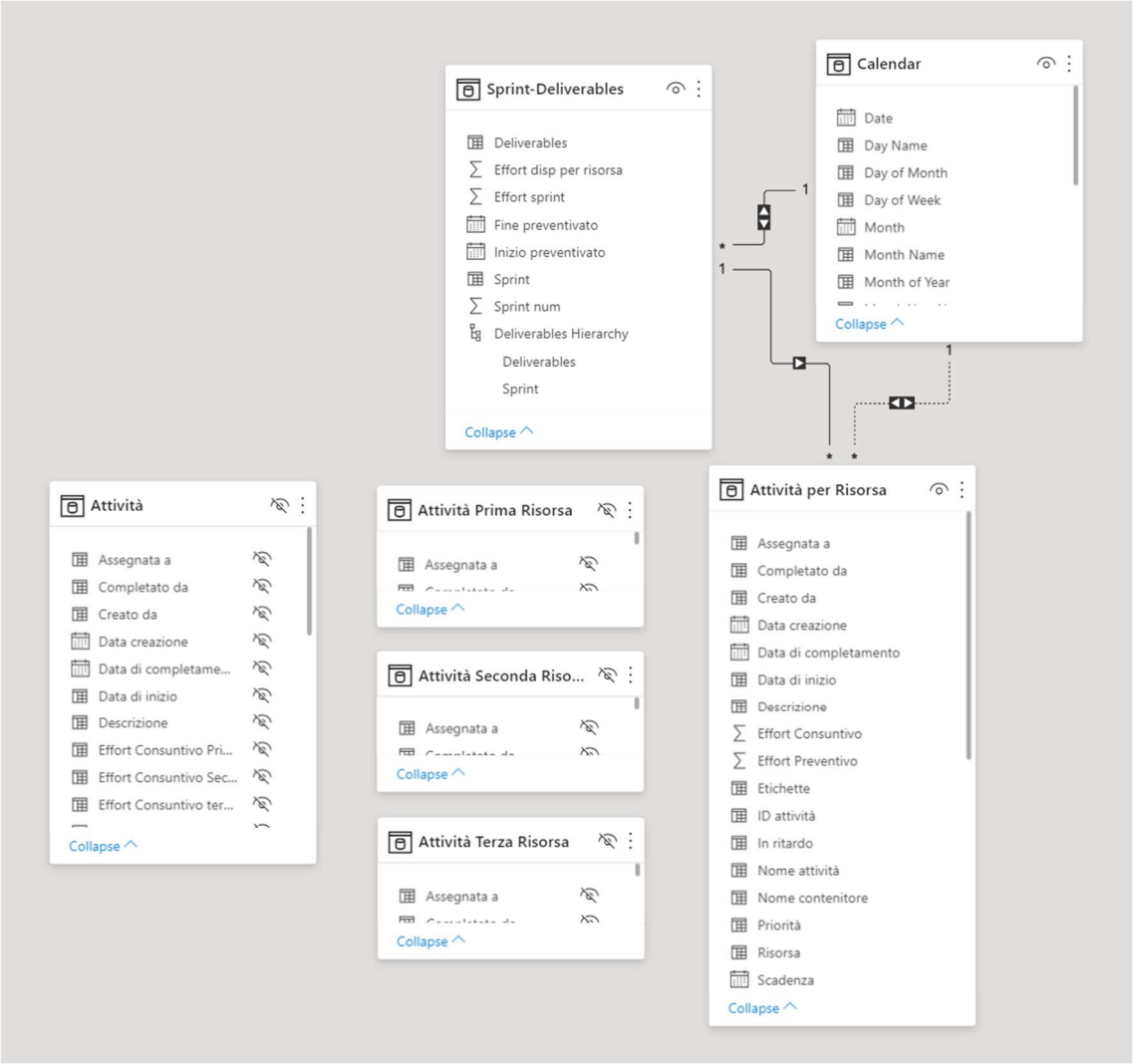

Figure 31 Model used to visualize data

The four tables that have been used for the transformation of data to create the "Attività per Risorsa" table have been all inactivated, as there is no need to use them in the creation of the model for the aim of the monitoring dashboard.

The "Calendar" table has been linked with a 1:* (one to many) relationship with the "Sprint-Deliverables" table, linking respectively for each table the Date field and the Fine Preventivato (planned due date for each sprint) one. The relationship in this way allows to have many rows of the "Sprint-Deliverables" table which have the same Fine Preventivato due date, while keeping univocal the Date in the "Calendar" table that cannot have the same date in different rows.

Another 1:* relationship has been created among the "Sprint-Deliverables" table and the "Attività per Risorsa" one by linking respectively the Sprint field and the Nome Contenitore (namely, bucket name). The first one is univocal, as each row of the first

table contains a different sprint, while the second table has several rows containing the same sprint, as the detail level is higher, and each row is detailed based on a single resource appointed to a task.

The last relationship among the three tables has been done to create a link among the Date field in the "Calendar" table and the Data di Completamento (namely, completion date) into the "Attività per Risorsa" table. As Power BI allows to create only one active relationship for each table and there has been the need to have two active relationships in the same table, it has been necessary to operate through the DAX operator USERELATIONSHIP that allows to activate a relationship among two tables, even if there is already an existing active relationship created at the model level.

From the model point of view the relationship created is inactive, and this is shown by the dashed line that links the two tables, compared to the other links that are done through a continuous line. The image below shows the DAX level in which it has been necessary to operate, and this is also used to create the measures used to create the graphs and KPIs in the monitoring dashboard during the front-end implementation.

```
1 Effort preventivo cumulato per Data Completamento = CALCULATE( [Effort Preventivo running total in Fine preventivato],
2 USERELATIONSHIP('Calendar'[Date],'Attività per Risorsa'[Data di completamento]),
3 FILTER(ALLSELECTED('Attività per Risorsa'[Data di completamento]), NOT(ISBLANK('Attività per Risorsa'[Data di completamento])))
4 )
```

Figure 32 DAX operation to activate the inactive relationship

The model has been created and the back-end implementation has been completed, therefore it has been possible to go on with the front-end implementation in which the measures, graphs and KPIs have been created to release the monitoring dashboard for the pilot project.

5.4.2 Monitoring dashboard: Front-end implementation

The starting point of the front-end implementation has been the literature review and the needs that have arose from the surveys done with the project managers. The tool has been thought in a way to be as much integrable possible with the project management approach to be used as a standard for the future. The main areas of a project that needed a monitoring tool have been found to be the project progress and resources information.

Four dashboards have been created to display all the information gathered, and each of them will be shown through the pilot project in three different phases: at the end of the fourth deliverable, during the eighth deliverable and during the twelfth deliverable.

The first dashboard has been designed with a cumulative flow diagram, a bar chart showing for each deliverable the different kind of tasks identified by the labels, and the total effort that has been spent by deliverable for each type of task. Three KPIs have been chosen: the total planned effort for the whole project which will increase or decrease throughout the project due to the change requests from the client (Effort Fine Progetto), the actual effort spent so far given by the sum of the completed tasks (Effort Consuntivo), and the actual effort spent in the project given by the sum of the completed tasks and those that are in progress (Effort consuntivo WIP).

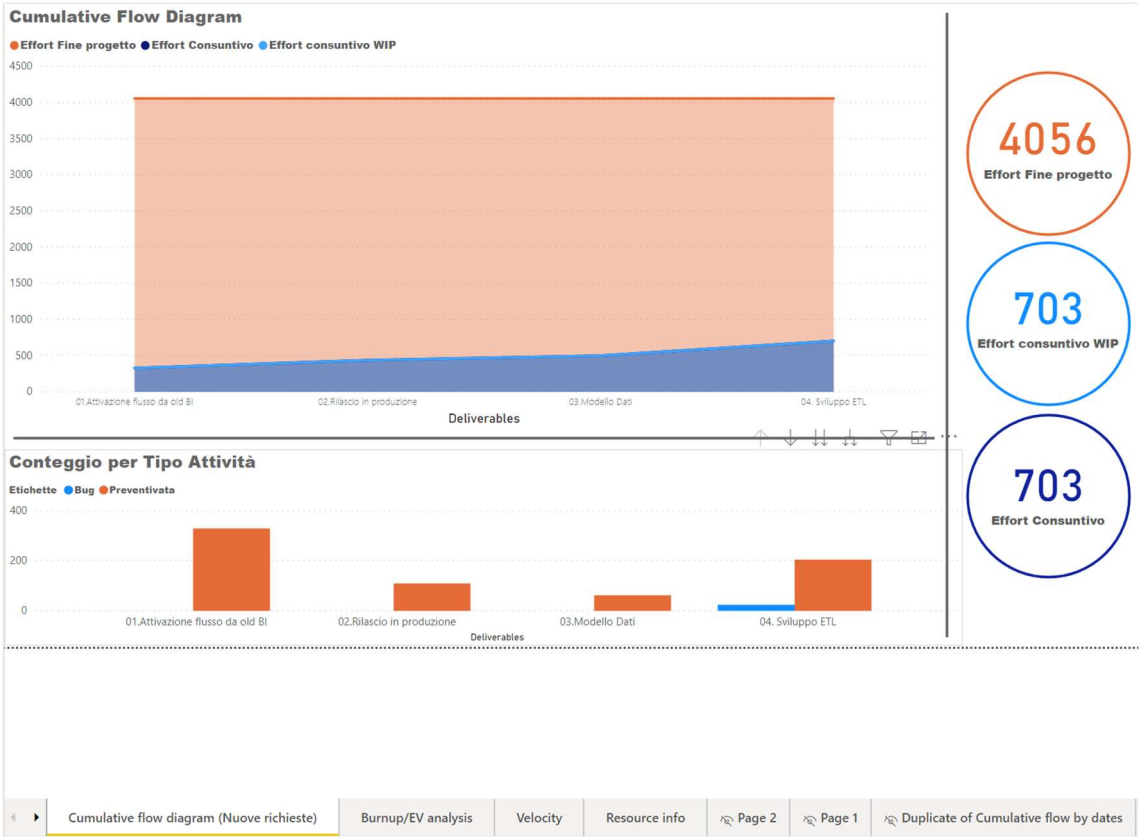

Figure 33 Cumulative flow diagram view, end of 4th deliverable

At the end of the deliverable 4 as seen in the screenshot above, two KPIs have the same values as the deliverable 4 has been released and no tasks are in progress. The line of the Effort Fine Progetto in the cumulative flow diagram is flat as no new requests have arisen from the client, indeed no labels indicating a new request are still present.

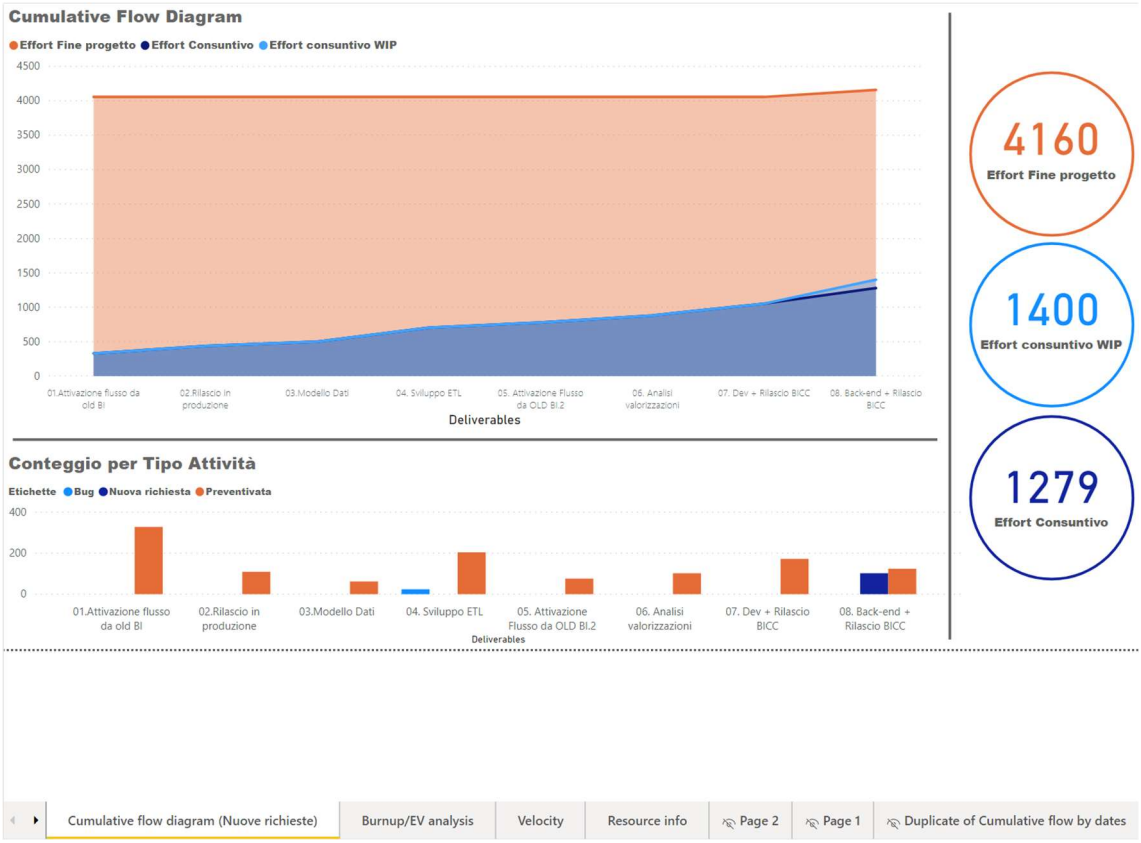

Figure 34 Cumulative flow diagram, during 8th deliverable

The image below shows the progress during the deliverable number eight, and there is a small difference among the two actual effort metrics as the deliverable is in progress and some tasks have not yet been completed. The cumulative flow diagram shows an increase in the planned effort for the whole project, as a new request has arisen during the deliverable in progress. The new request labelled task can be seen in the chart below the cumulative flow diagram.

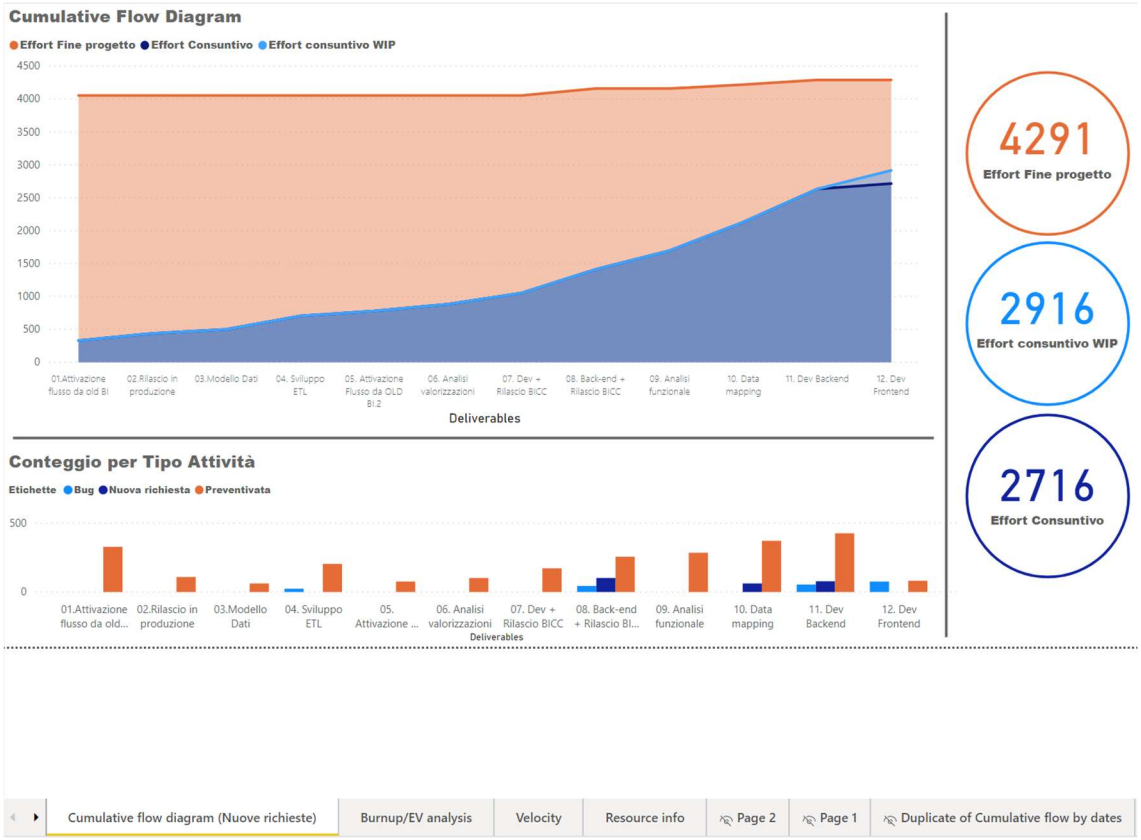

Figure 35 Cumulative flow diagram, during 12th deliverable

In the deliverable 12, which is the deliverable at which the project is in progress during the end of this thesis, activities are in progress and there is a higher discrepancy among the two KPIs about actual effort compared to the deliverable 8. Some bug labelled tasks can be detected, and the consequences in terms of project performance will be shown in the next dashboards.

In the visuals displayed above, the x-axis of the two graphs shows the deliverables dimensions. As the deliverables and the sprints have been set in a hierarchy, Power BI allows to drill down the graphs to the more detailed dimension. Through the drill down function, the two graphs can change the x-axis dimension from the deliverable to the sprint. This could be useful especially internally to the company, as the sprints help to keep track of the project progress inside each deliverable, while the higher-level dimension could be displayed to the clients as well. The screenshot below shows how the visuals changes when drilling down the two graphs.

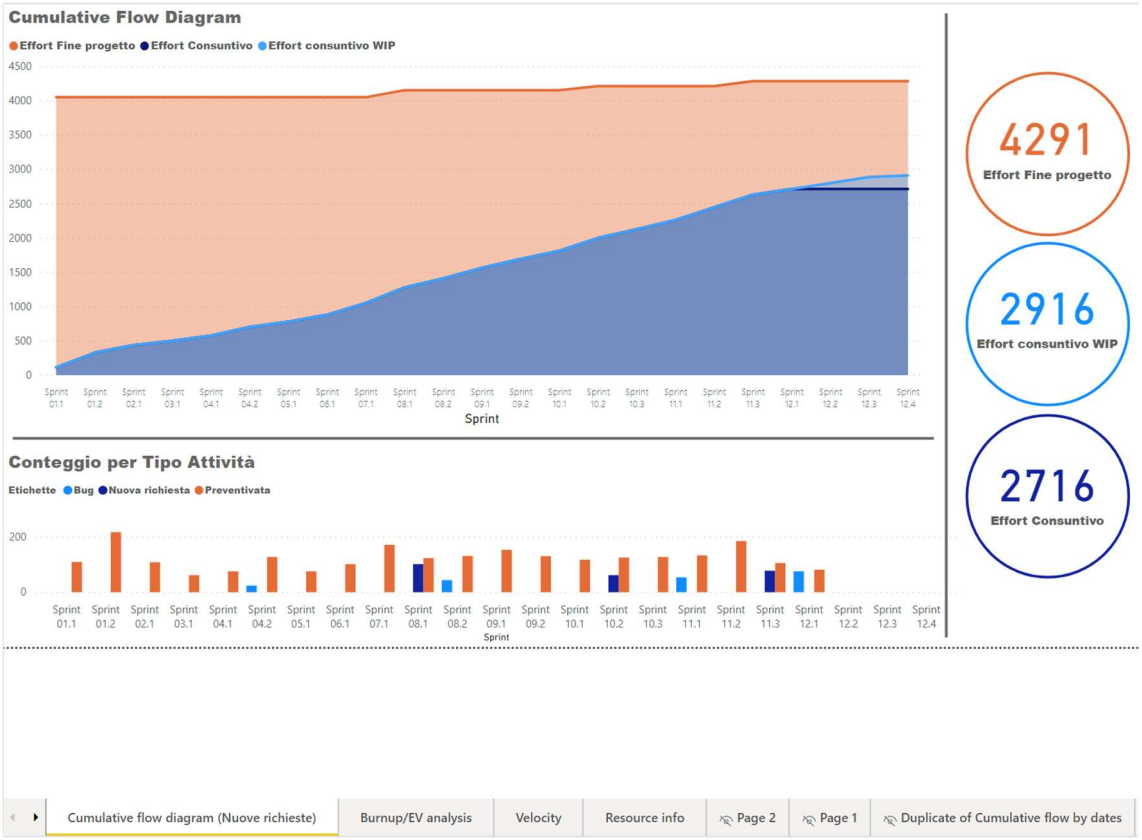

Figure 36 Cumulative flow diagram, during 12th deliverable with sprint view

The measures such as the cumulative sum of the actual and planned efforts have been created through DAX, which is the programming language used in Power BI. Below is shown how the Effort consuntivo WIP metric has been created, and the method has been repeated and slightly changed for each of the metric needed for the monitoring dashboard. The coded measures can be used as the other data to create graphs and useful insights or KPIs for the dashboard.

```
Effort cumulato wip = CALCULATE([Effort Consuntivo running total in Deliverables] +
    CALCULATE(SUM('Attività per Risorsa'[Effort Preventivo]),
        'Attività per Risorsa'[Stato]="Non iniziate",
        FILTER(
            ALLSELECTED('Sprint-Deliverables'[Deliverables]),
            ISONORAFTER('Sprint-Deliverables'[Deliverables], MAX('Sprint-Deliverables'[Deliverables]), DESC)
        ),
        FILTER(
            ALLSELECTED('Sprint-Deliverables'[Sprint]),
            ISONORAFTER('Sprint-Deliverables'[Sprint], MAX('Sprint-Deliverables'[Sprint]), DESC)
        )
    )
)
```

Figure 37 Example of DAX code for creation of measures

The second dashboard shows the earned value analysis for the project. On the x-axis, the linear time is considered while the y-axis does not have the cost as the traditional s-curve,

but the effort is considered, as the costs in Mediamente Consulting are directly proportional to the effort of the consultants.

The s-curve graph shows the planned value, earned value and actual cost. There is the possibility to choose whether to look at the overall performance of the project, or at the single resource performance over the project. It could be a useful insight for the project managers to understand the value that each resource creates with respect to the costs. The KPIs displayed in this dashboard are the CPI and SPI index, which are created as measures in Power BI and are calculated as suggested from the literature.

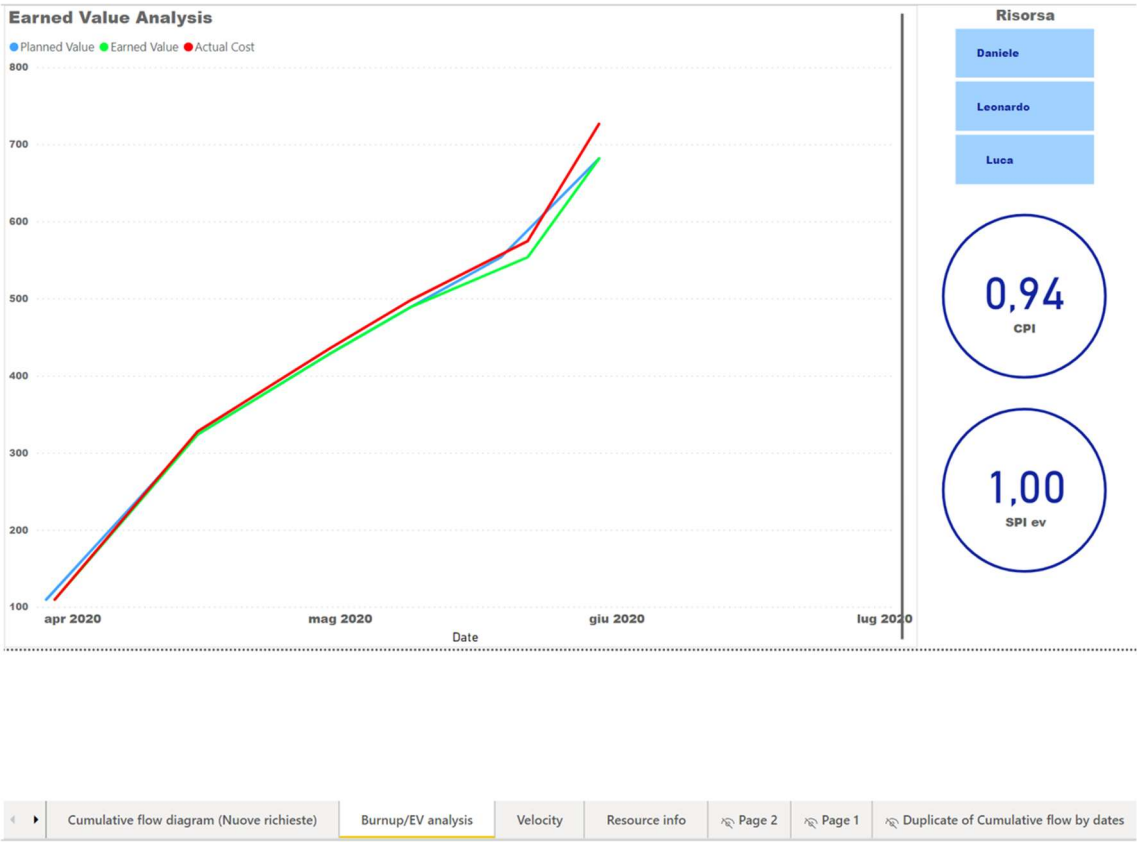

Figure 38 EV analysis, end of 4th deliverable

As shown in the screenshot above, at the end of the fourth deliverable the project is on track in terms of time, while it has been spent slightly more than planned.

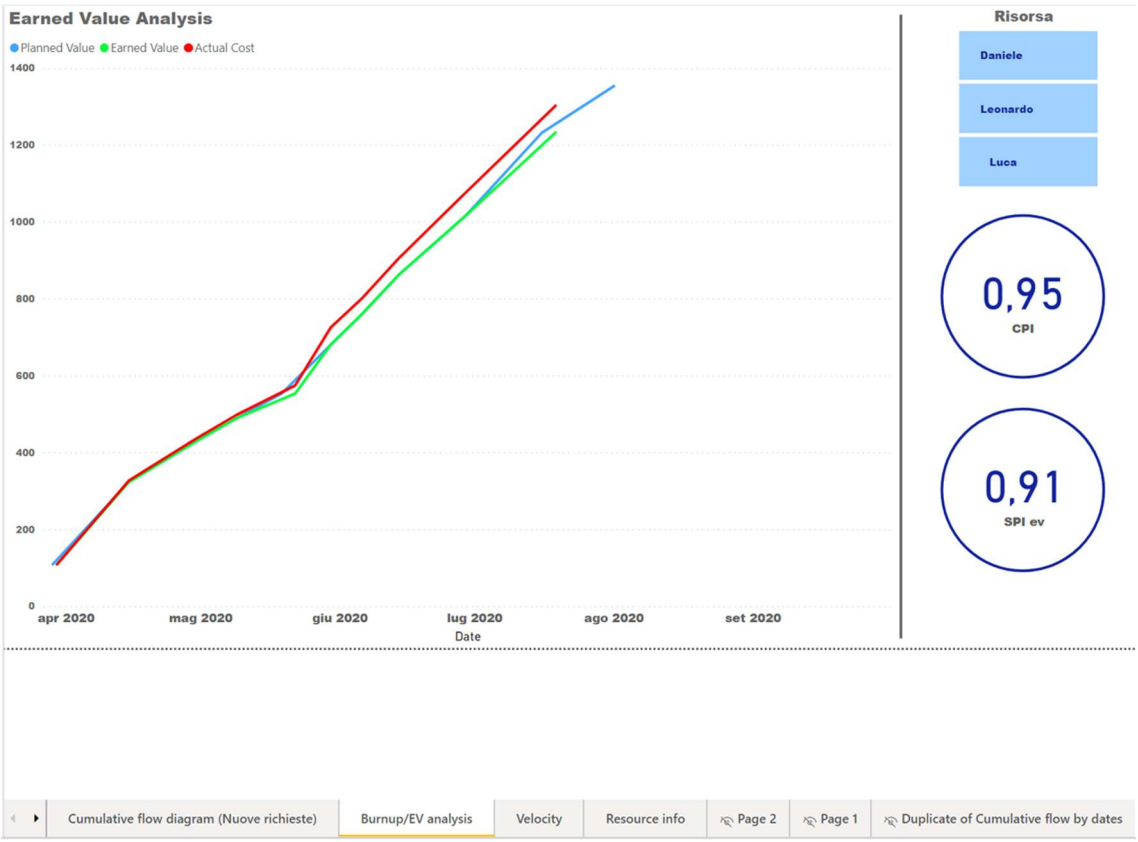

Figure 39 EV analysis, during 8th deliverable

While the eighth deliverable is in progress, the planned value line is longer than the other two lines. This is because the planning phase is done for the entire duration of the deliverable, therefore the length of the planned line goes until the deliverable is finished. The actual cost and earned value line are instead updated at the end of each sprint, therefore if the deliverable has not been completed there will be a discrepancy in the length of the curves.

The screenshot below shows the progress of the project so far, where it is displayed that the project is slightly in delay and is running overbudget. A high increase in costs can be seen in November 2020 in order to put the project back on track in terms of schedule.

Figure 40 EV analysis, during 12th deliverable

The image below shows the other possible view of the current dashboard, in which one single resource is selected, and this allows to keep track of the resource performance.

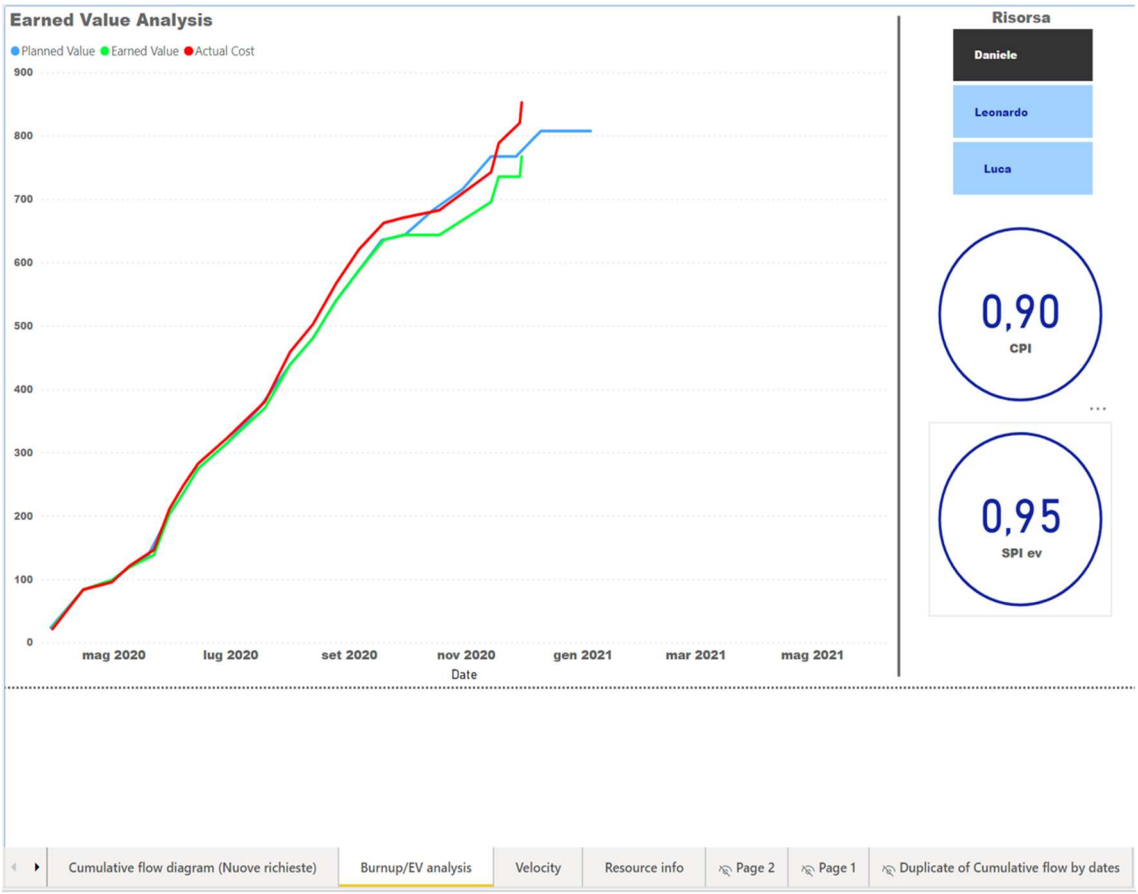

Figure 41 EV analysis, during 12th deliverable with single resource view

The third dashboard shows the velocity, which is expressed as a comparison between the planned effort and the actual effort for each deliverable. By dividing these two data, the resource efficiency can be found: this could be an insight to understand the productivity of the resources and to plan in the best way the workload for the following sprints and deliverables. Other two KPIs are related to the number of activities which are related to bugs and new requests.

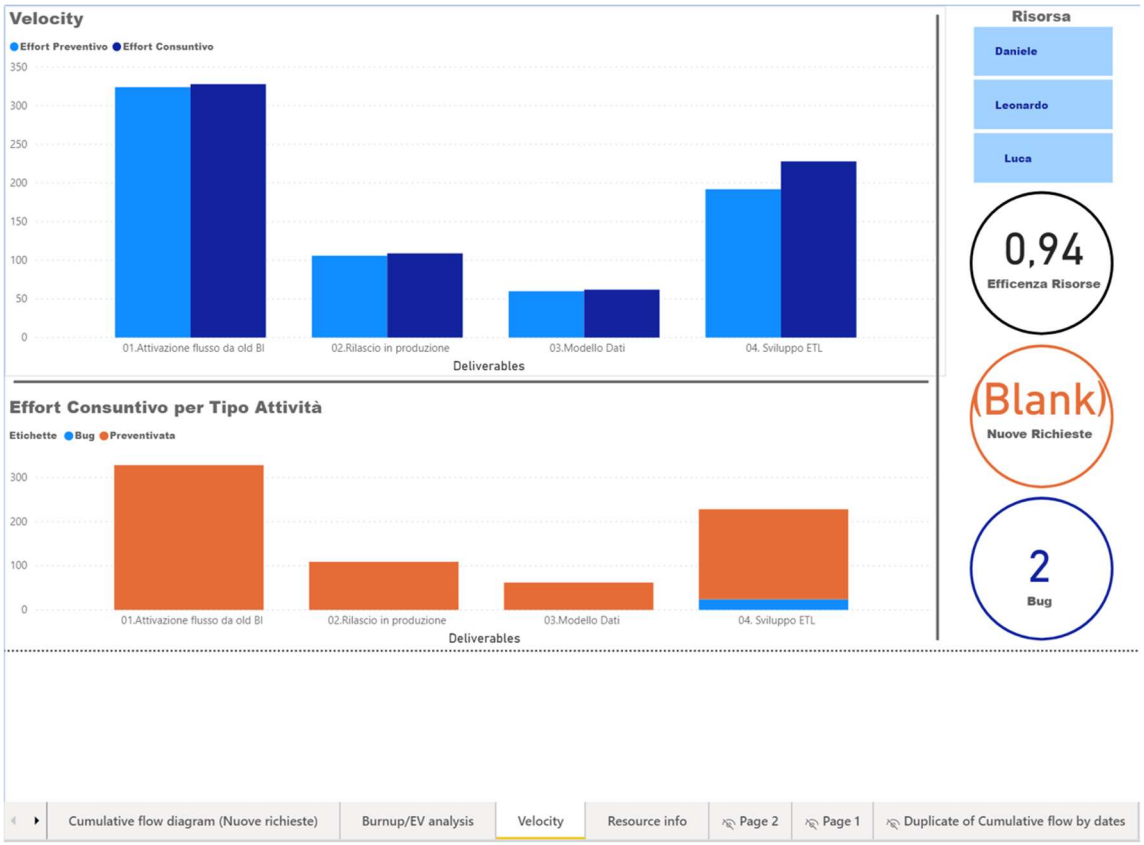

Figure 42 Velocity view, end of 4th deliverable

In the case of the project at the end of the fourth deliverable, the KPI related to the new requests is blank as no new requests have arisen. The graph below the velocity chart shows the share of effort for each kind of activity, divided by deliverables.

At the eighth deliverable it is displayed a high discrepancy between the planned effort and the actual effort, this is because the deliverable is in progress. The efficiency of the resources is almost optimal, and three new tasks are added due to new requests coming from the client.

Figure 43 Velocity view, during 8th deliverable

The efficiency has decreased at the twelfth deliverable, this has been mainly due to bugs that have arisen in the deliverable number eight, eleven and twelve. In the deliverable number eight and eleven it is clearly shown a discrepancy among the planned effort and the actual effort, as shown in the image below.

Figure 44 Velocity view, during 12th deliverable

A drill down operation is possible in this dashboard as well, it allows to keep track of the inefficiencies at a sprint level compared a lower detail level.

Figure 45 Velocity view, sprint view during 12th deliverable

The dashboard can be shown as well at a single resource level instead of an overall project level. This flexibility allows a high variety of visuals giving insights about several aspects of the project from different points of view.

Figure 46 Velocity view, single resource during 12th deliverable

The fourth dashboard represents information about resources that project managers need in order to keep track of the progress in terms of resources, and to understand possible root causes of certain issues occurred during the execution of it.

The clustered column chart shows the actual effort of each resource with respect to the potential available effort per resource. By comparing these measures, the KPI about the resource occupation is found. The 100% stacked column chart shows the distribution of the actual effort spent in a deliverable by each resource in percentage points. The first graph changes while each resource is selected, while the second one shows a general view to compare the amount of work that each resource has spent in the project.

Figure 47 Resource Info view, end of 4th deliverable

During the fourth deliverable, it is shown a 48% of utilization of a resource, meaning that it might be allocated to other projects while working on this one.

Figure 48 Resource info view, during 8th deliverable

At the eight deliverable the situation has not changed with respect to the previous one, meaning that the resource has been allocated to this project in a 50% of its available time, while working on other projects during the remaining time available.

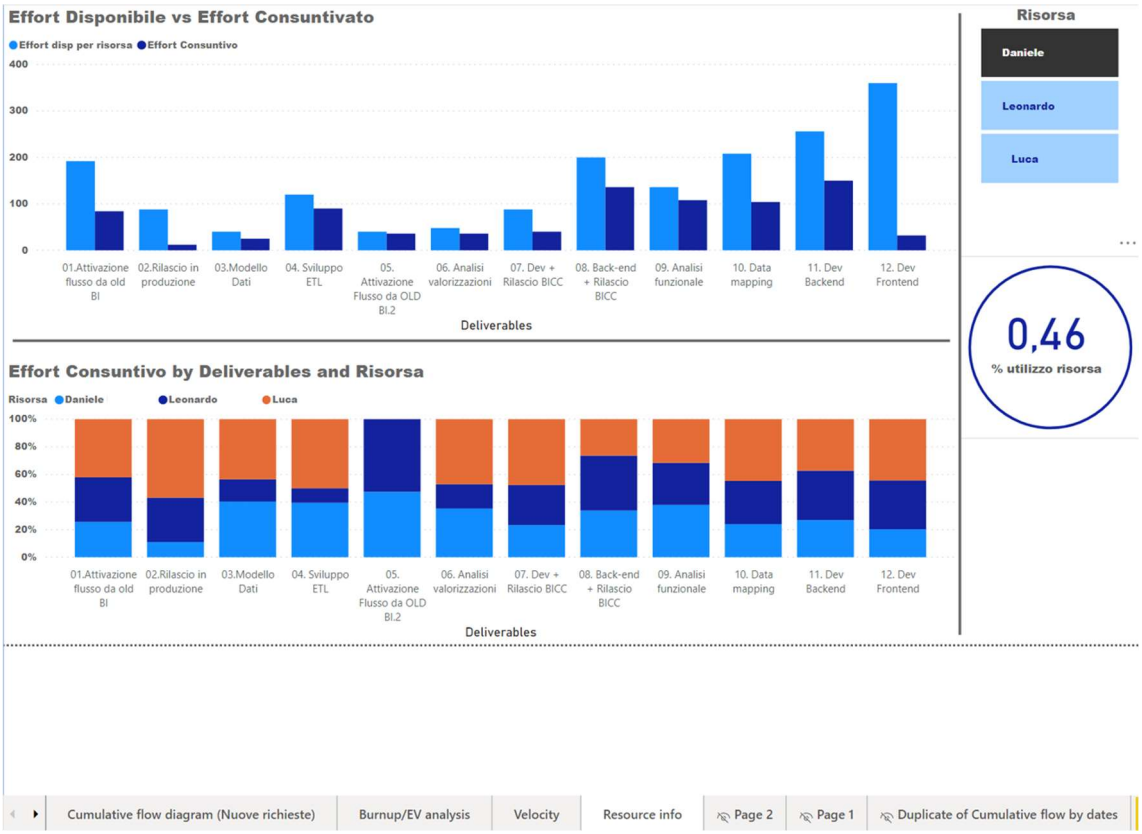

Figure 49 Resource info view, during 12th deliverable

This can be shown during the deliverable number twelve as well, while in the 100% stacked column chart it is possible to understand the utilization of all the resources in an aggregate way, where some resources have been allocated most of their time in this project, while others have been allocated to a lower percentage of their available time to this project and working on other projects as well at the same time. As Mediamente Consulting is a management consulting company, it happens very often that the resources are allocated to multiple projects at the same time.

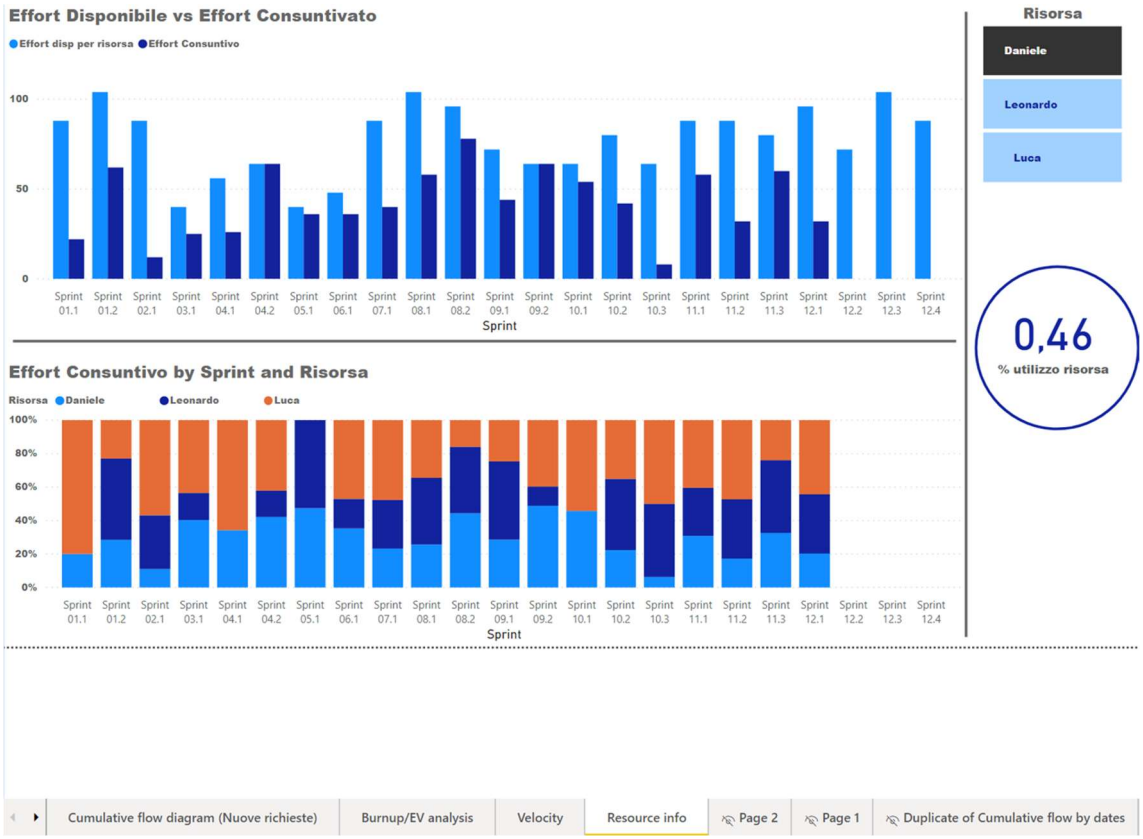

Figure 50 Resource info view, during 12th deliverable with sprint view

The screenshot above shows a sprint view compared to the previous deliverable, which has been obtained by using the drill down function as in the previous dashboards. It allows to understand in a more detailed way the allocation of each resource for each sprint and enables project managers to better understand how resources have been utilized an in which percentages for each project.

5.4.3 Results, validation, and benefits

The monitoring dashboard is intended to overcome the problem of the lack of project's progress and related resources information, which starting from an already existing project management approach and adding some information it has been demonstrated that the problem could be overcome. One important step to adopt the above monitoring tool is to standardize and make sure that the project management approach used as starting point will be adopted and accepted by all the members the company. If needed, there could be the possibility to allow some changes in the project management approach in order to create a unified method, which is the starting point for the creation of the monitoring dashboard. Another important step is to make sure everyone in the company adopts the same tools: as MS Office 365 is the standard tool, the monitoring dashboard

has been created according to an already established environment that allows to minimize the training to learn a new tool. Other tools such as Freedcamp have been used in the past but keeping a single established environment will help to improve from the monitoring point of view by just improving some processes instead of radically changing them. This will also help to create an internal culture in which the new approach and tool is accepted without any reluctance by the team members.

The final result of the monitoring dashboard has been presented to the project managers, who would become the main users. As the dashboard has been created by following the criticalities and the guidelines proposed by the project managers through a constant informal feedback throughout the design of the monitoring tool, it has gained a general appreciation by the project managers and it has been recognized to be a platform which could be well integrated into the already established company processes, as everyone in the company is already trained with the tools used.

The tool allows a good flexibility in terms of data visualization, in fact the function allowing to switch the charts from a deliverable to a sprint points of view enables the monitoring dashboard to be presented both internally by looking also more in detail for each sprint, and also externally to the client by showing the progress of the project at a deliverables level.

The main drawback that has been recognized by the majority of the final users is the set-up time, which requires a considerable amount of effort in terms of back-end and front-end implementation. For this reason, it has been agreed that the tool is potentially usable for medium and large-sized projects, while for small projects with a duration of few weeks it would be too time consuming to set up such a complex tool. Another drawback is the need for a high commitment and attention of the users while inserting the efforts in the description field of the tasks in Planner, as an error for example in the parenthesis could lead to misleading input data for the monitoring tool. Team members will also need to remember inserting the effort information in each task, therefore a training could be important to explain and let them understand the benefits of using such a structured approach, which could be perceived as a waste of time by some of them, but it is very important for the monitoring aspect of the project and to timely intervene as issues occur.

The tool has been particularly recognized as useful when the weekly project managers meetings occur. To show the projects progress right now, an Excel spreadsheet is used,

while no visualization tool is used. Adopting such a monitoring dashboard could give valuable insights in a highly impactful and visual way, helping understand immediately the issues and the main key points of a project. As the CEO asks for the projects progress to each project manager, a monitoring tool like this could be helpful to exchange information whenever is needed without the need to ask directly to each project manager.

This tool has been recognized to be a further step useful to create a standardization which is needed for the company, as it is in a growing phase and many of the informal processes that are now used are becoming less efficient compared to other structured approaches.

6. Conclusions and future perspectives

A future development idea of the monitoring dashboard is to improve and expand the tool in such a way that it would be able to gather information at a project portfolio level, instead of looking at a single project. This would be particularly helpful to gain insights at a Board of Directors level, to understand the profitability and the status of each project with respect to the initial plans. The actual developed dashboard is more addressed to the single project managers and their teams, while a portfolio dashboard would be very useful for the top management level. The two dashboards might ideally be integrated together, where it would be possible to go in detail from the portfolio level to the single project, helping understand in which projects it could be possible to improve and which return the highest profitability, gaining insights on the project managers performance as well instead of just the team members of the single project.

To conclude, this Master Thesis has shown a possible application of a tailored hybrid project management approach, with a particular focus on the monitoring phase by designing a monitoring dashboard which reflects the project management approach used as a standard. It has been an exploration of a hybrid approach, which is one of the trends that are gaining more attention in recent years, and this could be a change in a culture in which the project management approach is ideally created according to each company characteristics, rather than following an established and standardized project management approach.

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