NOVA IMS Information Management School

MGI

Mestrado em Gestão de Informação
Master Program in Information Management

Strategic use of Scrum framework on BPMS projects

João Fernando Campos Mendes Pires

Dissertation presented as partial requirement for obtaining the master's degree in Information Management

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação
Universidade Nova de Lisboa

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação
Universidade Nova de Lisboa

STRATEGIC USE OF SCRUM FRAMEWORK ON BPMS PROJECTS

By

João Fernando Campos Mendes Pires

Dissertation report presented as partial requirement for obtaining the master's degree in Information Management, with a specialization in Information Systems and Technologies Management

Supervisor: Professor Vítor Manuel Pereira Duarte dos Santos, PhD

September 2021

ABSTRACT

It is rare to find nowadays a business methodology that does not involve any kind of technology, whether in the research or development phases. One methodology that rises above the others when it comes to business processes is BPM. This type of methodology when added a specific software with BPMS integrated becomes highly beneficial to implement. Nevertheless, there are always flaws and gaps that could be filled. On the other hand, software development companies have grown exponentially since the digital transformation was accepted. One reason for that is the working methodology these types of companies follow, as they are known as Agile companies. What this document aims to present is enough artefacts and pros for Scrum, an Agile framework, to rule BPMS projects and minimize the current failures.

This dissertation follows a design science research approach to apply multiple analytical methods and perspectives to create an artefact. The type of evidence within this methodology is a systematic literature review, to attain insights into the current state-of-the-art research of BPMS projects and Scrum. Thereby, the systematic literature review shall be used to pinpoint, analyse, and comprehend the obtainable empirical studies and research questions. This approach supports the main goal of this dissertation, to develop and propose evidence-based practise guidelines for the implementation of the Scrum framework on BPMS projects strategy.

KEYWORDS

Project Development; Scrum Framework; BPM Methodology; Agile BPMS; Design Science Research

INDEX

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS AND ACRONYMS

AI	Artificial Intelligence
BPM	Business Process Management
BPMS	Business Process Management System
BPR	Business Process Reengineering
CEO	Chief Executive Officer
CFO	Chief Financial Officer
CIO	Chief Information Officer
COO	Chief Operations Officer
CRM	Customer Relationship Management
DBMS	Database Management System
ERP	Enterprise Resource Planning
HR	Human Resources
IoT	Internet of Things
IT	Information Technology
KPI	Key Performance Indicator
ML	Machine Learning
PRISMA	Preferred Reporting Items for Systematic reviews and Meta-Analysis
PTS	Project Tracking Software
SDLC	Software Development Life Cycle
TOGAF	The Open Group Architecture Framework
UML	Unified Modelling Language
WFMS	Workflow Management System
XP	Extreme Programming

1. INTRODUCTION

The problem that this study is proposing to solve is introduced in this section. Firstly, the two methodologies are going to be introduced, with a brief explanation of both BPM and Agile. Within the context identification, it is also mentioned the motivation and the reasons that lead to the research of this topic. Then, the already existent research regarding the linkage between those methodologies is briefly explained since they are a baseline for this topic. Furthermore, the objectives are defined for a clearer perspective from the target audience to inform them better what is going to be done in this study.

1.1. BACKGROUND AND PROBLEM IDENTIFICATION

In the current days, where every company and industry in the world are facing a huge problem in their hands that is to continue to create value during the pandemic, all the employees from IT companies had to start to work in different ways (Brynjolfsson, Rock, et al., 2020). To keep creating value during the lockdown, the work methodologies adopted by these companies had to be more focused on the quick interaction between workers and to ease the documentation part of the processes instead of following a normal project plan with all the baseline requirements (Moon, 2020). One relevant example comes when companies invest in BPM systems development, they want guarantees that there is no need to increase the budget during the project and that client's requirements are going to be fulfilled for a better acceptance (Thompson et al., 2009).

Regarding BPMS projects, there is an obvious choice when it comes to mind all the work methodologies that would stand out during this outbreak, that is the Agile Methodology. This methodology is commonly adopted by the software development industry, where a more dynamic way of work is predominant (Matharu et al., 2015). Four main values give Agile the perfect opportunity to be one of the most successful methodologies nowadays: Individuals and Interactions over Processes and Tools; Working Software over comprehensive documentation; Responding to change over following a plan & Customer collaboration over contract negotiation (Poppendieck & Poppendieck, 2003).

Overall, these four values describe perfectly what is necessary for software development. Although there is a lack of bureaucracy involved (Denning, 2016), in times like Covid-19 where social distancing is mandatory in extreme cases and remote work is the solution, Agile values fit perfectly. Moreover, Agile methodology sums up also twelve principles for a better understanding of is culture: Customer satisfaction; Welcome change; Deliver frequently; Working together; Motivated team; Face-to-face; Working software; Sustainable pace; Good design; Simplicity; Self-organization & Reflect and Adjust (Beck et al., 2001).

Inside this methodology, some frameworks can be adopted to accomplish its principles (e.g., XP, Lean), but the one that is going to be focused on in this document is Scrum. The term *Scrum* comes from rugby when at a certain moment the referee stops the game and most of the players from both teams gather to make an orderly formation to win back the position of the ball, introduced in the *Scrum* by another player. This event can happen multiple times during a game of rugby (Quarrie & Wilson, 2000).

In a certain way, what succeeded in the sport applies to projects with this framework. Scrum's principles say that the process should be based on gathering a team of developers and some specialists in a specific area, nominating a Scrum Master that will be responsible for reporting to the Product Owner and organize the Daily Scrums (everyday meetings to understand the situation point and keep track of team tasks) and focusing on delivering the task in time due to the deadlines. These tasks are called Sprints and most of the time they take from 1 to 4 weeks, being repeated with new tasks until the project ends (Martin, 2009).

If we do not take into consideration the pandemic and remote work, there are better methodologies that can document business processes and analyse KPIs for organizations. When business and processes are mentioned in the same sentence, it is almost impossible to let BPM out of the equation since it is one of the most beneficial methodologies to organizations (Alibabaei et al., 2009). Some studies go even further and say that is CIOs top priority nowadays (Gartner, 2009).

BPM is a management approach that focuses on describing, controlling, modelling and optimizing already existing business processes inside a company (Buchwald et al., 2010). It is a different working methodology from Agile since BPM focus is not on creating value, but on adding it, by optimizing processes performance to make them more efficient and minimize resource usage and hence costs (Janiesch et al., 2014). With all the competitiveness in the most diverse industries, but specifically in IT, the companies that better succeed are those who implement inside their departments managing tools that bring the best out of their facilities and resources. With that in mind, BPM methodology is considered to be a top priority for IT companies (Rudden, 2007).

There are a few principles to have into consideration when applying this BPM, more specifically, ten of them: Principle of context-awareness; Continuity; Holism; Institutionalization; Involvement; Joint understanding; Purpose; Simplicity and Technology appropriation (Vom Brocke et al., 2014). Both Agile and BPM do not interfere with each other, meaning that there is some space in companies to implement them in the same scenario making them compatible (Kruba et al., 2012).

Although the idea of merging the foundations of the Agile manifesto to BPM is not new, there is still a big gap of specific information regarding this topic that would be of good use to prove the benefits of this linkage. Thiemich & Puhlmann (2013) have done exceptional work suggesting this combination and explaining their benefits. In the software development field, today, most of their projects are based in Agile with the Scrum framework, leading to constant interconnections between customers and developers, minimizing the possibility of misunderstandings in the requirement phase (Rising & Janoff, 2000). Not only that, but clients can add more specifications and modify their requests throughout development so that the final version can match their expectations.

1.2. MOTIVATION

Even though it is important, the risk of investing in BPM is still very high given the percentage of failure (Trkman, 2010). For that reason, the research community deepened the studies on how other up to dated and effective methodologies could improve results and reduce the risk by interacting with each other. The importance of letting, not only IT companies, know the benefits of approving a new framework based on Scrum and implement it on BPMS is what strive this research. It is of great interest that this combination achieves good forecasting results built on real-life business cases and their testimonials so that there is the possibility of overcoming previously known failures and continue to improve the way of how business is conducted.

However, it is still not clear if the use of the Scrum framework in line with BPMS leads to beneficial outcomes, due to the lack of information regarding this topic. If the business management community held more scientific facts and trustworthy articles proving the benefits of a Scrum BPM methodology, when it comes to the phase of defining the right approach for project development, definitely this new one would be opposing with the top choices. This study aims to reveal itself to be substantially important for the scientific and business community. Since there is already a methodology that connects both parts, BPM core methodology with Agile work practices, this will give extra strength to the already existing frameworks that support this innovative idea.

There is never a maximum number of researches and articles regarding a specific topic, much less when the area in question is IT, where innovation and new outcomes are being discovered with a high frequency (Jeyaraj et al., 2006). To cement the already existing framework, this study has the conceptual importance of giving extra value to the Scrum BPMS approach and leverage it, making sure the business world will be more careful when it comes to deciding which project development methodology they should adopt.

Building knowledge in Business methodologies is critical, given the importance of BPM and due to the lack of success on projects that are associated with it (Attaran, 2004). For the management and scientific community, if there is a possibility of adding value by studying and increasing certain hypotheses already proven, then the benefits will be seen as a whole. In a more practical view, this study could also be important due to the connection it will be made. By collecting and study previous projects that used a BPM methodology, it will be possible to focus on the parts that the project has failed and incorporate Agile practices that could overcome those problems. By doing that, the business community will have more practical evidence that this relatively unknown approach could improve the outcomes of their ongoing and future projects.

1.3. RESEARCH QUESTIONS

It is still not clear how BPMS projects can be executed with the help of the Scrum framework, that is why some research questions can be lifted:

- Can the Scrum framework be compatible with BPMS development?
- How can the Scrum methodology be used to improve BPMS processes?
- What will be the benefits of using Scrum in the execution of BPMS projects by a remote work approach?

At the end of this research, it is expected that these questions were properly answered and there is factual information regarding the topic.

1.4. OBJECTIVES

Having that, the objective of this research is to make a systematic analysis of the benefits and drawbacks of the use of Scrum framework on BPMS projects and propose an improvement to existent guidelines to help to get better compatibility between Scrum and BPM. To reach this goal, the following intermediate objectives should be achieved:

1. Study BPM concepts and BPMS;
2. Study Agile concepts and Scrum;
3. Analyse the current frameworks that could be used in BPMS project development (e.g., IBPM, Agile BPM Project Methodology, etc.);
4. Create an artefact regarding Scrum and BPMS;
5. Discuss and describe the results;

2. LITERATURE REVIEW

In this section, both BPM and Agile methodologies will be introduced and contextualized. First, it will be described the principles of BPM and its main features followed by the lifecycle describing their stages. Then, there will be different BPMS typologies to have a better overview of the current options on the market. Second, it is also important to mention the concepts of Agile as well as its famous lifecycle. Some Agile frameworks will be briefly described and finally, Scrum will be studied in parallel with BPM to merge them and understand in which stages this framework can make an impact.

2.1. BUSINESS PROCESS MANAGEMENT

What makes BPM a must-have methodology implemented inside the companies is the number of processes and competitiveness in business. To succeed, organizations have to be extremely organized during their business processes and assets whilst managing their employees to optimize the work that is done (Malinova et al., 2014).

BPM is something that started to be seen as reengineering of the existing processes. One of the most famous reengineering cases is the "Ford-Mazda purchasing process". When Ford acquired a substantial part of Mazda, they went inside the company to overwatch how their processes were being developed. This englobes the number of workers per sector, revenues and process optimization. Rapidly, Ford specialists noticed that their productivity could be much higher if they had similar processes to their American company. In the reengineering process, the main goal was to improve performance, cost efficiency, product quality and production speed and quality (Hammer, 1990). In the XX century, this process of rethinking was called BPR.

2.1.1. Theoretical Background and Concepts

As BPR grew into something that was seen as an important process by most of the companies, with all the technological innovations and increase of demands, companies started to want even more improvements. Specifically, it gave them all the methods, techniques and tools that could cover all their needs, such as planning, monitoring as well as executing. This new demand gave birth to the still-existent BPM methodology (Dumas et al., 2013).

The way BPM sees and understands business processes can be described as a horizontal point of view instead of a vertical and functional perception (Schmiedel et al., 2015). This perspective was the perfect ecosystem for the two main focuses of this methodology: efficiency and effectiveness (Hammer, 2015). Furthermore, certain elements that should be approached holistically, such as strategic alignment, governance, methods, IT, people and culture (Rosemann & vom Brocke, 2010). With the transformation in IT, the business world saw a need of implementing new technologies to increase their value. This gradual change was also felt in the BPM concept since IT solutions were being created and providing evidence in the importance of tracking workflow models and processes automation (Jeston & Nelis, 2014).

As for the main concepts, ABPMP International (2019) has already given an explicit overview in its publication (*BPM CBOK®*). BPM is described as a strict methodology that can lead companies' assets, from humans and finance to materials and intellectual resources, maximizing their value for the customer. After being implemented, BPM can be seen as a core capability, which means that at that moment, BPM is another valuable asset of the company, having people and technology providing services to achieve BPM goals (Vincenza et al., 2019). Another important aspect is the alignment that the organization will acquire. The main purpose will be value delivery to the customer, whether in the form of a product or a service.

Moreover, it addresses end-to-end work and the orchestration of activities across business functions as well as answering *'What, Where, When, Why & How'* work is done and Who is responsible for performing it. After succeeding, organizations that achieved maturity within their BPM capabilities start managing their processes in a closed-loop cycle that can be identified by planning, design, implementation, execution, measurement, control and continuous improvement of business processes (Rosemann & De Bruin, 2005). Once companies decide to move forward with BPM implementation, one guarantee is that it will require a significant investment inside their business capabilities.

Additionally, this concept results in the introduction of new roles related to BPM which can address the principles and practices, such as a Process Owner, Process Analyst or Process Governor. As easy as it can be misunderstood, BPM is not a prescribed framework, methodology or a set of tools. There are already a few business frameworks, such as TOGAF, that can define the organizational context or optimize business process designs (Riwanto & Andry, 2019). Since BPM is a different approach, its implementation can employ any other framework that can elevate business processes. It is important to stress that technology or any IT innovation do not play a leading role but a supporting role. Because BPM implementation is very expensive, and it is a strategic decision, it should be sponsor by a strong group of executives (Santana et al., 2011).

2.1.2. Lifecycle

The BPM lifecycle is the description of the different business processes phases (Malinova et al., 2014). It can be an infinite cycle for the reason that there can always be improvements in the processes and the output of the last phase feeds into the starting phase (Dumas et al., 2013). There are already a few proposed BPM lifecycle models from different researchers with certain differences, however, the fundamental of recognizing business processes as objects that can be continuously improved (Reijers et al., 2010). For that fact, only the lifecycle described by Dumas et al. in his publication, Fundamentals of Business Project Management (2013), will be taken into consideration.

For organizations that are not familiar with BPM and are in the early stage of implementing it, the first thing that needs to be done is to identify the relevant existing processes. This is the *process identification* phase, which leads to the process architecture, which is a collection of processes and links between those. Once the processes are identified, the next step is to understand in detail those business processes. This phase is called *process discovery*. The expected outcome of this phase is one or more *as-is* models, which reflect the understanding people have about how work is done. There are several ways of creating these models, but the most common one is the use of *flowcharts*.

Due to the importance of this phase, BPM users started by using UML to design these models. To avoid misunderstandings between models, a notation was standardized, nowadays known as BPMN. Knowing the *as-is* models, we can move forward to the *process analysis.* The goal of this phase is to identify and assess issues and opportunities for process improvements. Then, process analysts proceed to the *process redesign*, where they propose a redesigned version in the current processes, also known as the *to-be* models. To implement those changes, the team progress onto the *implementation* phase, whereas the specified models are transferred into operational environments (Zur Muehlen & Ho, 2005).

For that purpose, organizations must be prepared to welcome new IT systems (BPMS) that can implement the necessary organizational change management and process automation. After going through all these phases and all the investment, it would be harmful to management not to monitoring and control what was done. That is why BPM considers *process monitoring and controlling* a phase as important as the others, so it could continuously improve and adapt to the new customer needs, technologies or competition. Some companies are already adopting high analytical technology techniques, such as Big Data, IoT, Machine Learning or even Artificial Intelligence (Szelągowski, 2018). A visual interpretation of the cycle can be seen below in Figure 1.

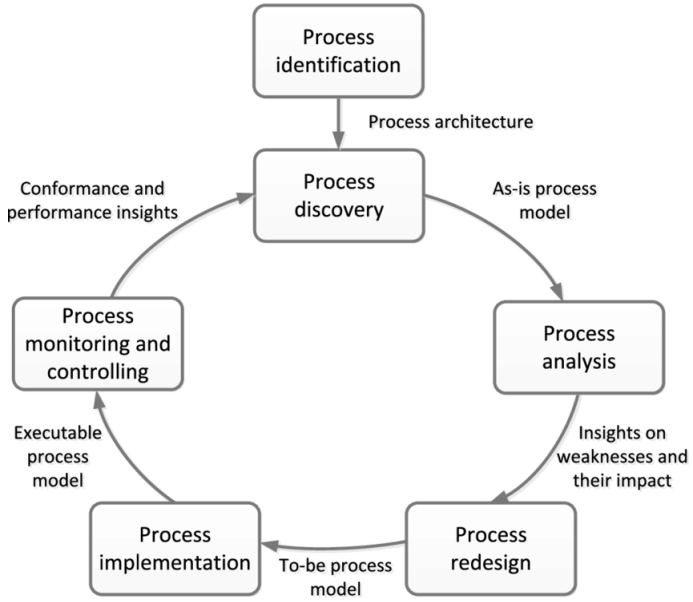

Figure 1 – BPM Lifecycle (Dumas et al., 2013)

It is easy to identify a wide range of stakeholders during this cycle. Beyond all the process participants and analysts, there can be included in this set some positions from the management team: the CEO has to be a mandatory stakeholder since is responsible for business success. Since BPM is adding value to both operations and technology, we can include the COO and CIO. The CFO, which is the person who is responsible for the financial performance, has also interest in the success of BPM. It cannot be forgotten the HR Director, whose team plays an important role in processes that involve a significant number of participants (Neubauer & Stary, 2017).

2.1.3. Business Process Management Systems

The perfect relation between BPM and IT translates into a BPMS. In the same way that in the past BPM was known as something else, BPMS are the evolution of WFMS. Its focus was only on routing work between co-workers and did not include process intelligence functionalities. Along the way, WFMS was extended with modules that could monitor and analyse the execution of business processes. Due to the increased sophistication in these systems and the better integration with other enterprise systems, they can now be called BPMS (Harmon, 2010).

One of the main features of these systems is the representation of process models that exploit a specific description of a business process. This is what distinguishes BPMS from other process-aware information systems, such as CRMs or ERPs. Moreover, the main purpose of a BPMS is to coordinate all the time and resources of an already automated business process. We can outline the relations between entities in BPMS architecture as it is visualized in Figure 2. The central entity of the architecture is the *execution engine*, which communicates with every other entity inside the system. The main features are the creation of executable processes instances or even distributing work to process participants (Dumas et al., 2013).

The *processing modelling tool* is used to create and modify process models or even to store, share and retrieve those models that are contained in the *process model repository*. Also, the *worklist handler* has important functions with the participants. It is this entity that offers the work items and the respective commitment for the *execution engine* to keep track of them. Another important set of tools are the *administration & monitoring*, which are necessary for the administration of all operational matters of a BPMS. Additionally, the execution-related events are stored in a second repository called *execution logs*. To make the connection with exterior services, there must be an interface that links the central entity of BPMSs and *external services*.

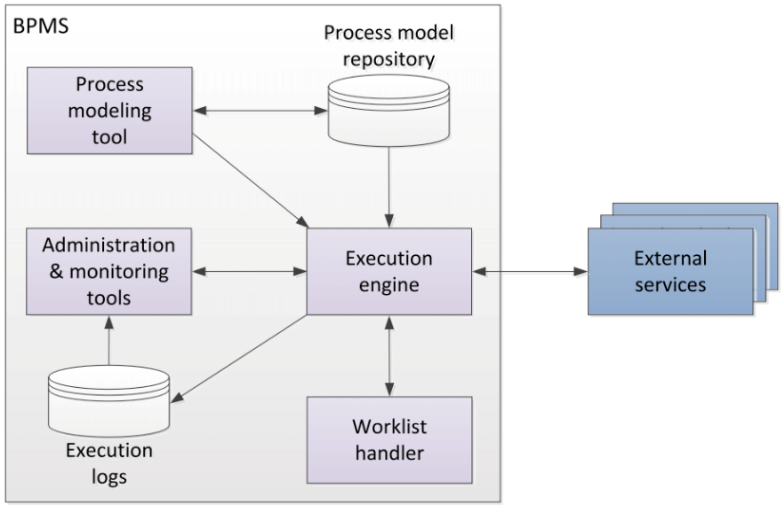

Figure 2 - BPMS Architecture (Dumas et al., 2013)

2.1.4. BPMS Projects Features

Projects related to BPMS have to be faced gently since they are complex and have a high failure possibility compared to ERP systems. Also, BPMSs offers individual opportunities for organizations to have multiple BPM projects (Hagemans & Kelder, 2010). BPMS projects normally require a business process re-engineering and some kind of organizational change beyond traditional project management principles (Bingi et al., 1999). Additionally, BPM is considered to be a multidisciplinary methodology and requires multiple business factors to be taken into contemplation (Bandara et al., 2005), which makes BPMS implementation a continuous process consisting of multiple BPM projects (Ravesteyn & Versendaal, 2007). The objective of a BPMS project is to reach the next levels of organizational and strategic level incorporation with the technical level. For that, BPMS projects have to delegate tasks to certain people, with the right intel. It should support modelling and analysis of tasks to verify, evaluate and modify inside structures (Karagiannis, 1995).

2.1.5. BPMS Project Techniques

As a tool, BPMS can assist several projects being developed or deployed. There are a few types that are exploited with the digitalization of business management techniques. In this section, there will be described some of the most. common BPMS project types, which will be included in the strategy toolbox further in this document.

Process Mining

With the innovations in the Data Mining and Business Intelligence sectors, it was just logical to take the step of adapting these technologies into the business process field. This type of project enables the possibility to discover, analyse and improve business processes based on event data (Van Der Aalst, 2012). All of those characteristics are exploited with the use of BPMSs, where it gives a better overview and the necessary tools for employees to work around and doing exactly the mining of their existing processes. In other words, what process mining does to achieve what is proposed, is to extract knowledge from event logs available in nowadays ISs (Van der Aalst, 2011).

BPM Simulation

Simulation projects are very useful to forecast close to real business cases with high efficiency. For that purpose, BPMN is the elected notation to input data into the BPMSs in use since with the right elements incorporated in it, the project's team can achieve not only simulated processes but also model them (Freitas & Pereira, 2015). The advantage of adopting simulation projects is that it gives companies the possibility of analysing and testing different scenarios without taking any risk to the existing systems (Ribeiro & Pereira, 2014). Moreover, the utilization of simulators with BPMN 2.0. can eliminate truly a series of costs and risks that would be inherent to test.

Business Process Integration

To keep the business growing, there is a need of maintaining up to dated technologies and keep on technological trends. For that reason, business process integration plays a big role. As described in other research, process-oriented companies are continually integrating their processes, and process integration is a key focus for many types of reengineering and optimization activities (Wakayama et

al., 1998). With the hand of the BPM department, all the integrations needed can be fulfilled, using their know-how in tools such as BPMSs, business processes can be integrated very quickly and without having many downfalls (Berente et al., 2009).

Robotic Process Automation (RPA)

It is almost visible the progress in Artificial Intelligence and Machine Learning over the past few years. More and more sectors are automating their businesses due to these two scientific advances. Having that, it was just a meter o time until companies understood the advantages of automatizing their business processes as well. RPA is defined as a type of project which automates processes within a broad of different technologies (Hofmann et al., 2020). The aim of its implementation is, as the name suggests, to automatize processes that were previously done by employees, to reduce its repetitiveness and to liberate employees for tasks better suited only to humans (Van der Aalst et al., 2018). Of course, BPMSs have again an important role, since companies can only deepen their inside processes knowledge by utilizing software and tools capable of giving overviews and suggest improvements in those business processes.

Workflow Automation

This type of project focus on improving the existing workflow business processes. It is also known as a reengineering process (Georgakopoulos et al., 1995). Workflows describe business process tasks at a conceptual level for a better understanding, evaluation and redesign. They are supported by WFMS to fulfil its objective, a system that was later upgraded into the BPMS used nowadays.

Process Transformation

In the era of digitalization, it can be said that almost every process transformation project can be categorized as digital transformation. With the leverage of BPMS, these types of projects have some specific contexts to differentiate themselves. Firstly, it has to opt for emerging digital technologies to reconceptualise business needs, whether they are models or processes (Yoo et al., 2010). Another thing people should have in mind when working for a process transformation project is that, if the transformation is based on a BPM methodology, the outcome of the project will change dramatically inside business structures (Besson & Rowe, 2012). If companies are not willing, after the project is implemented, to train or re-educate their employees for the new working methods, then this type of project should not be the one to choose from all the BPMS project types.

2.2. AGILE METHODOLOGY

When Agile was created, the main purpose was to provide a more appealing and simpler methodology for the software development companies (Beck et al., 2001). In the Manifesto, it was clear that the key values for this methodology were *Individuals & Interactions, Working Software, Customer collaboration and Responding to change*. At that time, software was emerging and becoming a vital component for companies that want to surpass their competitors (Herbsleb & Moitra, 2001). Consequently, the demand for software increased the number of companies that supply software solutions.

2.2.1. Theoretical Background and Concepts

Behind the Manifesto in 2001, the seventeen software experts already had similar opinions regarding the existing working methodologies at the time. All of them agreed on four values and twelve principles that became the Agile fundamentals to companies who wanted to adopt Agile methodology. If software development organizations follow these four values, they could call themselves an Agile company. Therefore, the rules are (Beck et al., 2001): Individuals and interactions, over processes and tools; Working software, over comprehensive documentation; Customer collaboration, over contract negotiation; Responding to change, over following a plan.

To fulfil these organizational values, companies should follow the twelve principles defined in the Manifesto, which are (Beck et al., 2001):

- Our highest priority is to satisfy the customer through early and continuous delivery of valuable software;
- Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage;
- Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale;
- Business people and developers must work together daily throughout the project;
- Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done;
- The most efficient and effective method of conveying information to and within a development team is face-to-face conversation;
- Working software is the primary measure of progress;
- Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely;
- Continuous attention to technical excellence and good design enhances agility;
- Simplicity--the art of maximizing the amount of work not done--is essential;
- The best architectures, requirements, and designs emerge from self-organizing teams;
- At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behaviour accordingly.

2.2.2. Lifecycle

As for its lifecycle, there are a few different phases that can be defined along the process whilst the principles will remain the same. For this research, the Agile Lifecycle will be divided into six main phases: *Requirements*, *Design*, *Development*, *Testing*, *Deployment* and *Review*. The completion of one full loop is called *iteration*. When an iteration is completed, it will start the next one. Starting with the Requirements phase, this is where the key stakeholders and users meet to identify business requirements that are relevant for the work that is starting (Sohail, 2019). Next, the Design phase is where the team discusses how to tackle the requirements and proposes the tools to achieve the best results. It can be defined which programming language to use or even the libraries that the project is going to need. The Development phase is generally the longest and it is the backbone of the cycle, where the team puts their effort into converting the design documentation into software (Feoktistov, 2020).

Moving on to the second part of the cycle, the Testing phase is where the team ensures the quality of the code previously done (Thakur, 2019). There are a few types of tests that can be implemented: unit tests – testing individual methods and functions from classes, components or modules; integration tests – testing interactions with the database or making sure microservices work as expected; functional tests – focused on the business requirements of the application; end-to-end tests – replicates the user behaviour with the software in a complete application environment; acceptance tests – formal tests to verify if the system satisfies its business requirements; performance tests – checking system behaviours when it is under a significant overload; smoking tests – quick tests to check basic software functionalities (Pittet, 2021).

Furthermore, in the *Deployment phase*, the application under development is deployed on the servers and provided to the client, either in the form of a demo or the final result. Finally, the *Review Phase* is where the product owner gathers with the Agile team and wrap the iteration with some questions or doubts that anyone has. When everyone is done talking about the finished iteration, the team starts approaching the next iteration, starting the cycle all over again. It is fundamental that in these team meetings everyone listens and there should not be any embarrassment from anyone. That is what the Agile methodology is all about.

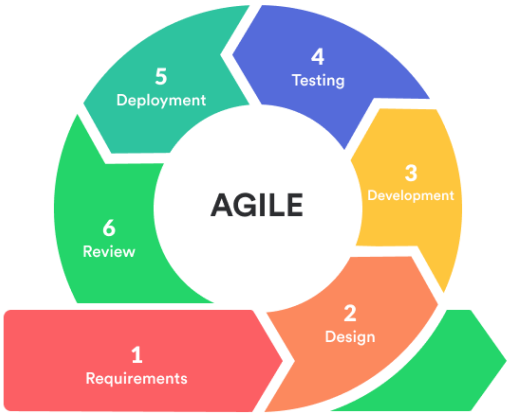

Figure 3 - Agile SDLC Lifecycle (Anurina, 2021)

2.2.3. Agile Frameworks

After the definition of the Agile methodology, different frameworks diverge and differentiate themselves with some principles, regarding having always the same Agile priority: satisfying the customer with continuous deliveries of valuable software (Beck et al., 2001). In this section, there will be introduced and briefly explained not only Scrum but also three very popular frameworks: Crystal, XP and Lean. It is important to have some knowledge in other frameworks than Scrum to explain why it is the most compatible Agile approach to integrate with BPM projects.

Crystal

It is common to see this framework defined as a family since there is more than one crystal method. These methods are categorized and scaled by variables, which are *losses due to system failure*, *comfort*, *discretionary money*, *essential money* and *life*. There are known four Crystal methods arranged by colours and opacity: Crystal Clear, Crystal Yellow, Crystal Orange and Crystal Red. Despite that, only Crystal clear and Crystal orange are defined and used in software development. They have all the policy standards, documents and artefacts description and the personnel roles (Abrahamsson et al., 2017). Firstly, created by Alistair Cockburn in the early 90s when he worked at IBM, he found out that the teams he interviewed, were lacking in communication and collaboration tools (Cohen et al., 2004). That is why this set of methods focus on people collaboration.

The policy standards for the Crystal clear and orange are *incremental delivery of tested work product*, *direct user participation*, *automated regression testing*, *project progress tracking by milestones* and *workshops after each delivery for methodology* adjustments (Abrahamsson et al., 2017). Whilst Crystal clear is designed for projects of up to six members, Crystal orange can be adopted by teams from twenty up to forty members. There are a few advantages when adopting Crystal as your Agile framework. It is almost guaranteed that the guidance that Crystal delivers will lead to effective communication, which is a key factor to success. Not only that, but this framework provides good risk management and technical practices. Unfortunately, Crystal yellow and red are still not defined so their scope is reduced by half. Crystal family lacks in design and code verification activities and it cannot give any guidance when it comes to business enterprise (Mnkandla & Dwolatzky, 2007).

Extreme Programming (XP)

When a software development company wants to adopt a new framework that advocates rapid iterations, rigorously tested code and close look up from the end-users, there is no better option than Extreme Programming (Beck & Fowler, 2001). This is the most widely used Agile framework from these four presented in this research (Cao et al., 2004). There are a few principles companies have to follow to implement XP: *Whole Team Involvement; Planning Game; Customer Tests; Simple Design; Pair Programming; Test Driven Development; Design Improvement; Continuous Integration; Collective Code Ownership; Coding Standard; Metaphor* and *Sustainable Pace* (Jackson et al., 2004). With all these set of principles, it is guaranteed that the organization in cause will elevate their software development to extreme levels (Beck, 2000).

It is proven that XP has positive outcomes in small software projects (Murru et al., 2003). Nevertheless, it should not be seen as a framework viable to all project development organizations. Despite bringing advantages like lower management overhead, higher team productivity or shorter release cycles, the

application of this Agile approach is constrained by the type and size of the project, the experience of project personnel and high commitment from the customer (Cao et al., 2004). The recommendation in some researches is to not implement this framework in big projects due to insufficient architecture planning, over-focusing on early results and low levels of test coverage (Boehm, 2002).

Lean

This framework has grown from a primary organizational improvement, which was, reducing/eliminating waste. From the late 40s that some companies started to focus on how they could improve their revenues without investing more money (Poppendieck & Poppendieck, 2003). Due to its efficiency and importance, *Eliminating Waste* has become the fundamental principle of Lean and the basis for the follow-up principles. At first, it was difficult to define wastes in the current business process. Nevertheless, something that needs to be taken into consideration in software development, is that, even though there are a lot of phases required, none have more direct contribution than the analysis and coding phases (Royce, 1987). For that reason, if a software development company need to cut some wastes, it should point first to the other phases of their processes. Some examples of manufacturing wastes that could be related also to the software industry are *Inventory, Overproduction, Transportation, Waiting time, Defects* or *Motion* (Shingo & Dillon, 1989).

The best approach to improve the software development environment is to *amplify learning*, making it the second principle of this framework. The *Decision as late as possible* can be a controversial principle but in fact, it can be very beneficial. Sometimes when the future is closing in an economic market it is easier to predict. Not only that but postponing the decision making also means that more facts can be gathered during that period, so the decision can be based on them and not on speculations. On the contrary, *deliver as fast as possible* is a must in Lean. Since there is constant interaction with the client, without fast deliveries software teams could not have reliable feedback. The remaining principles are based on the further view of the team (Poppendieck & Poppendieck, 2003). *Empower the workers* is a principle that translates into elevating the team's importance.

Having developers involved in the technical decisions is fundamental to achieve excellence. With the necessary tools, expertise and guidance, everyone who can share their knowledge will reach much higher development levels. In the presence of conceptual integrity, the systems will work much smoother, cohesive and it is a critical factor in creating perceived integrity (Clark & Fujimoto, 1990), making *building integrity* another important principle. Finally, *see the whole* is the last Lean principle. If there is some requirement missing, it is better to have a further overview of the project for a better decision.

Scrum

A very popular framework, created by Jeff Sutherland and Ken Schwaber in 1995, quickly became one of the best methodologies to leverage projects under development. As for the other types of Agile frameworks, Scrum was formalized to help the software development. One thing that distinguishes this specific framework, is that works well for any complexity or innovative scope of work (Mahalakshmi & Sundararajan, 2013).

The main Scrum outcomes that could be highlighted are (Marchesi et al., 2007):

- Ensure high quality of products and deliverables;
- Scalable from a single process to entire project;
- Provide better estimates to time and cost;
- Better control over project schedule and state.

The people that are involved in this framework are, most of the time, the Product Owner, the Scrum Master and the Development team itself. With a low number of enrollees, the team maximizes their interaction and cooperation at a lower time and cost. The role of the *Product Owner* is close to what a normal client would perform. Creates and prioritizes a list of needs to be fulfilled and decides about the business value. This role can also change the software requests along with the project. Then, the *Scrum Master* is responsible for the implementation of the project, keeping the team focused on the goal and grant their requests whenever possible and protecting its team from external influences. It can be considered the project manager. The scrum team is a set of specialized people that can add value to what the Product Owner demanded. They have to be self-organized and have cross-functionalities (Cho, 2008).
After the definition of the roles present in Scrum, it is necessary to understand the tasks and events that this framework defines. The list of features that the Product Owner defines at the beginning of the project is called the *Product Backlog*. From that list, the team gathers and creates the *Sprint Backlog*, which is a certain number of backlog items that they compromise to accomplish until the end of the Sprint and commit the solution (Darwish & Abdelwahab, 2016). This act can be seen as the *Sprint Planning*. It is important to understand what a Sprint is, and it can be traduced in an iterative, time-boxed duration with fixed times (Sutherland, 2016). Normally, a Sprint duration is between two and four weeks.
Every day, there is a team's reunion that has the objective to track the progress and to see if everyone is aligned with what was defined previously, what are going to be the upcoming tasks or even if there are any obstacles. These meetings are known as the *Daily Scrums*, guided by the Scrum master. The *Increment* is a chart that shows how much work is left to do. At the end of each Sprint, there is the *Sprint Review*, where the work is revised and is presented to the Product Owner (Cho, 2008). It is also done a retrospective to understand what went well during this Sprint and what can be improved in the next one. A visualization of the Scrum framework can be seen in Figure 4.

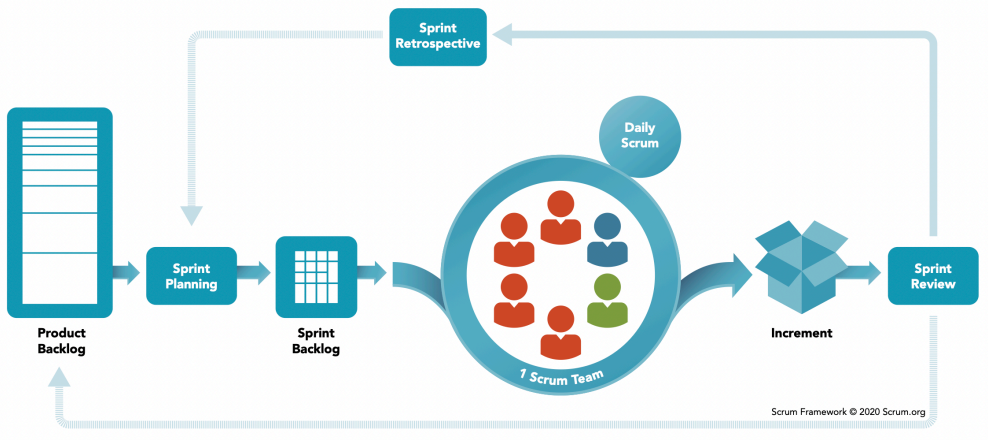

Figure 4 - Scrum Framework (Scrum.org, 2021)

This framework was adopted by so many companies that Scrum even had an impact at an academic level. Since the increase in demand for this methodology, universities saw an opportunity to educate their students so when they reached the working world, they had already worked with all the Scrum rules. The term that nowadays is used to coach students where the responsibility for the learning process is delegated from teachers to students based on Scrum operations is *eduScrum* (Delhij et al., 2015). With eduScrum, students can tackle complex adaptive problems, while productively and creatively achieving the learning goals that universities strive for. This approach was adopted by many Software and Computer Science Schools to prepare better their students and consequently, increase their reputation along with Software Development companies.

2.3. SCRUM & BPMS

In this section, the concern is to do good research of the two methodologies combined. For the sake of that, a well-known research methodology will be applied to end up with the best results, which is PRISMA. This research approach has the goal of reducing and shorten already existent papers to be analysed efficiently. PRISMA method follows five phases, starting with the identification of relevant manuscripts of the domain, followed by the screening of titles and abstracts. Next, it is done an eligibility analysis of those papers which will be followed by a full-screen reading of the remaining papers. Lastly, the papers selected by the author will be analysed in detail to contribute to the cause of this research (Moher et al., 2010).

2.3.1. Search Strategy

To begin the *Scrum & BPMS* search by the PRISMA method, a search schema was thought with to find the best suitable and already available papers and articles. As for the repositories to find them, there were used well known digital repositories such as IEEE Xplore, Science Direct, Springer and Google Scholar. For the creation of the search query, three main keywords were used linked with the Boolean connector 'AND', which led immediately to a plausible number of published papers ("SCRUM AND BPMS").

In Figure 5 it is presented the PRISMA flowchart. This chart illustrates the 5 phases of the manuscript's selection process. Some manuscripts were excluded in each phase according to their conditions which led to the papers that fit better to this study's topic.

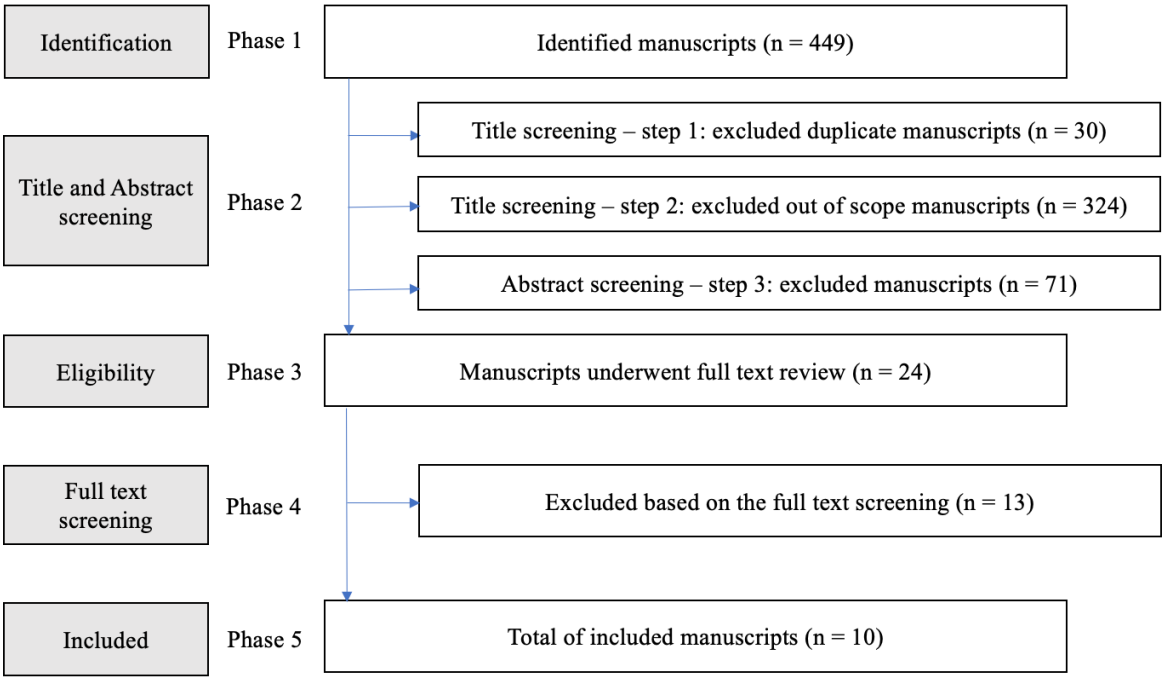

Figure 5 - PRISMA Flowchart

Phase 1 is the Identification of manuscripts searched in the previous mention digital repositories with the created search string. Other important information regarding all the PRISMA Phases, is that only papers are written in English, Spanish and Portuguese were selected to move forward. The number of identified publications was 449, including duplicates. The next step, Phase 2, is the Title and Abstract screening. Firstly, was applied a filter to exclude duplicates from different repositories (30 duplicates). Then, there were excluded 324 publications according to their full title visualization and based on the abstract reading, other 71 papers have been put aside. After just two out of five PRISMA phases, the number of publications was reduced by almost 20 times. Phase 3, the Eligibility process, gathered 24 manuscripts, validating them for the next filter based on the full-text screening (Phase 4). From there, it was possible to exclude 13 more manuscripts, leading to Phase 5, the Included papers, which were 10.

2.3.2. Search Results

Badakhshan et al. (2019) have done a Systematic Literature Review (SLR) and an integrated framework regarding the Agile methodology and BPM. The goal of their publication was to provide enough resources and guidelines of a framework for the use of an Agile BPM. The results of the SLR were as the authors expected, agility in BPM would be beneficial to companies, enabling more flexibility and leanness. Flexibility emphasizes BPM's continuous readiness and leanness emphasizes iterative value creation. Furthermore, the proposed framework gives an overview of how agility and BPM can interact systematically. Its main concerns were implementing Agile principles like quick reaction to change in BPM phases like Process Innovation or Process Improvement. Not only that, but it must contribute to the development of the perceived economy, quality or simplicity in the Process Change Initiation. Lastly, the framework suggests that the Agile principle of being continuously up to date when it comes to environment trends (e.g., new technology) have to be aligned with the process improvement methods, such as process mining or business process automation.

Probably the most similar research to this document's topic is the proposal from Thiemich & Puhlmann (2013), which studied both Integrated BPM (IBPM) and Scrum. IBPM focus on analysis and design, while Scrum is the best Agile methodology to deliver a holistic approach on how to get requirements implemented. To these two authors, since there are no previous studies of combining IBPM and Scrum, it seemed obvious to create a new value-adding combination to both frameworks. It was described as an Agile BPM Metamodel that could keep the BPM project big picture and be developed with all the Scrum guidelines, changing the terms Scrum Master to Agile BPM Master and some other simple modifications. All the Scrum artefacts and phases would be the same, but also, the tools and techniques of a universal BPM project. This proposed framework was put into work in September 2012, in a Service Portal Project and the known BPM and Scrum issues were overcome.

There is another meta-model represented by a UML diagram, relating to business process management entities. Several entities are related to each other on the diagram presented in the article written by Zacarias et al. (2017). The meta-model proposed by the three authors reflects a combination of traditional and agile BPM through layers where business process changes are fed within daily work practices. The ultimate goal of this meta-model is to foster responsiveness in business process improvements with any frequency appropriate by the organization. Additionally, two of these authors also wrote an article regarding agile business process improvements, and it concludes that the

fundamentals of agile BPM propose a different view on certain aspects. Since there are always improvements in agile software development models, the authors emphasize that business process improvement methodologies should also reflect agile practices (Martins & Zacarias, 2017).

Furthermore, von Rosing et al. (2015) explains how agile principles can be applied to BPM. Firstly, by presenting the Agile methodology and making a literature review it gives enough overview to contextualize the reader. Then, there are present the most common challenges for an Agile BPM methodology, which are, Static, Dynamic, Political and Knowledge Frictions. The authors also declare that once there is a solid agile knowledge implemented, those frictions will start to diminish.

In their proposed method, all the phases are described to overcome the difficulties between both Agile and BPM separately. The Analysis, Planning, Architecture & Design, Deployment and Terminology of this Agile BPM methodology are very well explained so that the ones who want to implement it have no difficulties and any doubts. Also, it is concluded that this type of approach reaches better ways of thinking and working for better and more efficient teamwork.

Moreover, Herden et al. (2016) publication, it is described the development of an Agile approach that would be very beneficial to companies working with BPMSs. The Agile PDD (Process Driven Development) contains the Agile manifesto values and adopts BPM concepts. Its phases are Scope Definition, System Prototyping, Sprint Production, Deployment, Monitoring and Optimization. What is proposed by the authors is that the development of modern BPMS demands a new approach for workflow systems development, being Agile PDD a solution. To testify their saying, Agile PDD was implemented in two case scenarios that worked around BPMSs and used BPMN. In the first project, the system developed was to control the allocation of vehicles using a BPMS and a DBMS.

The second project was the development of a mobile application for Android and iOS. From the vehicle control system, the researchers were notified that Agile PDD was well implemented and worked properly. For the mobile application development, the researchers interviewed three project workers to understand their opinion and retrieve some feedback. The answers suggest that, by having a methodology that provides both an Agile methodology and is compatible with BPM, the main benefits were the increase in communication and rework reduction, saving time.

On the contrary, there are also researches that instead of studying Agile principles implemented in BPM projects, proposed an approach based on BPM to manage agile development processes. One example of that is the paper written by Zaouali & Ghannouchi (2016). One of its proposals is the adoption of both Scrum roles and artefacts to BPM. It is known that Scrum has a very strict team, composed of just the Product Owner, Scrum Master and its developers, which makes it very easy to communicate between them. When it comes to its artefacts, it is mentioned the Product Backlog and Sprint Backlog as examples. The authors developed an abstract model and then the detailed model, which would be constantly under the BPM approach, and in continuous business process improvement. The models are presented in BPMN, giving more strength to how Scrum and BPM interact well with each other.

The validation of the solution was done by a fake project called “Scrum-Picnic” which had all the normal project phases and software development. With the project finalized, the authors improved the BPMN to their already detailed model, calling the new one, the *Improved model*. In short, the paper describes an elaboration of an automated IS from a Scrum’s process modelling that has been deployed thanks

to BPMS and BPMN, a set of tools from BPM. They also concluded that Scrum teams will be able to conduct their projects according to an improved approach based on BPM, which offers advantages in Guidance, Reinforcement of communication and collaboration, Storage and monitoring, Continuous improvement and Training.

3. METHODOLOGY

Overall, the Methodology section is where is described all the proposed research. As this document involves two well-known working methodologies and wants to develop a new way of interaction between them, the best approach is a Design Science Research. This type of research will be very beneficial since it combines perfectly the design fundamentals of the future proposal to the analytical part according to the theoretical background previously done (Baskerville et al., 2015).

Additionally, when following the steps of a design science research, the output of it is going to be the creation of an artefact, which is exactly the kind of results this thesis has in mind. The objective of the artefact is to clarify the business needs and to suggest solutions regarding the topic (Hevner et al., 2004).

Along with this chapter, the Design Science Research will be contextualized and fitted in with this thesis topic. As for the validation part, the Methodology has a validation segment, which in this study will be done by individual interviews.

3.1. DESIGN SCIENCE RESEARCH (DSR)

The DSR is a type of research approach that has the ultimate goal of creating artefacts for the research community. Regarding the problem defined, every DSR aims to improve the proposed subject by giving more and more open-source tools to other researchers. The six phases of this method are Problem Identification & Motivation; Objectives of a Solution; Design & Development; Demonstration; Evaluation and, lastly, Communication.

There are other options for what the DSR Model can be. Nevertheless, the one that will be adopted was firstly idealized by Peffers et al. (2007). Its model is presented below in Figure 6.

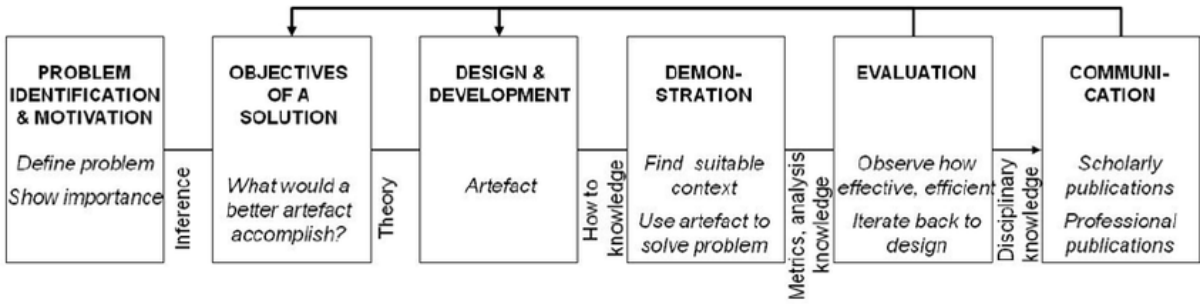

Figure 6 - DSR Methodology Model (Peffers et al., 2007)

As it is noticeable, the DSR model is not a one direction flowchart. After the development of the first four stages of the process, the last two are based on feedback given from researchers that are familiar with the topic but have nothing to do with the creation of this document. Consequently, the proposed Demo can be not accepted by them, which would cause a rollback in the DSR stages, making it in some ways a cycle.

3.2 DESIGN SCIENCE RESEARCH IMPLEMENTATION

For this specific investigation, the DRS methodology was applied as followed:

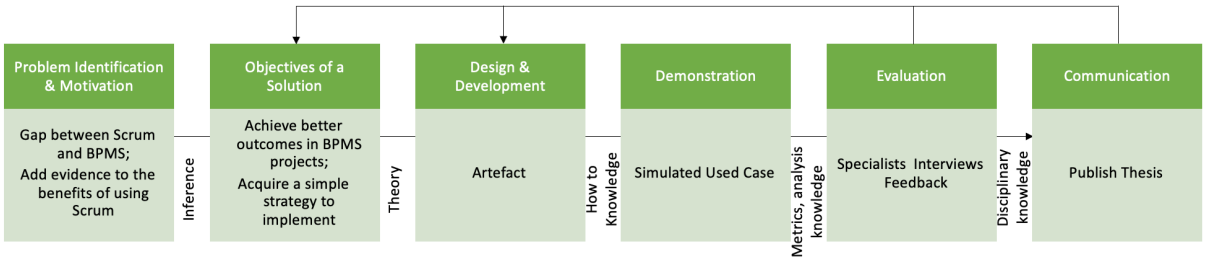

Figure 7 - DSR Method Implementation (Peffers et al., 2007)

Identify Problem and Motivation

The initial stage of the DSR has already been done in Chapter 1. This stage is of great importance since is where the main problem is identified, accompanied by the justification of the value of an effective solution to the stakeholders and their earnings regarding a solution. One mandatory condition for the start of the DSR is that the problem in hands should still be undiscovered, making it a gap in the research community and giving extra motivation for the artefact success (Dresch et al., 2015).

As for this thesis topic, the problem identified is the lack of artefacts between the Scrum framework and BPMS projects, and the motivation is, the fact that those real-life projects have still a high risk between investment and revenue for the company to support them, and the possibility that a new artefact could improve those numbers.

Define Objectives of a Solution

The second step in the DSR is where the objectives are defined, and the author lets the reader understand what the benefits of an artefact creation are. This leads to a basic perception on how the solution for the problem in hand will end up being since it is also done a Literature Review (Chapter 2) to acknowledge the existent studies and possibly a closer solution to the one the author has thought of. That is why this stage is so important, to not only complement the introduction and motivation of the problem but also to have the finish goal in mind and the way of reaching that point.

In this case, the objective is a proposal of a new artefact relating and giving a new strategy to a new Scrum and BPMS projects interface, accomplishing a new interaction which the author hopes will be well accepted in the DSR Evaluation stage.

Design & Development

Stage three of the DSR is where the actual artefact is developed. This phase aims to create enough knowledge by the design and development of the artefact itself (Gregor & Hevner, 2013). By the end of this stage, the reader has to be clarified by the artefact endured by theoretical background present to give more robustness to the proposal (Peffers et al., 2007).

As the artefact must have a visual interpretation, in Figure 8 it is possible to comprehend how it will be designed, as well as which components it will have.

Proposed Interface b/ SCRUM and BPMS projects					
	SCRUM Artefact A	SCRUM Artefact B	SCRUM Artefact C	SCRUM Role A	…
BPMS Project Type A	X	X			
BPMS Project Type B		X	X	X	
BPMS Project Type C	X		X	X	
BPMS Project Type D	X		X		
…					

Figure 8 - Artefact Example Structure

The first column of the artefact will be filled with all the BPMS project types this study will act, and the first row with the Scrum artefacts, rules, roles and whatever that is of great interest to adapt to the projects. In the cells common between those components, it is marked an 'X' to understand what will be assigned to each. Of course, the 'X' representation has to have much more information, so that the final artefact behaves as a guideline for future projects. Therefore, in each 'X' cell, there will be bullet points, briefly explaining how the owning Scrum component will have to interact with the BPMS project.

Demonstration

Following the artefact development, there is a need to demonstrate its effectiveness. For that, the fourth stage, Demonstration, is where the artefact is applied in a fictitious project and forecast the possible results. Normally, in this phase, the author puts itself in the role of the target user/stakeholder of the artefact, so it can go through what was previously done and overview its procedure (Baskerville et al., 2018). However, due to lack of time to perform a real and empirical demonstration will exemplify the use of the artefact through a use case. This use case tries to simulate a real-life example where the Scrum BPMS strategy could be implemented. For this specific example, optimization of a takeaway restaurant will be done by a company specialized in BPMS projects, which have a working methodology similar to the Scrum framework. All the interactions, the guidelines will be explained, with all the processes to achieve the pretend results.

Evaluation

The Evaluation stage is the first one whereas the DSR can have a delay and go back into previous phases. This is where the efficiency of the artefact is put to the test, by being presented to stakeholders, and consequently, evaluated (Peffers et al., 2007). Moreover, the Evaluation phase is almost of approval and certification of how well the artefact performs (Cronholm & Göbel, 2016). For that matter, the evaluation process is expected to be done by personnel experienced in the BPM and BPMS subjects, so they can give valid feedback based on their technical and professional background. Taking this into account, the most suited DSR method to evaluate the artefact during the pandemic is via individual interviews. Since the concept of an interview is vital for the artefact proposal, it will be explained how it is going to work in the next section of this document. Based on the feedback retrieved

in the arranged focus group, the ideal setting is for the DSR to advance onto the final stage. If there are a considerable number of flaws or mistakes pointed out in the artefact, it is mandatory to take a step back in the process and improve, either the Objectives and the Solution, or the Design & Development approaches.

Communication

Lastly, the final stage of the DSR aims to make this developed artefact public to everyone that manifests interest. The Communication phase is extremely important so that the scientific community have access to the thesis and all the steps taken in the development of the artefact. Liberating and distributing the DSR throughout communication methods, is the best way to announce the effectiveness regarding the identified problems, which could be mutual to other researchers. For that purpose, since this thesis is being developed as a partial requirement for obtaining the master's degree in Information Management from NOVA IMS, the institution has full authority to publish the document in any source. Of course, being a well-known IT Management School, NOVA IMS has better knowledge and status to reach the best Information Management journals based on Scimago rankings, like *Journal of Management Information Systems* or *International Journal of Information Management* among others. Because this thesis topic is the application of the Scrum framework on BPMS projects, it is also plausible to aim for the best software engineering journals. Other communication methods could be conferences or international or national papers as well.

3.3 SPECIALIST INTERVIEWS DESIGN

After the creation of the artefact in the first four stages of the DSR, the Evaluation stage needs to have approval and validation from experienced people, embedded in the process. That is why the proposed approach on that matter is to schedule a conversation/interview with around 3 or 4 people as individual interviews. This evaluation method is used to collect the stakeholders or customers' judgements without having to create a survey (DeVault, 2018). One big advantage over the surveys is that the interviewer or the creator of the artefact can have a customized perception regarding each person in the focus group, while in the surveys the data retriever can only work with the answers for each question.

In these types of interviews, the guest is only speaking with the interviewer and the expected duration should be around 20/25 minutes. Before the interview, the interviewer, who is the author of the thesis, must write a formal e-mail to each guest to make the will official and to ask permission to record the interview. For the sake of academic research, there should be at least 3 specialists invited. Since the thesis is a DSR based on a working methodology, the specialists should be from the corporate field, although there is no problem having academic professionals used to the topic.

Afterwards, the author needs to prepare a presentation with the research questions of the document, as well as a brief explanation of its goals and proposed strategy. Ultimately, by the end of the presentation, the author will question 3/4 questions regarding the guest's sincere opinion. Of course, the questions that will be asked for this specific case will have the aim to approve the developed artefact, so it is expected to have questions to the stakeholders regarding BPMS projects adversities and pitfalls that the author knows its strategy could have avoided those failures.

Despite the current pandemic situation, where online meetings are now more common than face-to-face ones, is completely plausible to conduct the interviews in any meetings software (Zoom, Microsoft Teams, etc.). The interviewer will arrange a virtual meeting, regarding the pandemic situation in the future. In the past year and a half, it was proven that those meetings are still very productive and easier to schedule. After all, the participants will be professionals from different companies, and the probability of an overschedule would be high. This way, the invitees only need an access point and with the platform and a quiet surrounding. Overall, the objective at the end of each interview is not to have the same answers from the guests but to have an affirmation for the artefact and valid information to move forward with the thesis.

4. FRAMEWORK FOR THE USE OF SCRUM ON BPMS PROJECTS

4.1. ASSUMPTIONS

Based on what was studied in the Literature Review, regarding BPMS projects and Scrum framework, it was defined that, for the new strategy between both methodologies to be successful, it should:

- Adapt the Scrum artefacts and roles to each specific BPMS project type. There are different needs to distinguish BPMS projects, which leads to a customized approach by project type.
- Have at disposal all the existent Scrum artefacts, ruler and/or roles for implementation.
- Have a fully committed and trained team, both familiar with Scrum framework and BPM methodology.
- Leverage the outcomes of BPMS projects by fulfilling its cons with the most known features of the Agile methodology, specifically, Scrum.

4.2. PROPOSAL

4.2.1. Scrum on BPMS Projects Concept

Following the extensive study of the literature regarding BPM and Agile, in deeper and more conclusive detail, BPMS, Scrum framework, its main features, advantages of adoption, compatibility and similarities between both and room for improvement, it was possible to have a crystal-clear acknowledgement and prototype on what must be included for the proposal behind this master's thesis: how artefacts and features of Scrum could improve BPMS projects by creating a new working strategy.

Having the acknowledge that BPM projects, more specifically, BPMS, share an already very well structure and lifecycle, it is also known that there are flaws that could be reduced. The concept of merging Scrum to BPMS projects is not in vain, since the most complaints from BPM employees or any interactor of the project could be improved by some of the most iconic and beneficial features of the Scrum framework, giving that its roots came from the Agile methodology.

4.2.2. Conceptual Model and Hypotheses Development

Following the defined concept, it was possible to build a framework to help to get better compatibility between Scrum and BPMS. The framework main goal is to clarify the use of Scrum in BPMS projects by propose, improve and refine the already existent Scrum guidelines to get a strong fit between the different BPMS projects typologies and the efficient use of Scrum artefacts.

The defined guidelines followed a logical procedure, that took into consideration the difficulty, importance of achievement, stakeholders and average duration of each BPMS project type. The sum of each variable gives the level of procedure.

Table 1 - Scrum Roles and Artefacts guidelines in BPMS project types

Scrum Artefacts & Roles / BPMS Project Types	Product Backlog	Sprint Duration	Sprint Backlog	Project Tracking Software	Scrum Meetings	Sprint Review	Product Owner	Scrum Master	Project Team
Business Process Integration	A	B1	C	D	E1	F1	G	H	I1
BPM Simulation		B2			E2	F2			I2
Process Mining		B1			E1	F3			I3
Process Transformation		B2			E1	F2			I4
Robotic Process Automation		B1			E3	F3			I3
Workflow Automation					E2				I3

Table 2 - Description for each BPMS project type regarding *Product Backlog*

A	Having a Product Backlog is going to be highly recommended or almost mandatory to every BPMS project. This gives a better overview of what needs to be done even before the project starts. The product backlog is not only tangible or visible but also the first interaction between the project's representatives. It is the reference point for the project's team and can be described as well as the first meeting where the client's demands are noted down. Of course, over time there can be modifications and changes from those demands. Nevertheless, the Product Backlog will remain the same until the end of the project. It is very beneficial at the end to compare the final result and features to the initially proposed, granting Product Backlog an important seat in the Project Review down the road.

Table 3 - Description for each BPMS project type regarding *Sprint*

B1	Duration of Sprint is expected to be between 1 and 2 months. These types of projects, which involves a large number of interactions, process reengineering and new business models. Despite that, also it is important to give enough time for training employees on the new business models. It is important that after the BPMS project implementation, everyone inside the company is synchronized and prepared for taking advantage of the high investment. Recommended for projects with a high level of procedure.
B2	Sprint duration should be between 2 weeks and 1 month. For BPMS projects where doesn't involve excessive modifications from the business models, the time defined takes into consideration the number of interactions between the project's team and the client. Not only that but also the intensity and importance of the projects are not crucial for the good flow of already existent business processes. Recommended to smaller projects with a lower level of procedures.

Table 4 - Description for each BPMS project type regarding *Sprint Backlog*

C	Common to all projects, the Sprint Backlog is where the features and tasks are defined for each Sprint. It is a mandatory artefact so that the project team knows what needs to be done in the next time frame. Each specific task will also be assigned to different team workers.

Table 5 - Description for each BPMS project regarding type *Project Tracking Software*

D	Software to support and facilitate managing resources, task allocation and employee's workload. Most of the Agile and Scrum projects use this type of tool, to have a better overview of all the Backlogs and tasks progression. It is not mandatory for the BPMS projects but is highly recommended.

Table 6 - Description for each BPMS project type regarding *Scrum Meetings*

E1	Meetings between the team's manager and the team's members. These meetings are very relevant to engage everyone on the working progress. It leverages feedback and interactions between stakeholders. It gives room for improvement and mods. Recommended frequency is 3 times a week. The client's representative can also be present. Best fit for lower importance projects or projects with high progress ratio, mainly the ones which depends on machinery.
E2	Frequency of meetings should be twice a week. Best match for a medium level of procedure projects, or even projects with high demand but with low difficulty. The team's manager needs to on every meeting, as well as all the members. The product owner can also participate in them, but it is just required its presence once a week.
E3	Meetings with extreme importance. These types of meetings, since it is recommended to be only once a week, should have all the stakeholders present, including the client representative. The frequency recommendation can be explained by the difficulty of each task, sprint duration and the progress slack regarding the software involved. Fits better for automated BPMS projects, together with AI, ML or simply robotics.

Table 7 - Description for each BPMS project type regarding *Sprint Review*

F1	Reviews with medium impact. The presence of the client representation is not mandatory.
F2	Reviews with less impact. The presence of the client representation is not mandatory.
F3	Reviews with high impact given the importance of the projects. Client representation is mandatory.

Table 8 - Description for each BPMS project type regarding *Product Owner*

G	Mandatory role, which can also be known as the Project Owner. It is the person who subsidizes or is the representative of the subsidiary. As well as being a stakeholder, it communicates regularly with the *Scrum Master* intending to make the demands clear and to know the state point of the project. It is present in diverse meetings regarding the project and

Table 9 - Description for each BPMS project type regarding *Scrum Master*

H	Extremely important role. The scrum master in the Scrum framework is the most similar role to what a project manager plays in other types of projects. It is the one who connects the Product Owner to the Project's team. It is the spokesperson of the client, describing to his team what are the demands, and if there is any change of need, it is up to the Scrum master to translate them as fast as possible. Also, it is the project's team face. If there is any obstacle in the project, the Scrum Master should report to the client the most important information.

It is relevant to add that, since the projects are based on the BPM methodology, inside each Sprint, the cycle of project development follows the BPM cycle (Process Identification, Discovery, Analysis, Redesign, Implementation, Monitoring). This way, the tasks divided by the team are related to the six phases of the BPM cycle.

Table 10 - Description for each BPMS project type regarding *Project Team*

I1	The project team should be between 5 and 7 employees. Whenever a project with average dimensions and importance is in hands, the total number of stakeholders can have a big variation, depending on the company's labour or other variables. These variables are not relevant to the framework or the guidelines.
I2	The best fit for smaller and less relevant projects would be a team between 2 and 3 workers. With a smaller team, the work that needs to be done would have much fewer conditions and fewer people working on it, reducing some errors or mistakes. It leverages the communication as well between the Project Manager, which will have much more customized feedback for each member.
I3	Project team for bigger projects can be comprised of between 7 and 9 workers. The total number of stakeholders must not surpass 10 people, as defined as the limit for an Agile team, including the *Scrum Master*.
I4	When in doubt of the level of procedure of the BPMS project, this option is highly recommended. It could have a project team of between 3 and 5 people, giving space for smaller or bigger projects. Keeping the good and agile relation with the Scrum Master, the communication will still be very fluid and the errors that could occur in a bigger team are not as often expected.

4.3. USE CASE SIMULATION

To test the previous metrics and guidelines, there is a need to describe a project as close as possible to a real-world case. With that purpose, the use case of a food delivery company, which requires the help of BPM specialists in process transformation, is what will be reported hereafter.

TeleSushi is a sushi delivery company based in Portugal, being one of the first companies specialized in sushi delivery operating in the country. The founders opened the company because, contrarily to the case of pizzas or roasted chicken, although its increasing popularity, there were no options for sushi delivery. The company's first store was in Lisbon and opened at the end of 2013. In 2014, they expanded to Almada; in 2015 to Oporto; in 2016 Cascais; and in 2017 they opened two more stores in Lisbon's metropolitan area. At the moment, TeleSushi has more than 100 employees, ranging from sushiman to couriers, middle and top management staff, food engineers, as well as people working in supporting areas.

The increasing competition in the food delivery market, e.g., the opening of numerous restaurants with a delivery option, and the arrival of international delivery companies, draw the attention of top managers to the need of optimizing TeleSushi internal processes, aiming at magnifying efficiency.

That is why TeleSushi managers got in touch with a company specialized in BPM: Optimal Business Solutions (OBS).

TeleSushi current business models lack quick and responsive feedback to their customers. The restaurant is going through a difficult time handling errors and wastes that should not happen if they want to keep up with the competitors. TeleSushi has three types of ordering processes: Orders registered by phone, by the website and in person at the stores. Not only that, but their Order Processing needs improvements as well. Their proposal for OBS is to help and improve all of them, the best as possible within the agreed budget.

OBS is a company that focuses on the optimization of current business processes from other firms. Provides new digital solutions during a certain amount of time, after instigating the inside of their contractors to have a better overview. Then, it takes a certain amount of time, with their IT Advisors, BPMS engineers, Developers and all their collaborators, to come up with improvements. Afterwards, there needs to be a phase where a specialist from OBS, which is probably the team leader, brings the new optimised processes to their contractor, presents the changes and gives training to their co-workers to adapt to the new IT technologies.

The standout factor between OBS and the other BPM optimization companies is that their working methodology is based on a mixture between BPM and the Scrum framework. Their guidelines are different between BPMS project types since the Scrum BPMS strategy offers tips to each specific project.

By the time that both parts have agreed to the contract terms and OBS could start their work, something that was mandatory was to identify which type of BPMS project they had to deal with. There were already existent business processes, therefore, the best fit should be to improve and digitalize them, nominating this type of project, a Process Transformation.

Having that, the working methodology adopted by OBS for a Process Transformation BPMS project, following the Scrum BPMS strategy is not one of the most demanding ones, and the level of the procedure is around average. The nominated team from OBS consists of five people, including the Scrum Master, which is the Project Manager. Following the Scrum BPMS framework's, the Product Backlog is mandatory, so it is the first concern of OBS's team. For that definition, a first meeting between the project's team and a TeleSushi manager happens. Then, the first Sprint takes place, with the Sprint Meeting for the definition of the Sprint Backlog. The Contractor manager does not need to be present, since this meeting is where the work is divided by the project team. The task division has in consideration the duration of a Sprint for a Process Transformation project, which is between 2 and 4 weeks. OBS defined the Sprint duration to be a 3-week cycle.

Of course, for a better organization and overview of the project, the team used a PTS called JIRA. In this software, the team can see their tasks, monitor and chat with their team members. It is important that during the development of the transformed and optimized processes the Scrum Master and the Product Owner keep in touch frequently, so new information or new demands from TeleSushi can be talked during the Scrum meetings, which take place 3 times a week.

At the end of each Sprint, the final meeting is called the Sprint Review, where every project member gathers and speaks about what was done previously. Everyone must be completely honest and open to listen, so in the next Sprint, the flaws can be fixed. The presence of the TeleSushi manager is again not mandatory. Then, as it is a cycle, everything will be repeated from the Sprint Meeting to start a new Sprint. This cycle can be visualized in Figure 9.

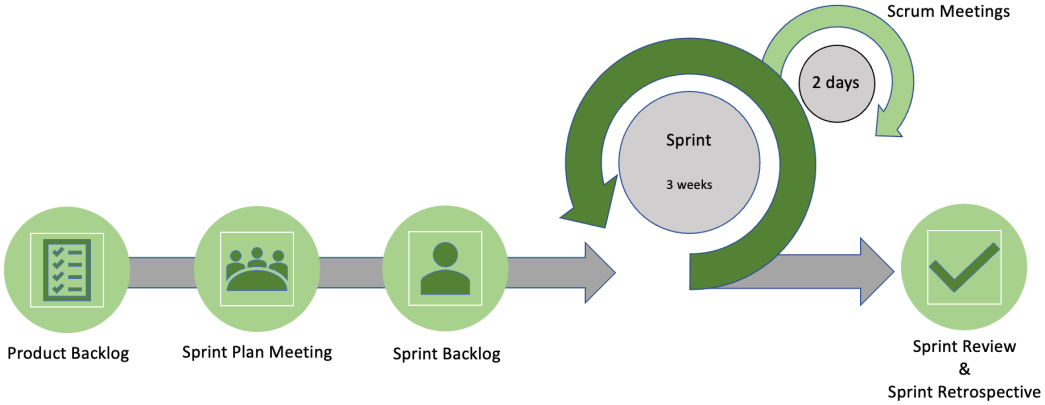

Figure 9 - Scrum BPMS cycle used by OBS in the Process Transformation project

The project took the OBS team two sprints, basically around one and a half months. To declare full project closure, the process transformations need to be reported directly to the stakeholder. That final and vital task has been done by the Project Manager. This role had acknowledged the client and gave training to their employees so that they could work with the digital innovations without any doubt and improve the business process.

4.4. VALIDATION

Validation was carried by scheduling individual interviews with three specialists, connoisseurs in both Scrum Framework and BPMS Project types. They were professor Paulo Proença (PRP) – software engineering professor at Instituto Superior de Engenharia do Porto (ISEP); professor Paulo Gandra de Sousa, PhD (PAG) – software engineering professor at ISEP as well as a product manager at MSG Life Iberia and last but the not the least, Joaquim Nogueira – Head of Process Architecture & Performance at a well-known Portuguese Bank. The order of the specialist follows the same order of temporary interviews.

Before the interviews took place, a brief presentation was prepared with the research questions of this thesis, the main goals, as well as a table resuming the proposed framework in Chapter 4.2.

Lastly, to retrieve the necessary information and feedback regarding the presented strategy, the specialists answered three questions, and their exact words are going to be transcript in the next section of this document, with due consent.

The three questions made were:

Q1	Do you consider the proposed strategy useful?
Q2	Would you consider implementing the proposed strategy?
Q3	Do you have any criticism/recommendation/suggestions towards the proposed strategy?

The interviews were conducted with each listed expert individually. All agreed on being recorded to write the answers to the three questions in the next chapter of this thesis. The interviews were conducted between July and August 2021.

4.5. DISCUSSION

In this section, there are transcripts of the answers of each expert to the previous questions defined by the author. Everything that is written, was previously recorded and nothing is fictional nor made-up. It is of extreme importance that the discussions were truthful and the feedback positive, which in this case the author can confirm that both conditions were fulfilled.

Regarding Q1, the answers were:

PRP: Yes, it is useful, of course. The approach is very interesting. The methodical analysis of the entire process and having all the phases of the process very well structured and encapsulated in time, and therefore having a good linkage between all the phases of the process are the great advantages.

PAG: I think, and one of the great advantages of the Scrum framework is that it is quite simple to apply to the business world. The great utility of the proposal is to turn BPMS projects that are more business-oriented, being ruled by an Agile methodology. The more strategies there are, the better.

JON: Scrum can actually help BPM projects. My answer is definitely yes.

Concerning Q2, the answers were:

PRP: If I were in the business field instead of Accademia, I would definitely consider implementing it.

PAG: Generally speaking, I'm a great apologist of Scrum as a project management methodology, by itself, as such, I think everything can be managed following the Scrum principles and rules, regardless of what we're talking about. So, I would say yes.

JON: I answer affirmatively. As a matter of fact, we have already done it within the company when we transformed a credit-granting process 10 years ago. It was the first project in the company that used Scrum. We set up a Scrum team that started precisely by understanding the process (at the time we didn't have Process Mining, so everything was based on interviews). We did a set of Sprints to understand how everything worked, then we idealized a new process and started implementing it. We used Scrum throughout the entire project phase.

Lastly, about Q3 the answers were:

PRP: For me what raises the most doubts are the duration of the Sprints. Sprints between 2 weeks and 2 months seem to be a very large discrepancy between the size of the phases. I understand that for BPM Simulation, 4 weeks is something exaggerated, as, in Process Mining, a Sprint of 2 months is also exaggerated. I also consider that the automation tasks do not need that much time.

Another suggestion is that team members developing less dense types of projects, such as a BPM Simulation, do not need to be 100% allocated to this phase, they can develop another phase of the processes in parallel, for example, Process Mining.

PAG: My big doubt regarding the existing framework has to do with the duration of Sprints and the regularity of Scrum meetings. From the moment the team works every two months and meet only twice a week, it is no longer Scrum. Scrum is building Backlog Items with the right size so that iterative progress can be made after 1 or 2 weeks and that it is possible to monitor the status of the team every day. That is the foundation of the Scrum methodology. It is acceptable that in projects that are not 100% software development there is a longer Sprint 0 for starters, for a possible adaptation and education of the team. More than an iterative method, but also incremental, in the sense of refining and improving.

Another suggestion has to do with the presence of the Product Owner in the Project. For me, it must be present throughout the project, in planning, in reviews and daily meetings. The main sponsor, the large stakeholder, will not have the availability for this if this entity is named the Product Owner, but in my view, it must always be there constantly and be included in the team.

The size of the team is usually 7 to 9 people independently of the size of the project. It doesn't seem to me that there is a team dimension per project type, whether it is in an RPA or Simulation project. And when I think about the team of 9 it includes the Product Owner, the Scrum Master, quality assurance engineers (in a more software development view), release managers, developers and if necessary, the design surrounding. All people must be involved in all responsibilities.

JON: First of all, I wouldn't call it BPMS project types, but rather methods around BPM and processes working articulately. This is because, I can't help seeing all these techniques being part of the same ecosystem, which is dealing with processes. Therefore, to deal with a process we can go from discovery - to understanding a process - to its automation. And for that, we can use each of these techniques in the same project: BPI, Simulation, Process Mining, Process Transformation, RPA and Workflow Automation. Process Mining is something that arises in the embryonic stage, it is what will make me understand the process right from the start. The optimization of a process can include its transformation, automating some repetitive activities by RPA or even automating the entire workflow with a more robust BPM tool.

I see myself using all these technologies in a single project, overviewing process by process. If we were to sequence these methodologies, Process Mining would be the first, as it is what allows us to know the process. Next, we could use a BPM Simulation tool to study potential changes to the process. Then, RPA if I understand that the immediate solution for my case is just to robotize an activity, and the other techniques like Workflow, BPI or Transformation so I can move more structurally in my process.

Another suggestion is regarding different profiles that must exist in the teams that will participate in each of these techniques. The Process Mining team does not need necessarily to have 7 to 9 members. We would need someone who masters the mining itself and someone who knows the process, at the very least. Basically, a person who knows the technology and a person who knows the business. In Simulation, there may be more people involved, but those who were in the Process Mining team should be included. I would also suggest that the BPM project techniques in the strategy's table should be reorganized and reconsider the duration of Sprints. The project's team will not be doing Process Mining for 2 months at all. Yes, you can be doing mixed Sprints, in which they would be doing Mining and/or Simulation concurrently.

4.6. REVISED FRAMEWORK FOR IMPLEMENTATION

After listening carefully to the three experts, the author of the proposal has come up with updates to the existent framework. The best part of having experts from both methodologies of the thesis is that the updates idealized will have an impact on both parts as well.

Considering Table 1 to be the visualization of the framework, the column which previously defined the BPMS Project Types will become the column of BPMS Project Techniques. It is unfair to think that for each technique there will be different projects. In a BPM, project there could be implemented a diverse number of techniques, as it should. Other than that, the techniques studied in this thesis will be ordered from top to bottom, being the first one the most likely to be done at the beginning of the project, which is Project Mining (a technique to understand and to know the process). One thing that has become clear, is that the rules of this proposed strategy should be equal to every BPMS technique since they can be all part of the same project. It wouldn't make sense to change the working methodology in the middle of the project. That is why, in the revised strategy, there will only be one set of rules, like Scrum itself.

Another information that was common in everyone's feedback, was the Sprints duration. On a traditional project ruled by Scrum, there should be Sprints between 2 and 3 weeks. Everything more than that could point out to a wrongly done Product Backlog. If the Product Backlog shows tasks that would take 1 month to be done, then those tasks should be divided, giving place to two new tasks, each of them with an expected duration of accomplishment of 2 weeks. That is why for the updated framework, the guideline for the Sprint duration will be the same as in a conventional Scrum project.

The same applies to the number of team members. It was wrong to define different numbers of workers to different BPM techniques. The new guideline will give a bigger possibility to those who want to apply the strategy in their BPMS projects. One rule for the framework regarding the project team is that, if different techniques are used in the same project, the team's core should remain the same. That means that there can be variations and changes in team members, but the team doesn't change drastically. It is important to point out that the number of team members now include the Scrum Master and the Product Owner, being the range of members in the strategy between 4 and 10. Four should be the minimum number of team members, with a Scrum Master, a Product Owner, a BPMS specialist and a Process specialist. The maximum number is ten since it is the defined maximum in the Agile Manifesto for an Agile team. With all these updates described, Table 11 there are exposed the new guidelines without any further explanation similar to the previous tables.

Table 11 - Revised Strategy

Scrum Artefacts & Roles / BPMS Project Techniques	Product Backlog	Sprint Duration	Sprint Backlog	Project Tracking Software	Scrum Meetings	Sprint Review	Product Owner	Scrum Master	Project Team
Process Mining	Mandatory Artefact	2 – 3 weeks	Mandatory Artefact	Highly recommended	3 - 5 times p/ week	Mandatory Event	Mandatory Role	Mandatory Role	4 - 10 team members
BPM Simulation									
Robotic Process Automation									
Business Process Integration									
Process Transformation									
Workflow Automation									

5. CONCLUSIONS

The last chapter of the document aims to respond directly to the first chapter research questions and objectives. The reason for that is so the Conclusion can clarify if the described research questions and the proposed objectives in the Introduction have been answered and fulfilled, accordingly. After going along all the DSR phases, it is safe to say that this thesis will add value to the Project Management community, more specifically, to BPMS projects. The framework idealized was well received in the validation phase and is ready to be presented as a viable possibility for the business environment.

Throughout the Conclusion, there is present a synthesis of all the work done during the development of the thesis. Then, there are described the biggest limitations for this research, and lastly, some ideas for future work and prospects of what this research could take.

5.1. SYNTHESIS OF THE RESEARCH

The approach for this dissertation has followed a traditional subsequent procedure regarding a DSR. A literature review was conducted with the condition of searching the most recent scientific papers, except the most important ones that gave the first guidelines to the well-known methodologies studied in this document. Furthermore, a systematic literature review was also done, to give more emphasis to the topic.

Having that, the actual framework was created based on the previous steps and with the knowledge of the author. The strategy has every guideline for its implementation and to clarify any doubt regarding it. Then, the framework went through a validation phase by three specialists. This process was done by individual interviews, where the author presented the topic and gave enough time for any questions from the professionals. By the end of the interviews, the author had the feedback and opinion from them, which turned up to be the expected. They approved the framework and gave suggestions for improvement. With those feedbacks, the strategy was revaluated and improved and was declared as ready for implementation in the business world.

It is safe to say, that the initially proposed objectives were fulfilled, and the research questions were answered, giving meaning to this research.

5.2. RESEARCH LIMITATIONS

In every research, there are certain limitations and adversities that authors came across, and this thesis was no exception. It cannot be omitted that a master's thesis research has always a shorter scope than a scientific paper written by not only one professional with access to next level information. The main limitations should be expressed in this section to explain the forgetfulness and omission of that same content.

Unfortunately, because this topic was developed as part of obtaining a master's degree, the time invested was already defined in the beginning, giving a feeling that there were always possibilities to improve the research. The first obvious limitation is the number of interviewed specialists. Of course,

the more interviews were done, the better. This flaw was not due to the lack of interest from the author, instead, it should be seen as a temporal clause.

As it was possible to understand in the previous chapter, the use case described using the proposed framework was a simulation. The author tried to simulate as close to reality as possible, however, it will never have the possibilities and variables of a real-world use case.

Since this research followed the rules of a DSR, it is missing the last piece of the puzzle, the Communication phase. This last phase is a process that can take from weeks to years to be fulfilled. It would not be viable to wait for any kind of approval to publish the research in a recognized journal. Not only that, but the Communication phase also depends on the engagement and feedback from the community in which each specific research fits.

5.3. FUTURE WORK

The work that could be done in the future to add value to this research can achieve the previous limitations reached. It is important to mention, that for future work, the presence of the author is not mandatory. Since the developed strategy had the main focus of achieving a master's degree, this document will be available to every researcher that should search for these topics.

For instance, in the Evaluation phase of the DSR, the number of interviews should increase, both from Scrum professionals as well as BPM specialists. This goal will give more feedback and toughen the positive approval.

With a certain undefined time cap and with a company open to it, this framework should be implemented in a real-world business case. This would be a big step for the framework's approval, rather than having a use case simulation.

Lastly, it is important to spread the topic in the most known journals and platforms, to finalize the last phase of the DSR. Additionally, as this master thesis focus on the combination of two already known methodologies (Scrum and BPM), it could be possible that other researchers see this strategy combined with other working methodologies giving even better outcomes.

BIBLIOGRAPHY

ABPMP International. (2019). *BPM CBOK®*. https://www.abpmp.org/page/guide_BPM_CBOK

Abrahamsson, P., Salo, O., Ronkainen, J., & Warsta, J. (2017). Agile software development methods: Review and analysis. *ArXiv Preprint ArXiv:1709.08439*.

Alibabaei, A., Bandara, W., & Aghdasi, M. (2009). Means of achieving business process management success factors. *Proceedings of the 4th Mediterranean Conference on Information Systems*, 1348–1363.

Anurina, O. (2021). *Agile SDLC: How Your Project Can Benefit From This Model*. https://mlsdev.com/blog/agile-sdlc

Attaran, M. (2004). Exploring the relationship between information technology and business process reengineering. *Information and Management*, *41*(5), 585–596. https://doi.org/10.1016/S0378-7206(03)00098-3

Badakhshan, P., Conboy, K., Grisold, T., & vom Brocke, J. (2019). Agile business process management. *Business Process Management Journal*.

Bandara, W., Gable, G. G., & Rosemann, M. (2005). Factors and measures of business process modelling: Model building through a multiple case study. *European Journal of Information Systems*, *14*(4), 347–360.

Baskerville, R. L., Kaul, M., & Storey, V. C. (2015). Genres of Inquiry in Design-Science Research. *Mis Quarterly*, *39*(3), 541–564.

Baskerville, R. L., Kaul, M., & Storey, V. C. (2018). Aesthetics in design science research. *European Journal of Information Systems*, *27*(2), 140–153.

Beck, K. (2000). *Extreme programming explained: Embrace change*. addison-wesley professional.

Beck, K., Beedle, M., Bennekum, A. Van, Cockburn, A., Cunningham, W., Fowler, M., Grenning, J., Highsmith, J., Hunt, A., Jeffries, R., Kern, J., Marick, B., Martin, R. C., Mellor, S., Schwaber, K., Sutherland, J., & Thomas, D. (2001). *Manifesto for Agile Software Development*. The Agile Alliance.

Beck, K., & Fowler, M. (2001). Planning Extreme Programming. *New York, NY: Addison Wesley Longman*.

Berente, N., Vandenbosch, B., & Aubert, B. (2009). Information flows and business process integration. *Business Process Management Journal*.

Besson, P., & Rowe, F. (2012). Strategizing information systems-enabled organizational transformation: A transdisciplinary review and new directions. *The Journal of Strategic Information Systems*, *21*(2), 103–124.

Bingi, P., Sharma, M. K., & Godla, J. K. (1999). Critical issues affecting an ERP implementation. *Inf. Syst. Manag.*, *16*(3), 7–14.

Boehm, B. (2002). Get ready for agile methods, with care. *Computer*, *35*(1), 64–69.

Brynjolfsson, E., Rock, D., Horton, J., Ozimek, A., Sharma, G., & Ye, H. Y. T. (2020). COVID-19 and Remote Work: An Early Look at US Data. *National Bureau of Economic Research*, 1–16.

Buchwald, H., Fleischmann, A., Seese, D., & Stary, C. (2010). Communications in Computer and Information Science: Foreword. In *Communications in Computer and Information Science: Vol. 85 CCIS*. https://doi.org/10.1007/978-3-642-15915-2

Cao, L., Mohan, K., Xu, P., & Ramesh, B. (2004). How extreme does extreme programming have to be? Adapting XP practices to large-scale projects. *37th Annual Hawaii International Conference on System Sciences, 2004. Proceedings of The*, 10-pp.

Cho, J. (2008). Issues and Challenges of agile software development with SCRUM. *Issues in Information Systems*, *9*(2), 188–195.

Clark, K. B., & Fujimoto, T. (1990). The power of product integrity. *Harvard Business Review*, *68*(6), 107–118.

Cohen, D., Lindvall, M., & Costa, P. (2004). An introduction to agile methods. *Adv. Comput.*, *62*(03), 1–66.

Cronholm, S., & Göbel, H. (2016). Evaluation of the information systems research framework: Empirical evidence from a design science research project. *Electronic Journal of Information Systems Evaluation*, *19*(3), 158.

Darwish, N. R., & Abdelwahab, I. M. (2016). A Security Testing Framework for Scrum based Projects. *International Journal of Computer Applications*, *138*(7).

Delhij, A., van Solingen, R., & Wijnands, W. (2015). The eduScrum guide. *The Rules of the Game*.

Denning, S. (2016). How to make the whole organization "Agile." In *Strategy and Leadership* (Vol. 44, Issue 4, pp. 10–17). https://doi.org/10.1108/SL-06-2016-0043

DeVault, G. (2018). What is a market research focus group. *The Balance*.

Dresch, A., Lacerda, D. P., & Antunes, J. A. V. (2015). Design science research. In *Design science research* (pp. 67–102). Springer.

Dumas, M., La Rosa, M., Mendling, J., & Reijers, H. A. (2013). *Fundamentals of Business Process Management*. Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-33143-5

Feoktistov, I. (2020, November 9). *Agile Software Development Lifecycle Phases Explained*. Relevant Software. https://relevant.software/blog/agile-software-development-lifecycle-phases-explained/

Freitas, A. P., & Pereira, J. L. M. (2015). *Process simulation support in BPM tools: The case of BPMN*.

Gartner. (2009). Meeting the Challenge: The 2009 CIO Agenda. *Gartner*. https://www.gartner.com/en/documents/862717/meeting-the-challenge-the-2009-cio-agenda

Georgakopoulos, D., Hornick, M., & Sheth, A. (1995). An overview of workflow management: From process modeling to workflow automation infrastructure. *Distributed and Parallel Databases*, *3*(2), 119–153.

Gregor, S., & Hevner, A. R. (2013). Positioning and presenting design science research for maximum impact. *MIS Quarterly*, 337–355.

Hagemans, G., & Kelder, R. (2010). *How to Successfully Implement a BPMS?* 15.

Hammer, M. (1990). Reengineering work: Don't automate, obliterate. *Harvard Business Review*, *68*(4), 104–112.

Hammer, M. (2015). What is business process management? In *Handbook on business process management 1* (pp. 3–16). Springer.

Harmon, P. (2010). The scope and evolution of business process management. In *Handbook on business process management 1* (pp. 37–81). Springer.

Herbsleb, J. D., & Moitra, D. (2001). Global software development. *IEEE Software*, *18*(2), 16–20. https://doi.org/10.1109/52.914732

Herden, A., Farias, P. P. M., & Albuquerque, A. B. (2016). An Agile approach to improve process-oriented software development. *Computer Science On-Line Conference*, 413–424.

Hevner, A. R., March, S. T., Park, J., & Ram, S. (2004). Design science in information systems research. *MIS Quarterly*, 75–105.

Hofmann, P., Samp, C., & Urbach, N. (2020). Robotic process automation. *Electronic Markets*, *30*(1), 99–106.

Jackson, A., Tsang, S. L., Gray, A., Driver, C., & Clarke, S. (2004). Behind the rules: XP experiences. *Agile Development Conference*, 87–94.

Janiesch, C., Weber, I., Kuhlenkamp, J., & Menzel, M. (2014). Optimizing the performance of automated business processes executed on virtualized infrastructure. *Proceedings of the Annual Hawaii International Conference on System Sciences*, 3818–3826. https://doi.org/10.1109/HICSS.2014.474

Jeston, J., & Nelis, J. (2014). *Business process management*. Routledge.

Jeyaraj, A., Rottman, J. W., & Lacity, M. C. (2006). A review of the predictors, linkages, and biases in IT innovation adoption research. In *Journal of Information Technology* (Vol. 21, Issue 1, pp. 1–23). https://doi.org/10.1057/palgrave.jit.2000056

Karagiannis, D. (1995). BPMS: Business process management systems. *ACM SIGOIS Bulletin*, *16*(1), 10–13.

Kruba, S., Baynes, S., & Hyer, R. (2012). BPM, Agile, and Virtualization Combine to Create Effective Solutions. *ArXiv:1208.3887 [Cs]*. http://arxiv.org/abs/1208.3887

Mahalakshmi, M., & Sundararajan, M. (2013). Traditional SDLC vs scrum methodology–a comparative study. *International Journal of Emerging Technology and Advanced Engineering*, *3*(6), 192–196.

Malinova, M., Hribar, B., & Mendling, J. (2014). *A framework for assessing BPM success*.

Marchesi, M., Mannaro, K., Uras, S., & Locci, M. (2007). Distributed Scrum in research project management. *International Conference on Extreme Programming and Agile Processes in Software Engineering*, 240–244.

Martin, J. (2009). Agile Project Management with Scrum. In *Measuring and Improving Performance*. https://doi.org/10.1201/9781420084191-c2

Martins, P. V., & Zacarias, M. (2017). An Agile Business Process Improvement Methodology. *Procedia Computer Science*, *121*, 129–136. https://doi.org/10.1016/j.procs.2017.11.018

Matharu, G. S., Mishra, A., Singh, H., & Upadhyay, P. (2015). Empirical Study of Agile Software Development Methodologies. *ACM SIGSOFT Software Engineering Notes*, *40*(1), 1–6. https://doi.org/10.1145/2693208.2693233

Mnkandla, E., & Dwolatzky, B. (2007). Agile software methods: State-of-the-art. In *Agile software development quality assurance* (pp. 1–22). Igi Global.

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2010). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *Int J Surg*, *8*(5), 336–341.

Moon, M. J. (2020). Fighting Against COVID-19 with Agility, Transparency, and Participation: Wicked Policy Problems and New Governance Challenges. *Public Administration Review*. https://doi.org/10.1111/puar.13214

Murru, O., Deias, R., & Mugheddue, G. (2003). Assessing XP at a European Internet company. *IEEE Software*, *20*(3), 37–43.

Neubauer, M., & Stary, C. (2017). *S-BPM in the Production Industry: A Stakeholder Approach*. Springer Nature.

Peffers, K., Tuunanen, T., Rothenberger, M. A., & Chatterjee, S. (2007). A design science research methodology for information systems research. *Journal of Management Information Systems*, *24*(3), 45–77.

Pittet, S. (2021). *The different types of testing in Software*. Atlassian. https://www.atlassian.com/continuous-delivery/software-testing/types-of-software-testing

Poppendieck, B. M., & Poppendieck, T. (2003). Lean software development: An agile toolkit [Book Review]. *Computer*, *36*(8), 89–89. https://doi.org/10.1109/mc.2003.1220585

Quarrie, K. L., & Wilson, B. D. (2000). Force production in the rugby union scrum. *Journal of Sports Sciences*, *18*(4), 237–246. https://doi.org/10.1080/026404100364974

Ravesteyn, P., & Versendaal, J. (2007). *Success factors of business process management systems implementation*.

Reijers, H. A., van Wijk, S., Mutschler, B., & Leurs, M. (2010). BPM in practice: Who is doing what? *International Conference on Business Process Management*, 45–60.

Ribeiro, M., & Pereira, J. L. M. (2014). *Multi-paradigm simulation projects: The need for practical guidelines*.

Rising, L., & Janoff, N. S. (2000). Scrum software development process for small teams. *IEEE Software*, *17*(4), 26–32. https://doi.org/10.1109/52.854065

Riwanto, R. E., & Andry, J. F. (2019). Enterprise Architectures Enable of Business Strategy and IS/IT Alignment in Manufacturing using TOGAF ADM Framework. *International Journal of Information Technology and Business*, *1*(2), 7–7.

Rosemann, M., & De Bruin, T. (2005). Application of a holistic model for determining BPM maturity. *BP Trends*, *2*, 1–21.

Rosemann, M., & vom Brocke, J. (2010). Handbook on business process management. In *The Six Core Elements of Business Process Management*. Berlin: Springer.

Royce, W. W. (1987). Managing the development of large software systems: Concepts and techniques. *Proceedings of the 9th International Conference on Software Engineering*, 328–338.

Rudden, J. (2007). Making the Case for BPM : A Benefits Checklist. *Bptrends.Com*, *January*, 1–8.

Santana, A. F. L., Alves, C. F., & Santos, H. R. M. (2011). *BPM Governance: An Exploratory Study in Public Organizations*. 15.

Schmiedel, T., vom Brocke, J., & Recker, J. (2015). Culture in business process management: How cultural values determine BPM success. In *Handbook on Business Process Management 2* (pp. 649–663). Springer.

Scrum.org. (2021). *The Scrum Framework Poster*. Scrum.Org. https://www.scrum.org/resources/scrum-framework-poster

Shingo, S., & Dillon, A. P. (1989). *A study of the Toyota production system: From an Industrial Engineering Viewpoint*. CRC Press.

Sohail, A. (2019, April 29). *Agile Project Management — Part 1: Understanding and Benefits*. Medium. https://medium.com/@masads/agile-project-management-part-1-understanding-and-benefits-eb079b563288

Sutherland, J. (2016). *Scrum: The Art of Doing Twice the Work in Half the Time*. Leya.

Szelągowski, M. (2018). *Evolution of the BPM Lifecycle*. 205–211. https://doi.org/10.15439/2018F46

Thakur, M. (2019, June 14). Agile Lifecycle | Development Of Different Stages & Success Factors. *EDUCBA*. https://www.educba.com/agile-lifecycle/

Thiemich, C., & Puhlmann, F. (2013). An agile BPM project methodology. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*. https://doi.org/10.1007/978-3-642-40176-3_25

Thompson, G., Seymour, L. F., & O'Donovan, B. (2009). Towards a BPM success model: An analysis in South African financial services organisations. *Lecture Notes in Business Information Processing*, *29 LNBIP*, 1–13. https://doi.org/10.1007/978-3-642-01862-6_1

Trkman, P. (2010). The critical success factors of business process management. *International Journal of Information Management*, *30*(2), 125–134.

Van Der Aalst, W. (2012). Process mining. *Communications of the ACM*, *55*(8), 76–83.

Van der Aalst, W. M. (2011). Using Process Mining to Bridge the Gap between BI and BPM. *IEEE Computer*, *44*(12), 77–80.

Van der Aalst, W. M., Bichler, M., & Heinzl, A. (2018). *Robotic process automation*. Springer.

Vincenza, C., Giovanni, C., Michele, M., Carlo, P., Giulio, P., & Natalia, T. (2019). BPM tools for asset management in renewable energy power plants. *2019 Federated Conference on Computer Science and Information Systems (FedCSIS)*, 645–649.

Vom Brocke, J., Schmiedel, T., Recker, J., Trkman, P., Mertens, W., & Viaene, S. (2014). Ten principles of good business process management. *Business Process Management Journal*. https://doi.org/10.1108/BPMJ-06-2013-0074

von Rosing, M., von Scheel, J., & Gill, A. Q. (2015). Applying Agile Principles to BPM. In M. von Rosing, A.-W. Scheer, & H. von Scheel (Eds.), *The Complete Business Process Handbook* (pp. 557–581). Morgan Kaufmann. https://doi.org/10.1016/B978-0-12-799959-3.00027-6

Wakayama, T., Kannapan, S., Khoong, C. M., Navathe, S., & Yates, J. (1998). Documents, processes, and metaprocesses. In *Information and Process Integration in Enterprises* (pp. 1–14). Springer.

Yoo, Y., Henfridsson, O., & Lyytinen, K. (2010). Research commentary—the new organizing logic of digital innovation: An agenda for information systems research. *Information Systems Research*, *21*(4), 724–735.

Zacarias, M., Martins, P. V., & Gonçalves, A. (2017). An Agile Business Process and Practice Meta-model. *Procedia Computer Science*, *121*, 170–177. https://doi.org/10.1016/j.procs.2017.11.024

Zaouali, S., & Ghannouchi, S. A. (2016). Proposition of an approach based on BPM to manage agile development processes. *2016 Third International Conference on Systems of Collaboration (SysCo)*, 1–6.

Zur Muehlen, M., & Ho, D. T.-Y. (2005). Risk management in the BPM lifecycle. *International Conference on Business Process Management*, 454–466.