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Improving Business Processes with RPA Technologies

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To all who have contributed to this journey, especially my family, your support and encouragement have been essential to my success.

Integrity Declaration

I hereby declare having conducted my dissertation with integrity. I confirm that I have not used plagiarism or any form of falsification of results in the process of the thesis elaboration.

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Universidade Aberta, 20th of November 2023

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Resumo

A *Robotic Process Automation* (RPA) é uma tecnologia inovadora que utiliza *robots* em formato de *software* para automatizar tarefas repetitivas e melhorar processos empresariais. Esta investigação aprofunda-se nas suas vantagens e desafios, realçando o seu papel no aumento da produtividade, melhoria da precisão, redução de custos e no progresso da experiência do cliente. Apesar destes benefícios, a implementação do RPA enfrenta desafios, incluindo a necessidade de manutenção contínua e o potencial deslocamento de empregos humanos.

A investigação integra uma Revisão Sistemática da Literatura (RSL) com a metodologia Investigação-Ação. A RSL apresenta os benefícios e os desafios do RPA, as suas abordagens de implementação e o seu impacto presente na literatura atual. A Investigação-Ação seleciona quais são os processos adequados para automatização e destaca a seleção e análise de processos enquanto etapas cruciais nas atividades de melhoria de processos.

Adicionalmente, a investigação detalha as complexidades envolvidas na seleção, redesenho e otimização de processos para ajustar a distribuição de recursos humanos em tarefas que requerem um nível elevado cognitivo. Ao adotar RPA, é possível melhorar a eficiência e reduzir taxas de erro, possibilitando que outros recursos sejam alocados a atividades estratégicas e de valor acrescentado. Esta investigação, também apresenta um método para a seleção e redesenho de processos, essencial para uma implementação de RPAs.

Por último, proporciona a aplicação de RPAs em ambiente real, podendo servir enquanto modelo para organizações que pretendem implementar esta tecnologia, melhorando o seu desempenho e mantendo competitividade no atual panorama de constante mudança.

Palavras-chave

Robotic Process Automation; RPA; Investigação-Ação; Processos de negócio; BPM.

Abstract

Robotic Process Automation (RPA) is an innovative technology that utilises software robots to automate repetitive tasks and enhance business processes. This research delves into the advantages and challenges of RPA, emphasising its role in increasing productivity, improving accuracy, reducing costs, and elevating customer experience. Despite these benefits, RPA implementation faces challenges, including the necessity of continuous maintenance and the potential displacement of human jobs.

The study integrates a Systematic Literature Review (SLR) with Action Research methodology. The SLR defines the primary benefits and challenges of RPA, its deployment approaches, and its impact on business process tasks in the current literature. In contrast, Action Research selects the optimal business processes for automation and highlights the importance of process selection and analysis as crucial steps in business process improvement activities. It addresses the complexities of choosing, redesigning, and optimising business processes to maximise human resource allocation towards high-cognitive tasks.

By adopting RPA, companies achieve enhanced process efficiency and reduced error rates, allowing staff to dedicate more time to strategic, value-added activities. The research presents a robust framework for process selection and business process model redesign, essential for successful RPA implementation.

Furthermore, this research offers critical insights into RPA's application in a real-world environment, serving as a valuable resource for organisations intending to implement this technology, improving operational performance and sustaining competitiveness in the ever-changing business landscape.

Keywords:

Robotic Process Automation; RPA; Action Research; Business Processes; BPM.

Table of Contents

Conditions of use of the work by third parties.....	II
Acknowledgments.....	III
Integrity Declaration	V
Resumo.....	VI
Abstract	VII
Table of Contents	VIII
Table of Figures	XII
Glossary of Abbreviations and Acronyms.....	XIV
1 Introduction.....	1
1.1 Motivation.....	1
1.2 Problem	2
1.3 Objectives and Deliverables.....	3
1.4 Thesis Outline	4
2 Theoretical Background.....	6
2.1 Business Process Management	6
2.2 Robotic Process Automation.....	7
3 Research Methods.....	9
3.1 Systematic Literature Review	9
3.2 Action Research	10
3.2.1 Semi-structured Interviews	12
4 Systematic Literature Review	13
4.1 Planning the SLR.....	13
4.1.1 Motivation.....	13

4.1.2	Research Questions	14
4.1.3	Review Protocol.....	14
4.2	Conducting the SLR.....	15
4.2.1	Selection of Studies	15
4.3	Reporting the SLR	16
4.3.1	RQ1 - What are the major benefits of business process improvement with RPAs?	16
4.3.2	RQ2 - What are the major challenges in improving business processes with RPAs?	19
4.3.4	RQ3 - What are the most frequently used approaches to implement RPA technologies to improve business processes?	22
4.3.5	RQ4 - What type of business process tasks are improved by RPAs?.....	24
4.4	Discussion.....	26
4.4.1	RPA Benefits	26
4.4.2	RPA Challenges.....	27
4.4.3	Approaches to implement RPA technologies	29
4.4.4	Business process tasks improved by RPAs.....	30
5	Diagnosing	33
5.1	Organizational Background	33
5.2	Process Identification & Selection for improvement.....	36
5.3	Business Process Modelling	39
5.4	Qualitative Process Analysis	42
5.4.1	Value Added Analysis	42
5.4.2	Issue Documentation.....	44
5.5	Quantitative Process Analysis	46

- 5.5.1 Flow Analysis46
- 5.6 RPA Suitability Matrix49
- 6 Planning52
 - 6.1 Process Redesign.....52
 - 6.2 RPA implementation.....54
- 7 Action.....55
 - 7.1 New Business Process Model55
 - 7.1.1 Why-Why diagram.....57
 - 7.2 RPA Setup.....60
- 8 Evaluation63
 - 8.1 Key Performance Indicators analysis.....63
 - 8.2 Flow Analysis of New Process64
 - 8.3 Semi-structured Interviews Iterations66
 - 8.3.1 Evaluation Iterations68
 - 8.3.2 Evaluation Results.....70
- 9 Conclusion74
 - 9.1 Main Contributions74
 - 9.2 Research Limitations.....75
 - 9.3 Future Work75
- References77
- Appendix A84
- Appendix B85
- Appendix C86
- Appendix D88

Table of Figures

Figure 1: Action Research Cycle (adapted to the research).....	10
Figure 2: How to conduct systematic literature reviews in management research: a guide in 6 steps and 14 decisions[32]	13
Figure 3: SLR's Review protocol.....	15
Figure 4: Summary of RPA Benefits found in SLR	16
Figure 5: Summary of RPA Challenges found in SLR.....	19
Figure 6: Summary of most frequently used approaches to implement RPAs to improve business processes found in the SLR	22
Figure 7: Summary of the type of business process tasks improved by RPAs found in the SLR	25
Figure 2: Organizational Chart	34
Figure 9: Corporate IT Department Chart with Cross-Functions	34
Figure 10: P2P Process "as is" with emphasis on PR/PO Creation	41
Figure 11: Event Sub-Process "Process Monitoring"	42
Figure 12: Pareto Chart with top 3 issues of P2P	45
Figure 13: Cycle Time Efficiency Formula	49
Figure 14: Figure 7 - P2P Process "to be" with emphasis on PR/PO Creation.....	56
Figure 15: Event Sub-Process "Process Monitor RPA"	57
Figure 16: Why-Why Diagram: The Purchase Orders are not being delivered in time.....	58
Figure 17: Why-Why Diagram: Purchase Requisitions / Orders do not have any support information for the approval	59
Figure 18: Why-Why Diagram: SAP Good Receipts not issued in due time	60
Figure 19: Developed RPA	62
Figure 20: PR Template	84
Figure 21: Purchase Requisition Example before improvement	85
Figure 22: Purchase Requisition Example after improvement	85
Figure 23: Flow analysis of Event Sub-Process "Process Monitoring"	86
Figure 24: Flow analysis of P2P Process.....	87

Glossary of Abbreviations and Acronyms

BPM	Business Process Management
BPMN	Business Process Modelling Notion
CT.....	Cycle time
CTE.....	Cycle time efficiency
GR.....	Goods Receipt
KPIs.....	Key Performance Indicators
MES	Manufacturing Execution System
OCR	Optical Character Recognition
P2P	Procure-to-Pay
PO.....	Purchase Order
PR.....	Purchase Requisition
PT	Processing Time

1 Introduction

In this section of the master's thesis, our primary goal is to establish the necessary context for the research, articulate the core motivations driving its pursuit, define the precise objectives and expected outcomes, the scope of the study, and emphasise its relevance within the broader academic and practical landscape. Furthermore, this chapter provides a roadmap for the remaining sections and chapters of the thesis, which is elaborated upon in section 1.4 in the Thesis Outline.

1.1 Motivation

In today's dynamic business environment, organisations face a range of challenges, including evolving customer demands, intense global competition, stringent regulatory requirements, and persistent operational inefficiencies[1], [2]. Additionally, businesses must undertake the need for substantial investments to keep pace with rapidly advancing technology[3], [4]. As a result, companies are constantly seeking a competitive edge, which requires them to quickly adapt to change and deliver services with high efficiency, precision, and predictability[5]. However, the complexities and inefficiencies of traditional operational methods often hinder these efforts to optimise business processes[6]. Given the expectations of today's customers and stakeholders, achieving these objectives has become even more critical[7], [8].

Furthermore, the division between departments, the lack of ongoing process improvements, the absence of robust quality control mechanisms, and the limited use of automation leave employees feeling drained, leading to reduced operational performance and overall business competitiveness[9]. Furthermore, the division between departments, the need for ongoing process improvements, the absence of robust quality control mechanisms, and the limited use of automation leaves employees feeling drained, leading to reduced operational performance and overall business competitiveness [10]–[12]. RPA offers a clear proposition for businesses by promising to speed up routine tasks, improve accuracy, ensure process reliability, achieve cost-efficiency, and enable streamlined processes[13]. It also

allows for greater control and supervision in complex situations involving the integration of multiple systems[14], [15].

Considering the significance of RPA in addressing these challenges, it is essential to explore its benefits and challenges comprehensively. RPA brings improvements such as enhanced process efficiency, reduced operational costs, increased task accuracy and consistency, higher productivity, and an improved customer experience[16], [17]. However, it also comes with challenges, including the need for ongoing maintenance and the potential displacement of human jobs[18], [19]. Various approaches are commonly used to implement RPA, including mimicking human activities in cases where existing business processes are inefficient, process mining, desktop-activity mining, and the utilization of machine learning to address specific scenarios [26][27]. RPA is particularly effective in enhancing relatively simple tasks, but recent advancements in hyper-automation have expanded its capabilities to handle more complex data structures and apply machine learning to previously challenging scenarios.

In this study, the exploration of RPA and its versatile applications, it becomes evident that this technology has the potential to revolutionise business processes and significantly enhance operational efficiency, making it a compelling subject for further investigation and exploration in this thesis.

1.2 Problem

The Procure-to-Pay (P2P) process is an essential component of modern organisations, encompassing the procurement of goods and services, payments, and receipt of goods. However, many organizations currently require support in this domain, characterized by ineffective monitoring mechanisms. This deficiency in oversight and control has resulted in significant delays in the delivery of services/licenses, processing of payments, and recording of goods receipts.

These delays not only impact operational efficiency but also compromise the overall effectiveness and competitiveness of the organization. The lack of real-time visibility into

the P2P process hampers decision-making, increases the risk of errors, and hinders compliance with regulatory requirements.

To address this pressing issue, this master's thesis employs an action research approach to investigate the application of RPA technology as a potential solution on top of a business process improvement. RPA promises to automate routine tasks, enhance accuracy, ensure process reliability, and enable efficient management of complex P2P processes. By harnessing RPA's capabilities, organizations aim to streamline and take control of their P2P processes, mitigating delays, reducing operational costs, and ultimately improving the delivery of services, processing of payments, and goods receipts.

This research endeavours to explore the implementation of RPA within the context of the P2P process, examining its feasibility, benefits, challenges, and impacts. By doing so, it seeks to contribute valuable insights and practical recommendations that can support organisations in effectively addressing the monitoring and control issues within their P2P processes, thereby enhancing their overall operational performance and competitiveness.

Problem statement: Absence of effective monitoring mechanisms in an existing Procure-to-Pay process, resulting in substantial delays in delivering services/goods, and processing payments due to lack of visibility, error-prone, fragmented systems, limited automation, and process complexity.

1.3 Objectives and Deliverables

As highlighted in the motivation chapter, the contemporary business environment presents organizations with various challenges, including evolving customer demands, global competition, and operational inefficiencies. The inducement to address these challenges stems from the imperative for organizations to maintain their competitive edge by swiftly adapting to change, delivering services with precision and efficiency, and making judicious resource allocations.

In response to these challenges, this research endeavours to explore the disruptive potential of RPA technology within the context of action research. The objectives and

Rodolfo Fernandes

deliverables outlined here are closely aligned with the overarching goal of enhancing organizational and operational efficiency.

By understanding the potential benefits and challenges associated with RPA adoption, this research aims to demonstrate how organizations with the knowledge and strategic insights required can navigate the complexities of the modern business landscape effectively. It seeks to identify specific business process tasks suitable to automation through RPA, considering factors such as task complexity, frequency, and their impact on overall operational efficiency. This insight provides organizations with a structured method for task selection, facilitating a strategic RPA implementation approach.

Furthermore, this research looks for the methodologies and approaches commonly employed in the implementation of RPA solutions. With a special focus on process simplification and eliminating redundant, non-value-adding tasks, it aims to provide organizations with a comprehensive view of available methodologies, enabling informed and strategic RPA adoption.

The evaluation of this research is showcased through a practical demonstration within the action research context, showcasing the tangible enhancements attainable through the rational application of RPA technology. This empirical illustration highlights the transformative potential inherent in RPA adoption, aligning directly with the inducement to streamline processes, eliminate redundancy, and maximize resource value.

This research endeavours to provide organisations with the tools, insights, and a practical demonstration needed to thrive an RPA adoption in a rapidly evolving environment.

1.4 Thesis Outline

Chapter 1 sets the stage for the research by outlining its motivation, problem statement, objectives, and deliverables. The document expands as follows: Chapter 2 delves into a theoretical overview of business process management and Robotic Process Automation. Chapter 3 outlines the research methodologies employed, including systematic literature review, action research, and semi-structured interviews integrated into the evaluation phase of the action research. Chapter 5.133 provides a high level organizational chart and department

structure from the organization where this research had place to provide the necessary context to understand their business model. Chapter 4 provides an in-depth look at the systematic literature review process, along with conclusions and discussions. Chapter explores the Diagnosing phase of Action Research, focusing on key elements of BPM like process identification, selection, and analysis. Chapter 7 details the plan for actions designated in Chapter, which includes redesigning the process and strategizing the RPA implementation. Chapter 5 presents the practical application of RPA and the new business process model. Chapter 9 examines the evaluation phase of the research, containing a KPI analysis to compare the old and new processes, and an analysis of the improved business process flow. This chapter also incorporates semi-structured interviews and its evaluation. Finally, Chapter 9 captures the research conclusions, acknowledges its limitations, and suggests opportunities for future research.

2 Theoretical Background

2.1 Business Process Management

Business Process Management (BPM) is the art and science of overseeing how work is performed in an organization to ensure consistent outcomes and to take advantage of improvement opportunities. BPM involves managing entire chains of events, activities, and decisions that ultimately add value to the organization and its customers[20].

The range of activities in BPM can vary depending on the organization and its objectives, but their common activities are process modelling involving creating a graphical representation of the steps involved in a business process called process models illustrated as flowcharts, swim-lane diagrams, and Business Process Modelling Notion (BPMN) diagrams. The purpose of process modelling is to provide a clear and concise view of the process, which can be used to identify inefficiencies, bottlenecks, and other areas for improvement.

Additionally, process analysis is also object of BPM, and concerns analysing process models to identify areas for improvement through multiple techniques such as process simulation, process mining, and value stream mapping. The purpose of process analysis is to identify opportunities for process improvement and should be data-driven and should provide actionable insights. Furthermore, process redesign is the successive activity in BPM that aims redesigning business processes to improve their efficiency and effectiveness. Process redesign can involve changing the sequence of activities, eliminating unnecessary steps, and automating manual tasks in order to optimise the business process and to eliminate redundancies or non-valuable tasks. To monitor the performance of business processes and to ensure that they are meeting their objectives, the BPM field uses process monitoring. This activity uses various tools such as dashboards, Key Performance Indicators (KPIs), and process analytics. The purpose of process monitoring is to identify areas for improvement and to take corrective action when necessary.

In addition, within the scope of BPM, process improvement entails the ongoing enhancement of business processes in a step-by-step approach to introduce incremental

changes. The primary goal of this BPM activity is to optimise the process and align it with the organization's objectives.

Finally, process automation involves automating manual tasks using technology. Process automation can be done using various tools such as workflow management systems, robotic process automation, and business process management suites. Specifically, to this research, the aim is to enhance a business process through these activities with a robotic process automation implementation, as a drive to enhance a business process.

Overall, BPM is a holistic approach to managing business processes, and it involves a wide range of activities aimed at improving the efficiency and effectiveness of business processes.

2.2 Robotic Process Automation

Robotic Process Automation (RPA) defined has “the application of technology allowing employees in a company to configure computer software or a “robot” to capture and interpret existing applications for processing a transaction, manipulating data, triggering responses and communicating with other digital systems” by the IRPAAI Institute[21], emerged as a transformative technology in recent years, revolutionizing business processes and operations. RPA leverages software robots or “bots” to automate repetitive, rule-based tasks within organizations, significantly enhancing efficiency and accuracy[22].

The adoption of RPA offers substantial benefits, including increased productivity, cost savings, improved accuracy, and faster processing times. These advantages have been documented in numerous case studies and empirical studies, illustrating RPA's practical impact on organizations[10].

However, the implementation of RPA is not without challenges. Integrating such technology into existing systems can be complex, and organizations need to consider factors such as change management, bot governance, scalability concerns, and ongoing maintenance and updates[22].

Additionally, the intersection of RPA with machine learning has opened new possibilities. Machine learning capabilities can enhance this technology by enabling more

Rodolfo Fernandes

intelligent and adaptive automation. Furthermore, RPA and machine learning have potential synergies between for business process improvement[11].

In addition, this technology is not limited to a single industry since it has been applied across various sectors, including banking. Case studies, such as in the banking industry, revealed that RPA can streamline financial processes and drive efficiency[9].

Also, the user interface plays a crucial role in RPA. Designing user interfaces that align with RPA best practices is essential for effective implementation. Seven guidelines for designing user interfaces in RPA projects have been proposed, emphasizing usability and efficiency[23].

In conclusion, Robotic Process Automation is a transformative technology with the potential to significantly improve business processes. While it offers numerous benefits, organizations must carefully plan and manage its implementation to address challenges and fully leverage its capabilities. Additionally, the integration of machine learning and attention to user interface design are emerging trends that promise to enhance RPA's effectiveness further.

3 Research Methods

3.1 Systematic Literature Review

Systematic literature review is a method used in information systems research, aiming to provide a rigorous and standardized approach to reviewing the existing literature[24]. This method involves several stages, including defining the research question, searching and assessing the literature, measuring its quality, extracting and synthesizing data, and, providing recommendations and suggestions for future research[25]. In the context of information systems, SLRs play a crucial role in informing decision-making, identifying gaps in the existing literature, and guiding future research directions[26]. Therefore, this study was conducted for the research in order to identify the benefits, challenges, most frequently used approaches to implement RPA, and the successful tasks improved by this technology.

Before enhancing any of the organization's business processes, it was imperative to gain a thorough knowledge of the technology's advantages and its potential value to the organization. Additionally, it served to validate this thesis by presenting evidence of whether these gains were indeed realized. Likewise, when tackling the challenges, it empowered the researchers to gain a more comprehensive view of potential obstacles in adopting RPA technologies. Similarly, diving into the current approaches used for implementing this technology allowed for a better understanding of the approach to be adopted. Finally, understanding the critical business tasks essential for a successful RPA implementation, reinforced this study in developing an RPA Suitability Matrix, as detailed in the following chapters, to define which aspects or processes could undertake automation.

The structure and comprehensive study of this method is explained and described in the Section 4 of this research.

3.2 Action Research

The second methodology applied to this research was Action research which has gained recognition as a valuable research methodology within the field of information systems. It has been explicitly introduced as a purely research methodology by Wood-Harper[27], and it is well suited to information systems research due to the highly applied nature of the field[28], particularly for its ability to inform theory while making a practical difference[29]. In other words, it is a collaborative approach that involves the active participation of the participants in the research process, allowing them to contribute to the identification of solutions and the implementation of changes[30].

Action Research involves several stages, that vary according to the authors, but generally include five phases: diagnosis, action planning, action execution, evaluation, and learning/documentation[30]. For this specific research, we identified the learning/documentation as the conclusion phase of this study.

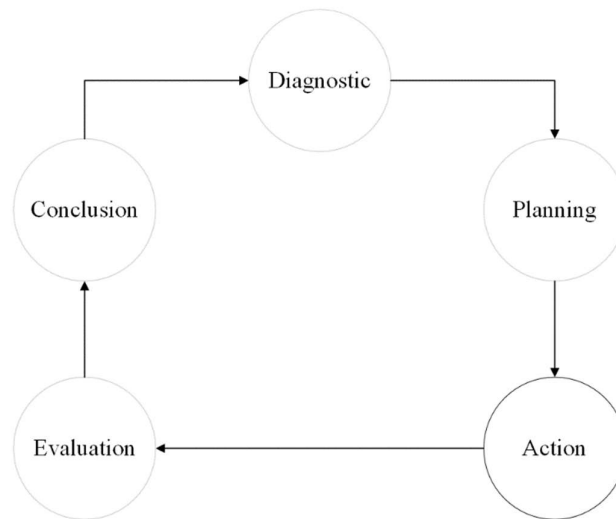


Figure 1: Action Research Cycle (adapted to the research)

During the diagnostic phase, the problem is identified and defined, and data are collected to better understand the situation[30]. In this stage of the methodology, the research approach employed three essential components of BPM. Starting with “Process identification” and “Process selection” which highlights the commonly used criteria to evaluate a

business process (strategic importance, health, and feasibility), allowed to qualify if the business process selected in this organization could fit into this study for improvement. Furthermore, in the same way, it supports the research on the prioritization of processes for improvement within this organization. It is a good practice to base priorities upon the importance of processes, their health, and the feasibility of improvements[20]. To be able to identify the pain points of the chosen process, within the scope of “Process analysis” qualitative and quantitative methods were used to understand its current state and identify areas for improvement.

Overall, process identification, process selection, and process analysis are critical components of effective BPM, as they help to ensure that the right processes is targeted for improvement, that resources are allocated effectively, and that improvements are implemented in a structured and effective manner[20].

In the planning phase, we aimed to identify possible solutions, and an action plan was developed with the support of the “Process redesign” method (also a component of BPM techniques) to revamp the current identified process to plan how to enhance the same based on the process analysis. Additionally, and linked to the RPA technology we describe a planned approach/strategy on how the automation of multiple tasks of the business process should take place.

Moreover, in the action execution phase, the plan was implemented, and changes were performed in the business process. In other words, a new process model is presented as well as the description of the RPA configuration/deployment. In the evaluation phase, the results of the proposed action were assessed to determine if the changes were effective by the means of a flow analysis along with a comparison between the older and new process with the support of two process KPIs. Also, as described in the following sub-section, semi-structured interviews were performed to validate from the organization side the results of the business process improvement and RPA implementation. Finally, in the learning/documentation that was named as conclusion phase, it is highlighted the research contribution, limitations, and future lines of research.

In summary, the choice of using this methodology relies on its ability to research in the field. Being able to work closely with the organisation leads to a better understanding of the problem and challenges tailoring the methodology to the specific needs of the research

Rodolfo Fernandes

objectives. Additionally, the research findings, for example, in process analysis, supports the researcher to implement new practices and changes the business process model, thus reducing the resistance management. Finally, the ground field with the support of the organizational stakeholders, and with the support of the semi-structured interviews, proves validity and reliability of the research.

3.2.1 Semi-structured Interviews

The Semi-structured interviews are an effective method for gathering data in action research, particularly in the field of information systems. This research method is valued for its flexibility, which facilitates the uncovering of insights significant to the participants[31]. Furthermore, in the context of this research, this method was designed to evaluate the process improvements and outcomes resulting from the implementation of RPA. In these interviews the participants consented was previously obtained, by the signature of the “Informed Consent Protocol”. The structured aspect of these interviews revolves around specific questions related to the impact of RPA and Business Process Improvement activities performed described in this research.

For this research, the Semi-structured interviews are particularly suitable since they enable to evaluate the study from a process participant perspective, offering insights into their experiences with the RPA implementation, as well as, future possibilities for improvement in regards with this technology and process enhancement. The research employed an interview guide, which includes a set of questions and topics in a specific order. This guide, however, was not restrictive to enable the interviewers to explore other relevant topics during the conversation to make the interviews adjustable to the participants’ perceptions.

4 Systematic Literature Review

In this master's thesis dedicated to the field of RPA, the primary research objective is how this technology can enhance established business processes. Therefore, acknowledging what is in the current literature supports the direction of this research by enabling the identification of the current scientific knowledge on the subject of RPA. Notably, its challenges, benefits, current implementation approaches, and successful improvement of business process tasks through the use of this technology.

4.1 Planning the SLR

This research phase belongs to the initial phase of the SLR process described earlier. It begins by elucidating the rationale behind this study then by delineating the goals and associated research questions the research endeavours to address. Subsequently, a review protocol is introduced.

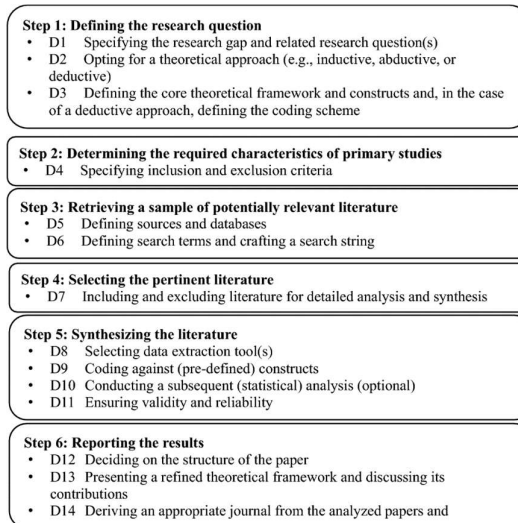


Figure 2: How to conduct systematic literature reviews in management research: a guide in 6 steps and 14 decisions[32]

4.1.1 Motivation

Robotic Process Automation is a rapidly growing technology increasingly used to streamline business processes across various industries, gaining popularity due to its ability to improve

Rodolfo Fernandes

process efficiency[11], reduce operational costs, and increase accuracy and consistency in task execution. The systematic literature review was essential to understand and gather valuable insights into the benefits, challenges, and types of business processes that can be improved using RPA. In that sense, the SLR produced below helped identify the most used RPA implementation approaches, the common challenges associated with RPA, and the specific business process tasks most suitable for RPA to determine in the section 0 “Diagnosing” which business processes or tasks as subject of improvement or automation.

4.1.2 Research Questions

In accordance with the four research questions designed to guide this study:

- RQ1 - What are the major benefits of business process improvement with RPAs?
- RQ2 - What are the major challenges in improving business processes with RPAs?
- RQ3 - What are the most frequently used approaches to implement RPA technologies to improve business processes?
- RQ4 - What type of business process tasks are improved by RPAs?

A comprehensive investigation was performed to determine the feasibility of realizing these benefits and addressing the challenges inherent in RPA technologies to improve business processes. This research was tailored to identify the most prevalent approaches and eligible business tasks suitable for RPA integration. The subsequent Systematic Literature Review will shed further light on these aspects.

4.1.3 Review Protocol

The chosen search engine for this research paper was EBSCO.

Search string: (RPA or "robotic process automation") AND (BPM OR "business process")

At such an exploratory stage, the wide search string was chosen on purpose to ensure a comprehensive overview, aspects, and dimensions of the RPA field. Similarly, Robotic Process

Automation, and Business Process Management are complex and rapidly evolving fields, and the intention was to ensure that no relevant papers were missed, especially when the terminology and concepts in the field may vary.

The process used to conduct this SLR can also be revisited on the Figure 3.

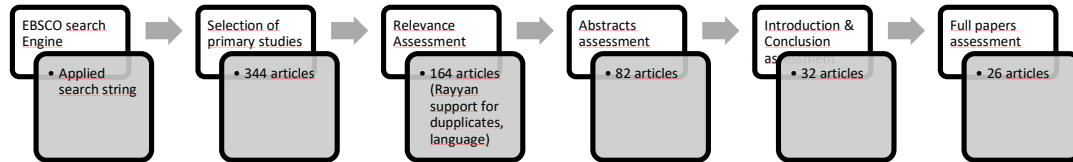


Figure 3: SLR's Review protocol

4.2 Conducting the SLR

4.2.1 Selection of Studies

Following the execution of the search string, the advanced search options were utilised to access essential features. Specifically, the search was narrowed down to include abstracts, and no restrictions were placed on the document type due to a lack of relevant literature on the primary project’s subject.

Each iteration of the search process served to categorize papers based on their relevance in answering the research questions. Papers were classified as “Included”, “Maybe”, or “Excluded”. The “Excluded” label was assigned when a paper lacked relevance to the research or had inappropriate language (limited to Portuguese or English).

Furthermore, articles were labelled as “Maybe” when their relevance was questionable, taking into consideration their potential value, and as “Included” when they aligned with the research topics. Consequently, “Excluded” articles were not considered in subsequent iterations. Both “Included” and “Maybe” papers were carried forward for further evaluation. A final decision regarding “Maybe” papers was made after a thorough review of each

paper and an assessment of its relevance. The inclusion and exclusion criteria summarised in Table 1: SLR's Inclusion and exclusion criteria.

Table 1: SLR's Inclusion and exclusion criteria

Inclusion Criteria	Exclusion Criteria
Full Text Available	Written in other languages
Written in English or Portuguese	Papers without references (author, year)
Papers about RPAs and business process management or business processes	Subjects not related to RPAs and business process management or business processes

4.3 Reporting the SLR

This phase aims to present the answers to the research questions gathered from the selected papers:

4.3.1 RQ1 - What are the major benefits of business process improvement with RPAs?

All the selected articles present benefits of improving business processes with RPA technologies. The Major benefits were selected by the number of findings in the literature and its possibility to drill down to other sub-categories of benefits.

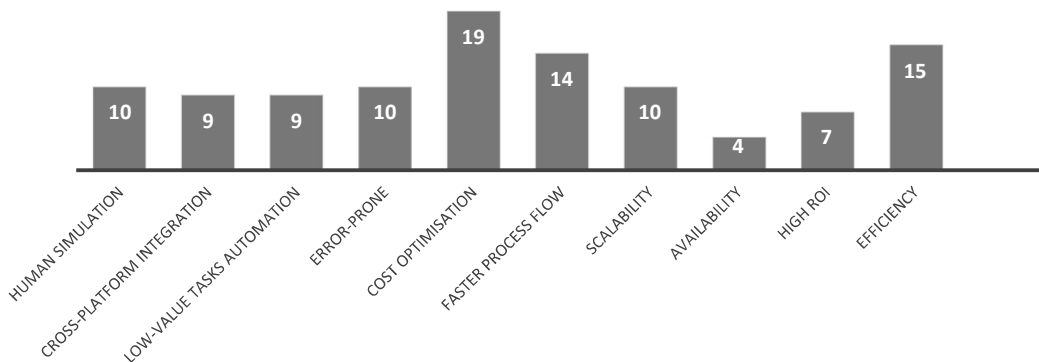


Figure 4: Summary of RPA Benefits found in SLR

Beyond the multiple advantages of using RPAs to improve business processes, human simulation constitutes 9% (10/26 articles) of the benefits due to this technology's ability to reproduce human behaviour [4]. Although it presents a low percentage of the findings, it can be considered one of the ultimate advantages of RPA, consequently leading to the next's. The considered "human behaviour" in the articles is restricted to non-valued, repetitive and strongly ruled tasks. In this perspective, human resources will be free to be allocated to cognitive, creative, and social /empathy-demanding activities [15].

Following the precedent benefit, the automation of low-value tasks, coming from the possibility of miming human behaviour, is 8% (9/26 articles) of the findings. This advantage is crucial to optimise the human FTEs turning routing tasks effectively [9]. Furthermore, it allows humans to exponentiate and develop skills to produce important tasks that enhance professional fulfilment.

Additionally, it was proven that turnover decreases[16], taking into consideration that RPA can contribute to a better life balance (today's trend) and even reduces burnout probabilities caused by highly repetitive tasks[33].

RPA brings cross-platform integration (8% of the benefits), which reduces the risks and complexity of the continuous rollout or deployment [7] of new information systems by enabling automation from also an end-user perspective, and on any IT system having a user interface, API or database. The aforementioned is directly linked to cost optimisation, the highest-scored benefit among the literature in 18% of the selected articles. This technology opens to society savings and optimisation opportunities, not only for human resources due to its ability to mimic them ("proven up to 60%" in study cases[8]) but also due to the cost and risk avoidance of deploying new information systems.

In addition, the error pone found in 10 out of the 26 selected articles (9%) is a generic benefit that could be drilled into, e.g., quality improvement or time avoidance due to the high precision of RPA robots. Therefore, it can lead to reductions of around 30%[34], leveraging the time used for each task, resulting in a better productive environment[16].

As a consequence, it was found that RPA can lead to a faster process flow (13% - 14/26 articles) which is linked to multiple factors such as having fewer errors (removing bottlenecks), productivity and availability increase due to its reliability and high rule-based

algorithms. Scalability, as mentioned above, is also one of the benefits of RPA technologies (9% - 10/26 articles) since robots can be adapted to the service request by resizing their productivity and scope (reuse components) without re-investing into deep development [16].

Moreover, its availability represents the lowest score in the literature findings (4% - 4/26 articles), perhaps (author's opinion) due to its obviousness. RPA robots are most likely available 24/7 [15] and do not need time off for any reason, providing improvements in service delivery lead time and flexibility to the business. Although, its score in the literature findings does not seem very high, (7% among the total of the 26 selected articles) high return on investment can be achieved within RPA implementations. Since this technology does not necessarily require a technical background for the designing and development phases (current platforms in the market are low-code), organisations tend to establish the “Center of Excellence” concept to monitor and manage future initiatives by business employees from multiple departments [35] to secure costs and ensure a high return on investment.

Nevertheless, this benefit can also be considered due to the other benefits exposed in this paper, such as error-prone, fast process flow, quality and efficiency increase [16]. In addition, as mentioned multiple times, efficiency was also one of the benefits present in the literature, being the second-rated benefit (15/26 articles), taking into account that improvement initiatives such as RPA implementations in crucial processes can lead to an efficiency improvement [17]. It is not surprising if we consider the *latum sensu* of “efficiency” because the overall sum of the majority of benefits exposed leads us to it (error-prone, fast process flow, availability, cost optimisation, cross-platform integration, and scalability). The Table 2 summarises the findings in the literature.

Table 2: Major benefits of business process improvement with RPAs

Benefit	Papers	#Papers
Human simulation	[4], [13], [15], [35]–[37] [3] [23] [38] [19]	10
Cross-platform Integration	[4], [7], [9], [12], [13], [36], [37] [16] [14]	9
Low-value tasks automation	[4], [35] [9], [13], [15] [3], [16], [22] [33]	9
Error-Prone	[8], [10], [11], [15], [18], [34], [39] [9] [3] [16]	10

Cost Optimisation	[1], [4], [7], [8], [10], [17], [18], [34], [36], [39] [11] [13] [5], [9], [14], [16], [19], [22], [38]	19	
Faster Process flow	[4], [7], [8], [10], [11], [13], [15], [18], [33], [39] [9] [3] [22] [16]	14	4.3.2
Scalability	[1], [4], [5], [7], [10], [11], [13], [35] [14], [16]	10	RQ2
Availability	[11], [13], [15] [16]	4	-
High ROI	[10], [13], [33], [35] [9] [16] [14]	7	
Efficiency	[1], [4], [7], [8], [10], [17], [18], [34], [35], [39] [11] [3] [5] [38] [12]	15	

What are the major challenges in improving business processes with RPAs?

Considering the 26 selected articles, 18 exposed the challenges of improving business processes with RPAs.

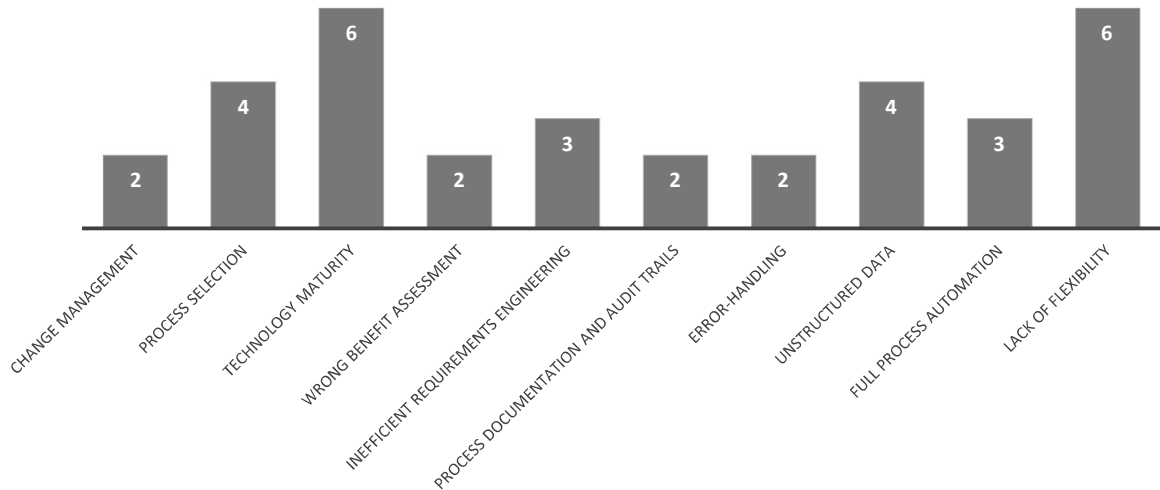


Figure 5: Summary of RPA Challenges found in SLR

Starting with change management as a challenge, the literature shows that RPA development is not supported enough[34] for which we can complement it by considering that this technology is still under development and lacks maturity not only in its conception but also in its business goals. Meaning employees show their fear of losing their employment since they take the bots as job opponents caused of myths that describe RPA as a technology to replace

human resources[15]. Nevertheless, we can consider it a paradox since, as mentioned in the major benefits research question, cost optimisation for which FTEs optimisation is included aims to reduce/reallocate human resources.

The process selection (found in 4/18 articles), part of the discovery phase of the RPA journey, is also considered a challenge since the selection of RPA process candidates needs an independent evaluation to assess its feasibility [4]. Moreover, this assessment will determine if the RPA will succeed and attain the general benefits of this technology deployment[18].

Technology Maturity is one of the highest-scored finding challenges of RPAs. As a matter of fact, RPA is still a growing technology where intellectual property rights remain in a limited market for which companies still need to invest considerably to acquire such services/products[7]. Additionally, RPA is still considered a workaround/short-term solution to automate business processes in old/obsolete systems since the new/to-date Information Systems are increasing automated features[16].

Furthermore, the literature considers that it is a wrong statement that RPA can automate the majority of process tasks since they are still limited to rule-based tasks and require human involvement[5]. In addition, with the current globalisation paradigm, outsourcing has been growing and is an opportunity for companies to buy managed services. However, this is still a challenge for RPA since when the outsourced business processes are geographically dispersed, the company lacks process management[19]. Again, its lack of maturity is also reinforced by the lack in literature of standards/recommendations for software development for RPAs[34].

Despite some instances, e.g., security or obsolescence-driven, IT projects are driven by their benefits. However, specifically for RPA, a promising technology in growth, the benefits are often wrongly assessed (2 out of 18 articles mentioning), and projects cannot achieve their goal[38], leading to, e.g., cost reductions lower than forecasted[17].

Another challenge to improving business processes with RPAs is the requirement engineering phase for this type of project. Currently, RPA suppliers/consulting firms are also running SW robots to gather business process requirements through logs for which not necessarily the automated flowcharts diagram can specify specific situations resulting in

inaccurate modelling of the robot[37]. Additionally, specifically in requirement engineering, RPA initiatives tend to fail when encountering a lack of support from the knowledge workers in the process[34]. Aligned with the last challenge exposed is the lack of process documentation and audit trails, since when automation takes place and robots mimic their activities, only limited human resources are aware of their activities, considering a problem when they leave the firm[35].

Furthermore, RPA is also a subject for improvement in the audit domain since they are currently only supported by logs that lack visibility on the robots' behaviour required for auditing activities[12]. While RPA is very efficient and error-prone, the literature states that error handling is still challenging [9] and is being mitigated by human resources due to this technology relying on rule-based processes and robots lacking cognitive skills [16]. Reinforcing the continuous challenges to RPA is their limitation on data handling (4 out of 18 articles). The literature exposes that the data used by robots must remain highly structured and unchanged[9] since they tend to fail if the data is not entered correctly[3]. To mitigate such challenges, the literature suggests that Optical Character Recognition (OCR) must be implemented to capture and print unstructured data, which requires an additional and significant investment[5].

Additionally, it is highly suggested that RPA lack of flexibility (the highest challenge identified with 6/18 of the selected articles). Business processes tend to change more than expected, and RPA solutions must be adapted and reconfigured, making it costly and time-consuming [16], occasionally requiring third-party plugins to handle specific tasks[3]. Combined with the previous challenges is the “full process automation” since RPA can only automate specific tasks and steps of business processes where rule-based processes still require human support [5], e.g., unstructured data. Human interactions, even at a minimum level, are still required, such as delegating tasks, reporting errors, and informing the task completion [23]. Again, RPA only fits rule-based processes due to the necessity of rules to be successful[16]. The Table 3 summarises the findings in the literature”.

Table 3: Major challenges in improving business processes with RPAs.

Challenge	Papers	#Papers
Change Management	[15], [34]	2
Process selection	[4], [15], [18], [34]	4
Technology Maturity	[7] [12] [5], [16], [34], [38]	6
Wrong benefit assessment	[17], [38]	2
Inefficient Requirements Engineering	[37] [34] [12]	3
Process documentation and audit trails	[35] [12]	2
Error-handling	[9] [16]	2
Unstructured Data	[3], [5], [9], [16]	4
Full Process Automation	[5], [16], [23]	3
Lack of flexibility	[16] [17] [9] [3] [5], [19]	6

4.3.4 RQ3 - What are the most frequently used approaches to implement RPA technologies to improve business processes?

Among the selected 26 articles, 50% present the approaches used to implement the RPA technology.

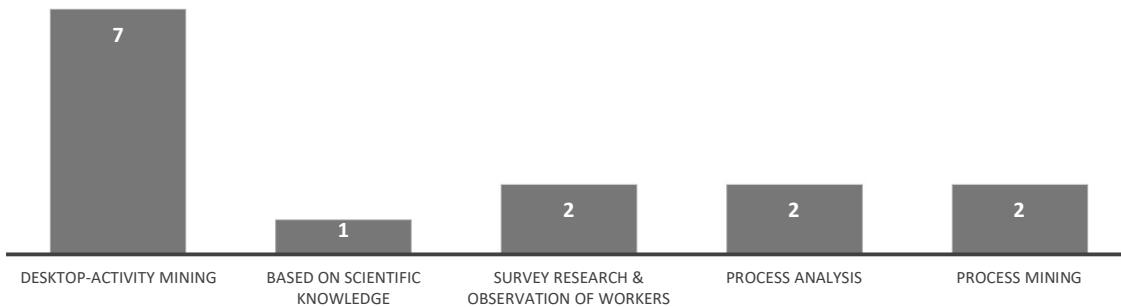


Figure 6: Summary of most frequently used approaches to implement RPAs to improve business processes found in the SLR

The highest score found was desktop-activity mining, also described as screen scrapping, presenting 40% of the research. This method involves recording end-user operations[39] using screen recording practices. Nevertheless, this approach depends on the stability user's used Information System[33], and it consists of copying/pastes actions and automating basic repetitive tasks[36], representing the most cost-effective and less time-consuming way to automate and labelling the RPA technology as "the poor man's workflow management solution"[36].

However, there are other approaches based on scientific knowledge, consisting of reviewing the state-of-the-art of this technology to identify the business processes having the potential criteria to be automated. Thus, based on raking their level of standardisation, frequency of its execution by identifying which systems are involved, the data structure, process maturity, number of errors and failure rate, its stability, the importance for the business, execution time and the number of tasks' handovers in the process flow[4].

Furthermore, processes are automated through survey research and observation methods, proving a more effective solution than desktop-activity mining[33]. The business process candidates are identified based on the end-user's routines, followed by flowchart diagrams built based on the conceptual and technical structure to map the tasks to be developed and consequently performed by the robots[37]. Nevertheless, the literature indicates that even if this technique has been effective for simple rule-based tasks, it is considered highly time-consuming and inaccurate if the routines are less conventional or require cognitive skills[37].

Another approach to implementing RPA to improve business processes is through process analysis. Like the previous approach, the process is analysed to determine its prerequisites [3], if RPA can be applied and if the investment in its automation is worth it. Multiple parameters are used to calculate its eligibility (potential, complexity, FTE, savings), and its results support the business decision to automate and forecast if there is an efficiency increase in the firm by investing in an automation initiative[13].

In addition, process mining is used to overcome the traditional process analysis approach, which is excessively time-consuming [17] and requires quick improvement in today's digital world. This approach can use WFM/BPM systems where the process is specified and, therefore, can be orchestrated by modelling simple activities for automation

Rodolfo Fernandes

through APIs (Application Programming Interfaces)[36]. The “Table 4: Most frequently used approaches to implement RPA technologies to improve business processes” summarises the findings in the literature.

Table 4: Most frequently used approaches to implement RPA technologies to improve business processes

Approaches	Papers	#Papers
Desktop-activity mining	[15], [19], [33], [34], [36], [39] [33]	7
Based on scientific knowledge	[4]	1
Survey Research & observation of workers	[33], [37]	2
Process Analysis	[13] [3]	2
Process Mining	[17] [19]	2

4.3.5 RQ4 - What type of business process tasks are improved by RPAs?

During the literature research, 65% of the selected papers have clearly identified the main process tasks improved by RPA technology.

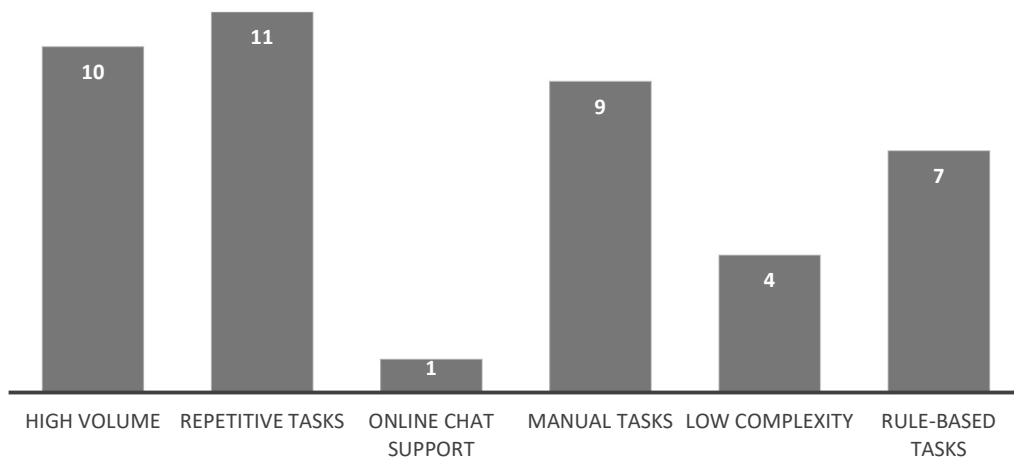


Figure 7: Summary of the type of business process tasks improved by RPAs found in the SLR

Within ten out of 17 selected articles, the high-volume tasks were emphasised due to the scalability of this technology[33]. In fact, this technology becomes highly effective from a cost perspective when applied to high-volume and repetitive tasks to free human resources from such low-cognitive tasks and take advantage of our cognitive skills to bring efficiency to organisations and work-life balance[16].

Online chat support has been one of the tasks less improved by RPAs in the literature. Nevertheless, it enables organisations to reallocate their employees from low-value activities to cognitive-wise support using intelligent Human-Computer Interaction (HCI) to simulate human behaviour [10]. It is considered in the article [10] that a chatbot is an “interactive agent, digital assistant, and intelligent conversation entities”, and their motivation comes from the productivity increase with its effectiveness in providing essential support and information to the end-users[10].

Furthermore, manual tasks, which represent 21% of the tasks found in the literature, are essential for the digitisation and agility of organisations. PwC oversees that RPA will be able to automate physical tasks in manufacturing and transport[36]. Moreover, RPA can automate and remove the low-complexity tasks where humans are not needed constituting selection criteria for RPA implementation[34], e.g., exception handling tasks.

The ruled-based tasks have also scored significantly in the findings (7/17 selected articles) since it has been proven that business processes with well-defined rules and mapping can be automated with great success[11]. Especially in administrative and HR activities, e.g., the onboarding processes that require the collection of CVs, offer letter dispatches and the employees' account creation[5]. The Table 5 summarises the findings in the literature.

Table 5: Type of business process tasks improved by RPAs

Approaches	Papers	#Papers
High Volume	[1] [17] [33] [15] [11] [13] [22] [19] [12] [16]	10
Repetitive Tasks	[1] [4] [33] [10] [18] [35] [15] [5] [19] [12] [16]	11
Online chat support	[1]	1
Manual Tasks	[1] [36] [10] [35] [15] [11] [13] [12] [16]	9
Low complexity	[15] [11] [19] [16]	4
Rule-based tasks	[10] [35] [15] [11] [5] [22] [12]	7

4.4 Discussion

4.4.1 RPA Benefits

RPA is fundamentally defined as the utilization of software robots to automate a spectrum of manual tasks, including those that involve computer programs stored in computer memory[22]. This transformative technology offers a multitude of operational capabilities that significantly influence the dynamics of modern organizations.

The operational capabilities of RPA involve a range of skills, processes, and routines developed within an organization's operations management system. These capabilities are regularly deployed to tackle complex problems and optimize operational resources[22]. RPA excels in streamlining operations by automating repetitive, rule-based tasks, thereby increasing operational efficiency. For instance, in the finance sector, RPA can automate the reconciliation of financial data from multiple sources, significantly reducing the time and effort required for this task[22]. Organizations can realize substantial cost savings through the

reduction of manual labour and the elimination of errors that come with it[10] as well as, its potential to reduce operational & maintenance costs that can be mimed by bots.

Additionally, this technology empowers the cognitive skills of the employees by automating routine tasks, freeing up their time for more strategic and value-added activities[34], and guarantees exceptional accuracy and improved data quality, crucial for data-driven decision-making[10]. In addition, it might lead to increase job satisfaction to employees that perform monotonous tasks daily[34].

Furthermore, delivers firm consistency in task execution by following predefined rules meticulous which leads to the minimization of errors and variations[2]. Organizations can easily scale up or down their RPA deployments to accommodate changes in workload or business processes due to its effortlessly scaled to accommodate evolving business demands, ensure agility and scalability[40]. In e-commerce, RPA can be applied to manage the overload in order processing during peak seasons, ensuring that the company can efficiently handle increased demand without a proportional increase in labour costs[16].

Moreover, RPA maintains comprehensive logs and records of all actions performed by its robots which left a valuable audit trail for compliance purposes, as it demonstrates adherence to regulatory requirements[2].

4.4.2 RPA Challenges

One of the primary challenges inherent in the implementation of Robotic Process Automation is effectively managing the transition in Change Management. Employees may have concerns regarding the security of their job positions, driven by misconceptions that RPA intends to supplant human resources. However, the fundamental goal of RPA often revolves around optimizing operational costs. This can include the well-judged reallocation of human resources within the organization, ultimately leading to a more strategic and efficient workforce[22].

Another substantial challenge lies in the meticulous selection of processes suitable for automation through RPA. The evaluation of potential RPA candidates necessitates an

independent and rigorous assessment to ascertain their feasibility and potential for successful implementation[10], [34].

RPA technology, while promising, deals with the pressing challenge of maturation. Intellectual property rights within the RPA domain remain relatively confined, compelling companies to commit substantial resources toward the acquisition of RPA services and products.

Additionally, RPA is often perceived as a provisional remedy for automating operations within legacy systems, exhibiting constraints in effectively managing rule-based tasks[11]. It is pivotal to appreciate the bounds of RPA's capabilities. While RPA excels in automating routine, rule-based tasks, it occasionally necessitates human intervention when confronted with more intricate processes[4]. The effective management of geographically dispersed outsourced business processes through RPA presents a noteworthy challenge. This challenge is further underscored by the absence of established standards and best practices within the realm of RPA software development, which underscores the technology's maturity issues[40].

Also, accurate benefit assessment in RPA projects can pose formidable challenges. Inaccurate assessments can result in projects falling short of their envisioned goals, such as achieving the expected cost reductions[16]. Furthermore, requirement engineering for such projects can prove to be intricate since often RPA suppliers struggle to precisely model the activities of “robots”, and a lack of support from knowledge workers can block its progress[33].

As RPA seamlessly automates processes, a limited number of human resources possess awareness of their actions. This becomes a significant issue when employees exit the organization. In addition, the auditing of RPA activities can be difficult, primarily due to the limited visibility into robot behaviour[8], [35], as well as the handling of errors in the context of RPA. While RPA excels in efficiently managing rule-based processes, its cognitive limitations, rendering the handling of errors a more complex endeavour[17]. On top of it, RPA sensitivity to data quality and structure since the management of unstructured or inaccurately inputted data may lead to failures. Consequently, the implementation of Optical Character Recognition (OCR) technology may be warranted to effectively capture and process

unstructured data. However, organizations should anticipate the accompanying investments in both technology and training[39].

RPA solutions can also translate into a time-consuming and financially taxing endeavour, occasionally obligating the integration of third-party plugins to address specific tasks[1] when it comes to flexibility or reconfigurations as business processes constantly change. Consequently, a full process automation poses a significant challenge. RPA, by design, is most proficient in handling rule-based processes or simply individual tasks. Therefore, it often necessitates human involvement, even if only to a minimal degree, for tasks such as the management of unstructured data or the reporting of errors[36].

The challenges outlined above highlight the complexity of embracing RPA, underscoring the necessity for precise strategic planning, seamless communication, and adaptability to fully harness the transformative potential of this technology.

4.4.3 Approaches to implement RPA technologies

Although the implementation of RPA's in organizations poses several opportunities to significantly enhance operational efficiency and effectiveness, steering its drive requires a thoughtful approach that includes strategic planning, effective communication, and adaptability[22].

In recent research, various approaches to implementing RPA technologies for the improvement of business processes have been explored. Among the most frequently cited methods is Desktop-Activity Mining, also known as Screen Scraping. This approach involves the recording of end-user actions through screen recording practices. Although its effectiveness depends on the stability of the user's Information System, it stands out as a cost-effective and less time-consuming way to automate basic repetitive tasks[33], [36], [39].

To deep dive into a comprehensive insight into business processes of business processes, some organizations choose survey research and observation. This approach involves the identification of business process candidates based on the routines of end-users. Subsequently, flowchart diagrams are constructed to map the tasks to be automated, providing a

comprehensive view of the automation potential. However, it is worth noting that this approach can be time-consuming, especially when dealing with complex or unconventional routines[33], [37]. Furthermore, process analysis is yet another approach that involves a thorough examination of the business process to determine its eligibility for RPA implementation. Several parameters are considered, including potential for automation, complexity, estimated savings, and the anticipated increase in operational efficiency. These evaluations serve as the foundation for making informed decisions regarding process automation[3], [13]. In response to the demands of today's fast-paced digital landscape, process mining has emerged as an alternative to traditional process analysis. This approach leverages Workflow Management (WFM) and Business Process Management (BPM) systems to specify and orchestrate processes. It allows organizations to model simple activities for automation through Application Programming Interfaces (APIs), offering a more efficient path to automation[17], [36].

Another significant approach is one grounded in scientific knowledge, where researchers systematically review RPA technology to identify potential candidates for automation. These candidates are evaluated based on a range of criteria, including standardization level, execution frequency, system involvement, data structure, and process maturity. This method aims to determine processes with the highest potential for successful automation[4], and is the method used for this research explored in section 5.6 with the “RPA Suitability Matrix”.

These approaches provide organizations with a spectrum of options for harnessing the potential of RPA in business process improvement. Each approach comes with its unique advantages and considerations, making it crucial for organizations to select the most suitable method based on their specific needs and goals.

4.4.4 Business process tasks improved by RPAs

In the landscape of task automation, RPA technology has emerged as a versatile solution, offering distinct advantages across a spectrum of categories. At the forefront of its

capabilities lies its ability in handling High-Volume Tasks. RPAs are particularly skilled at facing scenarios where organisations grapple with extensive repetitive work. Their scalability is a game-changer, enabling the efficient management of tasks that would otherwise demand significant resources and be susceptible to human errors.

Beyond efficiency, RPAs bring a cost-effective dimension by automating repetitive, low-cognitive activities, RPAs liberate human resources, allowing them to redirect their efforts towards more strategic and value-driven endeavours. This pivotal shift enhances productivity and fosters a healthier work-life balance within organisations[16], [33].

Nevertheless, the influence of RPAs in Online Chat Support is less experienced but significant. While this sector has witnessed comparatively fewer advancements in RPA integration, it is crucial in optimising resource allocation. RPAs facilitate the strategic reallocation of employees from routine, low-value tasks traditionally associated with chat support roles to positions that demand cognitive skills. This transformation is orchestrated by applying intelligent Human-Computer Interaction (HCI) techniques, effectively simulating human behaviour[10]. These AI-driven chatbots, often called “interactive agents, digital assistants, and intelligent conversation entities,” are motivated by their tangible contributions to productivity and effectiveness. They enhance the delivery of vital support and information to end-users while allowing organisations to harness human potential for more intricate responsibilities[10].

Manual Tasks, encompassing various aspects of organisational processes, constitute another crucial category significantly influenced by RPA technology[34]. These tasks, integral to organisations' digital transformation and agility, find a valuable ally in RPA implementation. This is relevant in sectors like manufacturing and transport, where RPAs demonstrate their capacity to automate physical tasks with precision and efficiency, as acknowledged by PwC[36].

Beyond physical tasks, RPAs can eliminate low-complexity assignments where human intervention proves redundant. This aspect effectively becomes a criterion for RPA implementation, encompassing tasks such as exception handling[34].

Furthermore, RPAs consistently exhibit their prowess in automating Rule-Based Tasks. These tasks typically revolve around business processes characterised by well-defined rules and structured processes. RPAs excel in such structured environments, consistently proving

Rodolfo Fernandes

their effectiveness in automating these rule-bound activities[11]. Administrative and HR activities, including intricate onboarding procedures involving tasks such as collecting CVs, dispatching offer letters, and creating employee accounts, have notably benefited from RPA adoption, leading to significant efficiency enhancements[5].

Yet, Low-Complexity Tasks represent another domain where RPAs excel. Though seemingly straightforward, these tasks often prove numerous and time-consuming. RPAs efficiently manage these tasks, resulting in streamlined processes and optimised resource utilisation[19].

In summary, the adaptability and efficiency-enhancing capabilities of RPA technology traverse diverse task categories, equipping organisations with a versatile toolkit to boost productivity, streamline processes, and foster a more balanced work environment.

5 Diagnosing

This action research phase corresponds to the initial phase of the Action Research cycle, with the primary aim of identifying opportunities for solutions or enhancements in problem previously identified in Section 1.2. During this phase, the objective is to gain a comprehensive understanding of the problem as a whole. To achieve this, it is employed a method for process identification to ensure the selection of the most suitable business process to enhance with the support of RPA technologies, and we apply different methods of process analysis to enable a full understanding of the performance of the business process, as well as its suitability to implement RPA. Additionally, it is provided an organisational background to elucidate the organisation's context where this study was conducted.

5.1 Organizational Background

In this chapter, the intention is to expose the organizational context where this study was performed. As indicated in the previous section, the methodology chosen to guide this thesis is action research, which combines action and research to investigate and solve a real-world problem in an existing organization. To enable a better understanding of this research, it is elucidated the type of the organization, its structure, and complexity.

The organisation in question is a global entity with a substantial and varied portfolio. It is characterised by its operation across multiple sectors and industries, indicating its complex and multifaceted corporate structure. This entity is present in various markets worldwide, revealing significant diversification in its operations. It encompasses a range of subsidiaries and divisions, with each one contributing to its comprehensive and diverse business model. It is managed through a sophisticated organisational structure that supports its extensive and varied operations. As shown in Figure 9, this organisation is composed of seven main entities, mainly divided by their geographic distinction but also by their business.

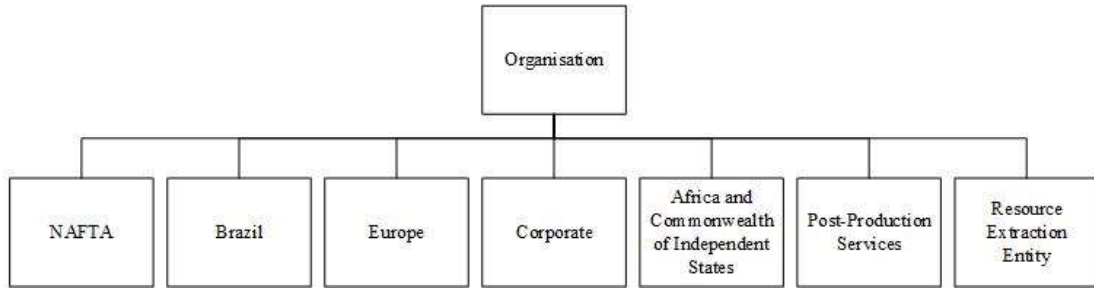


Figure 8: Organizational Chart

The entity where this research is performed is at the Corporate level, which is the parent organisation that mainly provides support in various domains to all the other entities. Specifically, to this research, it was identified in Figure 9 the Corporate IT department, where the study has been performed, and with regards to their specific processes. The Corporate Entity CIO leads this Department, and the majority of its members are service providers to the rest of the entities of the organisation. Each domain or field has its own manager and might have multiple service owners that manage a specific service. Additionally, it has some resources from a Corporate Department (Centre of Excellence), which are independent of the CIO, but also provide services to the entire organisation. Also, the Group IT Controlling, located in the European entity, manages the controllers and P2P-related resources due to being part of the management team of the P2P process (cross-functional reporting). Nevertheless, in the case of the P2P Process monitor, it also directly reports to the CIO, who is the Process Owner.

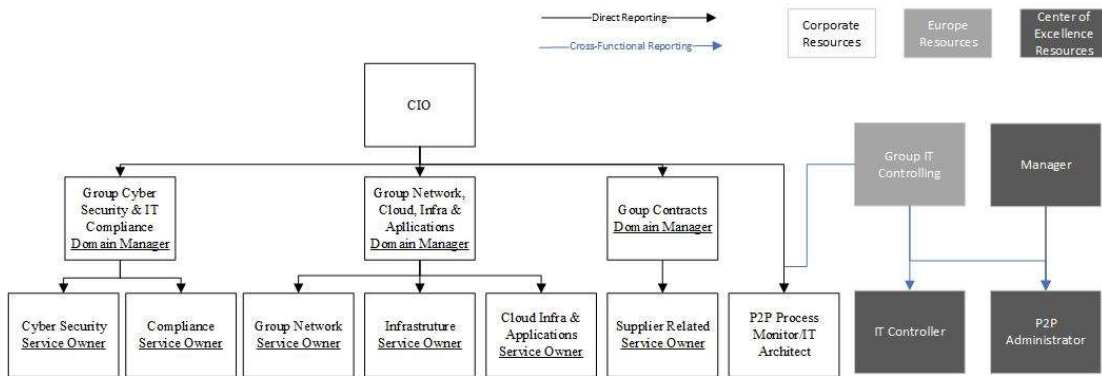


Figure 9: Corporate IT Department Chart with Cross-Functions

When considering the role of domain managers in delivering services to various entities, it is essential to note that most of these services are managed at the corporate level. This centralised approach underscores the importance of an efficient and streamlined P2P process. To illustrate, consider a hypothetical scenario where an entity using a sophisticated Manufacturing Execution System (MES) experiences a critical system failure. This failure leads to incorrect processing of production orders, resulting in substantial disruptions in the manufacturing process. This scenario underscores the critical importance of ensuring services are delivered on time and by the terms and conditions of contracts. Such oversights can drastically impact business continuity for the entity and risk damaging the group-wide reputation.

Moreover, a well-managed P2P process is essential to avoid losing contract opportunities. In this hypothetical case, the disruption caused by the MES failure could strain relations with suppliers and potentially jeopardize future contracts. It is vital that both suppliers and clients, who in this context are entities of other organisations, receive consistent and reliable services. This example illustrates how lapses in crucial systems like the MES can have far-reaching effects, affecting immediate production and the broader network of inter-organisational relationships and opportunities.

Finally, when it comes to the Information System, the organisation operates under a robust SAP system. This SAP system consolidates, harmonises, and standardises corporate processes, particularly in the Finance, Procurement, and Controlling departments. Implemented on a universal platform, it is designed to meet the requirements of the corporate entity. Moreover, the P2P process is handled through the Materials Management module, a core component of this SAP system. Additionally, the procurement module is seamlessly integrated and strategically aligned with the Finance and Controlling modules, ensuring uniform functionality across the platform. Particularly in this research, the SAP system has a pivotal role as the central hub of data and processes, facilitating the operations within the organisation.

5.2 Process Identification & Selection for improvement

The primary purpose of process identification is to direct an organization's attention toward those processes that either contribute substantial strategic value or face significant issues, and sometimes, both criteria overlap[20]. This identification process is dynamic and continuous because the landscape of processes within an organization is constantly evolving in response to the passage of time and changing circumstances.

One key driver for process identification is the dual consideration of value creation and strategic relevance. Processes that contribute value or align with the strategic objectives of the organization must be highlighted. To consider the problem mentioned in the above section (section 1.2), we have applied the most commonly used criteria to evaluate a business process which are strategic importance, health, and feasibility[20].

Strategic importance refers to the extent to which a process is critical to achieving an organization's strategic goals. This criterion supported the research to identify which process within the targeted company have the greatest impact on the organization's success and should receive the most attention.

The Procure-to-Pay process is strategically important to a company and can be subject for improvement. Procurement performs a strategic role in building sustainable supply networks[41]. It is often not acknowledged by other internal areas as making a significant impact on organization-wide performance, but it has the potential to contribute significantly to the overall success of the organization[41]. Hence, there is a need to recognize the strategic role of procurement and integrate it into the decision-making process early on. Strategic purchasing and supply management, which are integral parts of the P2P process, have been found to positively impact firm performance[42]. Through strategic procurement practices, organizations can enhance their supply chains, improve operational efficiency, and achieve better financial performance[42]. In conclusion, the P2P process can be considered strategically important to a company since it enables organizations to manage procurement efficiently, mitigate risks, build sustainable supply networks, and improve overall performance. Therefore, it is a suitable subject for business process improvement initiatives.

The **health** criterion aims to determine which processes are in the deepest trouble and may benefit the most from business process improvement initiatives[20]. Specifically, the health criterion supports on identifying processes that are not performing well or are causing problems for the organization. Processes that are considered unhealthy may be also candidates for consolidation, decommissioning, or elimination[20]. To support the rationale behind choosing the P2P process for improvement from an “Health” perspective, we present a process “issue register” of main problems encountered in Table 6.

Table 6- Issue register of "as is" P2P process.

Issue 1: Purchase Orders not delivered in time to supplier

Priority: 1

Description: The Purchase Orders are not being delivered in time.

Data and assumptions: In 2022, the company processed approximately 220 Purchase Orders (POs) with an average lead time of 13 days from Purchase Requisition creation to Purchase Order creation.

Qualitative impact: service delays, lack of contractual compliance, payment delays, deterioration of client-supplier relationship.

Quantitative impact: Not applicable

Issue 2: Purchase Requisitions (PR) / Orders do not have any support information for the approval

Priority: 2

Description: The SAP documents do not have any supporting documents that allow the approvers to review, per contract or budget, whether the items are correct.

Data and assumptions: In 2022, the company processed approximately 220 Purchase Orders (POs) where approximately 70% of the SAP documents created without supporting documents nor with correct description.

Qualitative impact: approval delays, budget overruns, contractual non-compliance, audit and compliance risks, operational inefficiencies

Quantitative impact: Not applicable

Issue 3: SAP Good Receipts not issued in due time

Priority: 3

Description: The Good Receipts have not been performed in due time and payments are delayed or not executed.

Data and assumptions: With a total of around 1200 Good Receipts for the POs of 2022, the average days to complete the first GR is 66, but the maximum was 295 days, 23 were performed in January 2023 (PRs were all created for the 2022 year services/goods, multi-year not included), and 101 were created in 31st of December 2022 to accrue open values.

Qualitative impact: budget overruns, contractual non-compliance, audit and compliance risks, operational inefficiencies

Quantitative impact: Not applicable

Feasibility serves as a vital criterion in the process selection process. It signifies an organization's capacity to effectively execute process enhancements, considering the resources, capabilities, and limitations at its disposal. Assessing feasibility can be accomplished through diverse methods, but it's crucial to consider both the time and financial resources available to improvement teams[20].

One of the primary challenges in improving the P2P process is its inherent complexity that arises from the involvement of multiple steps, numerous stakeholders, and intricate workflows. It can be challenging to fully understand, streamline, and optimize these complex processes. However, the feasibility of improvement lies in a structured approach since by gradually introduce enhancements, provide comprehensive training, and actively involve employees this risk can be mitigated.

Additionally, the resistance from employees to adopting new processes and technologies is another significant risk. People often resist changes that affect their daily routines and can potentially hinder the successful implementation of process improvements. However, overcoming this resistance is feasible through effective change management by communicating the benefits of the proposed changes, involve employees in the improvement process, and provide the necessary support and training. The lack of resources can also pose a substantial obstacle to process improvement, but it's possible to mitigate it by allocating the necessary resources and budget, therefore, the organisations must ensure that they have

the financial means to invest in improvements, the right talent to drive the changes, and access to the required technologies. Integrating enhanced P2P processes with existing systems can similarly introduce technical complications, but the feasibility of successful integration is attainable through meticulous planning and expertise and through testing before the implementation. Also, the constantly changing landscape of regulations related to procurement and financial processes presents a risk. Non-compliance can lead to legal issues, fines, and damage to an organization's reputation. However, continuous monitoring, adjustments, and meticulous record-keeping to align with changing compliance standards can mitigate this risk. Protecting sensitive procurement data is crucial, considering the significant risk posed by data breaches, therefore applying encryption, access controls, regular security audits, and employee training to maintain a secure environment for sensitive information is crucial.

Finally, changes to this process can potentially disrupt relationships with suppliers. However, maintaining an open and transparent communication with suppliers, and collaborating with them to adapt to the changes can assist that the supply chain remains resilient, and disruptions are minimized.

5.3 Business Process Modelling

Business process modelling holds a central position in the Business Process Management, establishing a foundational element for the effective management of business operations. It serves as a structured approach to comprehending, analysing, and optimizing processes within an organization.[20]

By creating visual representations of processes, organizations can enhance their understanding of complex workflows. Furthermore, these models serve as a means of communication, enabling stakeholders to share insights and knowledge regarding the processes they engage with daily. This shared understanding is fundamental to effective collaboration and decision-making[20].

Consequently, we are representing the business process candidate for improvement using BPMN (Business Process Model and Notation) diagrams to qualify it for enhancement,

Rodolfo Fernandes

by identifying and pre-empting issues within processes (Figure 10: P2P Process "as is" with emphasis on PR/PO Creation). Additionally, this representation aims to subsequently analyse if the business process is suitable for automation through RPA technology based on our SLR on the following action research phase.

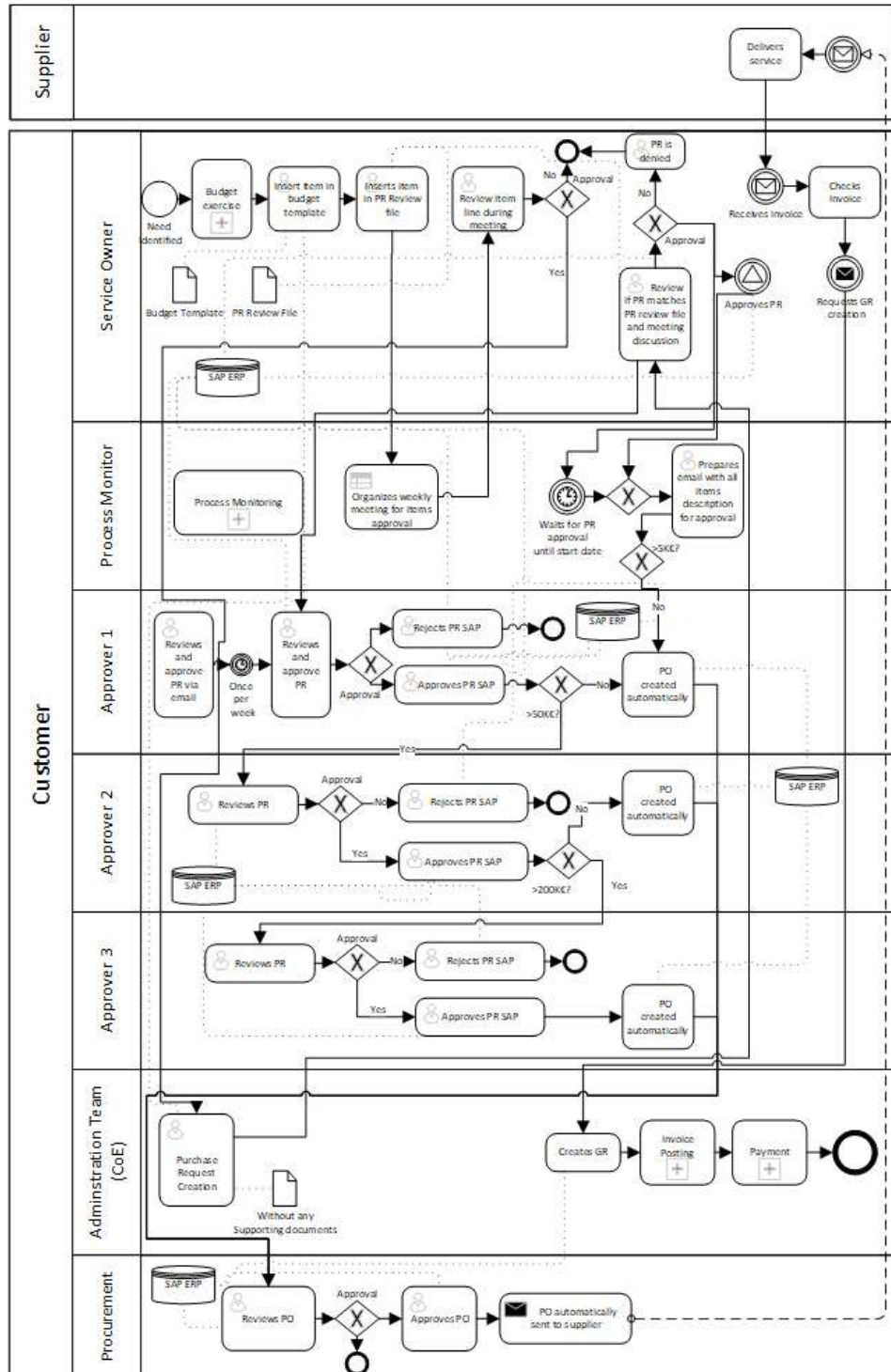


Figure 10: P2P Process "as is" with emphasis on PR/PO Creation

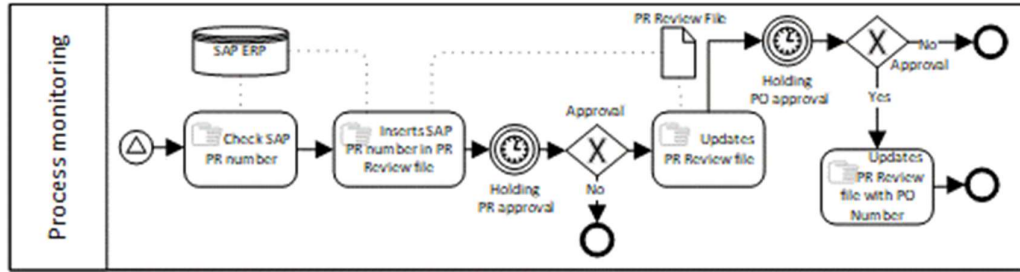


Figure 11: Event Sub-Process "Process Monitoring"

5.4 Qualitative Process Analysis

Qualitative process analysis is an approach employed for examining a process by relying on non-numeric information and subjective methods[20]. This method focuses on gathering and interpreting qualitative data, such as unnecessary steps of the process (value-added analysis) and to document issues in a process from multiple perspectives like from a stakeholder perspective. Furthermore, it can also be used to investigate the root causes of these issues through diagrams such as “Why-Why Diagrams”[20].

5.4.1 Value Added Analysis

Value-added analysis is a method employed to pinpoint redundant stages within a process. Its primary objective is to differentiate between steps that contribute value and those that do not, and it can be carried out by dissecting the process sequence, performance indicators, and customer demands[20]. Thus, with the business process modelling, we were able to dissect the value-added aspects of the process model represented in Figure 10. This analysis entails to break-down each task in the process into steps and categorizing each step into one of three categories: “Value Adding” (VA), “Business Value Adding” (BVA), and “Non-Value Adding” (NVA). Additionally, the NVA steps are further categorized into "Necessary Non-Value Adding" and "Unnecessary Non-Value Adding" based on their importance to the overall process.

Based on the research analysis, it is concluded that VA steps are those that directly add value to the customer or the process. In this case, activities such as creating Purchase Requisitions, approving them, generating Purchase Orders, and delivering services are all essential for the P2P process and contribute to its value.

The BVA step of inserting an item in the “PR Review file” is necessary for the business, for record-keeping, and for spend monitoring purposes.

The NNVA step involves emailing the “approver level 2” with all details. Although it doesn’t directly add value to the customer or the process, it remains important as it is part of the organization’s policy, given the high position of the approver in the chain of command.

UNVA steps consist of activities like organizing meetings, reviewing items, preparing unnecessary emails, and reviewing/approving PRs via email. These steps are not adding value to the process and could potentially be eliminated or streamlined to improve efficiency, since most of them constitute a double run on the process. It is necessary to highlight that the process is supported by an SAP environment where the process is integrated, meaning that those tasks are already triggered a second time in the information system. As a conclusion, in order to gain process's efficiency and effectiveness, this organization should focus on optimizing or eliminating UNVA steps while maintaining VA and BVA steps to ensure value delivery and business continuity. The Table 7 - Classification of steps in process model summarizes the analysis.

Table 7 - Classification of steps in process model

Step	Performer	Classification
Inserts item in budget template	Service Owner	VA
Inserts item in PR Review file	Service Owner	BVA
Organizes weekly meeting to discuss items of approval	Process Monitor	UNVA
Review items for approval	Domain Manager	UNVA
Creates Purchase Requisition	Administration Team	VA
Review if PR matches PR Review file and meeting discussion	Domain Manager	UNVA

Prepares email with all item's description for approval	Process Monitor	NVA
PO Created automatically	SAP System	VA
Reviews & Approve PR via email	Approver 1	UNVA
Approves in SAP (once a week)	Approver 1	VA
Emails L2 with all details	Process Monitor	NNVA
Creates GR	Administration Team	VA
Reviews PO	Purchasing Team	VA
Approves PO in SAP	Purchasing Team	VA
PO is automatically sent to supplier	SAP System	VA
Delivers service	Supplier	VA
Checks Invoice	Service Owner	VA

5.4.2 Issue Documentation

The purpose of issue documentation is to systematically assess the impact of issues on the business, considering both qualitative and quantitative aspects[20]. The documentation, found in the issue register included and summarized in Table 6. This method enabled the research to leverage visualization methods like Pareto charts to identify the most critical concerns requiring attention subject to improvement enabling a focus on high-impact issues.

The Pareto analysis, also known as the 80/20 rule, states that 80% of the effects come from 20% of the causes. In the context of process improvement, this means that a small number of issues are responsible for a large proportion of the negative impact on the process[20].

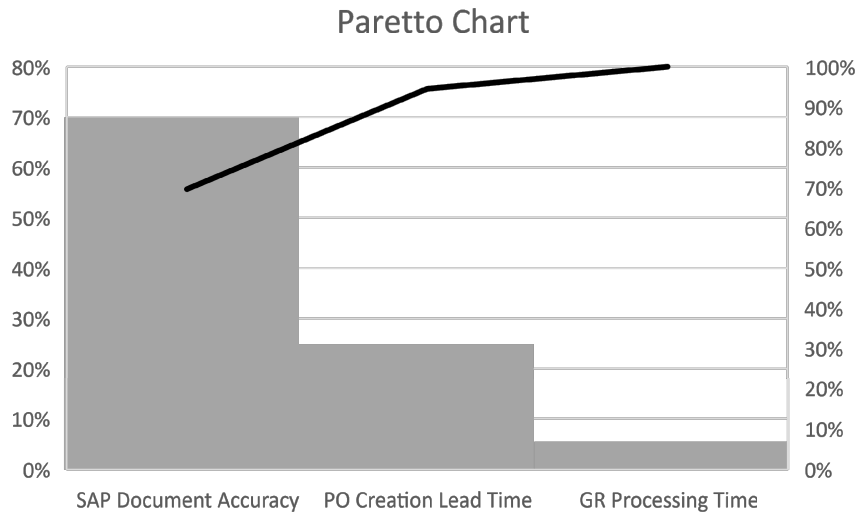


Figure 12: Pareto Chart with top 3 issues of P2P

The Figure 12 (Pareto Chart), effectively pinpointed the most critical issues demanding immediate attention within the process. Consequently, this insight facilitated the prioritization of efforts, focusing on addressing high-impact concerns. Particularly, the category “SAP Document accuracy” received the highest rating, signifying its disruptive influence, necessitating correction for process enhancement. To ensure process efficiency, it is imperative that all purchase requisitions and orders are initiated only when comprehensive and relevant information is provided. Furthermore, it should be explicit for approvers to receive essential details, including budget, vendor/supplier information, contracts, and supporting documents such as quotes and specifications. This approach minimizes inaccuracies in orders, budgetary challenges, processing, and approval delays, and ensures compliance. Importantly, resolving this issue is inherently tied to the second highest-rated category, “PO Create lead time”, as both are linked to clarity issues that can lead to Procurement staff needing to engage with requesters to obtain missing information, potentially slowing down the overall process.

5.5 Quantitative Process Analysis

Quantitative process analysis is a method to business processes that involves using mathematical and statistical techniques to measure and improve process performance. Quantitative process analysis is used to provide a solid basis for decision making by providing estimates of how the performance of the process will be measurably improved[20]. It involves collecting data on process performance, analysing the data to identify areas for improvement. Specifically, to this research, the “Flow analysis” method was developed.

5.5.1 Flow Analysis

This method supported the research to estimate the overall effectiveness of the P2P process modelled on section 5.1 by estimating the cycle time efficiency (CTE). It is important to mention that in this exercise, the process model was considered as if all approvals have been taken, since this is the overall objective of this part of the process. Additionally, the approval level considered was always the maximum to ensure that the whole process is covered, as the rejections should be only taken as an exception.

To be able to calculate the CTE, one of the essential elements of the formula is the cycle time (CT) which is the time that a process takes complete from start to finish, determined by the average time between its starting point and its completion[20]. On Table 8, it is visible the breakdown of the tasks and the considered cycle time in days for each activity of the process.

Furthermore, to determine the cycle time, especially when the process involves decision gateways like XOR-splits and/or XOR-joins, as is the case in this model, it becomes essential to assign probabilities representing the average duration of the branches in between. Considering the data extracted from the Information System, it was established that 80% of the PO/PRs have a value exceeding 5k€, while 20% have a value surpassing 200k€ (refer to Table 9 for detailed calculations). Consequently, the sum of all days establishes the cycle time for the business process (58 days).

Table 8: Analysis of cycle times for P2P process

Activity	CT	PT	CTE
Inserts item in budget template	1 day	0.5 hour	50%
Inserts item in PR Review file	1 day	0.5 hour	50%
Organizes weekly meeting for items approval	5 days	0.5 hour	10%
Review item line during meeting	1 day	0.5 hour	50%
Purchase Request Creation	1 day	0.5 hour	50%
Review if PR matches PR Review file and meeting discussion	1 day	0.5 hour	50%
Prepares email with all items description for approval	1 day	0.5 hour	50%
PO Created automatically	1 day	0.1 hour	10%
Reviews & Approve PR via email	1 day	0.3 hour	30%
Approves in SAP (once a week)	5 days	0.3 hour	6%
Reviews & Approve PR in SAP	5 days	0.3 hour	6%
Emails L2 with all details	1 day	0.2 hour	20%
Reviews PO	5 days	0.5 hour	10%
Approves PO in SAP	1 day	0.2 hour	20%
PO is automatically sent to supplier	1 day	0.1 hour	10%
Delivers service	1 day	24 hours	2400%
Checks Invoice	5 days	1 hour	20%
Creates GR	1 day	0.5 hour	50%
Invoice Posting	5 days	0.5 hour	10%
Payment	15 days	0.5 hour	3%

Another element of the CTE formula is the processing time (PT) which refers to the time that resources, such as process participants or software applications invoked by the process, spend on handling a process task. To elucidate, processing time represents the time that is

actually spent on value-adding activities within a process, and by reducing it, the overall process efficiency can be improved[20].

Table 9: Probabilities assigned for cycle and processing time

Probability	Weight 1	Weight 2	Calculation (cycle time)	Calculation (processing time)
PR above 5K€	80%	20%	$1/0.8=1.25$ days	$0.5/0.8=0.625$
PR above 200K€	20%	80%	$1/0.2=5$ days	$0.1/0.2=0.5$

To calculate the PT, it was measured the time taken by process participant to complete their task from start to finish by using historical data from the 2022 process instances, to estimate the average processing time for each task. On Table 8 it is visible the breakdown of the tasks and the considered processing time in hours for each activity of the process. With the same reasoning as for the CT time, the two decision gateways kept the same probability, representing the average duration of the branches in between. To conclude, the overall estimated time spent on such activities was 33.125 hours (breakdown in Table 8 considering the probabilities on Table 9).

In conclusion, once both variables were established the CTE of the whole process was calculated by dividing the processing time by cycle time (Figure 13), resulting into 52% of time efficiency. The breakdown between each activities supports the efficiency of each activity where the high score it is, the more efficiency is achieved. Notably, during the comprehensive process analysis, no instances were found where suppliers delayed their service deliveries, consistently ensuring that their goods/services were delivered within a 24-hour timeframe. However, delays in approvals within the information system were detected, subsequently resulting in delays in the delivery of purchase orders to suppliers, and, in certain instances, leading to breaches of contracts.



Figure 13: Cycle Time Efficiency Formula

In addition to the overall P2P flow analysis, the same technique was used to the event sub-process “Process Monitoring”, which, even if it is lead from end-to-end by the entire P2P process, serves as a support to monitor and control the performance of the process itself. Similarly, to the previous analysis, the CT was calculated per activity, leading to 4 days to complete the sub-process with a PT of 1.1 hours leading to 28% of efficiency (CTE), considerably low for such a sub-process that is a sequence without alternative paths (breakdown exposed on Table 10).

Table 10: Analysis of cycle times for Event Sub-Process "Process Monitoring"

Activity	CT	PT	CTE
Check SAP PR number	1 day	0.5 hour	50%
Inserts SAP PR Number in PR Review file	1 day	0.2 hour	20%
Updates PR Review file	1 day	0.2 hour	20%
Updates PR Review File with PO Number	1 day	0.2 hour	20%

5.6 RPA Suitability Matrix

By considering the SLR conducted for this research, specifically addressed in the “4.3.5 RQ4 - What type of business process tasks are improved by RPAs?” it was established an “RPA suitability matrix” to qualify the current tasks of the business process model eligible for automation. Nevertheless, out of the six types of tasks/criteria collected, only five were estimated relevant to the process model under analysis, while “Online chat support” was excluded from consideration. The assessment is based on the criteria related to the nature and characteristics of these tasks, as “High Volume”, Repetitive Tasks”, “Manual Tasks”,

Rodolfo Fernandes

“Low complexity”, “Rule-based tasks”, and as a scoring system that quantifies their suitability. To quantify the suitability of each task for RPA, a scoring system has been developed as:

- Low: is assigned when a business process task meets only 0 to 1 of the defined categories.
- Medium: is assigned when a business process task meets 2 to 4 of the defined categories.
- High: is assigned when a business process task meets 4 to 5 of the defined categories.
- Not applicable: is assigned when the business task is already performed by an information system, requires high-cognitive skills, or involves company policy concerns such as interacting with company executives (for e.g, “Emails L2 with all details”).

The matrix's practical application is illustrated with a set of business process tasks, each assigned a score based on their alignment with the defined categories. Tasks such as “Purchase Request Creation”, “Creates GR”, “Check SAP PR number”, “Inserts SAP PR Number in PR Review file” “Updates PR Review file”, and “Updates PR Review File with PO Number” have been found to meet 4 to 5 of the defined categories, indicating their high suitability for RPA automation. These specific tasks mostly require gathering data from a system and copying to another system which at the end is necessary to the business process but does not demonstrate the high application of cognitive skills, and therefore can be automated.

Moreover, tasks like “Checks Invoice” and “Invoice Posting” have been categorized as having a “Medium Score” by meeting 2 to 4 of the defined categories. Although they have potential for automation, the task “Checks invoice” present challenges since most of the suppliers have their own configuration of invoices and currently not identifying to which purchase order or goods receipt they are referring to, making it difficult to match the specific PO or GR to which they are referring.

Finally, certain tasks have been designated as “Not Applicable” due to reasons such as being already automated by an information system (“PO is automatically sent to supplier”), requiring high-cognitive skills or personal decision-making “Approves PO in SAP”, or involving sensitive company policy considerations such emailing informing an executive of a new PR (“Emails L2 with all details”). The Table.11 illustrates the results of the suitability matrix. Overall, there are nine business process tasks eligible for automation through RPA that are considered in the next phase.

Table.11: RPA Suitability Matrix

Process Tasks	High Volume	Repetitive Tasks	Manual Tasks	Low complexity	Rule-based tasks	Score
Inserts item in budget template						N/A
Inserts item in PR Review file						N/A
Organizes weekly meeting for items approval						N/A
Review item line during meeting						N/A
Purchase Request Creation	x	x	x	x	x	High
Review if PR matches PR Review file and meeting discussion						N/A
Prepares email with all items description for approval	x	x	x	x	x	High
PO Created automatically						N/A
Reviews & Approve PR via email						N/A
Approves in SAP (once a week)						N/A
Reviews & Approve PR in SAP						N/A
Emails L2 with all details						N/A
Reviews PO						N/A
Approves PO in SAP						N/A
PO is automatically sent to supplier						N/A
Delivers service						N/A
Checks Invoice	x	x	x			Medium
Creates GR	x	x	x	x	x	High
Invoice Posting	x	x	x		x	Medium
Check SAP PR number	x	x	x	x	x	High
Inserts SAP PR Number in PR Review file	x	x	x	x	x	High
Updates PR Review file	x	x	x	x	x	High
Updates PR Review File with PO Number	x	x	x	x	x	High

6 Planning

In this phase, is defined the strategy and method to solve the problem previously identified. At this stage of the research, it was vital to establish the objectives, goals, required resources, and activities to be performed.

6.1 Process Redesign

Process redesign, in the context of this research, involves rethinking and reorganizing the current P2P process under analysis to improve efficiency, effectiveness, and alignment with business objectives (based on the process analysis exposed on the previous section). Thus, the goal is to redefine process steps, reallocate resources, introducing new tools, and updating relevant the process documentation to drive organizational change and achieve process optimization[20].

To facilitate the streamlining of the P2P process analysed in this research, the 5.4.1 Value Added Analysis was the starting point. The primary objective was to identify and eliminate all activities categorized as "Unnecessary Non-Value Adding" that only extended process duration and was increasing the CTE. It is crucial to note that the current process relies on an ERP SAP system with established workflows. Activities such reviewing purchase requisitions via email duplicate the workflow are redundant. Therefore, all process approvals must exclusively occur within the SAP system, rendering weekly meetings for requisition review and email approvals obsolete.

In addition to addressing process instability, the current department director (CIO) has assumed ownership of the process. This is particularly important, in the sense that this role requires authority to make decisions about the process and allocate resources as needed. The process owner must ensure that the process is aligned with the organization's strategic goals and objectives, and that it complies with internal policies and external regulations. As consequence, the essential process participants were reviewed and, the service owners previously involved in the process should no longer be part of it. Domain managers are now responsible for managing purchase requisitions as soon as they are budgeted, ensuring the

timely issuance of purchase orders (POs) to mitigate delays, and their alignment with the Service Owners is no longer part of the process.

Instead of using the PR Review file as tool to document the purchase requests, the notion of a “capacity planning” was introduced to monitor the spend, purchase requisition status /approval and current status of good receipts per month to also enable to issue the GRs in time and trigger the payment in due time. Indeed, this tool is already used by the Director to monitor the same process in another department and should bring not only clarity on the process flow and spend, but also, to promote standardization and best practices across an organization (process reuse)[20].

Furthermore, to mitigate the delays or rejections in the approvals of the purchase requests and orders, it was advised that a document template should be mandatory attached to the SAP document with all the necessary information for approval (for e.g., reason of the spend, budget information, supplier, quote). In addition, purchase requisitions are no longer considered for creation without this document and without a supporting document from the supplier such as contract or order form that clearly stands the payment terms, and reference to the contract in place. Also, to enable to control the quality[45] (particularly concerning non-contractible product quality and private quality cost information) of the SAP administration (PR/PO creation and follow-up), it was identified that this activity could be re-internalized and brought back to in-house resources without impacting or raising the process cost by routing the service through an organization entity located in a economically attractive country (cost-effective).

To conclude, the goals of this redesign are the elimination of "Unnecessary Non-Value Adding" activities, the exclusive use of the SAP system for approvals, and enhanced quality control. The activities to be performed involve identifying redundant processes, re-defining participant roles, and implementing standardized document practices, to improve efficiency and quality for the process. To achieve this, a monitoring tool should be implemented (capacity planning), mandatory document templates, and internalizing SAP administration should be considered.

6.2 RPA implementation

In the previous section, several business process tasks were identified as suitable for automation. During process analysis of the existing business process, a lack of control over various activities in the process was recognised, including tracking purchase requisitions and approvals for timely delivery and creating goods receipts to ensure on-time payments, a critical issue. Given the user and cost considerations, dedicating a full-time equivalent (FTE) to manually monitor individual purchase requisitions, purchase orders, and goods receipts could not be considered. Hence, the primary objective of this research, from an RPA perspective, is to automate the Event Sub-Process "Process Monitoring". By leveraging RPA, it is aimed to facilitate daily monitoring of the process, promptly identifying and addressing the aforementioned challenges. To achieve this automation, the RPA bot must seamlessly integrate with the SAP environment, extract essential reports, and incorporate the data into the "capacity planning" tool.

7 Action

In this phase, the objective is to implement the strategy and method defined in the Planning phase. During this stage, the new process model is implemented along with the RPA and the change management activities (capacity planning, PR template introduction) are taken.

7.1 New Business Process Model

As identified in the planning phase, the "Unnecessary Non-Value Adding" were removed from the process, and all process approvals were exclusively conducted within the ERP SAP system, eliminating redundant activities like reviewing purchase requisitions via email (excluding the information provided to approval level 2 which is business policy).

Additionally, the service owners are no longer involved in the process, and domain managers handle the entire process. Indeed, service owners might be involved in the background but no longer part of the process itself, as it is up to their manager (domain manager) to start and follow the P2P process. Instead of using the PR Review file, a "capacity planning" tool was introduced to monitor spending, requisition status, and good receipts, and it is daily updated by the RPA. Additionally, to expedite approvals, the "PR Template" was added to the flow and is now mandatory for PR creation along with the supporting documents from suppliers. Furthermore, there was a re-internalization of the SAP administration in a Centre of Excellence of this organization located in Poland to control quality without raising process costs significantly. The Figure 14 illustrates the new business process model.

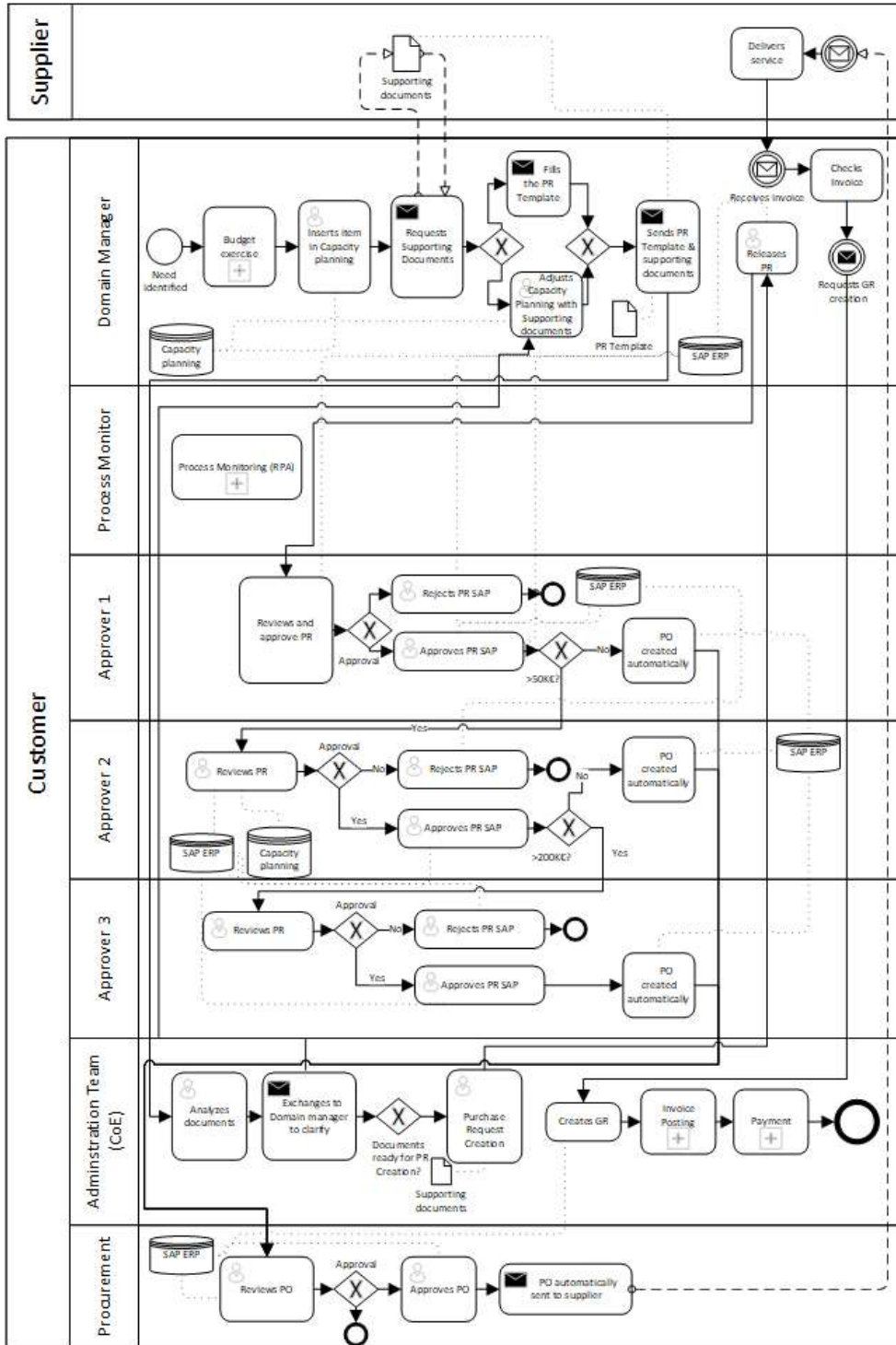


Figure 14: Figure 7 - P2P Process "to be" with emphasis on PR/PO Creation

Regarding the event-sub process that was monitoring the whole process to identify and monitor where the process token stands on each iteration is now simplified and conducted by an RPA (previous monitoring process was performed individually for each PR/PO, now simplified with SAP bulk reporting, and the help of this technology).

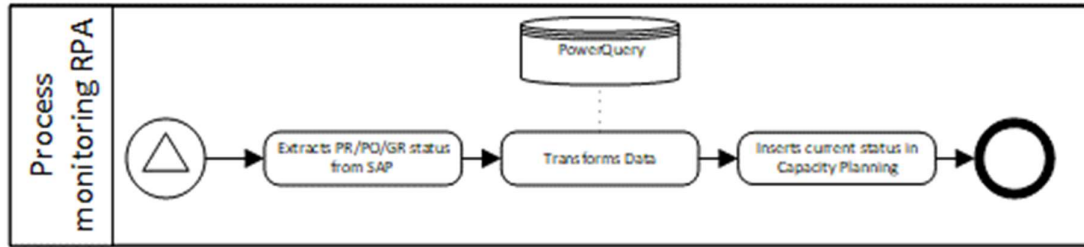


Figure 15: Event Sub-Process “Process Monitor RPA”

7.1.1 Why-Why diagram

Why-Why diagrams are a technique used to analyse the cause of negative effects, such as issues in a business process used to identify chains of factors behind an issue. Its objective is to research deeper into the root cause of an issue by asking a series of "why" questions. Each answer to a “why” question becomes the basis for the next “why” question, leading to a chain of factors that contribute to the issue[20]. Within this research we apply this technique to fully understand the root cause of the issues identified in Table 6- Issue register of "as is" P2P process., the Issue Register.

Starting with the first issue “The Purchase Orders are not being delivered in time”, represented in Figure 16, it is identified the absence of process ownership. The process owner plays a crucial role in BPM by overseeing the entire business process, making sure it meets performance goals, and guiding other participants[20]. The researcher observed that there is a lack of knowledge on the process leading to delays in approval transmitting also flaws of transparency on the spend of the organization. In order to overcome this issue, the process should be clearly communicated to the stakeholders involved in the business process, and a proper training to process participants should be provided. Furthermore, there is

an opportunity to remove the double approval task by increasing the process and stakeholders' reliability.

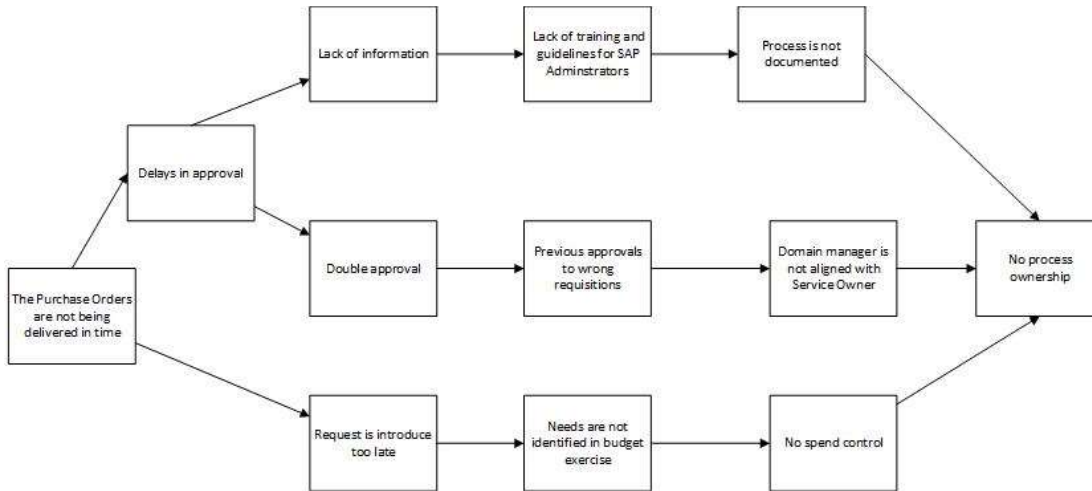


Figure 16: Why-Why Diagram: The Purchase Orders are not being delivered in time

Additionally, the Figure 17: Why-Why Diagram: Purchase Requisitions / Orders do not have any support information for the approval illustrates the issue on lack of support information to ease the approval flow of the purchase requisitions/orders. Although, the cost optimization, and enhancement of productivity can be achieved with outsourcing[43], there are also downsides, and two significant concerns are the risk of losing control over outsourced activities and the potential for quality issues to arise. These drawbacks can impact the effectiveness and success of outsourcing services[44] and this diagram indicates it. The carried research suggests that the process wasn't controlled (lack of monitoring), and the quality of the deliveries was unacceptable from the outsourced company. To mitigate such issues, it is required to reconsider if the outsourcing is valuable and/or are there any opportunities to reintroduce those activities in-house.

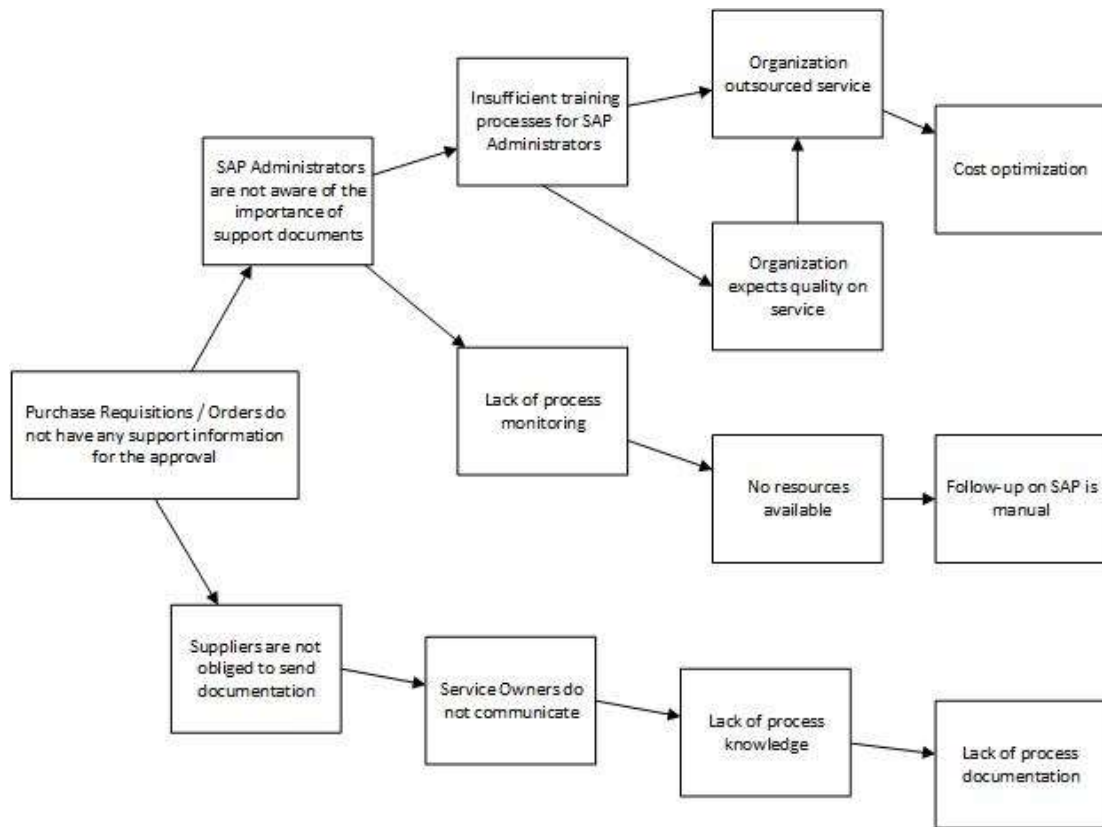


Figure 17: Why-Why Diagram: Purchase Requisitions / Orders do not have any support information for the approval

Finally, the last dissected issue, illustrated in Figure 18 states that the good receipts are not properly created, delays are occurring, and suppliers are getting delayed payments. Across the multiple diagrams, it has been noticed that all of them highlight the lack of process knowledge from the stakeholders involved in the business process. One possible reason for this could be traced to the department, where significant human resources changes have occurred, resulting in a loss of knowledge. In addition, it is possible to identify that there is a lack of human resources to monitor the process, and there is no automation behind, leaving the current process participants under multiple manual tasks. To access such problems, the organization must document the process, clearly communicate the guidelines to the process participants and picture how could the process monitored in an automated manner to re-gain control of the business process and mitigate the issues describe earlier.

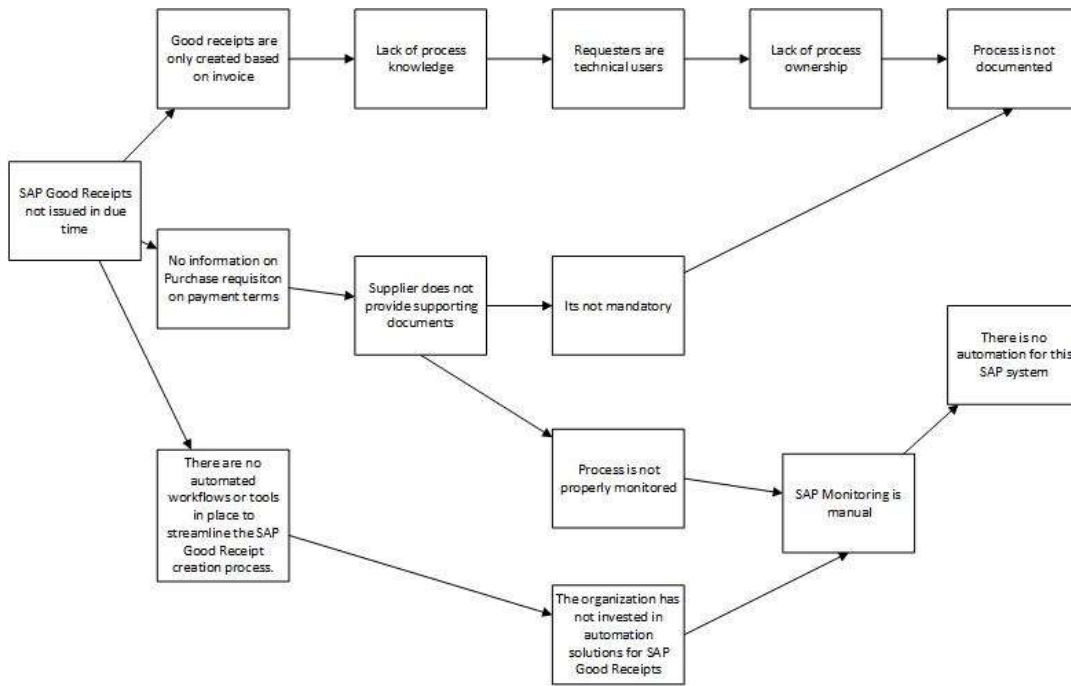


Figure 18: Why-Why Diagram: SAP Good Receipts not issued in due time

7.2 RPA Setup

Following the RPA implementation in the planning phase of this research, the bot was setup based on the previous considerations. However, there are three important aspects to be considered that might not be understandable without the necessary context when the Figure 19 is consulted. First, the organisation has already an RPA environment within an Automation Anywhere solution which obviously was used as per the firm’s policy. Secondly, to enable a better bot performance over the SAP manipulation, the “scripting tracker” software was used. The Scripting Tracker is a tool used for SAP automation tasks that offers GUI analysis and therefore enabling to target SAP objects instead of using the recording of the RPA tool which is by far less efficient and presents disadvantages. An example is, in case of software updates or change of screen layouts, the SAP objects remain the same and the bot does not require additional development or maintenance. Indeed, the flexibility in human actions recorded for RPA automation requires careful analysis and consideration to ensure accurate and

reliable automation[46]. Finally, to streamline the data processing tasks in RPA workflow, the Power Query was used to facilitate the integration of data from the extracted SAP reports (in CSV format). By leveraging Excel's Power Query, our RPA can achieve more efficient data extraction and transformation.

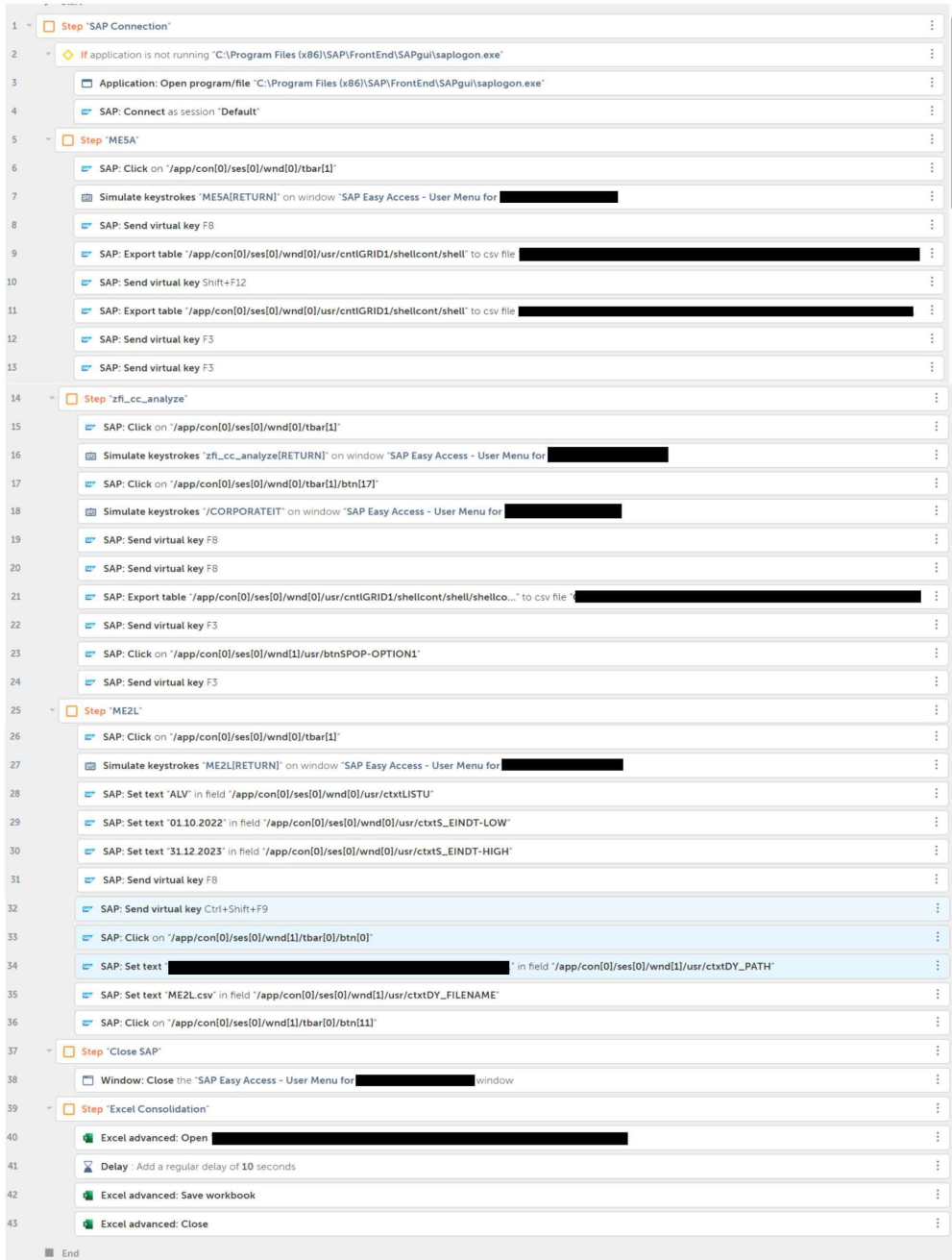


Figure 19: Developed RPA

8 Evaluation

In the evaluation phase, a comprehensive assessment was conducted on the effectiveness of the implemented strategy and methods. This phase involved an analysis of the improvements achieved in the process by comparing its performance before and after the implementation, utilizing two KPIs. Additionally, the new flow analysis was again performed to determine the CTE of the revamped process to quantify the improvements. The evaluation was further enhanced by conducting semi-structured interviews, providing qualitative insights into the impact and effectiveness of the changes made.

8.1 Key Performance Indicators analysis

The comparison of KPIs between 2022 and 2023 for the business process shows a significant improvement in operational efficiency and effectiveness. Regarding the “PR Cycle Time”, there is an obvious improvement in processing speed. In 2022, the average PR cycle time was 13 days, where the maximum waiting time for approval of 118 days. However, in 2023, this average was reduced to 8 days, with the maximum time cut down to 34 days. This reduction in PR cycle time is a clear indicator of streamlined and efficient process. This is a result on removing the unnecessary non-value adding tasks, the information availability improvement in the SAP documents, as well as the automation on PR status provided by the automation. The strong decrease in maximum PR cycle time also reinforces that bottlenecks and delays have been effectively addressed.

Moreover, the number of PRs rejected shows a significant decline, from 29 in 2022 to just 2 in 2023. This dramatic decrease points to a substantial improvement in the quality of information provided, indicating also an enhancement in the knowledge of the administration team in preparing the PRs, and more stringent preliminary checks and guidelines imposed in prior to the PR creation. The lower rejection rate not only signifies improved quality but also implies a reduction in time and resources wasted on reviewing and rejecting unsuitable PRs.

Overall, the data from 2022 to 2023 demonstrates improvement in the efficiency and effectiveness of the business process. These improvements likely stem from a combination of factors such as better training, improved process management, and the adoption of new RPA and its reliability and error-prone capabilities.

8.2 Flow Analysis of New Process

The process flow “as is” and “to be” (currently in place) shows significant differences in terms of activities, time allocation, and cycle time efficiency. Before, the process involved several steps with a total cycle time of 64.25 days, and the CTE was 52%. This figures, indicated that a significant portion of time was spent in non-value-added activities or delays. In contrast, the new process is more streamlined, with a total cycle time of 57.25 days and a higher CTE of 73%. The activities were optimized, and more emphasis was placed on tasks that added value. Notably, the “Requests Supporting Documents” step took 8 hours but added substantial value, leading to a higher overall CTE. The “Delivers service” activity still requires 24 hours (supplier SLA agreement), but had the process is more efficient overall.

Table 12: Table 8: Analysis of cycle times for the new P2P process

Activity	CT	PT	CTE
Inserts item in Capacity planning	1	0.5	50%
Requests Supporting Documents	2	8	400%
Fills the PR Template	1	0.5	50%
Adjusts Capacity Planning with Supporting Documents	1	0.5	50%
Sends PR Template & Supporting Documents	1	0.2	20%
Analyses documents	1	0.5	50%
Exchanges to Domain Manager to clarify	1	0.5	50%
Purchase Request Creation	1	0.5	50%
Releases PR	1	0.5	50%

Improving Business Processes with RPA Technologies

Reviews and approve PR	1	0.3	30%
Approves in SAP	1	0.2	20%
Reviews PR	1	0.3	30%
Approves in SAP	1	0.2	20%
Emails L3 with all details	1	0.2	20%
Reviews and approves	5	0.3	6%
PO Created automatically	1	0.1	10%
Reviews PO	1	0.5	50%
Approves PO	1	0.2	20%
PO is automatically sent to supplier	1	0.1	10%
Delivers service	1	24	2400%
Checks Invoice	5	1	20%
Creates GR	1	0.5	50%
Invoice Posting	5	0.5	10%

From the event sub-process perspective, the introduction of has fundamentally transformed the operational dynamics. Originally, tasks such were done manually, and the monitoring was performed individually, per PR/PO (the user would go to SAP, grab the status or PO number and inserted it in the PR review file). With RPA, the approach shifted from individual processing to bulk data management. The RPA system now collects comprehensive reports based on cost centres belonging to the department, subsequently integrating this data into the capacity planning items. This change makes calculating cycle time efficiency less relevant since the key efficiency metric now lies in the system's ability to process large volumes of data rapidly (consistently under 5 minutes), and in a more integrated manner.

This shift from manual labour to automated processing, not only enhances efficiency, but also ensures a holistic approach to managing departmental activities, focusing on the broader impact rather than individual task times.

8.3 Semi-structured Interviews Iterations

This evaluation phase also included conducting four semi-structured interviews with the process stakeholders, including the management team, process owner and participants, as detailed in Table 13. These interviews provided direct feedback on the specific enhancements that have already been implemented by allowing the process stakeholders to give insights into how these changes are functioning in their daily operations which is crucial for understanding if the enhancements are achieving their intended objectives and how they are impacting the workflow. Additionally, they allowed to evaluate the user experience in assessing the usability and practicality of the changes/improvements. Finally, it confirmed whether the enhancements were aligning with the original goals and objectives, thus validating the effectiveness of the enhancements.

Table 13: Semi-structured interview iterations

ID	Interview Date	Current Position	Organization Experience
IT01	2023-11-13	Domain Manager	12 years
IT02	2023-11-14	Domain Manager	32 years
IT03	2023-11-15	CFO – Management Team	22 years
IT04	2023-11-15	CIO – Process Owner	22 years

These interviews were part of 4 assessment iterations, following the interview questions outlined in the Table 14. The selection of interviewers was executed with strategic intent, aligning closely with the research objectives. From the process stakeholders, two members of the management team were selected, with one also serving in the capacity of the process owner. This dual role was helpful to provide both a managerial and an operational perspective on the process improvements. Furthermore, two process participants were chosen to ensure that a practical viewpoint was adequately represented. This composition of interviewees was crucial to cover the full spectrum of the process, from strategic point of view to daily operations, ensuring a comprehensive assessment evaluation.

In addition to the goals and structure of these interviews, an Informed Consent Protocol was signed by each participant as a crucial component in the research ethics practices.

This was done to ensure confidentiality and the protection of the participant’s identity, reflecting the ethical obligations of researchers to protect participant data and the nature of their contribution to the research. It also certifies transparency, participant understanding, and voluntary engagement in the interviews along with their permission to record the interview sessions (the template can be consulted Appendix D).

Table 14: Interview Iteration Questions and Objectives

ID	Type	Question	Objective
1	Open-ended	What were the specific pain points or challenges you encountered while working with the old business process?	Identify key challenges in the business process before improvement
2	Open-ended	In your view, what were the main benefits or improvements achieved in the new business process?	Evaluate the benefits of RPA implementation and process improvement activities
3	Open-ended	Were there any changes in the workflow or sequence of tasks within the business process as a result of RPA, and how did these changes contribute to improvement?	Analyse changes in workflow and task sequence
4	Open-ended	Can you provide insights into how the RPA implementation for the business process monitoring activities (meaning the capacity planning automation) affected the overall performance of the business process?	Understand the impact of RPA on the process monitoring activities
5	Open-ended	As someone with hands-on experience, do you have any specific suggestions or	Gather practical recommendations for

recommendations for optimizing the use of RPA in your business process?	future RPA optimisa- tions
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8.3.1 Evaluation Iterations

In this section, participant was interviewed individually to capture their unique perspective on the results of this research.

In the IT01, a Domain Manager was interviewed, as a process participant, responsible to introduce his purchase requisitions in his domain. The key challenges highlighted by the participant were the need for multiple approvals within the process, which caused delays in the process, and a lack of visibility in the status of the transactions. Additionally resulting in difficulties in tracking the progress of requests and accessing information about budget approvals and commercial figures. Another challenge identified, was the excessive exchange of emails between teams, causing inefficiencies in communication. From the benefits of the RPA implementation and the process improvement activities perspective, the interviewer mentioned were the improved efficiency, reduced lead time, better data availability, and greater accuracy.

The automation of capacity planning (event sub-process automation) also in his perspective played a significant role in enhancing the overall performance of the business process. The changes in the workflow and sequence of tasks within the business process as a result of RPA technology implementation improved also the delivery time and minimized the need for excessive emails. These changes contributed to better transparency, critical system access, and increased overall performance of the business process. The interviewer also suggested that for future optimisations the automation of the purchase requisitions, and goods receipt creation could further streamline the process, save time, and improve efficiency.

Moreover, in the IT02, the second Domain Manager was interviewed, also on his qualification of process participant denoted that the challenges faced prior to implementing the new business process included at first, the presence of duplication in the process, leading to wasted time and inefficiency, and secondly the quality of the data, which was often

incomplete or unavailable, affecting decision-making in approval flow. The participant pointed that the new process addressed these concerns by eliminating duplication of approvals and ensuring all necessary information concerning the purchase requisitions is available, as well as in the capacity planning for spend monitoring purposes. The implementation of RPAs for business process monitoring activities, specifically for capacity planning automation, on his perspective, has had a positive impact on the overall performance of the business process. It has improved data accuracy and freed up resources to focus on other technical tasks (removal of service owners from the process). Also, the automation of data collection and integration into the process has ensured that all necessary information is available, being SAP as the “source of truth” for approval. Finally, the participant suggested that for future optimisations, it could be explored the possibility of automating purchase order creation and invoice follow-up using RPA technologies.

Furthermore, in IT03, the CFO, part of the management team in this process was interviewed. The key challenges identified by the participant before the implementation of the new business process, were delays in purchase orders, which caused time and pressure issues within teams. These delays were attributed to reorganization within this department, lack of knowledge, and lack of processes. From his perspective, the new process is now lean and reliable, with most of the previous issues being resolved. The implementation of capacity planning tool has improved workflow and performance, and the ownership and responsibility within teams are now clearer. Also, the new process with the support of the RPA allows a better visibility of pending invoices and payments. Towards the practical recommendations for future RPA optimisations, the participant recommends exploring the possibility of improving the visibility of pending invoices and payments in the SAP system. It seems that there is a need for better reports and visibility in this area.

Finally, in IT04, the CIO and process owner was interviewed. He expresses that specific the pain points and challenges encountered in the old business process included the lack of structure, undocumented processes, and unclear roles and responsibilities leading led to process complexity, additional bureaucracy, and a lack of process ownership. In addition, as per his view, the main benefits or improvements achieved in the new business process include the improvement on process ownership by incorporating a specific member, the researcher that helped to bring control back to the process to clear roles and responsibilities

Rodolfo Fernandes

and improved accountability. Also, from an end-to-end perspective, taking a holistic view of the process from enabled the identification of steps that could be streamlined or automated, leading to quick wins and increased efficiency. Regarding the changes in the workflow or sequence of tasks within the business process as a result of RPA, the participant highlights the efficiency increase, reduction of process complexity. Also, a faster processing time in the approval, delivery of the Purchase Orders, and better structured and documented process, despite the initially challenges, such as resistance to change and the elimination of redundant tasks. In his view also the RPA implementation for business process monitoring, specifically the capacity planning automation, had a positive impact on the overall performance of the business process. The participant states that it helped in reconciling data from various tools, improving data access and visibility, and replacing manual work with faster and more efficient solution. Also, this automation reduced the time and effort required for tasks, leading to improved process performance.

The CIO also suggests exploring RPA opportunities in other business processes and mentions the success of RPA in back-office processes like financing consolidation and controlling. Additionally, suggests leveraging artificial intelligence tools for business activities like task prioritisation. In other words, to optimize the use of RPA in the business process, the interviewee mentioned that it would be beneficial to assess other areas/processes, such as task management and back-office processes, and consider integrating artificial intelligence tools to streamline and prioritize tasks.

8.3.2 Evaluation Results

In this section, we summarize and consolidate the key findings from four rounds of interviews, as outlined in Table 14. The aim was to aggregate the main points from each interviewee as much as possible, allowing to the research to draw conclusions from their evaluations and compare the outcomes in relation to the objectives set for each question.

When it comes to the key challenges in the business process before the improvement, the interviews revealed a consistent set of challenges. Among these were procedural delays, primarily due to multiple approvals and purchase orders, coupled with a lack of transparency

and efficient tracking mechanisms. Organizational challenges like reorganization issues, a lack of knowledge or processes, and the absence of structured processes were also highlighted. These challenges indicated a clear need for process restructuring and automation (summarized in Table 15).

Table 15: Key challenges in the business process before improvement

Consolidated Challenges	Interviews
Delays in process due to multiple approvals, lack of structure, and inefficiencies	IT01, IT02, IT03, IT04
Lack of visibility, tracking, and data quality affecting decision-making	IT01, IT02
Organizational and process-related issues (reorganization, lack of knowledge, unclear roles)	IT03, IT04

Regarding the benefits of the RPA implementation and process improvement, the interviews reported significant improvements in efficiency, reduced lead times, and streamlined processes. Also, a notable enhancement in data accuracy and process ownership, leading to a more reliable and lean operation. These outcomes demonstrate the effectiveness of RPA in transforming business processes, highlighting its role in improving workflow and data management (summarized in Table 16).

Table 16: Benefits of RPA implementation and process improvement activities

Consolidated Benefits	Interviews
Improved efficiency, reduced lead times, and streamlined processes	IT01, IT02, IT03, IT04
Enhanced data accuracy and reliability	IT01, IT02, IT04
Improved workflow and process ownership	IT03, IT04

On the subject of the consolidated changes in workflow/task sequence, a major impact of RPA implementation was observed in the workflow and task sequencing. The process became more structured, and the excessive emails exchanges seems to be bypassed, and the

Rodolfo Fernandes

monitoring tasks were automated. Also, there is enhanced system reliability, faster processing times, and improved transparency by defining the SAP environment as the single trusted source. These changes highlight the value of RPA in optimizing business workflows, making them more efficient and transparent (the Table 17 summarizes the consolidation).

Table 17: Changes in workflow and task sequence

Consolidated Changes in Workflow/Task Sequence	Interviews
Streamlined communication and reduced manual tasks (fewer emails, automated steps)	IT01, IT04
Improved transparency, faster processing, and structured task sequence	IT01, IT03, IT04
Enhanced system reliability and data access (SAP as a trusted source)	IT02, IT04

With respect to the impact of RPA on process monitoring activities, this integration seems to have improved data accuracy, visibility, and accessibility. Also, along with better resource management by removing the need to individually access the information multiple tools, since all the information is now consolidated in the Capacity planning tool (sourced from SAP). These improvements indicate that RPA not only streamlines processes/tasks, but also provides a robust framework for ongoing monitoring and management, leading to more informed decision-making and efficient operations.

Table 18: Impact of RPA on the process monitoring activities

Consolidated Impact of RPA on Monitoring Activities	Interviews
Enhanced performance and efficiency in process monitoring	IT01, IT04
Improved data accuracy, visibility, and accessibility	IT02, IT03, IT04
Better resource management and capacity planning	IT01, IT02, IT04

In the context of practical recommendations for future RPA optimisations, the interviewees commonly agree on the automation of key processes like the creation of purchase requisitions, and goods receipts. Additionally, improving system visibility, particularly in SAP systems when it comes to the invoice’s status and processing, as well as exploring AI integration within the RPA for other business processes.

Table 19: Practical recommendations for future RPA optimisations

Consolidated Recommendations	Interviews
Automate key processes (requisitions, orders, invoice follow-up) and improve system visibility	IT01, IT02, IT03, IT04
Explore further RPA applications and AI integration for efficiency and prioritization	IT04

The overall consensus among the interviewees reveals a clear and shared recognition of the benefits of RPA, along with a unified vision for its ongoing role in improving business processes, specifically the P2P process (object of this research). This agreement across different roles and perspectives within the organization not only validates the effectiveness of RPA and business process improvement activities taken by this research, in addressing pre-existing challenges, but also highlights a collective commitment to leveraging technology for future enhancements and maintaining a trajectory towards more automated, efficient, and data-driven operations.

This unified vision is taken by the research, as a positive and transformative impact of the business process improvement with the support of the RPA technology. This consensus among the interviewees not only reinforces the value of RPA in enhancing operational efficiencies but also underscores its role as a key driver in the evolution of business processes.

9 Conclusion

In this chapter, the research is brought to an end by providing a general conclusion, addressing its limitations, and outlining possibilities for future research.

9.1 Main Contributions

This brought an important contribution towards a business process improvement with the support of an RPA implementation. The research started by conducting a systematic literature review to identify the current scientific knowledge on the subject of RPA, including its challenges, benefits, current implementation approaches, and successful improvement of business process tasks. Additionally, this SLR, helped the researcher to select in the organisation environment proposed to this research, what business processes or tasks could be candidates for automation. Furthermore, enabled to build an RPA suitability Matrix to within the selected process, identify the tasks or group of tasks to be automated.

In addition, the action research as a driven methodology for this research, involved a comprehensive business process transformation, which included process identification and selection, process analysis and redesign, and RPA implementation. The entire process driven on the diagnosing phase of this research can be taken as a methodology or framework to follow on RPA implementation to enhance business processes. It can be concluded that, specifically to the business processed identified in this research, as per its state, an RPA implementation without its proper redesign would not necessarily improve efficiency. As matter of fact, the RPA in this research is the “extra” enhancement of this business process because, as it was identified in the diagnosing phase, the lack of control in this business process was significantly. However, it worth to say, that after the process streamline, redesign, it can be concluded that RPA technologies can even take monitoring activities to gain control over the process and its workflows. Indeed, the results of the action research, either performed by the researcher, either from the conclusion in the semi-structured interviews,

showed that RPA implementation can lead to significant improvements in business processes, improving efficiency, reduced lead times, enhance data accuracy and reliability.

Overall, this research provides a valuable resource for businesses and researchers seeking to understand the benefits and challenges of RPA technologies in improving business processes, but also provides a robust framework or strategy that can be followed in an operational environment towards the activities of business process management, and improvement.

9.2 Research Limitations

The limitations on this research relay on multiple areas. First, the organisation where the study was conducted is extremely wide and their complexity, including their multiple geographic locations does not allow to completely streamline an entire business process. In addition, the shape of the business process was so defective that the RPA instead of being a drive, became a tool to only automate a small part of the process whereas the opportunities to automate were very optimistic. In particular, the purchase requisition creation that could also lead into a cost reduction, or interacting with the supplier through chatbots when it comes to request of supporting documents for the PR creations. Additionally, the research, obviously because of the methodology chosen (action research) was conducted in a single organization, which limits the generalizability of the findings to other organizations. Also, since the study is focused on a specific business process, some the findings may not be applicable to other types of processes.

Finally, the study did not compare RPA with other process improvement technologies, such as Lean Six Sigma, which could provide additional insights into the benefits and challenges of RPA.

9.3 Future Work

This study revealed that there are opportunities in the P2P process where the RPA can effectively be implemented and lead to a possible future work. Specifically, to automate tasks, such as, the purchase requisition or the goods receipts creation in order to reduce costs and

Rodolfo Fernandes

promote automation. Aligned with the same idea, since the large organisations tend to allocate administrative tasks in cost-effective countries such Poland or India, to what extent can be interesting using RPA instead of moving the resources to another location where organisations face also cultural challenges.

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Appendix A

Corporate IT - Purchase Requisition				
version March 2023				
Date:				Comments:
Requester:				
Cost Center:				
Dgid:				Coming from capacity planning file
Approved in Capacity planning	<input type="checkbox"/> Yes	<input type="checkbox"/> No		
Name of the service/material/project:				
Vendor:				
Actual value in previous year:				Only if it's renewal
Amount for this PR:	Currency:	<input type="checkbox"/> Opex	<input type="checkbox"/> Capex	
Vendor Quote:	Comments:			
Budget Amount:	Comments:			
PR period:	From:	To:		current year BP; comments if variation between amount PR and BP dates dd/mm/yyyy
Category:	Existing Engagement	<input type="checkbox"/> Yes	<input type="checkbox"/> No	If yes, engagement reference: E-2023-XXX
ChargeBack	Payers			
Comments: why the organization needs this?				
Comments: reason for budget variation vs previous year				
Name of attachments (contract, scope of work etc.)				
Other comments:				
IF PR REQUIRES DIFFERENT LINE ITEMS: SPLIT THE DIFFERENT SERVICES OR MATERIALS GROUPS				
PR Lines:	Item Name	Unit Price	Quantity	Total
Line 1				
Line 2				
Line 3				
Line 4				
Line 5				

Figure 20:PR Template

Appendix B

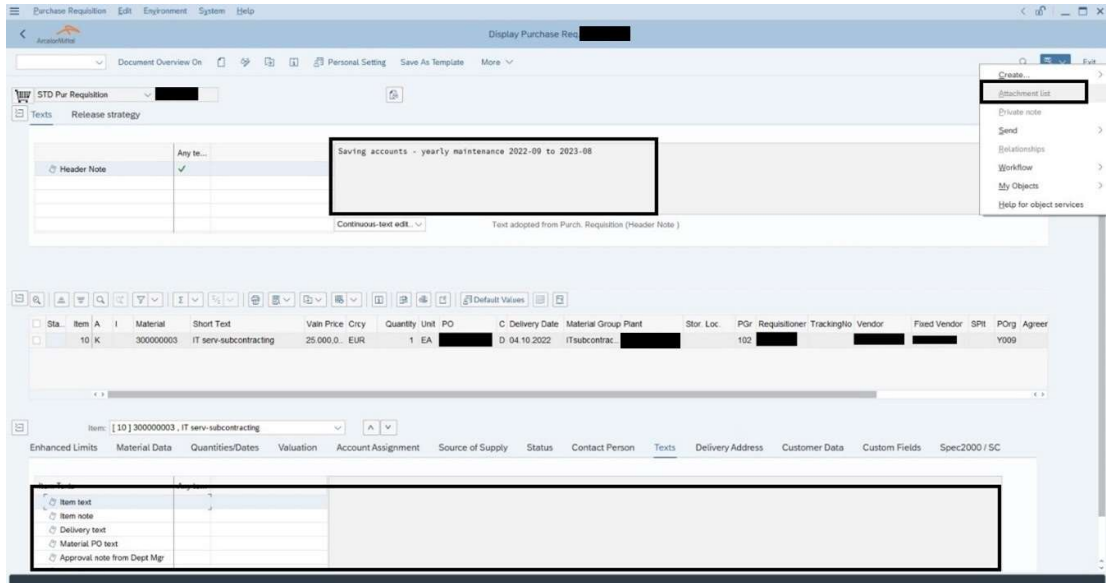


Figure 21: Purchase Requisition Example before improvement

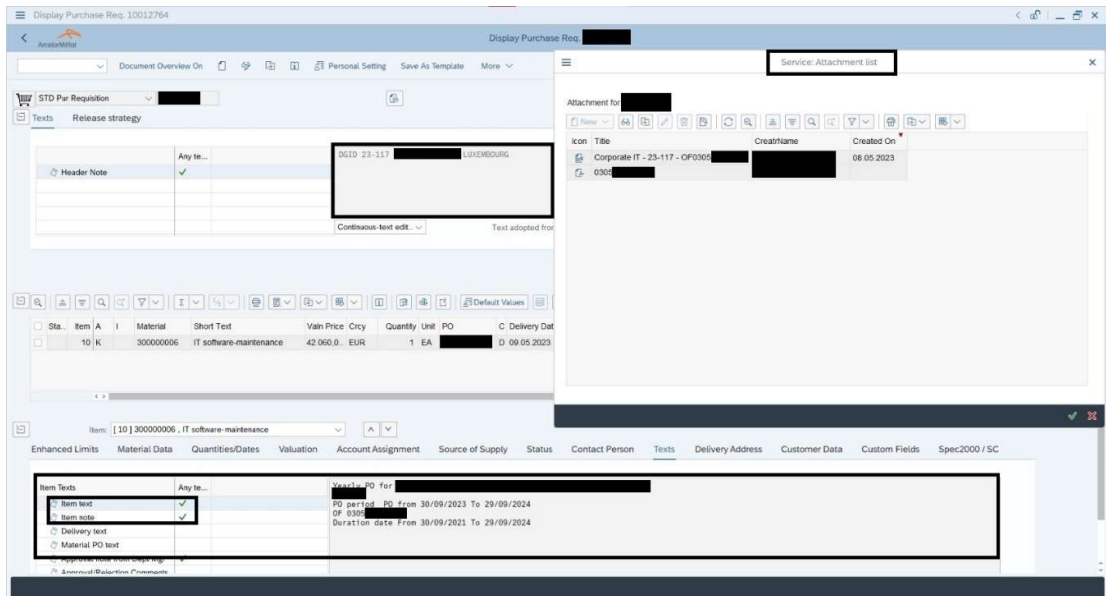


Figure 22: Purchase Requisition Example after improvement

Appendix C

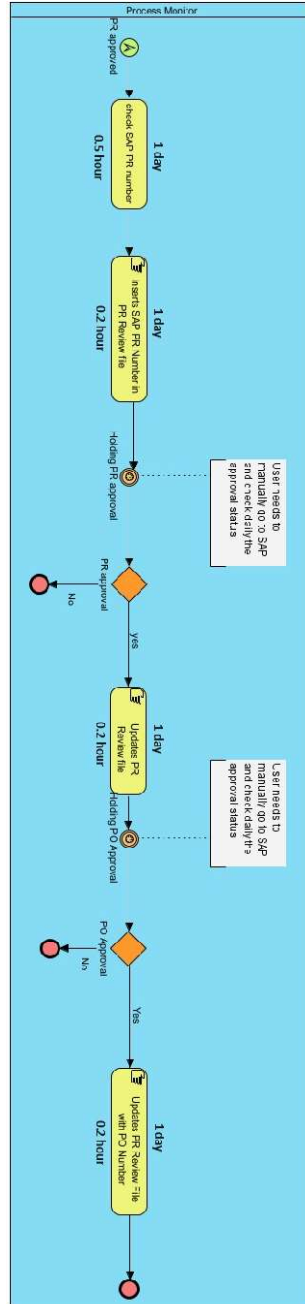


Figure 23: Flow analysis of Event Sub-Process "Process Monitoring"

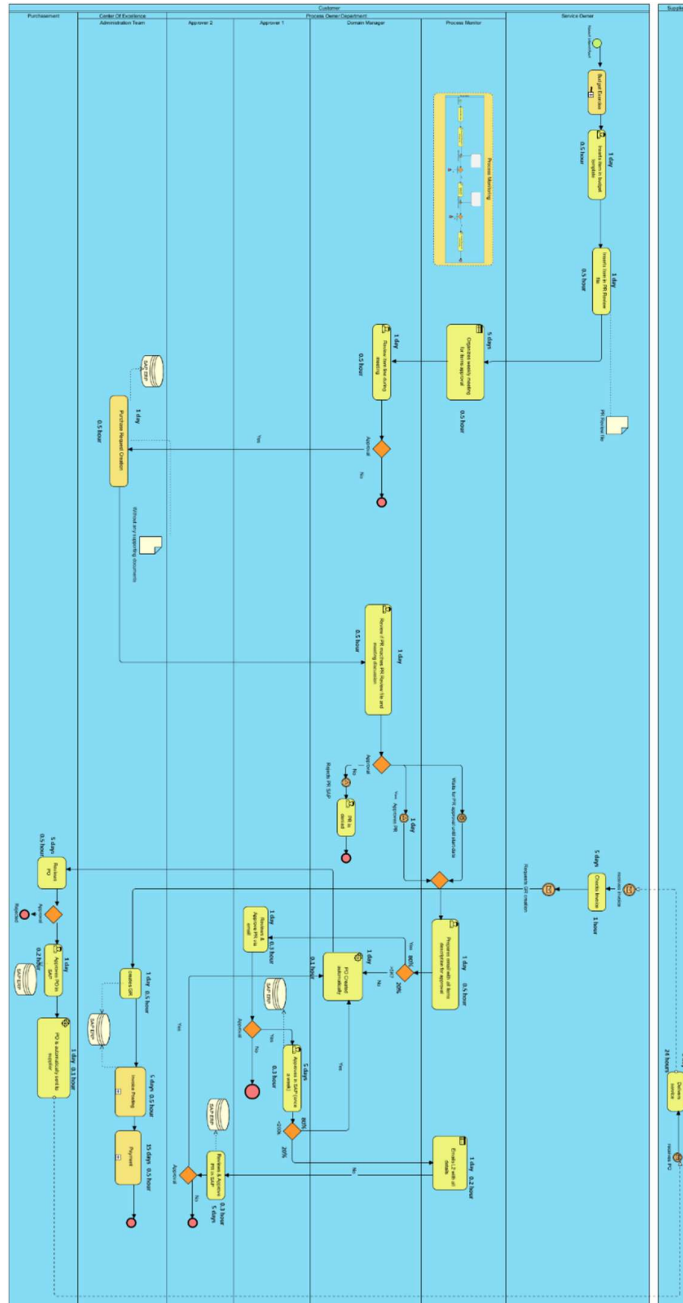


Figure 24: Flow analysis of P2P Process

Appendix D

Informed Consent Protocol - Semi-structured Interview

I, [Participant Name], willingly agree to participate in the study conducted by Rodolfo Gomes Severino Alves Fernandes (a student at the Universidade Aberta and Instituto Superior Técnico) under the guidance of Professor Dr. Henrique São Mamede & Professor Dr. Miguel Leitão Bignolas Mira da Silva as part of the Master's Thesis in the field of Information and Enterprise Systems.

I have been informed about and understand the main objectives of this study and, I understand and agree to participate in an interview that explores the business process improvement conducted in my working environment.

I understand that my participation in this research is voluntary, and I can withdraw at any time without any adverse consequences for me.

By participating in this study, I am contributing to research in the field of business process improvement with RPA technologies, although I acknowledge that there is no direct or indirect benefit agreed upon for my participation.

Furthermore, I understand that all information obtained in this research will be kept strictly confidential, and my identity will never be disclosed in any report or publication, or to anyone not directly associated with this research, unless I provide written authorization to do so.

Name:

Signature:

Date: