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Abstract

Purpose – The purpose of this paper is to analyze the benefits of the agile project management (APM) framework compared to the traditional waterfall model, and understand how it can help companies add value and gain competitive advantage.

Design/methodology/approach – The methodology used was the exploratory qualitative research through a case study of a software project, developed with the support and application of the Scrum framework, in a pharmaceutical industry information technology project.

Findings – There were benefits found in the utilization of the agile framework, such as increased motivation and staff satisfaction, better control of requirements and especially higher quality of the delivered system, generating added value to the organization. Additionally, the project allowed the use of features from the first month of the application deployed, enabling a 75 percent reduction in development time, compared to traditional methods. The software development time was four months, 30 percent of what would be the total if the traditional methodology was adopted. Based on the results, the agile framework, especially the Scrum, proved to be a viable option as a project management approach.

Research limitations/implications – Since this research is an exploratory case study, its results cannot be generalized.

Practical implications – The paper provides relevant practical information and experiences to managers interested in implementing APM, as well as those interested in improving the management of projects.

Originality/value – This paper provides a case study with practical implications of using APM, and APM's benefits and advantages are compared with the traditional waterfall approach. Companies can use this case study to better understand about the advantages and strengths of APM over the traditional approach.

Keywords Best practices, Project management, Pharmaceutical industry, Agile project management, Scrum

Paper type Case study

1. Introduction

Project management (PM) is a common practice in the management of organizations. However, the current competition in the market is forcing companies to respond quickly to these changes and make organizational and processes adjustments, in order to drive their projects to remain competitive, and increase their profit margin, especially when the projects are embedded in business environments where uncertainties and constant changes are present.

In this context, projects involving innovation and software development are essential, which require high flexibility and agility due to dynamic and changing environments. This leads to evolving project requirements, accomplished with more speed, compromising design performance and, therefore, requires a significant effort to update the plans and ability to adapt to change. As a solution to this situation, many companies have recently

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chosen to use the agile project management (APM), which suggests techniques to adapt the process to absorb application, scope and product features changes (Angioni *et al.*, 2006).

Misra *et al.* (2010) state that the agile software development (ASD) is an emerging approach in software engineering, which aims to improve quality, being initially defended by a group of 17 software professionals, who practiced a set of methods under the category "Light" and shared a common set of values for the software development. For the authors, because of the attractiveness and success of the ASD approach, many project managers, who followed the traditional model (plan based), gradually changed to projects management based on the agile principles. Larman (2004), Schwaber (2004) and Schwaber and Beedle (2007) indicate that these common principles were based on successful approaches in previous projects, and also the practical experience that resulted in failures in software development projects.

This study aims to verify the benefits obtained with the agile approach usage, applied to systems development, in an attempt to better understand this practice and the reason that has led many companies to use the agile model in search for added value, and achieve competitive advantage. The used research method was a case study in a pharmaceutical company, which applied the Scrum framework (an agile process model that was developed by Jeff Sutherland and Ken Schwaber in the early 1990s, according to Cervone, 2011; Misra *et al.*, 2010; Pressman, 2006) to develop an inventory control module into the company's ERP, and it could identify the benefits that the approach brought, against the prescriptive methodology ("waterfall") within software development project.

This paper's motivation is related to these significant limitations, and it issued questions related to traditional practices of PM (e.g. project management body of knowledge), especially when the project innovation and change degree is high. Precisely in such cases, the APM approach is more efficient (Chin, 2004). These difficulties reveal the importance of the study, which may help companies better understand this approach, and how it can help them manage their projects, adding value to their business.

In this sense, Cervone (2011) states that when considered the traditional PM approach to software design, and development, several disadvantages are immediately evident. In addition, the enormous effort required during the project planning phase is often so broad that about half of the project funds are spent even before any development work begins. In addition, software requirements definitions are often laborious and protracted so that the requirements for the project are sometimes changed before the software development starts.

The paper is organized as follows: Section 2 presents the fundamentals of APM and Scrum framework. The methodology used in the research is discussed in Section 3. Section 4 considers the case study and analysis. Finally, Section 5 presents conclusions, limitations and recommendations for future studies.

2. Literature review

This section presents the theoretical basis for this study, where the subjects APM and Scrum are explored.

2.1 APM

2.1.1 Brief history. The term APM began to spread in 2001, with its origin in software development, and culminating in the signing of the Agile Manifesto, a document prepared by professionals and theorists in the technology information area; they published it on the internet, questioning the traditional PM techniques, especially when applied in projects that involve uncertainties and are subject to ever-changing business environment. The application of agile principles had greater boost from the Conference OOPSLA in 1995, in which Ken Schwaber and Jeff Sutherland had such principles and discussed its application in software development (Cervone, 2011; Highsmith, 2004; Schwaber, 2004; Schwaber and Beedle, 2007).

Beck *et al.* (2001), Cervone (2011) and Schwaber and Sutherland (2013), analyzing the traditional software development process, realized that this methodology was not adhering to empirical, unpredictable and not repeatable processes. Authors cite the Manifesto for ASD was ruled on four key principles: individuals and interactions above processes and tools, working software instead of full documentation, customer collaboration over contract negotiation and response to changes instead of following a plan.

From this movement emerged several proposals for PM approaches aimed at software development or innovative products in dynamic project environments. Some of these approaches were named as follows: flexible (Thonke and Reinerstsen, 1998; Smith, 2007), adaptive (Cervone, 2011; Shenhar and Dvir, 2007), iterative and extreme (Beck, 1999; Cervone, 2011; DeCarlo, 2004; Wysocki, 2013), lean (Leach, 2005) and Scrum (Cervone, 2011; Chin, 2004; Highsmith, 2004).

There are other studies on agile approaches to software development projects, described by Arisholm *et al.* (2007), Ceschi *et al.* (2005), Chong (2005), Dalcher *et al.* (2005), Karlstroem and Runeson (2005), Layman *et al.* (2004), Mann and Maurer (2005), Mannaro *et al.* (2004) and Robinson and Sharp (2004).

To Cervone (2011), Scrum is the most often used, and it will be discussed in this paper. The author explains that those who follow rugby know that a Scrum is a way of restarting play after an interruption. Specifically, the front of each side meets in a tight formation of players, struggling to gain the ball possession when it is put into play, in the middle of the team. Such training requires from all team members organization and collaboration, each exerting precisely his role in a collaborative and self-manageable way, so that the team can achieve the proposed goal in the game. These principles apply to agile development projects, which require iteration and an incremental process, performed by a cohesive team.

2.1.2 Concepts. When talking about agile management, it is necessary to clarify the agility concept, which, in this context, can be understood as the ability to create and respond to change, in order to maintain profitability in a turbulent business environment, or the ability in balancing flexibility and stability (Highsmith, 2004).

Regarding the APM, a variety of definitions exist in the literature, with no single recognized meaning. To Highsmith (2004), for example, the APM can be understood as a set of principles, values and practices that help the team to deliver products or services value in a challenging environment projects. As for Chin (2004), the agile management is a way to proceed in a set of elements (principles, techniques, etc.), and the activities would be conducted through self-managed teams, using simplified tools, with better adherence to environments of uncertainty and constant change. In Augustine's (2005) view, the APM is a working way to energize, empower and enable the project team for fast, confident delivery of business value, through the integration of customers in a continuous process of learning and adaptation of changes, according to their needs and business environment. DeCarlo (2004), in turn, defined it as managing the flow of thoughts, emotions and interactions in order to generate value results in unplanned situations of great complexity, requiring speed and are placed in environments which involve changing and high levels of uncertainty and stress.

To Cervone (2011), although the APM is deeply rooted in the principles of the Agile Manifesto, it is at the same time adapted to be relevant in project development environment. Thus, the APM emphasizes two important concepts: first, the risk is minimized by the fact that there are short iterations and deliveries clearly defined, and second, direct communication with stakeholders, in order to develop the project (as opposed to extensive documentation). So, it is helpful for the project team to quickly adapt to uncertainties and rapid requirement changes common in projects.

However, although definitions differ, the concepts do not contain significant changes. Thus, there is a consensus among most authors regarding the essence of APM when they

say that it is an approach that seeks flexibility, simplicity, and iterations in short periods of time, and incrementally adds value (Boehm, 2002; Chin, 2004; Cockburn, 2002; Cohn and Ford, 2003; Highsmith, 2004).

When compared to the traditional approach, it turns out that agile methodologies are geared toward the outcome of the project, allowing process adaption to absorb application changes, scope and product features (Angioni *et al.*, 2006). Accordingly, Chin (2004) states that the approach of APM can be seen as a contribution to the theory of traditional PM, on uncertainties environments.

In this context, Denning (2011) presents the results of applying the APM into Salesforce.com, which resulted in not only a reversal of the trend of the financial results but also a value increment to customers, which resulted in a 41 percent annual returns to shareholders, after five years of implementation of agile practices, such as Scrum for PM. The author explains that in 2007 the Salesforce.com changed radically in just three months, from a traditional approach in information technology development projects to the Scrum framework.

2.1.3 Principles. Highsmith (2004) understands that a cultural change is needed to address the uncertainties and constant business changes, and in this context, he proposes six principles to guide the APM, which are related to aspects that impact product delivery and other related staff, leadership and collaboration features:

(1) "Product features deliveries by iteration," in a few weeks or months, mean that a partial version of a product or software is delivered, and in turn, this initial version is enhanced by regular periods of development and deliveries called iterations.

(2) "Delivering customer value" is based on collaboration between the design team and the client.

(3) "Search the technical excellence" aims to increase the agility and the chances of the project to be more successful.

(4) "Develop adaptive teams" means that the project manager is responsible for forming self-organizing and self-disciplined teams that can help in getting better architectures and requirements.

(5) "Encourage exploration of APM practices" means that the project manager should encourage the team to experimentation and learning.

(6) "Simplify the development process" allows the staff to work more flexibly, with less bureaucracy and more focused on value-adding activities.

2.1.4 Application. The APM approach is most suitable for projects which involve uncertainty and constant change, in which the traditional techniques of PM do not fully meet the requirements of flexibility to absorb changes in the project (Angioni *et al.*, 2006; Chin, 2004; Cockburn, 2002; Cohn, 2005; Conforto and Amaral, 2010; Highsmith, 2004; Ludwig, 2003).

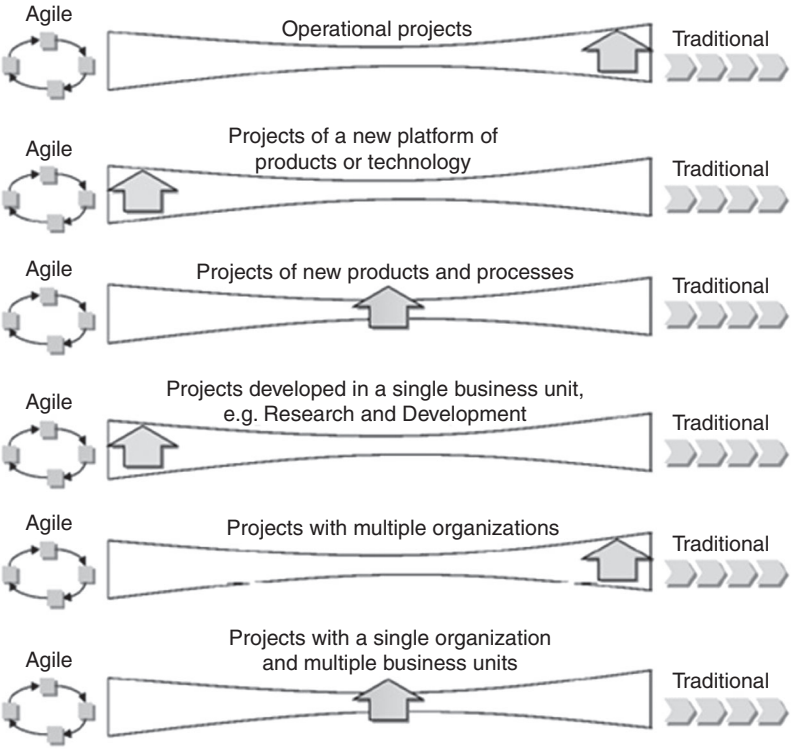
Boehm and Turner (2004) corroborate that the agile approach is best suited for dynamic environments that have a business environment influenced by constant changes. An example would be development of a new product, which in most cases requires further investigation (Cooper, 2008) and is usually conducted under uncertainties in turbulent environments, characterized by complex projects, unpredictable activities and changes, scenarios where the traditional approaches have limitations (Chin, 2004).

It is important to mention that the literature highlights the importance of the project context, and so it declares that the agile methodology is not suggested as the best universal practice (Highsmith, 2004). In fact, what is desired is to abandon at least partly a dependency on planning, reporting and documentation in favor of flexibility, informal communication and evolving requirements (Leybourne, 2009).

In Cobb's (2011) view, both traditional and agile approaches have their contributions and need be considered to develop an effective strategy. The selection of the project methodology is a very important strategic decision for all organizations that depend on effective PM. The approach should be well-aligned with the company's business strategy, culture, business environment, risks and complexity of each particular project. Therefore, in many cases, the best solution may not be a single methodology but a combination of agile and traditional methodologies that can be customized and adapted to the requirements of each project.

In this line of thought, Chin (2004) proposed a classification of the types of projects and what methodology to use, as shown in Figure 1. To Chin (2004), the pure application of the APM concepts best suits the project development of a new product platform or a new technology, where the level of uncertainty is high and requires creativity, determination and project team's commitment, or in projects developed in a single business unit in an organization where the customer is the department itself, for example, the department of research and development. On the other hand, traditional techniques would be best used in projects involving multiple organizations and operational projects, in which the level of uncertainty is low and activities, to some extent, predictable. The author proposes the combined use of techniques and tools of APM with the techniques of traditional management projects for new products and processes and also for projects where there is a single organization but with several business units involved.

2.1.5 Impact of APM. A study conducted by Serrador and Pinto (2015) tested the effects of using the agile approach in organizations in two PM dimensions: efficiency and



Source: Adapted from Chin (2004)

Figure 1. Application of agile and traditional management methodology

stakeholder satisfaction. The researchers analyzed data from 1,386 projects from different industries and countries. As a result, apart from evidencing that, in recent years, the APM methodology has been widely adopted in PM, the study also showed that 6 percent of all projects studied used completely or almost completely agile methods, and 65 percent of the total had some agile or iterative component.

In addition, the authors found that the percentage of the success of the projects was directly related to the use of the agile approach. That is, the greater the use of agile practices, the greater the success of the projects.

Another study, which was conducted by Augustine *et al.* (2005), shows a case in which Augustine and Payne were called to recover a project that was failing. This project was seven months behind schedule and used traditional methodology.

So, Augustine and Payne used agile methodology and, thus, could recover and stabilize the project. The result was a project completed in five months, on time, and on budget, with customer satisfaction and added value to the business. Among the main changes made in the way of managing the project included the following: used APM practices to manage and coordinate all the teams, and many people became more enthusiastic about agile; initiated two-week iterations of software delivery; employed the daily stand-up meeting; the major issue in terms of delivering customer value was the lack of shared understanding of the project's goals, so an existing release document was translated into an agile release plan, which was presented at the iteration planning meetings and at the daily stand-up meeting, reviewing it weekly to accommodate changes; the existing project-delivery process was replaced by establishing the agile practices and values as simple rules for all team members; the managers responded to the not-met-schedule and frustrated customers by micro-managing the developers, and increasing overtime due to pressure, instead a greater autonomy was given to each team members to determine what tasks had to be done, at the same time what were the required demonstrable results at the end of each iteration.

2.1.6 Phases of APM. Among the proposed APM models in the literature, the one from Highsmith (2004), as described in Table I, is considered the most complete and accepted, and therefore, chosen to be addressed in this paper.

The model proposed by Highsmith (2004) is presented in Table I with the aim of introducing some practical and simplified techniques for the project control and planning, and it is divided into five phases, which are discussed below.

2.1.7 Agile vs traditional. Chin (2004), Fowler (2000) and Highsmith (2004) describe the traditional PM as a methodology for structured processes, with emphasis on detailed planning and resistant to change. Schwaber (2007) corroborates that in typical projects (using traditional practices), about 50 percent of the time is spent on requirements, architecture and specification, and that all this is done even before building any functionality. However, 35 percent of the requirements change and 65 percent of the features described by the requirements are never or rarely used. Similarly, for Augustine *et al.* (2005), the traditional PM approaches are not compatible with the complexity and dynamic change of software.

For Chin (2004), there are situations in which traditional methods have significant limitations, such as when the degree of innovation is high and when teams are small. To intensify the time devoted to plans and controls, it generates disproportionate effort in managing the benefits in project performance. Thus, the agile approach is more efficient precisely in these cases.

Shenhar and Dvir (2007) present a comparison between traditional and agile management, highlighting main differences, as shown in Table II.

From the software development perspective, Hoda *et al.* (2010) highlight the main differences between the two approaches, presented in Table III.

Phase	Description
Vision	This phase is similar to the traditional model planning phase, and it aims to create a vision of the product, define what will be delivered to the customer, who is involved and how the team will work and interact. In the "vision" phase, it is needed to make a high-level description of the product to the project team, with documentation simplification, to facilitate implementation of next phases: speculation and exploration
Speculation	After defining the project, it begins the phase of "speculation," which aims to plan the project, based on the preliminary built view. The "vision" of the product will be refined, based on the identification of product requirements, project development plan, delivery plan, evaluation points, risk assessment, resource allocation, cost estimates and iterations plan vs deliveries from the project. This phase in the process is repeated as many times as necessary to achieve the expected results
Exploration	In the next phase, "exploration," what was planned in the "speculation" stage would be executed, and it consists of three critical parts. The first is the execution of the supplies to the proper workload management, and the daily life of the project team through constant feedback meetings (called "sprint daily meetings"). The second is to promote self-organization and self-discipline project team, providing conditions for each of the team members to be co-responsible for the results, and to commit to the project goals. The third deals with the management of the interactions among the project team, customers project manager and all stakeholders directly and indirectly involved in the project
Adaptation	Subsequently, the "adaptation" phase aims at reviewing the results of the previous stage to examine the project's progress and performance of the project team, to any eventual adjustment in the project plan, deliverables and iterations plan, if necessary. The considered review items are as follows: what was delivered vs what was planned, considering new requirements or deliveries to achieve the project objectives. This phase ends the cycle of iteration (speculate, explore and adapt), that can occur consecutively during the project life cycle. At each iteration, the team is trained and more able to absorb changes, learning about the project's evolution, which contributes to better results in the project
Closing	Finally, the "closing" phase starts when it is believed that there are no more requirements to be developed, or adjusted. In this phase, the key knowledge acquired in the project are transferred, and results celebrated. The authors argue for the importance of mini-closures at the end of each iteration in the project (cycle: speculate, explore and adapt), for better absorption of learning, and quest for flexibility level in the appropriate procedures for project and its context. These meetings, held at the end of each sprint, are described by Highsmith (2004) as sprint review, which consists of presentation of features made during the sprint, to stakeholders and the Product Owner, and sprint retrospective, where the working methods adopted in the previous sprint are assessed, as well as procedures, behaviors and actions performed

Source: Adapted from Highsmith (2004)

Table I.
Agile project management phases

2.2 Scrum

As stated before, Scrum is an agile process framework developed by Ken Schwaber and Jeff Sutherland (Cervone, 2011; Misra *et al.*, 2010; Pressman, 2006), originally designed in software development but that can also be used by any company that needs to implement PM processes, such as advertising agencies, architectural projects and banks (Silva *et al.*, 2010).

Schwaber (2004) explains that Scrum is not a predictable process, not defining what to do in all circumstances. Instead, it is used in complex jobs where events cannot be predicted and provides a framework and a set of practices that make everything visible. This allows the team to have an accurate view of the facts throughout the project and, if necessary, make the appropriate adjustments in order to achieve its goals.

Figure 2 shows, as Schwaber (2004) states, an overview of the Scrum process, discussed in detail throughout this section.

2.2.1 Characteristics. Based on an empirical control theory, Scrum was developed as an iterative approach, with incremental optimization of predictability and control risk. Still, according to Schwaber (2007), Scrum is supported by three pillars. The first pillar, transparency,

Approach	Traditional	Agile
Project objectives	Focus on completing the project on time, cost and quality requirements	Focus on business results, achieve multiple success criteria
Project plan	A collection of activities that are performed as planned to meet the triple constraint (time, cost and quality)	An organization and the process to achieve the expected goals and results for the business
Planning	Held once early in the project	Performed at the beginning and held whenever necessary
Managerial approach	Rigid, focusing on the initial plan	Flexible, adaptive variable
Work/execution	Predictable, measurable, linear, simple	Unpredictable and not measurable, non-linear, complex
Organizational influence	Minimum, impartial, from the project kick-off	Affect the project throughout its execution
Project control	Identify deviations from the original plan and correct the work to follow the plan	Identify changes in the environment and adjust the plan accordingly
Methodology application	Generic and equal application across all projects	Process adaptation depending on the project type
Management style	A model serves all project types	Adaptive approach, a single model does not attend all project types

Source: Adapted from Shenhar and Dvir (2007)

Table II.
Differences between agile and traditional project management approaches

Categories	Traditional	Agile
Development model	Traditional	Iterative
Focus	Process	People
Management	Control	Facilitate
Customer involvement	During requirements definition and on the delivery phase	Always involved
Developers	They work individually within the teams	Collaborative or in pairs
Technology	Any	Object oriented mostly
Product characteristics	All included	Most important first
Tests	At the end of development cycle	Iterative
Documentation	Complete	Only when necessary

Source: Adapted from Hoda *et al.* (2010)

Table III.
Differences between agile and traditional software project management

ensures that all aspects relevant to the success of the process remain visible and known, to ensure that the result is consistent with that defined previously. The second pillar, inspection, is made with the purpose to detect any non-compliance that may harm the team results. The third pillar, adaptation, which through the identification of fault, is the adjustments made to the process, or in process materials, reducing the likelihood of a poor outcome.

In the view of Schwaber (1995), Scrum has six main characteristics:

(1) Flexible delivery: the content of deliveries is set accordingly to the market needs or customer requirements.

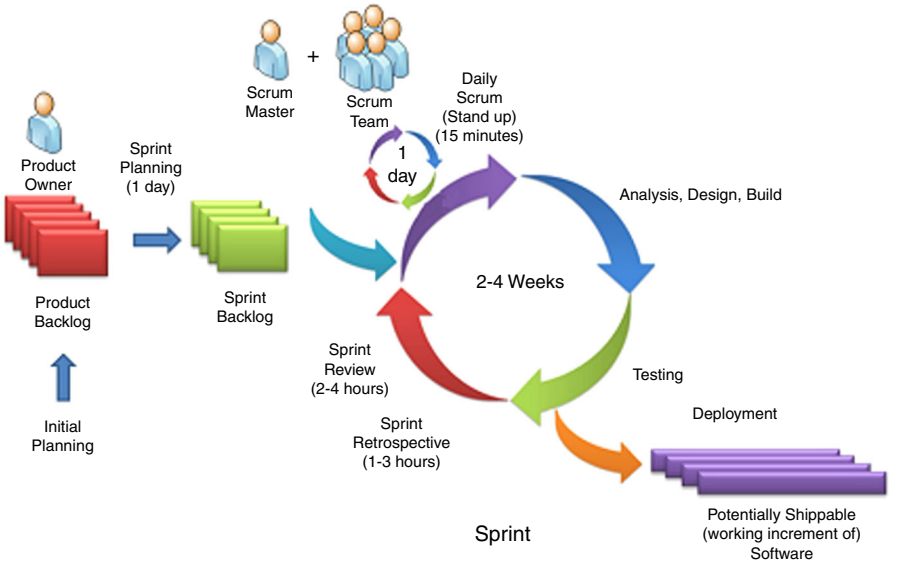
(2) Flexibility of deadlines: deliveries may be required before or after the originally planned deadline.

(3) Local teams: it is usually not composed of more than six members.

(4) Frequently revisions: revisions are made throughout the team progress.

(5) Collaboration: there are intra collaboration and intercollaboration among members.

(6) Orientation: each team will list the objects with well-defined interface and behavior.



Source: Adapted from Schwaber (2004)

Figure 2.
Macro vision of Scrum project development

2.2.2 Advantages. According to Schwaber and Beedle (2007), Scrum is a framework within which it is possible to employ various processes and techniques to develop complex products.

Pereira *et al.* (2007) report that the agility usage brings advantages such as creating an environment that facilitates defining requirements changes and innovation, throughout the product development cycle, as well as more collaborative and productive aspects between developers and customers, resulting in faster delivery of product, better suited to the customer's reality and with the expected quality. Another advantage is to facilitate PM, since there are greater integration and commitment of the project team, who consequently feel more motivated: the team morale is boosted. Even as a point in favor, it reinforces the constant planning of the project, which minimizes the risks, considering that planning is more important than the plan; moreover, it should not stop planning until it has found the desired customer satisfaction with the product delivery. And finally, but not least, it enhances customer satisfaction.

2.2.3 Scrum team (roles and responsibilities). According to Cervone (2011), Schwaber and Sutherland (2013), Misra *et al.* (2010) and Pichler (2010), the Scrum technique consists of three main roles, which have different tasks and goals in the process and practices: Scrum Master, Product Owner and Scrum Development Team. The Scrum Master is a new manager introduced to Scrum. He is responsible for ensuring that the project is carried out in accordance with the practices, values and Scrum rules and is advancing as planned. The Product Owner is responsible for maximizing the product value and the work of the Development Team. He is the only person responsible for managing the Product Backlog. The Development Team is the project development team, usually consisting of three-nine professionals who perform the job of delivering a usable version that increases the product at the end of each sprint. The team has the authority to decide the necessary actions to achieve the objectives of each sprint.

2.2.4 Scrum events. Cervone (2011), Misra *et al.* (2010) and Schwaber and Sutherland (2013) claim that the Scrum employs six types of events with a fixed duration, also called

time boxes, to create regularity. They are release planning meeting, sprint, sprint planning meeting, sprint review, sprint retrospective and daily meeting – described below as the vision of these authors.

The release planning meeting takes place at the beginning of the project, serving to bring together all representatives of Scrum roles so they can set the project guidelines. The time of this meeting is greatly reduced compared to the time spent in traditional methodologies, and any setting can be changed in future sprint planning meetings.

A sprint, in turn, is a working cycle with fixed duration, of one to four weeks. In this case, it is the role of the Scrum Master to ensure that this period is not exceeded.

The sprint planning meeting takes place to define what will be done in the next sprint, with the presence of everyone involved. This meeting is divided into two stages. In the first stage, the Product Owner stipulates the order of priority, which is opens for discussion by the others involved. In the second stage, the team provides hours of development for selected items. After the meeting, the Product Owner sorts the selected items according to their priority so that they run on sprint, always respecting the time stipulated for development.

The sprint review happens before the next sprint planning meeting and after the team finished the sprint that was underway. In it, the team will demonstrate to the Product Owner the evolution of its activities, and hence the functionality that the Product Owner had arranged the planning meeting. At that time, ideas that will help in defining the next sprint are also discussed, based on lessons learned from the development period.

After the review meeting sprint, but before the next sprint planning meeting, those involved should carry out the sprint review. At this meeting, the Scrum Master should make the team think about all the lessons that were learned during the sprint. The main idea of this meeting is to generate a continuous improvement through these lessons learned.

Finally, the daily meeting requires the participation of only the Development Team, and the Scrum Master's presence is optional. This meeting should take place on a daily basis, with a fixed duration of 15 minutes, always at the same place and time, to avoid communication problems. During the meeting, each member explains what he has accomplished since the last meeting, which he will do before the next meeting, and what obstacles stand in. Although the team is responsible for making this meeting happen, it is the role of the Scrum Master to ensure that it happens.

2.2.5 Scrum artefacts. Scrum has three artefacts, which represent work or value for providing transparency and opportunities for inspection and adaptation (Cervone, 2011; Schwaber and Sutherland, 2013), as described below.

The Product Backlog is an ordered list of everything that is necessary in a product and is a unique source of requirements for any change to be made in the product. The Product Owner is responsible for the Product Backlog, including its content, availability and ordering.

The sprint backlog is a set of Product Backlog items selected for the sprint along with the plan to deliver the increment of the product and achieve the goal of sprint.

The increment represents each Product Backlog item completed during the sprint and is ready for use, regardless of whether the Product Owner decides to release it or not.

3. Research methodology

Because this work deals with a subject in the area of research in development and the applicability of different approaches, involving various fields of knowledge, as well as the concern about the phenomenon and the reality of the relationship between performance on implementation and results of the projects software with the adoption of Scrum approach in the conduct of these projects, it is considered that the most adherent research strategy is qualitative research of exploratory nature, in which, according to Gil (2006), the researcher seeks greater knowledge on the subject in study. Additionally, based on Hart (1998), in

exploratory research, beyond the purpose of acquiring better understanding of the subject and context, the goal is to verify the feasibility study and identify its relevance.

The adopted method of investigation is the single case study, in a large pharmaceutical industry, with an investigation of improvement of information system project. The case study, according to Yin (2010), is a form of empirical research that aims to investigate current phenomena in which the boundaries between the phenomenon and context are not well defined. Eisenhardt (1989), on the other hand, explains that the case study is a research methodology that aims to understand the dynamic of case under review, thus combining the data collection methods, including documents and observations, and use of qualitative evidence or quantitative evidence, or both. Thus, the case study is a thorough analysis of one or more objects (cases), through which it acquires broad and detailed knowledge of these objects (Berto and Nakano, 2000; Gil, 2006), "deepening the knowledge about a problem not sufficiently defined, in order to encourage understanding, suggesting hypotheses and/or development of the theory" (Mattar, 1996).

Therefore, the case study is a methodological approach of proper research and design, and it will be used as the field research of this work.

The scope of the study is to verify the advantages of agile approach projects, analyzing their benefits over the traditional approach, and the difficulties encountered during the development of the project under study. Thus, the research seeks to answer the question "Why be agile?" In other words, is the agile approach to PM more advantageous than the traditional management approach?

This study also has limitations related to the bias of the researchers. In order to reduce the limitation of the results, the study implemented peer review among all researchers involved in this study.

In this work, due to strategic and confidentiality reasons, the organization and participants who served in the case study will not be stated.

The company's selection criteria used in this study considered the fact that it is a Brazilian large company in the pharmaceutical segment, marked by rapid and profound changes, the need for constant innovation, especially in the domestic market, the presence of one of this work's researchers on the project, and the fact that this is a pilot project in the use of Scrum approach in that company.

4. Case study

This section presents the company and the case study, which was based on how the pilot project was conducted, in accordance with the Scrum perspective, and the project Scrum Master's experience.

4.1 Company environment

The pharmaceutical industry, the focus of this research, called Farma Y, was selected because one of the researchers works in it, more specifically in the IT projects related to logistics supplies, internal movements and goods distribution. Thus, the researcher had access to information, as well as the enterprise documents, and did relative analysis, interviews and direct observation, which were facilitated.

The Farma Y was established in 2003, operating in the Brazilian market, with a focus on production and marketing of generic drugs, under 12 therapeutic classes: antibiotics, antidiabetics, antidepressants, antihypertensives, antihistamines, antilipemics, antifungal, anti-infectives, analgesics, anti-inflammatories, muscle relaxants and glucocorticoids. This company sells under its portfolio 59 drugs, and its capital composition is 100 percent from Brazilian capital.

The Farma Y occupies the 15th place in Brazil, both in units sold and in revenue. Between 2005 and 2006, the company achieved a growth of 56 percent in its revenues, with

50 percent increase in sales volume. Its products are distributed throughout the Brazilian territory, being present in the main pharmacies and networks of country medicines.

Because generic drugs are the basis of the portfolio of Farma Y products, and due to the fact that there are tight controls by regulatory bodies on drugs marketed in Brazil (such as Associação Nacional de Vigilância Sanitária (ANVISA)), especially regarding drugs expiration date and quality, the project's focus was drawn toward support mechanisms to optimize life cycle management of medicines lots, of the stock in its main distribution center.

4.2 Productive process

The production process for generic drugs in the Farma Y consists of the activities described in Figure 3.

The process starts with raw material receiving, performed based on an existing SAP ECC 6 ERP (SAP Enterprise Resource Planning) program, generated from the delivery confirmation from suppliers (electronically transmitted to Farma Y system, directly from the supplier's shipment notice, in the raw material origin).

The raw material receipts data are automatically loaded into the warehouse management system (WMS) of Farma Y and are used for schedule truck entry permits at the gate, as well as to generate labels from inspection lots/control/identification of the material received, after checking the quantity of the goods received.

Based on the invoice conference, at the Farma Y gate, the goods are unloaded onto the docks set by the system, based on grouping rules and location of goods. After that, validations are made of receipts through simultaneous bar code reading, and then samples are separated and taken for quality control.

After quality approvals, labels are generated for traceability and for batches' control. Then raw material goes to storage, based on the location indicated by the WMS application, which complies with the criteria of first expedited, first out (FEFO).

Based on the production schedule generated from the ERP, production and consumption orders are created, by the lot. Beyond orders, picking lists are created, for consumed materials. Separation of physical materials is done, and confirmations are made of collected items electronically, using bar code readers.

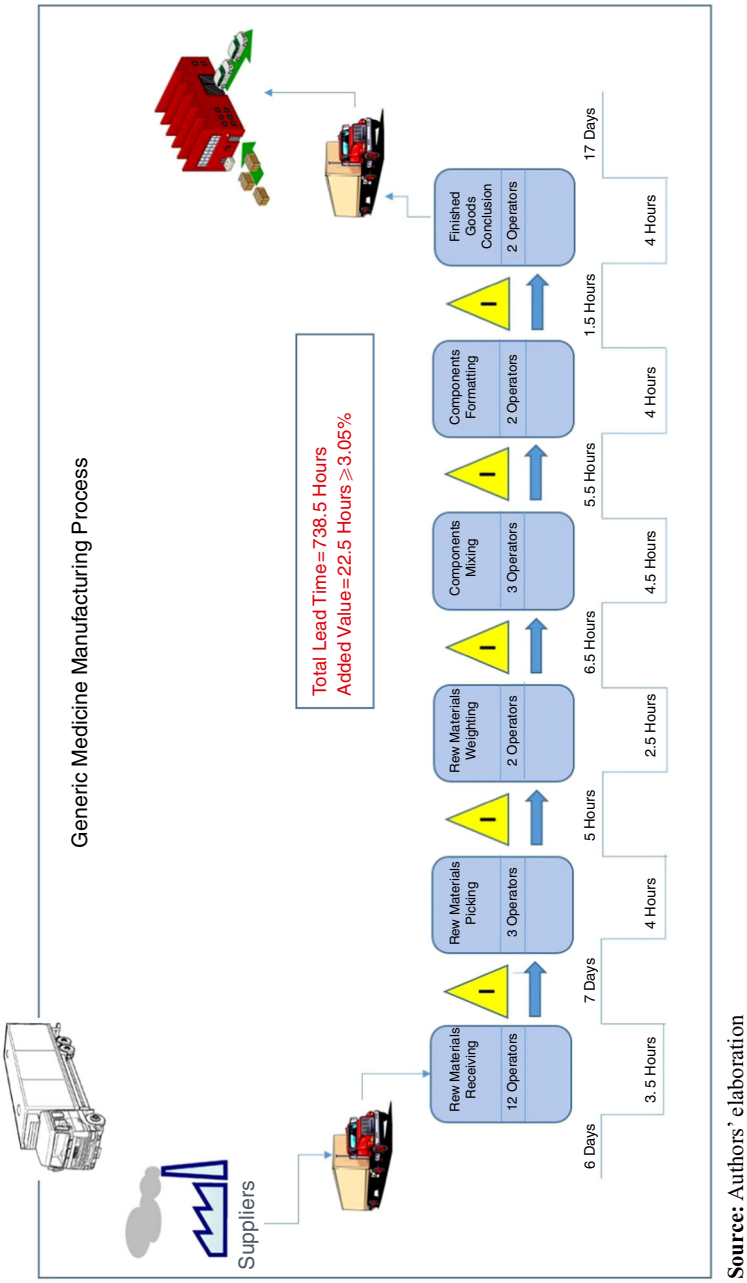
The next step comprises weighing of raw materials, which is performed for each production order, linking the material to the informed batch number. The weighing process, however, must follow the ANVISA mandatory regulations, considering the automation, without manual intervention (due to risk of cross-contamination). Thus, the weighing data held in special chambers and electronic scales are fed directly into the ERP production orders, without manual contact.

For each weighted component, a label is generated with the code in this semifinished component, batch number and weighted quantity. As for the unused remaining materials, a new ID tag is generated, and the material is returned back to the storage.

The next phase comprises the material homogenization (blending), held in mixers or reactors. For each batch component, there is an associated production order, to which both the amount produced and the consumed (for each material) should be reported.

After homogenization, the component is moved to the formatting process, which consists of production of coated pills, or tablets, depending on the specification and the material dosage. Because the production volume tends to be high, and the variability is low, the production process can be classified, based on Slack and Lewis (2011), as mass, since the production rate of the fastest machines is approximately 3,000 drugs per minute.

The final stage is the blister packaging, which occurs in an automated manner. The product passes at the end of these lines, where uniformity verification step is done, which is performed by mechanisms based on photoelectric sensors, and hey also provides



Source: Authors' elaboration

Figure 3.
Farma Y production process

the basis for high-accuracy scales for checking blisters without the specified quantity, in which process, data batch is printed on each medicine blister.

Finally, the product is packaged in individual boxes, which have the batch data. From this moment, there is, at the end of the line, a final quality control step, which is automated and performed by means of sensors and disposal mechanisms (for which no check boxes inserts, or damaged). These drugs, in individual boxes, are then unitized into larger boxes, which have a printed label for the entire unit.

From this validation, the products follow through crawlers, to the finished goods warehouse, based on the WMS receiving lists, and then goods are targeted to locations for packaging (based on FEFO criteria), until product shipment occurs.

The project, object of this study, had its scope in the medicines management, goods that are stored in this deposit, more specifically in controlling these products shelf-life, which accounted for Farma Y's potential losses of about 30 percent of its stocks assets.

4.3 The project

The scope of the project, called "XYZ Project" is to develop, within the Farma Y ERP (SAP), an inventory control module based on the effective date of the lots, whose objective was to reduce the potential losses in drugs with short shelf-life, which means those medicines whose batch expiration date is less than six months ahead. ANVISA prohibits the distribution and marketing of these lots, and they should, therefore, be discarded.

The project development approach considers the Scrum approach, dividing the deliverables in sprints, which for this project consisted of a 20-day cycle each. The goal of each sprint was determined: the first being structured to provide quantitative data (for queries and reports) of those batches whose volume in stock fits the short shelf-life criteria. The second sprint considered the inclusion of filters in these consultations, both class of drugs, or by time horizons (fences team). Later, this sprint had to be split into two, since the creation of the easing of the periods reported for consultation (fences team) consumed more time than that is available within the sprint. The third sprint aimed, based on each lot, to look for the associated costs, which occurs for considering to do it, the materials acquisition cost plus inventory maintenance costs. This third sprint also had to be split, because the requirements were clarified by the Product Owner, and greater effort was required by the project team.

4.3.1 Project execution. Within the Scrum approach, the project key stakeholders are as follows: Scrum Master, the Product Owner and Scrum Team (Highsmith, 2004). In the XYZ project, this was the adopted structure.

The Scrum Master appointed was the IT leader, because he had the knowledge of the Scrum approach (is a certified professional Scrum Master), being the responsible facilitator for ensuring that the project is carried out in accordance with the practices, values and rules of Scrum and is advancing as planned, generating agility and productivity in the process. In addition, the Scrum Master combines what is essential in the Agile Manifesto, with needs of complex projects. He is also responsible for eliminating impediments and to keep the team focused on the daily tasks, to deliver the sprint goals. The Scrum Master was, within the XYZ project, a key player, acting as the link between the customer and the Development Team. He was also the people leader in the project, playing the role of a coach (boost talents, create skills and stimulate potentialities) (Chiavenato, 2008), and directing the team in the sprint backlog requirements breakdown.

The Product Owner was the controller manager, since the aim of the project was directly related to improvements of internal control, reduction of inventory fixed costs and greater effectiveness of business operations. He was responsible for the project, the management, the control and bringing up the list of product backlog requirements. However, it is important to note that the backlog list was discussed in conjunction with the Scrum Master.

The project team (Scrum Team) was composed of IT employees, and IT SAP functional consultants (two modules: materials management, and financials), as well as two ABAP programmers.

The Scrum Team in the XYZ project was the technical team responsible for carrying out the tasks backlog, and while running sprints, exercising authority to take the necessary actions and to organize them in order to achieve each sprint objectives. The workplace had no bays separating project members' tables. Rather, 4 to 12 people were allocated on a table each, without partitions or any other physical barrier, precisely to facilitate communication among team members. It is a culture and common practice for each team member to be versatile and help where needed in the project, for example, a developer of a certain technical language helped not so experienced developers, in other languages.

Once roles and responsibilities involved were known, the operation of the XYZ project using the Scrum approach in practice can be described.

The project was initiated with the vision establishment by the Product Owner, which was aligned with the main objective, and to meet a need, as he declared: "drastically reduce the operational cost of Farma Y by reducing the need for drug stocks resulting in a better control of shelf-life of the materials, and consequently reduce the waste."

The next stage, speculation, was created through the Product Backlog by the Product Owner. The Product Backlog, according to Highsmith (2004), is a list of main activities or modules to be delivered in the project. For the XYZ Project, the Product Owner worked in defining the product backlog, based on Table IV, where it is possible to meet each requirement for the project (user story), with its identification, its requirement description, its importance degree (essential for prioritizing and defining what will be done in each sprint), an initial time estimation as well as details of how the requirement should be delivered (column "how to demonstrate") and some technical elements to be considered for the performance requirement ("observations" column).

From the product backlog, activities with greater value were identified, which then created the sprint backlog. This planning was done through backlog grooming, which is a meeting before each sprint and aims to manage and update the product backlog, preparing the activity and scope for the next sprint.

For the XYZ Project, the first sprint corresponded to the requirements 1 to 5, the second sprint corresponded to the requirements 6 and 7, and the last sprint plan was intended to implement the requirements 8 and 9, making up an estimated 20 days of workload for each sprint. These periods were negotiated between the Product Owner, Scrum Master and Scrum Team.

A later stage, exploration, covers the execution of activities of each sprints. Highsmith (2004) states that each sprint should last between two and four weeks, depending on the project complexity. The author also states that the first sprints are more difficult, since requests for adjustments and modifications by the Product Owner tend to be in greater number and, in many cases, superfluous and unnecessary. Overtime, all involved people come to better understand the Scrum process, causing the requests for changes to be more relevant, and enforcement of the fastest activities.

It is the Scrum Master's role to define or to make clear what is important to bring to the meeting, and also what is superfluous. In the early projects, this meeting is usually longer, lasting up to 30 minutes, but with the project progress, this time can be reduced to a maximum of 15 minutes. The daily meetings are pre-scheduled meetings defined by its own project team and can be done, for example, in the morning, when everyone comes to the company, or at the end of the working day. Based on the XYZ project Scrum Master, daily meetings are extremely important for the smooth project progress, and should cherish always to perform them.

In the case of XYZ project, daily meetings were led by the Scrum Master, always at the same place, in the room allocated for the Scrum Team, at a pre-set time (9 a.m.), lasting 15 minutes.

Table IV.
Project XYZ product backlog

Product Backlog – XYZ project					
ID	User case	Relevance	Estim.	How to demonstrate	Remarks
1	Know the expiration date of the medicine batches in stock	200	5	Create specific screen for in-stock materials, by batch expiration date	Use, if possible, view by the inquire screen of current inventory, through customizing
2	Correct inconsistencies in the expiration dates of the medicine batches in stock	180	3	Create manual update mechanism, with function segregation, to update inconsistent dates. Additionally, the possibility to black manual batch entry, at the end of the production line	Review access profiles and add new functionality, only for quality manager
3	Do not allow expiration date changes for medicine transferred among warehouses	160	2	Keep, during material transfer, expiration date of the original batch	Review stock transfer transactions, and check associated profiles
4	Validate the expiration date of medicine batches in stock	140	5	Complementary to ID no. 2. There must be a process of "auditing" of in-stock materials, with a record of changes in the validity of the materials dates	New program to be created, with restricted and controlled access execution
5	Enable full inquire of medicine batches with short shelf-life	120	5	Develop new query screen, with results print option, and generating Excel	Verify users who will have access to this information, with the Product Owner (Controller)
6	Allow filters inclusion by medicine class to check in-stock batches with short shelf-life	100	10	Add the filters by material group, according to the class of drugs, the screens prepared in consultation ID no. 5	Validate that there is no exception in material group of materials, requiring new aggregation rule
7	Enable filters inclusion by date limits to check in-stock medicine batches with short shelf-life	80	10	Include filters for material group, in accordance with the limit dates informed in query screens as ID no. 5	Check upper and lower limits of dates, in order to not impact system performance (response time)
8	Get costs of in-stock medicine batches acquisition costs with short shelf-life	60	10	For every batch of material, query and calculate the cost, with the date of entry into stock	The receiving invoice should be checked, which may require additional processing time. Check now to deal with fractional lost receipts
9	Get costs of in-stock medicine batches total costs with short shelf-life	40	10	Each batch of material, then proceeding with the ID no. 8, include the storage cost based on the cost of the department sheet	The costs allocation on each batch should be better detailed by the controller. Possibly more processing time

Source: Authors' elaboration

It was adopted for all the meetings that all participants should stand up, in order to be more focused and objective. The main objective was to ensure that the scope was being followed. Basically, each member reported: main performed activities on the previous day, difficulties encountered and what was planned to be done in the current day. These difficulties were then conducted by the Scrum Master, after registering in the impediment list. The identified main difficulties in sprints implementation are as follows:

- Lack of knowledge of Scrum approach by all members: the adopted action plan was ongoing communication and coaching by the Scrum Master with the Development Team, showing the benefits of following the Scrum framework, and clarifying team doubts.
- Lack of involvement of other IT areas: because the approach requires agility in problems solving, there was a need of constant communication, and in some cases, escalate the need to higher organizational levels, in order to perform tasks that were prerequisites for the project. The following areas and requirements stand out: basis (application infrastructure) for availability of approval and development environments and IT risk management, to define the access profiles required by the project.
- Tendency to return to work in the traditional approach: this fact demanded greater effort by the Scrum Master, since the traditional approach is prescriptive, and Scrum is an iterative and evolutionary approach. The tendency to plan the entire project, even the functions that would be held on the third sprint, was constant within the project team, especially in the first cycle.
- Communication problems with the Product Owner: they often do not quite understand the technical terms, requiring, in some situations, other specific meeting between the Scrum Master and the Product Owner to clarify any doubts.

The next phase, adaptation, began with the sprint review, a meeting held at the end of each sprint, and attended by the Product Owner and the customer, in order to show what has been done, and discuss possible adjustments. An observed issue during the first sprints was the customer decided to change the result after know it. This change came at the next sprint, but the project lost capacity, which led to a split of 3-4 sprints, adding on another 40 days project. However, this situation can be considered normal, both because it is a pilot project, in which all were learning, as well as the very nature of Scrum, where changes are always welcomed. Overtime, however, the client realized the limitations and he became more realistic in its requests.

Soon after the sprint review, the Development Team held the sprint retrospective, a meeting in which they had the opportunity to review and discuss positive and negative performances and behaviors of the last sprint, and adjust/improve for the next sprint, making it more effective and efficient. In addition to the Development Team, the Scrum Master participated in 90 percent of cases. This meeting allowed that there was a record of all documents similar to the "lessons learned" from the traditional methodology, and aimed to improve the procedures and knowledge, both for future sprints and for future projects.

Another important step was adopted, the value engineering, a method for evaluating the function or purpose of a product or service delivered, in order to increase their quality or value, and to achieve customer satisfaction at the lowest cost (Sakurai, 1997). This step took place at the end of each sprint and intended to check the entire project scope, to ensure that they were being prioritized with the right requirements (Freeman, 1984).

Upon completion of each iteration sprints, that is, when there were no more needs to be developed, or adapted within each sprint, began the release sprint, which occurred at the end of the first, third and fifth sprint (both the second as the third were deployed, depending on

the complexity). The first release was to scope the sprint 1, which is the total analysis of the lots with shorter shelf-life, and which also included validation and correction of the validity of wrong dates on medicines in stock, not changing the expiration date for transfers between warehouses and restricting changing the expiration dates during operation. The second release, which had the scope to include filters in the short shelf-life queries, considered the sprints 2 and 3, and requirements 6 (enable the inclusion of filters for class of drugs in consultations lots with short shelf-life) and 7 (enable the inclusion filter by date limit on short shelf-life consultations). And finally, the third (and last) release considered the sprints 4 and 5, comprising the requirements 8 (defray lots of drugs with the short shelf-life, by the cost of acquisition) and 9 (defray lots of drugs with short shelf-life, by the total cost).

The closing phase began after the system goes fully operational in the production environment, and the project was then officially closed, with the delivery of a minimum documentation, covering the functional and technical development specifications, operation and technical manuals, and "lessons learned" documents, useful for future developments.

4.4 Main results

The project was built in five sprints, totaling 100 days (about four months). However, the results could already be used after the first month, providing important information for decision making, besides knowledge and experience, which made possible that subsequent sprints were improved, which is one of the benefits described in the literature (Schwaber and Sutherland, 2013). The total project cost was US$145,000, and the time spent was four months (already considering backlog changes). Such significant changes in scope, which were carried out during the development of the project, corresponded to the complexity in adding filters by dates limit in the queries, and to the costing (defrayal) of medicines based on the total cost (purchase cost plus storage cost).

In the traditional approach, and excluding changes in scope, based on the project plan generated in the initiation phase, there were an estimated seven months for completion of the project, with an estimated cost of US$291,000 (time and cost that could be increased, based on the changes implemented).

Thus, according to the project results, the APM approach provided several benefits, especially for the project team, to customers, and to the results (deliverables) of the project, as shown in Table V.

5. Final considerations

The research objective was to analyze the APM with Scrum and to identify what benefits and advantages it brings to companies, compared to the traditional approach. Thus, a case study was made, considering a development project of a stock management module, within the ERP system, in a pharmaceutical company. From the case study results and analysis, it can be inferred that agile management practices can help companies in getting value for their businesses and customers. In the view of the managers of the company studied, using the agile approach brought the company quantifiable benefits, mainly related to people, clients and the project itself, with 80 percent time savings (four months of Scrum for seven, the traditional approach) and 50 percent in costs, and deliverables in less time (one month for the first release, compared with seven, the project plan, the traditional approach), which increases confidence and the added value of the project.

These results corroborate those found by Augustine *et al.* (2005) and Serrador and Pinto (2015) in their studies, as it confirms a greater successful of the agile approach over the traditional approach. That is, the project of this case evidenced efficiency and stakeholders satisfaction as in Serrador and Pinto (2015) research, and was completed on time, on budget, with customer satisfaction and added value to the business as demonstrated by Augustine *et al.* (2005).

Consideration	Explanation	Participant's quote
Project team	In the team's point of view, the fact that the results are being frequently delivered was motivating, providing greater satisfaction in seeing what was done and deployed. In addition, another important factor was the constant and real-time communication, which made a pleasant work environment (even in the early stages of the project)	According to the developer, "seeing what was done and delivered generates greater satisfaction. In addition, constant communication and in real-time makes the working environment more pleasant"
Results (deliverables)	With the project, the project team reported that changes in the scope were quickly addressed. For example, in agile management, customer reviews were made at the end of each sprint, and any customer requirement non-compliance could be immediately addressed, not waited until the end of the project, as it often happens in traditional approach	In the Scrum Master's view, "any change in the project scope is quickly addressed, and I consider this as a strength of the agile"
Customer	From the customers' point of view, they already receive something to use at the end of the first month. In addition, the Scrum approach helps to discover, with frequent deliveries, if there is something wrong and thus correct it in advance. A constant review of the scope coupled with frequent deliveries was also seen as a benefit, since the customer can see new needs or understand what does not need to be implemented	As a customer mentioned, "within a month, you already have something and can start using it." Another customer declared that "with frequent deliveries, you can find something wrong than was requested or find out something you had not considered before, allowing fixing it in advance"

Source: Authors' elaboration

Table V.
Project's main results

Furthermore, frequent deliveries, provided by sprints, generate motivation to the project team, and constant communication, another feature of the agile method, led to the most pleasant working environment. All these increased employee satisfaction. This finding was also indicated in the cases of Augustine *et al.* (2005) and Pereira *et al.* (2007).

Another important proven benefit relates to the better project control, mainly its scope. This is due to the review meetings (sprint review) occurring at the end of each sprint, in which any non-conformities or customer-appointed issues can be immediately addressed, and meetings daily sprints, where the impediments to achieving the objectives of sprint might be identified and prompt action can be applied. Control scope and deliverables were one of the most important practice for the success of Augustine *et al.*'s (2005) project, since initially the lack of understanding of the project's goals was the major issue in terms of delivering customer value. Thus, to address this, an agile release plan was created and presented at the iteration planning and daily stand-up meetings, reviewing it weekly to accommodate changes.

A major benefit was the value aggregation to the customer through frequent deliveries and functionality increases, in short periods of time. Thus, the client, besides to monitor the software project progress, could also start using results from the first delivery. This benefit was also pointed out by other authors (Augustine, 2005; Augustine *et al.*, 2005; Boehm, 2002; Chin, 2004; Cockburn, 2002; Cohn and Ford, 2003; DeCarlo, 2004; Denning, 2011; Highsmith, 2004; Serrador and Pinto, 2015).

In addition to these benefits indicated in project execution, we can highlight others, such as the figure of the Product Owner, customer representative, next to the Development Team and the development team cooperation and motivation.

Moreover, in practice, there were some mismatches between this study and the literature, since the latter suggests self-manageable and self-organizing teams (Cervone, 2011; Chin, 2004; Highsmith, 2004), but in this case study, it has been observed that the Scrum Master has incorporated this role of leading the Development Team.

It is noteworthy that this work consists of a single exploratory case study in a company in Brazil, and therefore results cannot be generalized to other companies. However, despite the limitations of a single case, the findings may provide general learning, as well as important practical information and experiences to managers interested in implementing the agile approach. Moreover, this is an in-depth exploratory study in a relevant sector for the Brazilian industry, that addresses a more flexible PM method in practice with managerial and economic implications for organizations, and it may encourage further research to explore the efficacy of the agile method. And, in order to reduce the limitation of the results, they were compared to a multiple case study conducted by Serrador and Pinto (2015) and a case from Augustine *et al.* (2005), both researches with scope and goals similar to this study.

The suggested future scope of research is to carry out studies in this line of research that demonstrate the practical results of using the agile methodology and whether the agile projects are more successful, since there is little research in this area (Augustine *et al.*, 2005; Dyba and Dingsøyr, 2008; Serrador and Pinto, 2015), and studies to investigate the degree of autonomy of the teams on the self-management and self-organization, as suggested by literature but not evidenced in this study.

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