NOVA IMS Information Management School

MDSAA

Master Degree Program in

Data Science and Advanced Analytics

DEVELOPING A STRUCTURED METHODOLOGY TO HELP COMPANIES PREPARE THEIR PROCESSES FOR A SUCCESSFUL RPA IMPLEMENTATION USING BPM CONCEPTS

Renan Leal Stoffel

Master Thesis

presented as partial requirement for obtaining a Master's Degree in Data Science and Advanced Analytics

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

DEVELOPING A STRUCTURED METHODOLOGY TO HELP COMPANIES PREPARE THEIR PROCESSES FOR A SUCCESSFUL RPA IMPLEMENTATION USING BPM CONCEPTS

by

Renan Leal Stoffel

Master Thesis presented as partial requirement for obtaining the Master's degree in Data Science and Advanced Analytics, with a specialization in Business Analytics.

Supervised by

PhD Vítor Santos

November, 2023

STATEMENT OF INTEGRITY

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration. I further declare that I have fully acknowledged the Rules of Conduct and Code of Honor from the NOVA Information Management School.

Lisbon, November 30th

ABSTRACT

This master's thesis presents a detailed methodology for Robotic Process Automation (RPA) implementation using Business Process Management (BPM) techniques and its core principles. The study addresses the need for a structured approach to implement RPA using BPM to help improving the processes before automating. This study will use the Design Science Research (DSR) approach to create a framework, a step-by-step guide, that will help companies achieve the results expected through automation. The study is relevant because it addresses the increasingly growing adoption of RPA in businesses and the lack of academic studies on the subject, especially if paired with BPM concepts. This structured methodology will also help avoiding common problems such as targeting the wrong processes for automation.

KEYWORDS

Robotic Process Automation; Business Process Management; Requirement Analysis; Process Design; Process Optimization.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS AND ACRONYMS

AI	Artificial Intelligence
BPM	Business Process Management
BPMN	Business Process Model and Notation
CBOK	Common Body of Knowledge
CEO	Chief Executive Officer
CFO	Chief Financial Officer
CoE	Center of Excellence
CSV	Comma Separated Values
DSR	Design Science
DSRM	Design Science Research Methodology
EPM	Enterprise Process Management
FTE	Full Time Equivalent
IPA	Intelligent Process Automation
IS	Information Systems
IT	Information Technology
PDD	Process Definition Document
PDF	Portable Document Format
RPA	Robotic Process Automation
ROI	Return on Investment
SDD	Solution Design Document
UAT	User Acceptance Testing
UI	User Interface

1. INTRODUCTION

1.1. BACKGROUND AND PROBLEM IDENTIFICATION

Digital businesses need to manage growth while also reducing costs, but most company leaders often struggle to do this. One important step that will help reaching that goal is the Robotic Process Automation (RPA). RPA is one of the most discussed themes on the Digital Era. This technology, that emulates human action using systems and software, is a known way to reduce costs and enhance operational performance. (Aguirre & Rodriguez, 2017). Automation increases accountability, efficiency, and predictability while lowering cost, variability, and risk. These are compelling advantages, that many businesses are seeking nowadays. (Gartner, 2016)

Using RPA will help companies automate common and repetitive tasks often performed by analysts, enabling those employees to work in activities that will return more value to the company. It allows the automation of manual tasks and small processes with robots using the User Interface (UI) (Lacity & Willcocks, 2016). Normally it focuses on tasks performed repetitively on a daily, weekly, or monthly basis that demand a high level of effort from the staff (Mendling et al., 2018). Therefore, using RPA is an economically relevant alternative, considering that the returns can be quickly achieved due to the nature of the automation approach (van der Aalst et al., 2018).

In addition to that, the technology will also help the company reduce headcount regarding more operational positions. The tasks performed by a robot will be done faster, more efficiently, and will be more robust. That will be done without the need to change the interface of the systems used or without any integration with other tools. (UI Path, 2022)

RPA may be summed up as a technology that uses software robots that work on the UI layer of existing software to automate jobs and processes in a lightweight, quickly deployable manner. (Herm et al., 2022)

Having a good RPA solution does not start straight into development. Statistics say that 30-50% initial RPA implementation projects fail (Ernst & Young, 2016), and it is important for the company that wants to adhere this technology to understand which processes are good candidates to be automated, identify the gains with the use of automation, and understand the key factors of success for those goals to be reached (CIO Insider, 2018). Most companies can have a simple goal to just automate labor-intensive tasks, but if the objective is to go beyond that, improving the process before automating will be fundamental. In addition to that, a robust and detailed requirement analysis is another important step before automating (Davenport & Brain, 2018). This is where the process diagnosis and a potential redesign comes into play, using a structured approach based on Business Process Management (BPM).

The RPA technology, however, being a new concept, is yet to be a theme with solid resources and strong theoretical foundations provided by the scientific community (Syed et al., 2020).

Therefore, having a structured framework or methodology on how to apply RPA in a company is one of the main motivations of this study.

1.2. OBJECTIVES

The goal of the paper would be the development of a BPM based methodology on how to properly perform a requirement analysis and steps for RPA implementation in a company.
To achieve this goal, the following intermediate objectives were defined:

- Understand and study the most employed techniques in process automation, including selection, prioritization and requirements mapping.
- Understand and study the BPM discipline and how can it support the RPA design methodology.
- Understand the common misconceptions amongst BPM and RPA and how those can be synergized.
- Propose a structured method to prepare processes for automation using RPA supported by BPM.
- Validate the proposal.

1.3. IMPORTANCE AND RELEVANCE

The main goal of this research is to identify the best practices through reviewing the literature and translate those best practices into a methodology that can be used in real-world settings to implement and validate the RPA strategies.
From a business perspective, RPA has been growing significantly. In a press release published by Gartner in 2020, they predicted that, especially leveraged by COVID-19, "90% of large organizations globally will have adopted RPA in some form by 2022 as they look to digitally empower critical business processes through resilience and scalability, while recalibrating human labor and manual effort". Also, by knowing that IT started leading most of RPA initiatives, Gartner believes that the adoption of automation using robots will increase as the key-users from the business become aware of what RPA is capable of. In fact, by 2024, Gartner predicts almost half of all new RPA clients will come from stakeholders that do not belong to the IT area in the company (Gartner, 2020).
In addition to that, from a research perspective RPA is only vaguely understood and still in the early stage of scientific research which indicates a lack of transparency, resulting in a mistaken understanding of RPA and its potential as evidenced by its placement in the hype cycle (Herm et al., 2022). Also, it is important to note that this research will enable the potential of using BPM and RPA altogether, another area that is not thoroughly explored in the scientific community (Flechsig et al., 2019).
This study aims, therefore, to contribute to the scientific community regarding the themes surrounding RPA with BPM and its challenges of implementation.

Consequently, by publishing this study, organizations will be assisted to successfully utilize RPA in their processes. The companies will also benefit from this methodology by understand what processes are good candidates for automation, making sure the processes chosen are a good fit with RPA, or what needs to be improved before automating.

By having a clear methodology and a roadmap of implementation for RPA, the companies will be able to successfully deploy RPA in their environments without failing due to the most common issues in RPA projects, such as not considering RPA as a business-driven approach or targeting the wrong RPA processes (Ernst & Young, 2016).

2. METHODOLOGY

Having set the objectives set for this study, a good strategy and an adequate methodology should also be chosen for this research. There is various research based on natural sciences and social sciences trying to understand the reality as is, and many different methodologies in the Information Systems (IS) area could be used for those types of problems.

However, as mentioned earlier, the objective of this study is to create an artifact - a BPM based methodology on how to properly perform a requirement analysis for RPA implementation in a company. In this scenario, where there is a need to attempt the creation of something to serve human purposes, we opted to used Design Science Research (DSR) methodology, or Design Science (DS). (Peffers et al., 2007)

2.1. DESIGN SCIENCE RESEARCH

The design science research methodology, or DSRM, was developed by Peffers et al. (2008) with the following three goals in mind: "(1) provide a nominal process for the conduct of DS research, (2) build upon prior literature about DS in IS and reference disciplines, and (3) provide researchers with a mental model or template for a structure for research outputs.".

According to Hevner et. al., 2004, design science is basically a process of problem solving. All the guidelines for the use of DSR are based in the fundamental principle that "knowledge and understanding of a design problem and its solution are acquired in the building and application of an artifact". (Hevner et al., 2004)

The figure 1 below presents an overview of the methodology, which summarizes step by step guidelines that will be explained.

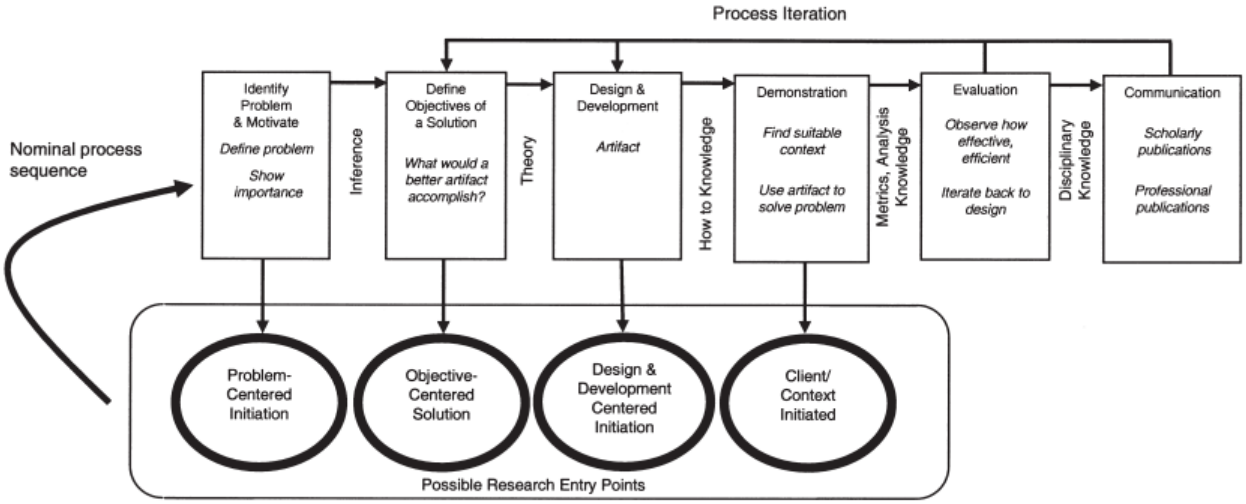

Figure 1 - DSR Methodology Model – Source: Peffers et. al (2007)

The figure 1 presented is a framework created for the DS researchers to know what steps and guidelines to follow when carrying out research based on the Design Science principles. This framework was developed amongst several researchers, each one contributing to specific areas of expertise – theoretical bases, applied problems, problem enumeration, need identification and the assertive that DS research should address important and relevant problems. (Peffers et al., 2007)

The comprehensive framework presented in the image is explained in 6 activities by Peffers, 2007:

1st Activity: Identify problem & Motivate – In this first step, a specific problem should be defined to be researched and why there is a need for the solution. It may be helpful to break down the concepts of the problem so that the solution may address every aspect of the problem to be solved.

2nd Activity: Define Objectives of a Solution – After the problem definition you should be able to infer the objectives for the creation of the solution, be it quantitative or qualitative.

3rd Activity: Design & Development – In this step, there should be the definition of the proprieties of the artifact itself – how it will work: its architecture, its functionalities.

4th Activity: Demonstration – This is where the practice starts, where the artifact will be used to solve one or more instances of the problem, in experimentation, simulation, case study, among other possibilities.

5th Activity: Evaluation – In this activity, the artifact will be observed and measured on how well it's supporting the solution to the problem. This is where the actual results will be compared to the expected results of the solution, defined in the objectives.

6th Activity: Communication – Final step, in which the authors communicate the problem studied, the relevance, the artifact built and how it was designed and the evaluated results. This communication can be done in a traditional research structure, in scholarly research publications. (Peffers et al., 2007)

2.2. RESEARCH STRATEGY

After listing the concepts of each one of the activities of the Design Science Research framework, the details of what will be done in each of the steps are listed below, presenting how exactly this methodology will be applied in the current research study.

1st Activity: Identify problem & Motivate – As a first step, the area of study was defined, along with the problem and the motivation that were discussed with the thesis supervisor and thoroughly justified and well-reasoned. A comprehensive literature review was conducted, followed by outlining a step-by-step methodology on how to understand the automation needs of the company, through the requirement analysis, and defining which processes can be enhanced with the use of RPA supported by BPM concepts.

2nd Activity: Define Objectives of a Solution – Aiming to specify and define the problem to be researched and solved, a comprehensive list of 5 intermediate objectives was created and placed in a previous section of this paper. The goal of the intermediate objectives is to help build the artifact knowing exactly what needs to be solved and break down the problem in smaller concepts.

3rd Activity: Design & Development – This is where the artifact will be properly built, based on the steps mentioned above: well-structured intermediate objectives and a thorough literature review to make sure the best practices are being applied.

4th Activity: Demonstration – The idea for this activity in this research will be to apply the knowledge and the artifact built in a real scenario of an organization, similarly to a case study. Every step of the framework will be applied and, finally, we will be able to reach a conclusion and measure the results.

5th Activity: Evaluation – In this step, once applied, the results of the use of the artifact will be gathered, and we will be able to compare the actual results to the intended goals and objectives. We expect to be able to measure, at least qualitatively, if the goals were reached and if the artifact helped improve the whole automation process – from process mapping to deployment of the automation.

6th Activity: Communication – For the final activity, our goal is to publish the paper and enhance the academic context, improving and contributing the current knowledge basis for the BPM and RPA themes.

3. LITERATURE REVIEW

3.1. BUSINESS PROCESS MANAGEMENT (BPM)

In this section, our literature review will focus on the overview of BPM: its concepts, history, lifecycle, areas, and a more specific approach to BPM which is the Enterprise Process Management (EPM).

3.1.1. Concepts & History

The recognition of the significance of business processes are becoming more and more evident since the 80's. Most organizational structures of the modern world are focusing on the importance of the business processes, especially after Porter defined the value chain in 1980 (Harmon, 2019).

Hence, process management is a very important part of operational business in organizations as well as in new projects to improve performance. According to (Smith & Fingar, 2003), the history of Business Process Management can be divided in three waves. The first wave began early, even before Porter's value chain, when (Huang et al., 2013) suggested a theory of management where we can find the origin of what is known today as Process Management. The following period was more focused on the movement of reengineering business processes in the 90's, evidenced by (Davenport, 1993), while the third period started with the advances of multiple methods that were merged and came to be known as Business Process Management (BPM) (Lizano-Mora et al., 2021).

According to Gartner's Glossary, BPM is a discipline that merges a diversity of methods to "discover, model, analyze, measure, improve and optimize business processes". A business process is inherently a coordinated combination of people, systems, information, and things which outcome is produced to support a business strategy. (Gartner, 2018)

BPM aims to improve the efficiency, effectiveness, and agility of organizations by aligning their processes with their goals and strategies. BPM typically involves the use of process modeling languages and tools, such as Business Process Model and Notation (BPMN), as well as process automation technologies, such RPA and workflow management systems. (Weske, 2019)

3.1.2. Life cycle

Marlon Dumas (Dumas et al., 2018), one of the authors of the book "Fundamentals of Business Process Management," defines the BPM lifecycle as follows:

- Process identification: This involves identifying the process and the scope that are about to be improved and defining the goals and objectives of the process.

- Process discovery: This involves mapping the current process flow the way it's performed by the current users, but in this stage some bottlenecks and inefficiencies can already be identified, while also gathering data on process performance. The current process flow is commonly known as "as-is process model".

- Process analysis: This step focuses on a deeper analysis of the process data to identify areas for improvement and potential solutions, while also bringing back the bottlenecks and inefficiencies that were previously identified.

- Process redesign: This involves designing an improved process flow, based on the results of the analysis, and testing the new process using process simulation or other techniques. This new process flow is commonly referred to as "to-be".

- Process implementation: This involves implementing the new process, including any necessary changes to technology, organization, or infrastructure.

- Process monitoring: This involves monitoring the new process to ensure that it is meeting its goals and objectives and making adjustments as needed.

- Process optimization: This involves continually improving the process over time, based on ongoing monitoring and analysis.

Dumas' framework is a widely recognized and used model, and is presented in the figure 2 below, extracted from his book:

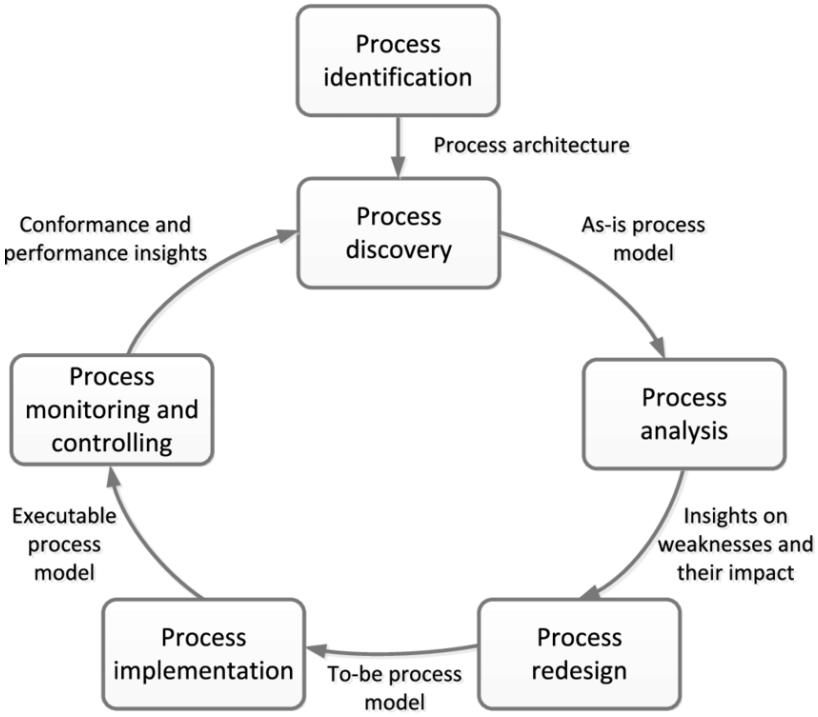

Figure 2 - BPM Lifecycle (Dumas et al., 2018)

3.1.3. Enterprise Process Management (EPM)

According to the CBOK 4.0 BPM guide (ABPMP, 2019), Enterprise Process Management (EPM) is a new approach to managing business operations that does not follow traditional organizational structures. It involves looking at an entire process from start to finish, including all the work that is done to deliver the product or service, regardless of which business units or locations are involved. This view starts at a higher level in the organization than the level where work is performed and then breaks down into subprocesses that may be performed by one or more business units, and finally into individual activities and their workflow within the business units.

CBOK also bases its definition of Enterprise Process Management on the concept first introduced by Howard Smith, concluding that, overall, transitioning to enterprise process management requires a significant shift in the way organizations think about and manage their processes. It requires a focus on end-to-end process performance and a willingness to break down traditional organizational structures to achieve process integration and optimization (ABPMP, 2019). By following these guidelines and recommendations, organizations can improve their ability to manage processes effectively and achieve their strategic objectives. (Smith & Fingar, 2003)

3.2. PROCESS AUTOMATION

In this section Process Automation will be introduced, and the literature review will focus on the main areas of process automations including how we can merge this theme into the BPM subject.

3.2.1. Concepts & Types

Process automation is a broad term that defines the use of technology to automate business processes and workflows to improve efficiency, reduce costs, and increase accuracy. It involves the use of software applications to streamline repetitive, manual tasks and replace human intervention with automated workflows.

There are several types of process automation, including but not limited to:

- Robotic Process Automation (RPA): RPA is the use of software robots to automate repetitive, rule-based tasks. These robots are programmed to perform specific tasks, such as data entry, data validation, and data extraction, without the need for human intervention. (Gartner, 2018)
- Intelligent Process Automation (IPA): IPA combines RPA with machine learning and artificial intelligence (AI) to automate complex business processes that require

decision-making and problem-solving skills. This type of automation can handle unstructured data and adapt to changing business conditions. (Automation Anywhere, 2023)

- Workflow Automation: Workflow automation consists of automating sequential steps and tasks of a specific process or workflow, such as an approval flow or a form submission. It is not as flexible as RPA, because it does not have the possibility of working with desktop-based systems, for example, and is normally limited to digital platforms, however, it might be a great application in conjunction with RPA (Microsoft, 2022).

In this study, we will focus on RPA, which is detailed in the next section.

3.2.2. Robotic Process Automation (RPA)

IEEE, 2017, defines RPA as a "preconfigured software instance that uses business rules and predefined activity choreography to complete the autonomous execution of a combination of processes, activities, transactions and tasks in one or more unrelated software systems to deliver a result or service with human exception management".

RPA is of particular interest to industries that have traditionally been quick in the uptake of new technology, such as banking and insurance. Demand for RPA technologies is rapidly increasing, and it is estimated that up to 90% of large and medium-sized organizations will opt for RPA solutions by 2020. (Grand View Research, 2020)

The magic quadrant created by Gartner and updated recently is presented in the Figure 3 below, with the most known and used platforms in the market, *UiPath* being the leader for the 5th time in a row, but with close competitors: Automation Anywhere, Blue Prism and Microsoft.

Figure 3 - Magic Quadrant for RPA (Gartner - August 2023)

3.2.3. Challenges and Opportunities

Using RPA is not always the best solution for your company's processes – some limitations and challenges were also found while studying this literature review. Some of the limitations are more widespread and well known to the companies who want to implement RPA, as presented by N Karthik, 2019 – such as choosing the right process to automate, setting unrealistic goals for the automation, existing processes, IT integration and workforce resistance.

According to Davenport & Brain, 2018, on the other hand, most of the limitations derive from the differences between human capabilities and robot capabilities – because although the

automations are getting faster and able to perform more complex tasks, it will not substitute the human mind.

Our focus, however, will be on challenges that are often not noticed at first glance when implementing RPA in your company. After interviewing 26 RPA stakeholders at a specific Fortune 500 company, Eulerich et al., 2023, identified 5 key challenges with RPA usage considering the experience of professionals who have been using RPA for a few years:

- RPA is often used as a quick-fix band-aid, not focusing on the bigger problem lying underneath.
- RPA can cause serious control and security issues.
- The true cost of RPA is often understated.
- Governance is complex in the RPA environment.
- RPA can also lead to knowledge loss in terms of processes.

The Dark Side of Robotic Process Automation, 2023, also notes that most of those challenges arise, ironically, from the RPA adoption itself. According to the article,

> *"RPA's ease of use may lead to a wide variety of employees creating personalized bots, and this makes it challenging for auditors and IT managers to track, monitor, and manage security concerns from potentially rogue or malfunctioning bots."*

To address those challenges, the methodology being proposed will focus first on understanding, documenting and, if necessary, improving the current processes before implementing RPA. Creating a proper methodology and well-defined process for the implementation of any automations.

Although there are multiple other challenges of using RPA, some opportunities that go beyond the obvious gains of implementing RPA (such as FTE reduction and reduction of extremely manual processes) also must be presented. Hence, RPA use have many benefits not only due to the RPA itself but also to the change of mindset that it brings to the company. Some of the opportunities are summarized by Willcocks et al., 2015 in form of lessons from a case study:

- RPA brings the opportunity of creating an RPA structure – making sure to align business with IT, creating a RPA Governance board to manage and assess new RPA opportunities.
- Enhance the current organizational structure defining clear roles and responsibilities for all the people involved.
- Scalability. Implementing RPA will also bring the opportunity of creating a low maintenance environment and a growth strategy. (Willcocks et al., 2015)

The next step of this study is to start building and presenting the methodology that will be used for RPA implementation.

4. BPM BASED METHODOLOGY FOR RPA IMPLEMENTATION

4.1. ASSUMPTIONS

When thinking of implementing RPA in your company using this BPM based methodology, there needs to be some key assumptions in place, that will be critical to the success of the implementation. If some of those assumptions are not met, extra steps will need to be taken before using the methodology itself.

- Process Understanding: This assumption is based on the fact that organizations have a reasonably well-documented understanding of their business processes – or at least clear knowledge to document their processes. This assumption is crucial because RPA relies on a clear understanding of the processes it will automate, and the BPM methodology will need to focus on the process improvement before jumping into the automations. If processes are not documented, organizations must first invest in process analysis and documentation.

- Organizational Willingness: Assume that organizations and its employees are willing to embrace automation and process optimization. As mentioned before, workforce resistance is one of the pain points and challenges of implementing RPA. This requires a willingness to change existing processes and workflows.

- Personnel Availability: Even with an organization willing to change and implement RPA, there needs to be dedication from the people involved, and time needs to be invested. Even if there is a specific RPA team designed to the implementation, the existing process owners will be constantly needed to help mapping, improving, and implementing RPA successfully.

- Access to Necessary Resources: Assume that organizations have access to the necessary resources for RPA implementation, such as the required software, hardware, and skilled personnel. This includes having an RPA platform in place.

- Continuous Improvement: Assume that organizations recognize that RPA is not a one-time solution but requires continuous improvement and optimization. RPA should be seen as an evolving part of process automation and efficiency efforts. After RPA is implemented, there needs to be also support and monitoring of the robots in place.

- Communication and Collaboration: Assume that effective communication and collaboration exist, or an extra effort will be made between the IT and business departments. Successful RPA implementation often requires close collaboration between these areas, especially when documenting and improving existing processes will be a part of the implementation.

Some specific needs may arise depending on the type of business such as regulatory compliance and access to specific data and resources, especially if working with third-party companies.

4.2. METHODOLOGY

In this section, we propose a comprehensive 6-phases methodology for implementing Robotic Process Automation (RPA) within any organization using BPM principles. This methodology is designed to guide the end-to-end process of RPA adoption, with a specific focus on leveraging Business Process Management (BPM) principles in the early phases (Phase 1 and Phase 2), and RPA good practices moving forward.

The primary objective is to ensure that RPA will be aligned with business goals and lead to improvements in efficiency and effectiveness, and that any changes and automations created are properly documented.

This methodology is presented in a way that can be applied either internally using a Center of Excellence (CoE) or internal workforce through analysts and developers. This can also be used as a methodology for a consulting company, for example.

Multiple validation points should be followed with the process owners and executives, to make sure that everyone is on board with the changes and documentations created.

The figure 4 provides a high-level overview of the methodology, and each phase is described in detail in the next pages.

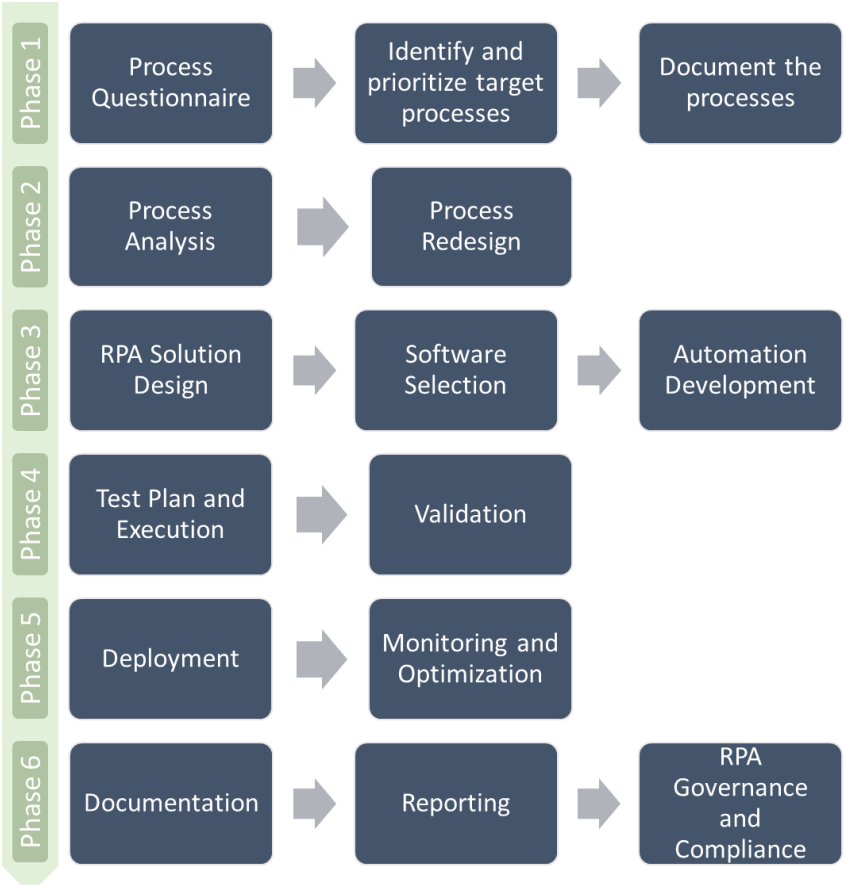

Figure 4 - Methodology Overview

4.2.1. Phase 1: Prioritizing and Documenting the Processes

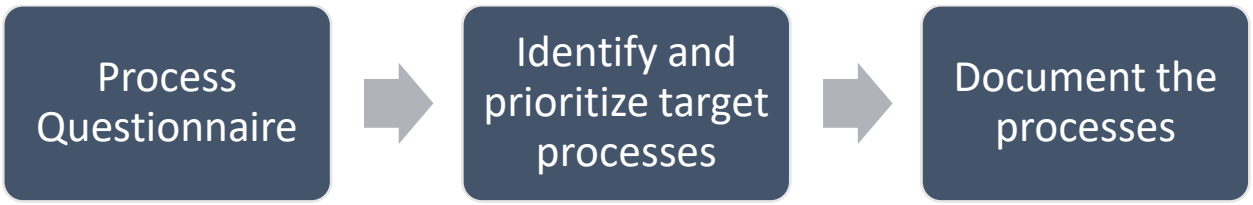

Figure 5 - Prioritizing and documenting the processes.

The first phase presented on the Figure 5 emphasizes the importance of understanding the existing processes of the organization, while focusing on BPM principles. This phase begins with an initial survey step, which involves deploying a questionnaire to process owners who are requesting new automations.

The questionnaire's key questions serve as the foundation for identifying target processes and documenting existing processes. This step is critical for setting the basis for the other phases.

4.2.1.1. Process Questionnaire

Provide a survey to process owners, asking for key information about their processes, including frequency of execution, manual tasks, exceptions, and any other information that might be relevant to the next steps of the methodology. This questionnaire can be provided in a web-based format (Google Forms, PowerApps) or simply an excel or word document with all the questions and answers.

This methodology offers a standard questionnaire with the key questions to be asked, and the field type that should be used if applicable. The suggestion survey is presented in the appendix B. However, this should be treated as a framework – adjustments can and should be done to attend to specificities of your company or client. This will be a primary survey about the overview of the process; however, meetings will be necessary for the business analysts fully understand the process.

4.2.1.2. Identify and Prioritize Target Processes

Based on the questionnaire responses, select specific processes that are good candidates for automation. These processes should be repetitive, rule-based, and involve a high amount of manual effort. If there are many areas involved, it’s advisable to include a streamlined approval step from stakeholders, just to make sure the right processes are being prioritized.

4.2.1.3. Document the Processes

Create the detailed “as-is” process documentation, including process flows, inputs, outputs, and any other information needed. If the process is already documented, it’s important to at least review it and make sure it’s updated to the current way the process is executed within the company. It is very important that meetings are scheduled with the process executors,

and the business analyst should make sure to understand the whole process and its exceptions. Recording the meeting, if possible, is also a good approach, so the business analysts can refer back to it without having to contact the process owners/executors every time.

There is multiple process-modeling software that can be used in this step, such as Visio and Bizagi – the most widely known. The company should choose the one best suited for each case.

4.2.2. Phase 2: Process Analysis and Improvement

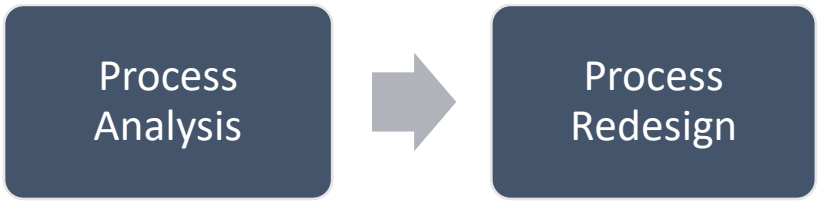

Figure 6 - Process Analysis and Improvement

The second phase continues to leverage BPM principles, focusing on a more in-depth analysis of the documented processes, identifying areas for improvement, and potential solutions. This phase, which is based on the outputs of the Phase 1, plays a very important role in the successful implementation of RPA, and is often neglected by companies who want to automate their processes.

In addition to that, the process redesign in this phase should incorporate RPA concepts, to make sure the process will be suitable for automation. This means that any changes made to the existing "as-is" process should be done thinking of what is expected from the automation.

4.2.2.1. Process Analysis

In this step, the analyst should conduct a thorough analysis of the as-is process models, emphasizing BPM principles, to identify bottlenecks, inefficiencies, and areas where the process can be further improved and suited even more for the automation that is going to be created.

4.2.2.2. Process Redesign

After analyzing and understanding potential improvements for the process, this is the step where the improved version of the model is designed. The "to-be" process models, considering efficiency and quality of life improvements, while ensuring alignment with BPM principles.

It is essential that the company in this step takes the necessary time and resources to work on updating the existing process and execute it based in the new standards.
It's also worth noting that a common challenge in RPA implementation is the temptation to rush into automation without addressing existing process inefficiencies. Many organizations tend to overlook this step to save time and resources. However, failing to optimize processes before automation can lead to automating inefficient processes, which may not yield the expected benefits.

4.2.3. Phase 3: RPA Design and Development

Figure 7 - RPA Design and Development

Phase 3 is marked by the actual design and development of RPA solutions. The proposed steps in this phase are as follows:

4.2.3.1. RPA Solution Design

In this step, the focus is on building the definition documentation for the RPA solution based on the "to-be" process models developed in Phase 2. The RPA solution design is documented in what is known as the Process Definition Document (PDD).

This document outlines the specific steps, logic, and rules that the RPA bots will follow. It provides a clear path for automation development and serves as a reference for robot behavior. This is the document that will serve as a handbook for the developer, so it should be concise and well-explained – this is the moment we start to create a “bridge” between the business and the technical team.

The Process Definition Document (PDD) is a critical component in this phase. It consists of detailed information about the tasks to be automated, including input data, expected output, and exception handling. The PDD is a guiding document that ensures a comprehensive understanding of the automation requirements and serves as a reference point throughout the bot development process.

The PDD template summary is available on the appendix of this master’s thesis. Same as the questionnaire, it’s a framework – any adjustments can be made to have it tailored to more specific purposes.

4.2.3.2. Software Selection

Once the PDD is ready, the next step is to identify and select the most suitable RPA software or platform. The selection process should consider factors such as cost, compatibility with the designed solution, scalability, and the organization's existing IT infrastructure.

It's essential to choose RPA software that aligns with the specific needs of the automation project. Normally, some companies (and consulting companies) have partnerships pre-established with certain providers and this shouldn't be a problem as most RPA platforms in the market are well-rounded and suited for any kind of automation. Please refer to the item 3.2.2 in the literature review where we present the Gartner's quadrant for RPA software, for some of the best choices available in the market.

4.2.3.3. Automation Development

With the design and software selection in order, the development phase begins. In this step, the RPA developers will create the software automation, also known as robots, that will execute the predefined tasks.

These bots are programmed to follow the instructions outlined in the Process Definition Document (PDD), making sure the actions are accurate and consistent. The development process requires a deep understanding of the chosen RPA software, as well as the ability to fully understand the details of the process designed in the documentation.

In this step, it's important to the project manager and technical leaders to guarantee that the robot will have the necessary credentials to the systems involved, and provide a testing environment if necessary.

4.2.4. Phase 4: RPA Testing and Validation

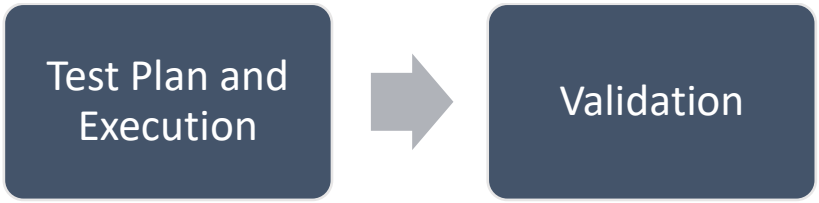

Figure 8 - RPA Testing and Validation

In Phase 4, presented in the Figure 8 above, the focus start changing towards the process of testing and validating the RPA solutions, making sure all the objectives are met with the automation that was developed, and it's working as intended by the stakeholders. This phase

is also important to assess the reliability and efficiency of the RPA implementation. The steps in this phase include:

4.2.4.1. Test Plan and Execution

The most important part of having an effective test phase is making sure to build a comprehensive test plan. This plan is basically a document, that can be a spreadsheet, for example, that summarizes the testing scenarios and the expected results for those scenarios. It is a step by step that will guide the developers on testing the solution themselves and with the key-users.

The test plan usually will include unit testing, integration testing, and user acceptance testing (UAT), to ensure an end-to-end testing before going live. A well-constructed test plan is a cornerstone in the testing and validation process and must be created in conjunction with the process executors.

4.2.4.2. Validation

After the testing phase, the RPA solutions will pass through a final validation step. This phase is basically the confirmation whether the UAT was successful or not, and it's ready to deploy. Usually, this step requires a written confirmation from the stakeholders that the RPA solutions align with their expectations and requirements, validating their fitness for the intended purpose. This will also serve as accountability for the people responsible for approving the migration to production environment.

This step is essential before proceeding with the RPA implementation "Go-Live", as it confirms that the automation operates as expected and meets the needs of its users. Once the automation is approved and ready to go, the company will be able to go to the most expected phase of the whole project: the RPA deployment.

4.2.5. Phase 5: RPA Deployment and Monitoring

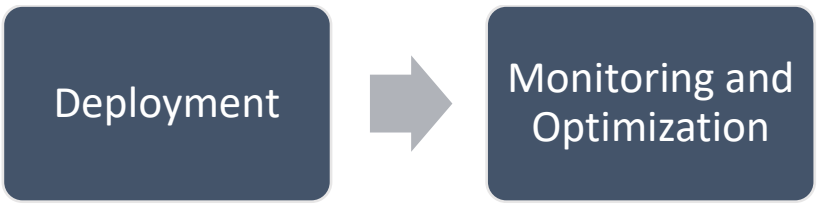

Figure 9 - RPA Deployment and Monitoring

The 5th phase of this proposed methodology consists of the critical transition from testing and validation to the practical implementation of RPA solutions in the live production environment. Once the automation is approved by the key-users and ready to be published, this phase comprises two key steps:

4.2.5.1. Deployment

The deployment phase consists in the implementation of RPA solutions into the live production environment, also having a backup plan in case the implementation does not go as expected. The users must always have a way to return the process to the manual standard and do it manually.

This process requires detailed planning and execution to minimize operational disruptions and guarantee the successful integration of RPA into the existing operational framework. Business and IT should work together in this step to make sure the implementation will run smoothly. Failure to execute this phase effectively may result in operational setbacks and inefficiencies, so it's also important to assess the potential risks of the implementation.

However, as previously seen in the literature review, the automation will, in short, imitate human behavior. This means that the actions can be followed by a human and are likely to be reversible depending on the scenario. This is why along with the deployment there needs to be the second step of this phase: Monitoring and Optimization.

4.2.5.2. Monitoring and Optimization

After the deployment, the implementation is still not over. Ongoing monitoring and optimization are now the focus, reinforcing the importance of maintaining the efficiency and effectiveness of RPA solutions. Continuous monitoring of the RPA bots' performance is conducted to identify any issues, errors, or inefficiencies. From the monitoring, optimization processes are initiated to address identified issues, improve operations, and enhance overall efficiency.

This ongoing process ensures that RPA bots continue to meet their intended objectives and remain aligned with the evolving needs of the organization, and an automated process should not be forgotten after its implementation. Neglecting this phase can result in reducing performance and the benefits from the expected RPA implementation in the long run.

4.2.6. Phase 6: Documentation and Reporting

Figure 10 - Documentation and Reporting

In the final phase, presented in the Figure 10 above, the team starts with the documentation and reporting. This might run in parallel with phase 5 and is focused in maintaining a comprehensive record of RPA implementations and their organizational impact. The steps of this phase are described in the sections below.

4.2.6.1. Documentation

The documentation phase plays the role of preserving the details of the RPA solutions, including their configurations and any modifications made during their lifecycle. A central component of this phase is the development of the Solution Design Document (SDD), which encompasses detailed information about the RPA solution, such as the logic, workflow, and system integration. The SDD serves as a critical reference point for developers and subsequent stakeholders, providing insights into the RPA solution's functionality, design, and integration with existing systems.

The Solution Design Document (SDD) summarizes the essence of the RPA solution, facilitating understanding, maintenance, and future enhancements. Additionally, a well-documented RPA solution is ensuring transparency, accountability, and effective collaboration among the project team members.

Having a well-documented process and automation also ensures that the knowledge is transferrable as the teams change. The SDD suggestion template for this methodology is on the Appendix.

4.2.6.2. Reporting

Reporting involves the regular generation of comprehensive reports that shed light on various aspects of RPA performance. These reports can cover metrics related to efficiency gains, cost reductions, error rates, and ROI. The insights derived from these reports are invaluable, enabling key stakeholders to gauge the value and impact of RPA on the organization. These reports serve as a means of transparently communicating the benefits of RPA to both technical and non-technical stakeholders.

Reporting is not just a formality but a vital communication tool that demonstrates the actual benefits of RPA to the organization. It serves as a basis for informed decision-making and ensures that RPA investments are aligned with organizational objectives.

4.2.6.3. RPA Governance and Compliance

As an additional step, establishing RPA governance and ensuring compliance is an important part of this phase. RPA governance involves the development of policies, procedures, and controls that guide the use of RPA within the organization. It helps in standardizing RPA processes, ensuring security, and adhering to regulatory requirements. Compliance efforts help maintain the organization's integrity and prevent potential legal or ethical complications.

RPA governance and compliance helps guaranteeing that RPA implementations align with organizational ethics, security, and legal standards. It mitigates risks and incentivizes responsible RPA usage for everyone involved.
By applying this comprehensive methodology, organizations can ensure that their RPA implementations are well-structured, efficient, and aligned with BPM principles, leading to successful automation initiatives and long-term benefits.

The table below summarizes the phases and a suggestion of the key participants that should be involved in each part. In addition to that, the table also presents the key factors of success for the implementation of RPA using this methodology. This serves as a "quick guide" to prepare the company's team to an RPA project.

Phase	Phase Name	Key Participants	Key Factors of Success
1	Prioritizing and Documenting Processes	Process Owners, Business Analysts, High level executives	- Clear and constant communication with all stakeholders. - Identifying high-impact processes for automation. - Comprehensive process documentation.
2	Process Analysis and Improvement	Process Owners, Business Analysts	- Thorough analysis of existing processes - Efficient process redesign focused in RPA's best practices - Avoiding or improving processes that are not suitable for automation
3	RPA Design and Development	RPA Developers, Business Analysts	- Comprehensive RPA solution design (PDD) - Careful software selection - Accurate automation development
4	RPA Testing and Validation	RPA Developers, Key-users, Business Analysts	- Well-structured test plan - Effective unit, integration, and user testing - Stakeholder validation of RPA testing results
5	RPA Deployment and Monitoring	All stakeholders	- Participation of all involved teams, including IT and Operations. - Keep monitoring and optimization for efficiency, not only during deployment
6	Documentation and Reporting	RPA Developers, Business Analysts, Legal team, High level executives	- Comprehensive solution documentation, including SDD - Deriving actionable strategies from the reports presented.

Figure 11 - Implementation quick guide

4.3. USE CASE

In this section, we will present a real-world use case involving an automation project for a small US-based airline company. It's important to note that in this case, the entire methodology wasn't strictly followed, as is often the case in real-world scenarios. However, for the purpose of this study, we will present certain aspects of the project as they ideally should have been if the full methodology had been adhered to.

Also, this study will not present the actual documentation generated for this airline, for data protection reasons, however some sample files will be presented for illustrational purposes.

Phase 1: Prioritizing and Documenting the Processes

a) Process Questionnaire

The airline company's accounting department identified a time-consuming process involving two daily credit card expense reports received in PDF format, and they asked to automate this process. The survey was sent to the person responsible, for the RPA team to understand the overview of the process and its pain points.

From the survey, it was clear that the user took around 30 minutes for each of the two PDFs daily, totaling 5 hours a week only filling out spreadsheets with the data from the PDFs. In addition to that, sometimes he also received weekend PDFs which piled up to his Monday's work.

Process name	Time done manually	Frequency	Hours/year
Credit Card Expenses	1 Hour/day	Daily	260
Credit Card Expenses (Weekends)	Extra 2 hours weekly	Weekly	104
		Total	**364**

Table 1 – Hours returned per year

Considering the extra 2 hours weekly, this process would sum up to 364h in one year saved. If this employee's hourly pay was estimated in $60.00, automating this process would result in approximately $22.000 a year in savings.

This is just a quick example based on real numbers of how powerful the automations can be, especially those who can be finished in one or two weeks' worth of development. Having this in mind, the Accounting area quickly identified how important this process was to be automated.

b) Identify and Prioritize Target Processes

The accounting department recognized the need to streamline the credit card expense reporting process. They identified this as a priority process for improvement due to its time-consuming nature, and the CFO, main sponsor of this project, agreed.

Normally, there can be multiple processes in need of automation in this step. One way to prioritize the processes is from calculating the time needed to execute each process manually and the time needed to develop the new automation. This information is readily available when the key-user answers the survey, and the RPA team estimates the effort.

In this case, this was the only process that the company wanted to focus on now, so it was briefly moved to the documentation part. From the survey, all the teams agreed that this was

a relatively simple process to automate, but with great potential benefits for the accounting team.

c) Document the Processes

The as-is model of the process was created, after a few meetings with the main user of this process. The user described in detail the steps taken to achieve the final output that he expects to achieve with the automation.
In summary - the "as-is" process model outlined how PDF credit card expense reports were manually reviewed and the expenses entered an Excel spreadsheet. The figure 12 presents a very simplified version of the as-is documentation:

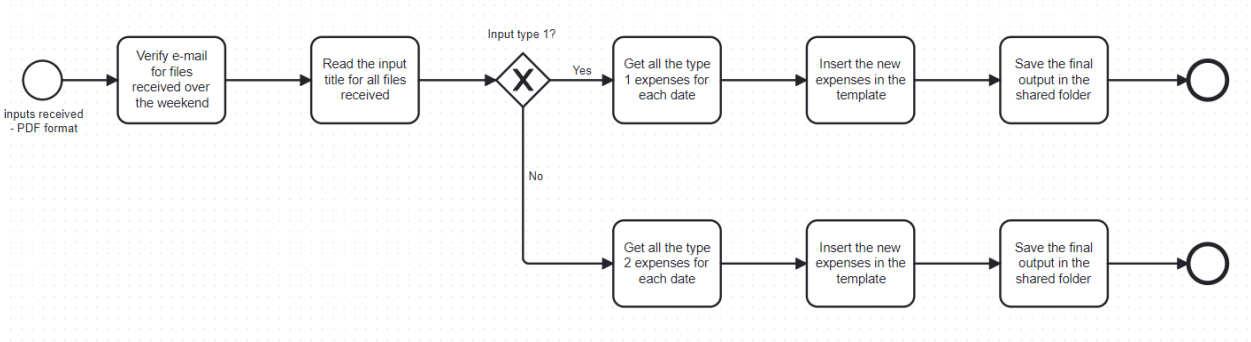

Figure 12 - Process "as-is" model

Phase 2: Process Analysis and Improvement

a) Process Analysis:

Reading and writing data into a spreadsheet is a simple task for an automation, considering that you have a clear source to read the data from and a clear place to input the data. In this case, the output file template was optimized to the accounting team, so no changes were needed for the spreadsheet.

However, reading PDFs can be tricky depending on the issuer. To ensure a more robust and foolproof automation, the accounting team asked the issuer to start sending the files in a CSV format instead of PDF. The issuer bank accepted, and the team was ready to move forward.

b) Process Redesign:

In this case, the only change in the process would be changing the input format from PDF to CSV, to which the issuer bank quickly complied. The “to-be” model was designed with this simple change.

As mentioned in the start of this section, not all parts of the proposed methodology were strictly followed in this use case. Another potential improvement would be to, along with the Accounting team, review and redesign the spreadsheet template used which was apparently optimized, but there could be room for improvement.

The figure 13 below demonstrates a very simplified version of the to-be documentation, with the slight change in the input file. Also, since the automation would run daily – including weekends, no need to check for weekend files received:

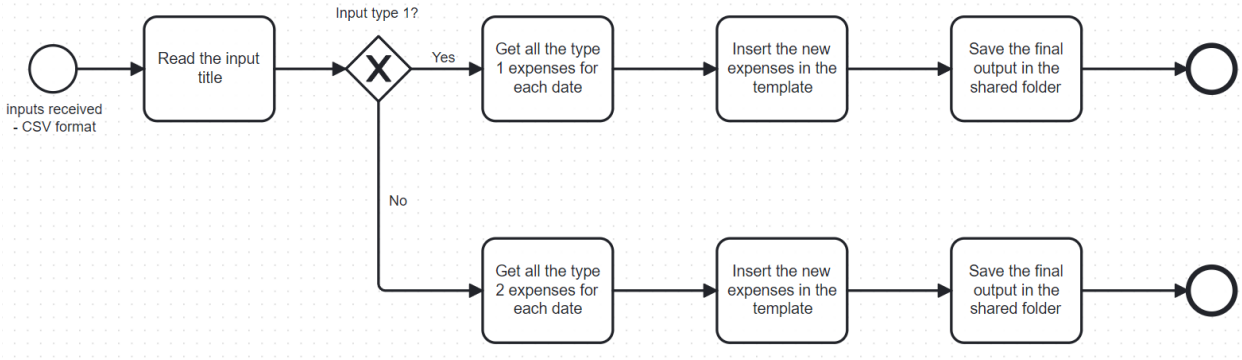

Figure 13 - Process "to-be" model

Phase 3: RPA Design and Development

a) RPA Solution Design:

In response to the new process model, a brief Process Definition Document (PDD) was created, with all the steps necessary to be followed by the automation. A sample summary below of what a basic but valuable PDD looks like:

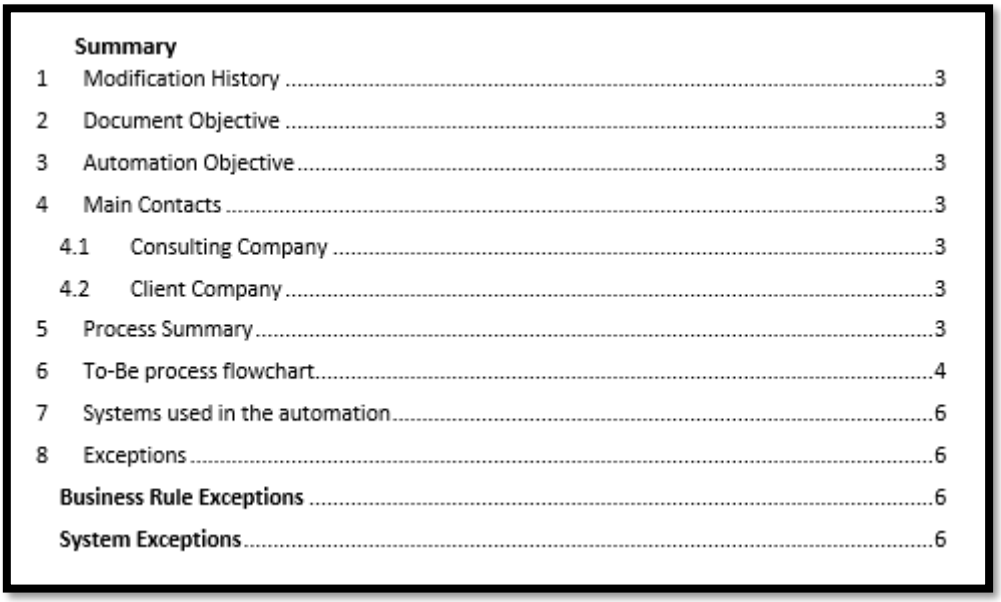

Figure 14 - Sample summary of a PDD

The “Process Summary” and “To-be process flowchart” will list the exact steps that will need to be followed by the automation to fulfill the user’s needs. It needs to be in an accessible language for the technical team to understand the process.
Also, it’s very important to work along with the users to spot potential exceptions for each process mapped.

b) Software Selection:

The company in question did not follow the software selection step, as they were already partnered up with a consulting company that used UiPath as their automation only platform. However, this step will be important by companies that have no prior experience with RPA. It’s important that they assess costs, benefits and if the software have all the requirements for their process needs.

c) Automation Development:

RPA developers created an automation that would firstly read and understand which input file was being analyzed (input file 1 or input file 2). The following step would be to read the CSV and, step by step, add the dates and the extracted expenses from the CSV files to the output spreadsheet. The automation took around 45 hours to be completed, considering all the steps prior to the testing phase.

Phase 4: RPA Testing and Validation

a) Test Plan and Execution

For data protection purposes, this study will not disclose the exact testing scenarios that were followed in this specific project. However, the table 2 presents a sample test plan that could be followed by this process with the users. It is important to note that when a test fails (test ID 4) a new test (ID 10) should be created to verify if the issue was fixed, as present in the example.

One important aspect to be tested is if the robot has all the credentials needed for the process in question. In addition to that, each step of the process model that can be tested should be considered for testing.

ID	Sample Test Scenario	Expected Behavior	Actual behavior	Test succeded?
1	Access to e-mail	Successfully access the e-mail	Successfully accessed the e-mail	Yes
2	Download and open	Attachment 1 succesfully opened	Attachment 1 succesfully opened	Yes
3	Download and open	Attachment 2 succesfully opened	Attachment 2 succesfully opened	Yes
4	No attachments received	No updates required in the spreadsheet, while raising a flag to the users that no attachments	Robot was expecting at least 1 attachment and stopped working.	No
5	Only 1 attachment	Attachment 1 succesfully opened	Attachment 1 succesfully opened	Yes
6	Attachment failed to open	Try to download and open again. If it doesn't succeed, notify the users about the failures.	Notified the users about the failed attachments.	Yes
	Access to the shared folder	Successfully access the folder	Successfully accessed the folder	Yes
7	Spreadsheet not found	Automatically report the exception to the users.	Automatically reported the exception to the users.	Yes
8	Spreadsheet failed to open	Automatically report the exception to the users.	Automatically reported the exception to the users.	Yes
9	Spreadsheet in use	Try again in 5 minutes, if it doesn't succeed, make a copy of the spreadsheet.	Tried again and it was still in use. Successfully created a copy and updated that copy.	Yes
10	No attachments received	No updates required in the spreadsheet, while raising a flag to the users that no attachments	Notified the users about not receiving attachments that day.	Yes

Table 2- Sample test scenarios

b) Validation

After successfully running all the tests with the users, they validated the test results and formalized via e-mail that they were ready, and we could start preparing to go to production.

This will serve as accountability for all parties involved that the automation was tested and it's ready.

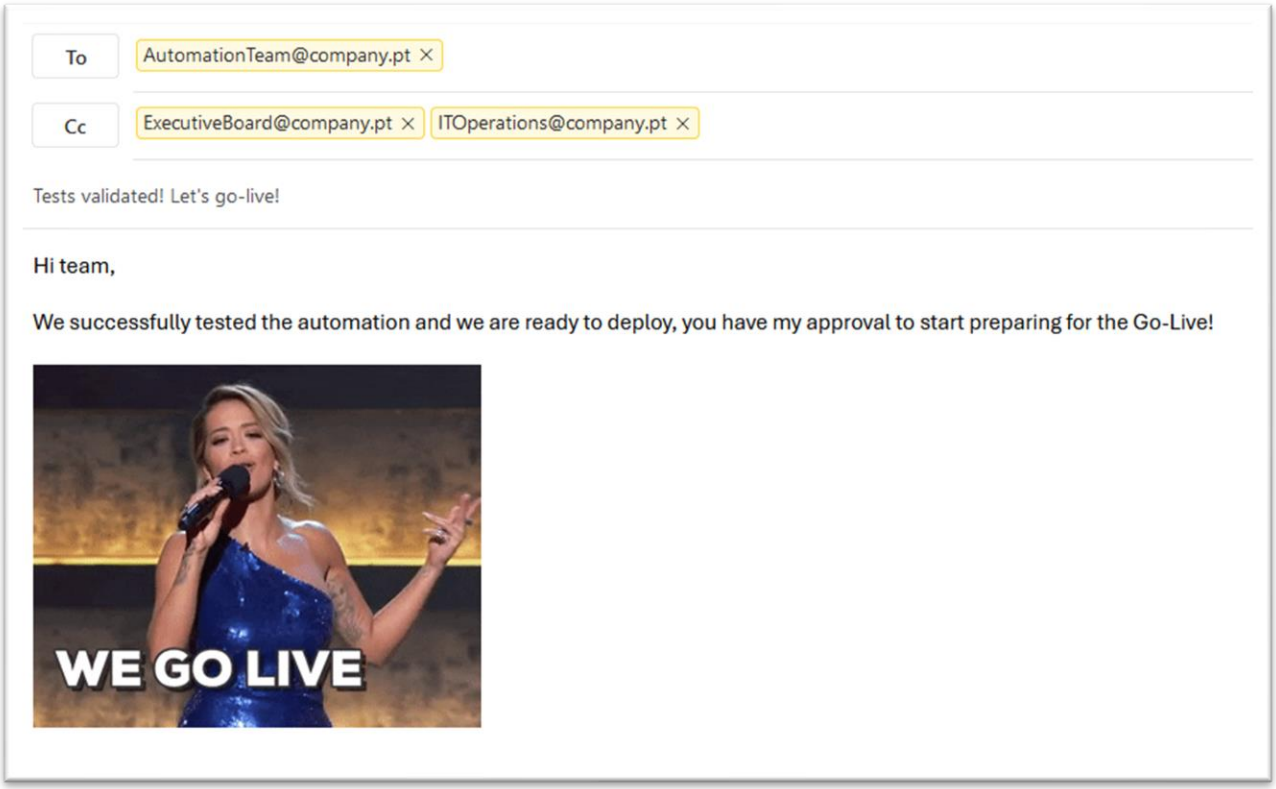

Figure 15- Valid approval e-mail

Phase 5: RPA Deployment and Monitoring

a) Deployment:

In the deployment phase, after having all the tests validated and approvals formalized, the RPA solution was implemented into the live production environment. The accounting department and the IT team worked together to make sure the transition would be successful.

b) Monitoring and Optimization:

After the deployment, the team made sure to monitor and check for potential issues when the automation was running daily. There is a period after deployment that the developers' team is also aware that they might need to adjust or make some changes to their RPA solution, so they were also ready for that. Thankfully no optimizations were needed, and the automation was running smoothly – those are probably direct results from the successful testing that happened in the previous phase. That is why it's very important when planning the timeline for the project, consider enough time to test everything that is needed. The monitoring keeps happening in the company even months after the implementation, since there is a team responsible for checking the RPA executions.

Phase 6: Documentation and Reporting

a) Documentation:

The documentation phase played a crucial role in preserving the details of the RPA solution. A comprehensive Solution Design Document (SDD) was developed, summarizing the RPA solution's logic, workflow, and system integration. This SDD provided insights into the RPA solution's functionality, design, and its alignment with the organization's processes. It facilitated understanding, maintenance, and future enhancements.

b) Reporting:

After a few months, some dashboards could have been created by the Analytics team to report on the results of automating this process. In those panels the executives and accounting team would be able to understand the efficiency gains, cost reductions, error rates, and return on investment after implementing RPA.

c) RPA Governance and Compliance:

This step was not a focus of the CFO when the process was implemented, therefore, not prioritized. However, for the sake of this study, there are some suggestions below of what could have been done regarding Governance and Compliance. The organization could have established RPA governance policies, procedures, and controls that would guide the use of RPA within the organization. For example: governance can be responsible for making sure the methodology is being followed, everything is being documented and the approvals are properly formalized.

Regarding compliance, the legal team could be responsible to make sure that the development was following ethical guidelines and prevent legal complications (for example, using the automation to go through a 'Are you a human?' validation in a system is sort of a grey area in the automation industry). Steps like those would mitigate risks and promote responsible RPA usage for the teams involved.

In summary, the use case presents a simple process that was automated by this airline company and partially followed the methodology, with some suggestions of what they could have done in some scenarios where the methodology was not fully applied.
In the next stage, this study will focus on the evaluation and discussion of the potential and actual results achieved from this use case, while also presenting some limitations and future work possibilities.

5. EVALUATION AND DISCUSSION

5.1. EVALUATION METHOD

To evaluate the methodology proposed, the framework was briefly presented in a quick 15-minute call (September 2023) and later forwarded to a focus group who happily agreed to participate, along with 3 main questions. This e-mail format interview follows one of the final steps of the Design Research approach proposed by Peffers et al., 2007 and previously presented in this study.

5.2. EVALUATION INTERVIEWS

The focus group was composed of 3 key participants – they chose not to disclose their names and company name – the numbers (x) are to make it easier to identify in the answers:

- (1) - CEO at RPA Consulting Company.
- (2) - CFO and Sponsor of the main RPA project of a client company (US Airline).
- (3) - IT Director from the same US Airline.

The focus group has been carefully selected as the experts to participate in this brief survey. They all have 20+ years of work experience and have been participating actively in RPA projects for at least the past 5 years. The CFO and IT Director of the US Airline have been on the client-side of multiple RPA projects performed by the consulting company.

3 main questions were presented to all, and to avoid bias towards the consulting company, a fourth question was presented only to the clients' CFO and IT Director (2) and (3), which responded the questions together. The questions and summary of answers are presented below, with some specific insights brought by the participants.

1st Question (Q1 - all participants): Do you believe that using BPM and improving processes before implementing RPA is important? Why?

Overall, the respondents agreed unanimously that improving the processes can be very important before thinking of automation, although there might be certain obstacles to this approach.

The consulting CEO (1) stated that from his point of view, most clients look for the consulting company's help when they are already at a point where they want to see results and improvements as quickly as possible, and the process owners/executors do not have the time to investigate and work on process improvements, so they end up going straight to automating the existing process. But most of the clients also regret not spending some time on redesign certain processes later. However, as a consulting partner, he believes it's his duty to make it transparent to the clients what could be the consequences of not improving the processes before automating.

(2) and (3), from a client company, agreed that improving the process before automating should be always a part of the project, and mentioned that this step is as important as testing the automation before deploying.

2nd Question (Q2 - all participants): Do you believe that the proposed methodology will be helpful for a more robust RPA implementation? Please justify.

The CEO (1) mentioned that this methodology will be great when applied in practice, and it's something that they have been trying to build internally, to make sure all projects follow the same methods. For a consulting company, he believes that this is extremely important and will help them have standards to be followed in all projects. In addition to that, it will also empower them to manage the developers if necessary. If, for some reason, he needs to exchange two consultants between projects, the steep learning curve would not be that steep, as they would follow the same methodology.

(2) agreed that having a structured methodology will not only help the processes to become more robust after implementation, but also is a big opportunity to treat the project as a "all in one package", which will directly help on the previous question. Basically, either you spend some time to improve your process before automating or you won't be able to automate it at all.

(3) agreed and pointed out that he specially liked the first phase of the methodology, in which a survey is applied to the process owners and executors. He mentioned that often the first process mapping interviews are longer than they should be, and by having a pre-answered survey will help make the process mapping interviews much more productive.

3rd Question (Q3 - all participants): Do you have any suggestions of improvements that can be made to the proposed framework?

Respondent (1) and (3) both agreed that this framework was very complete, and the end-to-end is very useful especially knowing that you can adapt to certain businesses or circumstances. (3) as an IT Director mentioned that in further studies, he would like to see more on compliance regarding data security and protection, which was not very explored in this methodology. Having this in mind, they did not suggest any further improvements.

The CFO (3) of the US Airline pointed out a very important aspect from his experience as someone who has embraced RPA in his company. He mentioned that the first step to apply any kind of automation in a company is to make sure everyone is onboard. He's had difficulty in the past to show to his employees that the automations are not there to take their jobs, but to improve and empower them. He believes an analyst should be spending his time doing insightful and useful analysis, and not filling out spreadsheets for hours.

Having that in mind, he suggested that before sending any surveys to the process executors, there must be a previous step with a sort of workshop, to show everyone the possibilities that RPA will bring to the table and to make sure everyone is engaged.

4th Question (Q4 - only clients, participants 2 and 3): After your years of experience participating in RPA implementation, what benefits do you think this methodology could bring to your company?

For this question, the CFO (2) has sent a very thorough explanation as to why he thinks RPA is the future and he believes in having a structured methodology:

> *"(RPA Consulting Company) has already helped us break the paradigm that automation is labor replacement. For us, automation is labor **augmentation**. By deploying our robots, our workforce is more productive, its product more reliable, consistent, we have been able to generate a lot of new insights and above all **we enabled the workforce to use more their brains and less their fingers**. I'm really excited about this journey that we experienced so far. That is why we believe that by starting to use this methodology I believe we will be able to fully remove the Backoffice as a bottleneck for this company's growth."*
>
> *(Chief Finance Officer - Small US Airline Company)*

(3) emphasized what (2) said about the bottleneck and as an IT Director, he stated that this methodology with well-documented automations will also help him structure an internal team to take care of RPA monitoring, instead of having all the adjustments and requests fully dependent on a third-party company.

5.3. DISCUSSION

Considering that the chosen focus group were high-level executives of their companies, this study tried to formulate the questions in a simple manner to make sure that the participants would be engaged. Although simple, the questions revealed important insights from the experts.

Overall, the group recognized that the methodology would be very useful and provided positive feedback. Some additional benefits were perceived, such as the facilitated knowledge transfer between consultants, as mentioned by the CEO of the Consultant Company. The group also highlighted the importance of having all the stakeholders engaged, which has been mentioned previously in the assumptions of the study, however it presents some opportunities for future work as well.

Another important part of the interview, well pointed out by the respondent number 1, was regarding the companies that seek quick results and might end up neglecting important parts of the automation process - such as having a thorough process examination for improvements.

6. CONCLUSIONS AND FUTURE WORKS

6.1. SUMMARY OF THE STUDY

One of the main motivators for this work was the lack of resources and strong theoretical foundations provided by the scientific community (Syed et al., 2020). Although RPA is a very powerful resource for the companies, through this study we expected to have a structured way to implement it without hurting their processes.

This study was able to create a structured methodology to empower companies to implement RPA in their processes supported by BPM best practices. By applying this methodology, we believe that companies can improve the maturity in their processes while also benefiting from the use of consistently well deployed RPAs.
Going back to the intermediate objectives set for this thesis, the study was able to achieve the proposed goals:

- Through the literature review, there was a deeper understanding of the most used techniques in process automation, including selection, prioritization and requirements mapping.
- We were able to understand the BPM discipline and how can it support the RPA design methodology.
- Part of it was also understanding the common misconceptions amongst BPM and RPA and how those can be synergized.
- A structured proposed methodology was presented, in which companies can apply the end-to-end method to have their processes fully automated.
- Through a use case (real case with some added insights) and some interviews regarding the methodology, we were able to validate the proposal.

By applying this methodology, these are some of the benefits quickly measured:

- Time and cost savings.
- Efficiency gains.
- User engagement.
- Thorough documentation of company processes and automations.
- Workforce geared towards more strategic purposes.

However, considering this is a first version of the methodology, we also believe that there were some limitations and opportunities of improvement for future work.

6.2. LIMITATIONS

Having this methodology ready to use was one of the main goals of this study, however, there are some limitations that might reduce the visibility of the potential benefits of this methodology in its current state.

6.2.1. Limited “Real-World” Cases:

Although we have been working on RPA projects for years with the US Airline, and, empirically, most of the steps are already followed, there was not enough time and opportunity to start applying this new methodology in a well-structured manner. For this reason, we believe that we need to experiment with more use cases to have a more consolidated valuation on this framework, and a definite view of its benefits.

6.2.2. Cost-Benefit Analysis:

Although some actual financial benefits of the use case were presented, we could not include a detailed cost-benefit analysis of the whole RPA implementation and return on investment, as it includes more complex calculations that will depend on, amongst other factors:

1) the complexity of the processes to be mapped.
2) the effort to improve the processes.
3) the effort to automate the processes.
4) the hourly cost of labor for the company.

6.2.3. Limited shared information:

Having a real-world use case although important to validate how a methodology can be applied in practice, it also has its downsides. One of which is not being able to disclose all the information discussed in this study, such as process and technical documentation and the process flow that were not allowed to be shared.
However, having all this information on the limitations and what could have been done also empowers us to keep working on this study with further studies, discussed on the section below.

6.3. FUTURE WORK

For future research regarding RPA and the development of this first version of the methodology, there are some areas that deserve exploring considering all that was discussed in this study.

6.3.1. Intelligent Automation

RPA is very useful when talking about repetitive and predictable processes. However, to further enhance this methodology and the RPA, intelligent automation is a very interesting subject that might be incorporated into this study. Through intelligent automation, the RPA solutions have the potential of being even more advanced and can work for more complex processes that involve unorganized data and difficult decision making.

6.3.2. Process Mining

Process mining techniques are also a niche area that have high correlation with this methodology. For future studies, process mining should be considered as an option to map the processes in a more efficient manner, especially considering that a lot of exceptions and issues from the processes are not easily mapped when interviewing process owners. This would be a more data-driven approach to the methodology.

6.3.3. Adding the "engagement" factor to the methodology

As suggested by one of the interviewees in the Evaluation and Discussion section, one important factor of bringing RPA to a company is having the whole team onboard and engaged. Therefore, one opportunity of future work for this study is including a sort of workshop guideline or some directions on how to engage all the participants to make sure they all understand the possible benefits of using RPA and stop seeing the RPA as a tool to replace workforce, but instead, a tool to improve them.

6.3.4. Testing with more transparent case studies

Another opportunity of future work is to test the methodology with end-to-end case studies, specifically processes and companies that will be willing to share more information and details about their processes, so the evaluation can be even more insightful, and improved versions of this methodology can be derived from it.

BIBLIOGRAPHICAL REFERENCES

ABPMP. (2019). Guide to the Business Process Management Common Body of Knowledge (BPM CBOK® 4.0). *BPM CBOK Version 4.0*, *0*.

Aguirre, S., & Rodriguez, A. (2017). *Automation of a Business Process Using Robotic Process Automation (RPA): A Case Study*. 65–71. https://doi.org/10.1007/978-3-319-66963-2_7

Automation Anywhere. (2023). *Automation Anywhere - Intelligent Process Automation*. Https://Www.Automationanywhere.Com/Rpa/Intelligent-Automation. https://www.automationanywhere.com/rpa/intelligent-automation

CIO Insider. (2018, September 20). *Selecting the Right Processes for Robotic Process Automation*. https://www.datamatics.com/news-list/selecting-the-right-processes-for-robotic-process-automation

Davenport, T. H. (1993). *Process innovation: reengineering work through information technology*. Harvard Business Press.

Davenport, T. H., & Brain, D. (2018, June 13). *Before Automating Your Company's Processes, Find Ways to Improve Them*. Harvard Business Review. https://hbr.org/2018/06/before-automating-your-companys-processes-find-ways-to-improve-them

Dumas, M., La Rosa, M., Mendling, J., & Reijers, H. A. (2018). *Fundamentals of Business Process Management*. Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-662-56509-4

Ernst, & Young. (2016). *Get ready for robots*. https://assets.ey.com/content/dam/ey-sites/ey-com/en_gl/topics/emeia-financial-services/ey-get-ready-for-robots.pdf

Eulerich, M., Waddoups, N., Wagener, M., & Wood, D. A. (2023). The Dark Side of Robotic Process Automation (RPA): Understanding Risks and Challenges with RPA. *Accounting Horizons*, 1–10. https://doi.org/10.2308/HORIZONS-2022-019

Flechsig, C., Lohmer, J., & Lasch, R. (2019). *Realizing the Full Potential of Robotic Process Automation Through a Combination with BPM* (pp. 104–119). https://doi.org/10.1007/978-3-030-29821-0_8

Gartner. (2016, May). *Automation: The Next Frontier for IT*. https://www.gartner.com/smarterwithgartner/automation-the-next-frontier-for-it-2

Gartner. (2018). Gartner Glossary. In *Information Technology (IT) Glossary—Essential Information Technology (IT) Terms & Definitions.*

Gartner. (2020, September 21). *Gartner Says Worldwide Robotic Process Automation Software Revenue to Reach Nearly $2 Billion in 2021*. Stamford Conn.

Grand View Research. (2020). *Robotic Process Automation Market Size, Share & Trends Analysis Report By Type, By Application, By Deployment, By Organization, By Region, And Segment Forecasts, 2023 - 2030*.

Harmon, P. (2019). *Business process change: a business process management guide for managers and process professionals*. Morgan Kaufmann.

Herm, L.-V., Janiesch, C., Helm, A., Imgrund, F., Hofmann, A., & Winkelmann, A. (2022). A framework for implementing robotic process automation projects. *Information Systems and E-Business Management*, 1–35. https://doi.org/10.1007/s10257-022-00553-8

Hevner, A., R, A., March, S., T, S., Park, Park, J., Ram, & Sudha. (2004). Design Science in Information Systems Research. *Management Information Systems Quarterly*, *28*, 75.

Huang, K.-P., Tung, J., Lo, S. C., & Chou, M.-J. (2013). A review and critical analysis of the principles of scientific management. *International Journal of Organizational Innovation (Online)*, *5*(4), 78.

IEEE. (2017). IEEE Guide for Terms and Concepts in Intelligent Process Automation. *IEEE Std 2755-2017*, 1–16. https://doi.org/10.1109/IEEESTD.2017.8070671

Lacity, M., & Willcocks, L. (2016). Robotic Process Automation at Telefonica O2. *MIS Quarterly Executive*, *15*(1). https://aisel.aisnet.org/misqe/vol15/iss1/4

Lizano-Mora, H., Palos-Sánchez, P. R., & Aguayo-Camacho, M. (2021). The Evolution of Business Process Management: A Bibliometric Analysis. *IEEE Access*, *9*, 51088–51105. https://doi.org/10.1109/ACCESS.2021.3066340

Mendling, J., Decker, G., Hull, R., Reijers, H., & Weber, I. (2018). How do machine learning, robotic process automation, and blockchains affect the human factor in business process management? *Commun Assoc Inform Syst*, *43*(1), 297–320.

Microsoft. (2022, February 15). *Types of process automation*.

N Karthik. (2019, October 15). *Overcoming the common challenges of RPA implementation*. Https://Community.Microfocus.Com/It_ops_mgt/b/Sws-571/Posts/Overcoming-the-Common-Challenges-of-Rpa-Implementation.

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

Smith, H., & Fingar, P. (2003). *Business process management: the third wave* (Vol. 1). Citeseer.

Syed, R., Suriadi, S., Adams, M., Bandara, W., Leemans, S., Ouyang, C., Ter, A., de Weerd, I., Wynn, M., & Reijers, H. (2020). Robotic Process Automation: Contemporary themes and

challenges. *Computers in Industry*, *115*, 103162. https://doi.org/10.1016/j.compind.2019.103162

UI Path. (2022). *What is robotic process automation?* https://www.uipath.com/rpa/robotic-process-automation

van der Aalst, W. M. P., Becker, J., Bichler, M., Buhl, H. U., Dibbern, J., Frank, U., Hasenkamp, U., Heinzl, A., Hinz, O., Hui, K.-L., Jarke, M., Karagiannis, D., Kliewer, N., König, W., Mendling, J., Mertens, P., Rossi, M., Voss, S., Weinhardt, C., … Zdravkovic, J. (2018). Views on the Past, Present, and Future of Business and Information Systems Engineering. *Business & Information Systems Engineering*, *60*(6), 443–477. https://doi.org/10.1007/s12599-018-0561-1

Weske, M. (2019). *Business Process Management*. Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-662-59432-2

Willcocks, L. P., Lacity, M., & Craig, A. (2015). *The IT function and robotic process automation* (Issue 64519). https://ideas.repec.org/p/ehl/lserod/64519.html

APPENDIX A – ETHICS COMMITTEE REPORT

This is to certify that
Project No.: **DSCI2023-11-63230**
Project Title: **Master's Thesis on BPM and RPA methodology**
Principal Researcher: **Renan Stoffel**

according to the regulations of the Ethics Committee of NOVA IMS and MagIC Research Center this project was considered to meet the requirements of the NOVA IMS Internal Review Board, being considered **APPROVED** on 11/6/2023.

It is the Principal Researcher's responsibility to ensure that all researchers and stakeholders associated with this project are aware of the conditions of approval and which documents have been approved.

The Principal Researcher is required to notify the Ethics Committee, via amendment or progress report, of
- Any significant change to the project and the reason for that change;
- Any unforeseen events or unexpected developments that merit notification;
- The inability of the Principal Researcher to continue in that role or any other change in research personnel involved in the project.

Lisbon, 11/6/2023

NOVA IMS Ethics Committee
ethicscommittee@novaims.unl.pt

Field name	Field Type	Comments
Is this a new process or an improvement to an existing automated process?	Radio	New Process / Improvement
Requesting area	Dropdown	If "Other", say which area
Process Name	Short Text	Name of the process to be automated
Brief description of the process	Long Text	Summarize what the process is about in two or more sentences
Description of the steps to be automated	Long Text	Brief overview of the steps to be automated. Example: "Log in to NetSuite portal, download monthly report, save as excel file, send via e-mail"
Softwares included	Multi-select checkbox	
How long does it take to run one execution of the process manually?	Short Text	Example: This process is done manually two times a week for the whole year, and it takes one hour each time.
How often this process needs to be ran?	Short Text	
At what time?	Short Text	Example: 11am EST
Hours manually per year	Number	How many hours a year spent in this process. Example: 2h/week or 104h/year
How are the hours calculated?	Text	Example: This process is done manually two times a week for the whole year, and it takes one hour each time.
Other benefits	Text	Describe other benefits of this process that are not represented necessarily by hours
Possible schedules for process mapping interview	Long Text	
Additional comments	Long Text	

APPENDIX C – PROCESS DEFINITION DOCUMENT TEMPLATE SUMMARY (PDD)

This document presents an outlined suggestion of what topics should be present in a Process Definition Document.

Table of Contents.

APPENDIX D – SOLUTION DESIGN DOCUMENTATION TEMPLATE SUMMARY (SDD)

This document presents an outlined suggestion of what topics should be present in a Solution Design Document.

TABLE OF CONTENTS

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação

Universidade Nova de Lisboa