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REBOOTING PROCUREMENT PROCESSES: LEVERAGING THE SYNERGY OF RPA AND BPM FOR OPTIMIZED EFFICIENCY

Simão Pedro Acciaioli Gouveia dos Santos

Master Thesis

presented as partial requirement for obtaining the Master Degree Program in Information Management

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By

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Master Thesis presented as partial requirement for obtaining the Master's degree in Information Management, with a specialization in Knowledge Management and Business Intelligence

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STATEMENT OF INTEGRITY

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

Lisbon, 2024

DEDICATION

This thesis is dedicated to my family, whose unwavering support and encouragement have been my foundation throughout my academic journey. Your belief in me has been my greatest motivation. To my mentor and best friend, Dr. Vitor Santos, for his guidance, to be the reason that I completed this work, and to be my inspiration every day. To my son, Santiago Santos who had the patience to spend quiet times with me while I was progressing with this Thesis. To my mother, Ana Gouveia who is a role model and a clear example of what perseverance is. To my sister, Joana Santos who provided me help and incentive during all this process. To my brothers, and to my friends who have always supported me. And to all those who strive to make the world a better place through science and education.

Simão Santos

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ABSTRACT

Efficient procurement processes are pivotal for organizational success, encompassing cost reduction, revenue optimization, employee motivation, and customer satisfaction. This necessitates continuous process refinement and adaptation to dynamic market environments. This thesis investigates and demonstrates the potential for synergies between RPAs and BPM in Procurement processes. The primary objective is to analyse and evaluate a Procurement manual-intensive process, within the aiming to enhance its efficiency, reducing time-consuming interventions, and ultimately diminish costs and Cycle Time.

Employing a Design Science Research methodology, this research yields a practical artifact designed to streamline Procurement processes. An artifact was created with the use of BPM methods and RPAs tools. The RPA was developed after the application of BPM Redesign Heuristics into the current process. For its evaluation, a mixed-methods approach was employed, combining quantitative analysis on Cycle Time reduction with qualitative Confirmatory Focus Group of department experts.

The analysis revealed that the synergy between BPM and RPAs can leverage Procurement processes, decreasing cycle times and workload on intensive manual tasks, allowing employees time to focus on other functions.

This research contributes valuable insights for organizations seeking to harness automation technologies for enhanced procurement operations, having the findings suggesting promising enduring benefits for both efficiency and accuracy in the procurement lifecycle.

KEYWORDS

Procurement; Supply Chain; Robotic Process Automation (RPA); Business Process Management (BPM); Automation; Optimization

Sustainable Development Goals (SGD):

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LIST OF ABBREVIATIONS AND ACRONYMS

AI	Artificial Intelligence
B2B	Business-to-Business
BCM	Business Continuity Management
BPM	Business Process Management
BPMN	Business Process Management Notation
BPR	Business Process Reengineering
CFG	Confirmatory Focus Groups
D&S	Digital & Support
DSR	Design Science Research
DSRM	Design Science Research Methodology
IPA	Intelligent Process Automation
IoT	Internet of Things
IT	Information Technology
ML	Machine Learning
NLP	Natural Language Processing
P2P	Procure-to-Pay
PDD	Process Design Document
PICOC	Population, Intervention, Comparison, Outcomes and Context
PSM	Purchasing and Supply Management
RPA	Robotic Process Automation
SBO	Simulation-Based Optimization
SDM	Supplier Data Management
SLR	Systematic Literature Review
VB	Visual Basic

1. INTRODUCTION

1.1. CONTEXT

The management framework based on specialized functional divisions of labor, as proposed by Taylor (1911), exhibits constraints in its ability to effectively coordinate tasks. Nowadays, process-based lateral coordination mechanisms , are a must condition when facing present realities, enabling more agile, integrated and flexible organizations (Paim et al., 2008). These mechanisms allows to monitor and improve processes within the organization, leading to achieve lower costs, to have higher revenues, to motivate employees, and get happier customers (Rudden, 2007). Thus, and according with Broadbent, it is a key preposition to be always improving and monitoring the business processes within the organization, and to constantly adapt them to its market environment (Broadbent et al., 1999).

Any process failure has a highly chance of bringing corporate life and the entire process ecosystem to a standstill (Dumas et al., 2013) and so it is relevant to find out the best ways to mitigate these risks seeking to improve them.

1.2. RESEARCH GAP AND OBJECTIVES

Typically, in the Procurement department, employees routinely engage in manual processes, such as creating new suppliers, extending supplier to a new purchasing organization rather than the principal one, or updating supplier information. These tasks consume significant time and require greater accuracy. Requests for these processes are usually submitted as tickets, which can vary in structure - some are received via email without a defined format, while others follow a static template within an internal tool.

The repetitive manual intervention in these daily procurement processes leads to inefficiencies. The lack of standardization in these processes results in inconsistencies and difficulties in managing requests effectively. This increases the likelihood of errors in data entry, raising compliance and audit concerns. Managing varying request formats makes monitoring workflow progress challenging. Manual intervention also hinders process scalability, frustrating procurement employees and reducing overall departmental productivity.

These circumstances lead to the following question: How can it reduce the workload and the costs while improving the efficiency and accuracy of those procurement processes?

The primary goal of this research is to identify optimal strategies for leveraging existing process automation technologies to enhance the efficiency of procurement processes. This involves providing training to requestors, standardizing request formats, and implementing automation to fulfill these requests. Additionally, the solution aims to be scalable, accommodating the organization's growth and evolving procurement requirements to maintain efficiency despite increasing workloads.

2. LITERATURE REVIEW

In this chapter, the author begins an important phase by carrying out an exhaustive review of the existing literature, using a systematic and well-structured approach. The methodology guiding this literature review is inspired by the experience of Barbara Kitchenham.

Using a Systematic Literature Review (SLR) protocol, the author will meticulously navigate the vast body of relevant literature, ensuring a methodical and comprehensive analysis of the research landscape. Kitchenham's methodology serves as a guiding framework, known for its meticulous procedures in identifying, evaluating, and synthesizing academic work.

By following a systematic approach, the author aims to minimize bias, increase the reproducibility of the results, and provide a solid basis for the subsequent chapters.

By delving into the intricacies of this systematic literature review, it is intentioned not only to present a comprehensive synthesis of existing knowledge, but also to lay the foundations for the empirical research that follows.

2.1. THEORETICAL OVERVIEW

This section endeavours to delve more profoundly into the central theme of this research. It provides a theoretical examination encompassing essential definitions, features, and an academic perspective on the influence of both Business Process Management and Robotic Process Automation in Procurement area within organizational contexts. The items below are Procurement, Business Process Management (BPM) and Robotic Process Automation (RPA).

2.1.1. Procurement

According to Holm Andreasen (2012), with regard to the concept of Procurement in the literature, there are some differences in how it is defined (Holm Andreasen, 2012).

Although academia applauds the strategic contribution of procurement and offers frameworks for its importance and best practices (Cousins et al., 2008), there seems to be a misalignment between conventional expectations and actual procurement practices (Ramsay & Croom, 2008).The literature on procurement suggests a paradox: an area responsible for a substantial part of a company's expenditure and characterised by complexity, is not treated with the same professional perspective as other areas of the company (Cousins et al., 2008). This raises questions about how the role and value of procurement is perceived in terms of organisational structure and the development of best practices.

Ouyabaka Marius (2017) defines Procurement as "a service function that is provided by a dedicated team of professionals who operate at the interface between the organisation's suppliers and the end-user departments in order to effectively and efficiently meet the organisation's supply needs". This process involves " risk assessment, seeking and evaluating alternative solutions, awarding contracts, delivering goods, services and works, and paying for property and/or services and, where

relevant, the ongoing management of a contract and the consideration of contract-related options" (Marius, 2017).

2.1.2. Business Process Management

Business Process Management (BPM) is a crucial methodology for organizations that want to achieve operational excellence and raise overall performance (Baird et al., 2011). It encompasses the proficient and streamlined management of business processes, emphasizing workflow optimization, modelling, simulation, automation, execution, verification, and optimization, all geared towards achieving organizational objectives. In addition, BPM plays a vital role in ensuring the uninterrupted flow of essential processes through business continuity management (BCM) (Randeree et al., 2012).

The idea of BPM has been widely accepted since the early 1990s, but there is still a gap in the current spectrum of BPM methods regarding effective concepts in this domain (Lohrmann & Reichert, 2013). It is a developing field that revolves around the integration of all business resources to meet customer needs, with a specific emphasis on capturing, modelling, automating, controlling, analyzing and optimizing business processes through the use of IT technologies (Asmat & Iftikhar, 2018). BPM is crucial for managing and continuously improving the dynamic interactions between the levels of the organizational system to execute competitive strategic initiatives and achieve ambitious business goals. (Hernaus et al., 2020).

Dumas, (2013) describes BPM as “the art and science of monitoring how work is carried out in an organization to ensure consistent results and take advantage of opportunities for improvement”. The author also suggests that improvements can be associated with reducing costs, execution time, error percentages or gaining an advantage through innovation (Dumas et al., 2013).

2.1.3. Robotic Process Automation

Robotic process automation (RPA) is a growing technology with the potential to revolutionize traditional business models, particularly in the fields of auditing, procurement and business process automation (Moffitt et al., 2018). RPA allows organizations to automate repetitive administrative tasks by running scripts that code sequences of detailed interactions with web and desktop applications. This leads to the automation of high-volume routine processes (Leno et al., 2020).

In contrast to other process automation technologies, RPA is lightweight and interacts exclusively with the presentation layer of IT systems to replicate human behavior. This makes it a valuable tool for organizations looking to secure a competitive edge and improve operational efficiency (Herm et al., 2023). RPA technology is disruptive, automating tasks that were traditionally carried out manually and rapidly automating entire business processes and sub-processes (Gupta, 2023) standing positioned at the intersection of Business Process Management (BPM) and Artificial Intelligence (AI), as it serves as a bridge between these two domains (Agostinelli et al., 2019)

2.2. SYSTEMATIC LITERATURE REVIEW

According to Okoli (2015), the adoption of a systematic literature review methodology proves useful in acquiring a theoretical background and context for a research question, aiding in focusing on the question. This facilitates theoretical development by steering clear of areas saturated with

extensive and diverse research on the topic, while also highlighting other areas where further investigation is needed (Webster & Watson, 2002).

In this research project, the literature review unfolded in a comprehensive manner, following the Barbara Kitchenham's protocol (Kitchenham & Charters, 2007). Firstly, the author will undergo the Planning phase where it will be stablished the necessity of a systematic review to summarize existing information using comprehensively and impartially the PICOC criteria. The revision objective will be stated and a clear and focused research question that will guide the literature review process will be defined. After that, the development of a systematic approach to searching for relevant literature, incorporating appropriate keywords, databases, and inclusion/exclusion criteria will be held. Then, in the Realization phase, the establishment of a specific criterion for studies selection and systematically extract relevant information to categorize and summarize the literature into patterns, trends and gaps in existing knowledge will take place. Finally, in the Reporting phase, a quality assessment performance and results presentation will be incorporated (Kitchenham & Charters, 2007).

2.2.1. Planning Phase

Procurement digitalization is an emerging topic related to the digital transformation of supply chains (Handfield et al., 2019). Although there is a growing emphasis on research in Purchasing and Supply Management (PSM) and increasing academic interest (Harland et al., 2006), the field faces a notable deficiency in theoretical robustness (Chicksand et al., 2012).

In the wider context of a company's procurement process, as described in the Procurement Manual provided by the United Nations (2020), it is emphasized that Procurement is an integral part of supply chain management (*Procurement Manual | UN Procurement Division*, n.d.). However, many companies continue to fail to recognize Procurement processes and even ignore the value that this process can bring to their business. This negligence results in unfounded decision-making, ultimately harming the company (Kakwezi & Nyeko, 2019).

Before starting a systematic review, it is crucial to validate the need for it. Petticrew and Roberts recommend using the PICOC criteria (Population, Intervention, Comparison, Outcome, Context) to structure and formulate research questions (Petticrew & Roberts, 2008).

The PICOC criteria were followed:

Table 1 – The PICOC criteria (Petticrew & Roberts, 2008).

The PICOC criteria applied to this project	
Population: What is the problem / What are the groups involved?	The problem is the poor recognition and understanding of the value of procurement processes, as well as the fact that there is little awareness of the potential of automation and modelling to optimize procurement processes that require a lot of manual intervention. The population can be any organization that have a Procurement department.
Intervention: software / tool to address a specific issue.	Deploying a TO-BE model using BPMN language and BPM heuristics and recurring to UiPath to automate potential tasks.
Comparison: The software / tool with which the intervention is being compared.	The comparison will be made with the AS-IS model and the state of the art. A CFG will also be conducted to compare the suggested changes impact.
Outcomes: factors of importance to practitioners such as improved reliability, reduced production costs, and reduced time to market (Kitchenham & Charters, 2007).	This kind of intervention can provide alternatives to the repetitive and manually tasks that procurement employees goes through daily with inherent cost reduction and reduced time to market.
Context: the context in which the comparison takes place (Kitchenham & Charters, 2007).	The comparison takes place in industry once the work will be compared with the actual state of the art in a specific company.

There will be considered the following research questions:

Table 2 - Systematic Review's Research Questions.

RQ1:	How can companies enhance their recognition and understanding of the value of Procurement processes?
RQ2:	Which value does having procurement processes optimized to the organization?
RQ3:	Which value does having procurement processes automated to the organization?
RQ4:	Which are the Procurement processes that cannot be automated or semi-automated?

The main research objective is to find the best strategies to take advantage of the existing process automation technologies to improve the Procurement processes as well as to raise awareness about the importance of this department.

The search was conducted in December 2023 on the following scientific information resource databases:

Table 3 - Systematic Review's Resources and Domains.

Resource Database	Resource URL
Scopus	https://www.scopus.com/
Web of Science	https://www.webofscience.com/

This research established specific inclusion and exclusion criteria to select significant studies as exposed below:

Table 4 - Systematic Review's Inclusion and Exclusion Criteria.

Inclusion Criteria	Exclusion Criteria
Evidence of employing Robotic Process Automation (RPA) in Procurement	Publications before 2017
	Language distinct to English
Evidence of employing Business Process Management (BPM) in Procurement	Duplicates
	BPM or RPA applied to other fields than Procurement
	Publication not peer-reviewed
	Q3 or Q4 journals

2.2.2. Realization

The necessity for a systematic review emerges from researchers' imperative to consolidate all available information comprehensively and impartially regarding a particular phenomenon. This endeavor may aim to derive more overarching conclusions about the phenomenon than individual studies permit or may serve as a preliminary step in preparing for subsequent research activities (Kitchenham & Charters, 2007).

To answer the Research Questions, the following section will present an exhaustive analysis of the most important and relevant works. Consequently, the keywords chosen were intended not only to valorize the existing literature, but also to ensure a precise and targeted selection of studies.

In the literature already read was found some words used as synonyms: “Procurement” and “Sourcing”; “Automation” and “Robotic Process Automation”; “Intelligent Process Automation” and “Robotic Process Automation”. Thus, “Supply Chain”, “Business Process Management”, “Automation”, “Business modelling” and “Optimization” will be used to create the search string. Boolean queries were formulated to ideally incorporate one of the statements found in the abstracts, titles or keywords of the articles searched.

Only scientific articles published before 19 November 2023 and in the period from 2017 to 2024 were considered, with an emphasis on addressing recent advances in the fields of Procurement, BPM and RPA.

Table 5 - Search String.

Search String
("Procurement" **OR** "Sourcing" **OR** “Supply Chain”) **AND** ("Automation" **OR** "Robotic Process Automation" **OR** "Intelligent Process Automation") **AND** ("Business Process Management" **OR** "Optimization" **OR** " Business Modeling")

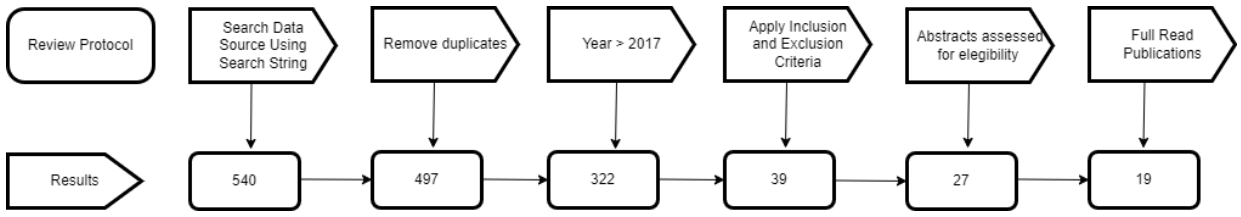

Figure 1 - Review Protocol

2.2.3. Information Extraction

This section analyses the results of research with the search string defined on Table 5. The aim is to review and synthesise existing studies on the subject, providing a context for relating the results of the current work to previous research.

The number of selected papers per year is represented in Figure 2.

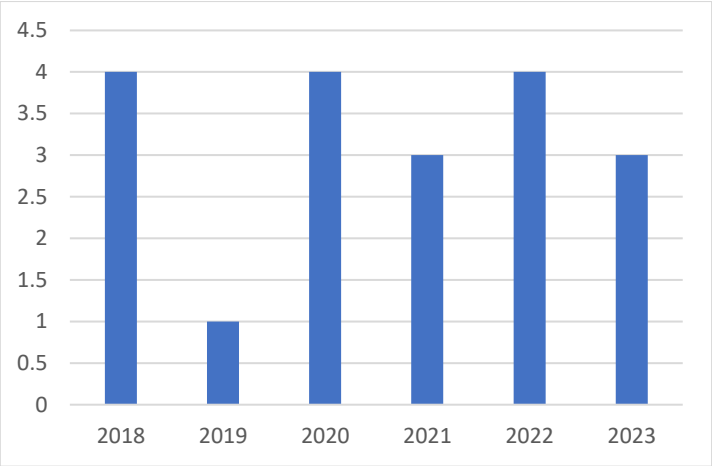

Chart 1 - Selected articles by year

The Journals of the papers are exposed below in table 6.

Table 6 - Paper's Journals

Authors	Title	Source title	Year	Source Quartile
(Chams-Anturi et al., 2022)	A Comprehensive Business Process Management Application to Evaluate and Improve the Importations Practices on Big-box Stores	Operations and Supply Chain Management - An International Journal	2022	Q2
(Tripathi & Gupta, 2020)	A framework for procurement process re-engineering in Industry 4.0	Business Process Management Journal	2021	Q1
(Lazareva et al., 2022)	Business Process Automation in Retail	2022 63rd International Scientific Conference on Information Technology and Management Science of Riga Technical University (ITMS)	2022	
(Impedovo et al., 2023)	Intelligent Robotic Process Automation for Supplier Document Management on E-Procurement Platforms	Machine Learning, Optimization, and Data Science, LOD 2022, Pt I	2023	
(Takeda Berger et al., 2018)	Pull-production system in a lean supply chain: a performance		2018	

	analysis utilizing the simulation-based optimization	2018 13th IEEE International Conference on Industry Applications (INDUSCON		
(Ylä-Kujala et al., 2023)	Robotic process automation deployments: a step-by-step method to investment appraisal	Business Process Management Journal	2023	Q1
(Ore et al., 2021)	Self-managed Organization: A Role of Business Process Management	2021 62nd International Scientific Conference on Information Technology and Management Science of Riga Technical University (ITMS)	2021	
(Bag et al., 2020)	Procurement 4.0 and its implications on business process performance in a circular economy	Resources, Conservation and Recycling	2020	Q1
(Chopra, 2018)	Technology in Procurement and Supply as Prevalent Today and Scope for Future	2018 International Conference on Automation and Computational Engineering (ICACE)	2018	
(Khan & Abonyi, 2022)	Information sharing in supply chains-Interoperability in an era of circular economy	Cleaner Logistics and Supply Chain	2022	Q1
(Dossou, 2019)	Using industry 4.0 concepts and theory of systems for improving company supply chain: the example of a joinery	29th International Conference on Flexible Automation and Intelligent Manufacturing (FAIM 2019): Beyond Industry 4.0: Industrial Advances, Engineering Education, and Intelligent Manufacturing	2019	
(Isaksson et al., 2018)	The impact of digitalization on the future of control and operations	Computers & Chemical Engineering	2018	Q1
(Parker & Grote, 2022)	Automation, Algorithms, and Beyond: Why Work Design Matters More Than Ever in a Digital World	Applied Psychology: An International Review	2022	
(Mukherjee & Ahmad, 2023)	Impact of Digital Transformation in Sourcing & Tender Management Processes on Employee Job Satisfaction - A Study on Malaysian Multinational Electricity Company	2023 1st International Conference on Intelligent Computing and Research Trends, ICRT 2023	2023	
(Chandrasekara & Wickramarachchi, 2020)	A literature-based survey on industry 4.0 technologies for procurement optimization	Proceedings of the International Conference on Industrial Engineering and Operations Management	2020	
(Singh et al., 2020)	The role of artificial intelligence and machine learning in supply chain management and its task model	Proceedings of the 3rd International Conference on Intelligent Sustainable Systems, ICISS 2020	2020	

(Bienhaus & Haddud, 2018)	Procurement 4.0: factors influencing the digitisation of procurement and supply chains	Business Process Management Journal	2018	Q1
(Viale & Zouari, 2020)	Impact of digitalization on procurement: the case of robotic process automation	Supply Chain Forum: An International Journal	2020	Q2
(Flechsig, 2021)	The impact of Intelligent Process Automation on purchasing and supply management – Initial insights from a multiple case study	Springer International Publishing	2021	

After careful reading of the articles found under the search string and filtering according to the proposed criteria, it was possible to build a table where articles vs findings are highlighted. These findings are presented below in Table 7.

Table 7 - Literature Findings

Authors	Article	Findings
(Bienhaus & Haddud, 2018)	Procurement 4.0: factors influencing the digitisation of procurement and supply chains	The findings highlight the advantages of digitizing procurement processes, highlighting benefits such as support for daily tasks, improved decision-making, strategic focus, organizational efficiency, and the creation of innovative business models. The study also underlines the importance of enabling technologies in the digitalization process. This study performs a quantitative approach to understand the impact of digitization in procurement, its main barriers and which technologies are required to leverage the potential of digitization. The conclusions were the following: 1. Employees do not have the required resources or capabilities to support digital transformation 2. RFID technology as well as smart sensors will support the procurement digitization 3. Participants agree that an increase in transparency and traceability will strengthen buyer supplier relationships and the level of trust.
(Viale & Zouari, 2020)	Impact of digitalization on procurement: the case of robotic	The findings analyse the transformative change in procurement processes due to digitalisation and explore the practical implications and impact of robotic process automation (RPA) on procurement functions. It provides

	process automation	empirical evidence of the attributes for procurement automation. This paper provides clear insights into RPA implementation within an organization. By conducting interviews, the major motives for adopting RPA and its major difficulties in implementation are emphasized: 1.RPA adoption allows procurement agents to focus on value added tasks and increase their legitimacy, 2.Helps and relives the procurement agent in terms of workload, 3. RPA does not necessarily lead to job cut, 4. Some procurement agents are afraid of changing their working habits, 5. Maturity and recognition of the procurement function is needed as a prerequisite"
(Flechsig, 2021)	The impact of Intelligent Process Automation on purchasing and supply management – Initial insights from a multiple case study	The findings state that Intelligent Process Automation (IPA) simplifies operations by saving time and costs, enabling informed decision-making, predicting results, and efficiently collecting, preparing, and analysing data. It states that its versatility extends to various operational, tactical, and strategic procurement tasks, promoting standardisation, operational efficiency, process quality and greater employee satisfaction in organisations. This paper also helps to identify the major's issues in IPA adoption on the future development of procurement: the technology, Purchasing and Supply Management function, and PSM employees. This paper states that IPA needs to overcome various technological, organizational, and environmental challenges.
(Chams-Anturi et al., 2022)	A Comprehensive Business Process Management Application to Evaluate and Improve the Importations	Contributions explore the implementation of a Business Process Management (BPM) model in a Colombian big-box store to optimize the import process. The BPM model, on this article, integrated with advanced information systems, promises a 43 per cent reduction in lead times and a projected 30 per cent reduction in default costs. The model increases competitive

	Practices on Big-box Stores	advantages. The BPM application provides accurate indicators of cost overruns, enabling better freight transport and distribution center efficiency. This paper is a proof of the benefits that implementing an BPM approach can lead to an optimization.
(Lazareva et al., 2022)	Business Process Automation in Retail	This paper presents the major opportunities and challenges in Business Process Automation in Retail. In Retail Procurement, this paper emphasizes the activities of processing of purchase orders, processing of invoices and inventory management as opportunities to automation. Process the lack of standardization and change management, are stated as challenges in automation projects as well business process maturity is considered as playing a vital role in supporting organizations and subject matter experts.
(Ylä-Kujala et al., 2023)	Robotic process automation deployments: a step-by-step method to investment appraisal	The paper presents a structured method for evaluating Robotic Process Automation (RPA) investments, addressing the lack of systematic approaches in the field. Using Design Science Research (DSR), the authors develop a step-by-step framework that incorporates process mapping and cost modelling techniques. The approach enables executives and managers to quantify RPA costs and benefits, facilitating comparisons with manual processes. The study contributes to the growing domain of business process management by offering a rigorous and practical approach to RPA investment appraisal, with implications for organizational decision-making and inter-organizational relationships.
(Ore et al., 2021)	Self-managed Organization: A Role of Business Process Management	This paper outlines the emerging trend of self-managed organizations amidst the backdrop of process automation and digitalization. With various titles such as Management 3.0, holacracy, teal organization, or reinventing organization, these models advocate for decentralization of decision-making power and the transition from traditional hierarchical structures to flat, self-organized teams. This paper also aims to initiate a discourse on whether self-managed organizations can benefit from a systematic approach to process management while considering the risks to business process continuity. It argues that Business Process Management, with its methods and practicalities, serves

		as an enabler for successful transition to self-managed organizations. Furthermore, the paper states that when there is no clarity and stability of the process , automation becomes more costly, not bringing as high benefits as it could with process standardization.
(Bag et al., 2020)	Procurement 4.0 and its implications on business process performance in a circular economy	This study aims to explore the impact of Procurement 4.0 and digital transformations on the optimization of procurement processes within the circular economy context, while also examining the moderating effect of information processing capability. The study reveals that Procurement 4.0 positively influences buyers' intentions to optimize business processes, with information processing capability moderating this effect. The managerial implications highlight the importance of developing Procurement 4.0 strategies aligned with sustainable development goals, enhancing Procurement 4.0 reviews, raising awareness among stakeholders, and focusing on circular economy performance measurement. This study supports the Hypothesis that Procurement 4.0 strategy is positively related to intention to optimize the procurement process under the CE.
(Chopra, 2018)	Technology in Procurement and Supply as Prevalent Today and Scope for Future	This paper states that in modern organizations, the role of Information Technology (IT) in procurement varies based on the organization's objectives, industry, and core business activities. I argues that the primary goal of procurement is typically to reduce purchasing costs while optimizing total procurement expenses, streamlining internal processes, ensuring a secure supply chain, and enhancing transparency in cost structures and quality guidelines. Furthermore, this paper states that with the advent of Robotics Process Automation (RPA) and Artificial Intelligence (AI), procurement stands on the brink of significant transformation. The benefits of RPA in procurement include its applicability to both legacy and modern systems, especially for small-scale processes that consume significant resources.

		This paper refers that collaboration among procurement, sourcing, asset management, finance, and vendor relationship management is essential to remain digitally relevant and efficient in the evolving procurement landscape.
(Khan & Abonyi, 2022)	Information sharing in supply chains-Interoperability in an era of circular economy	This paper exposes that the emergence of Industry 5.0 (I5.0) emphasizes data interoperability as a fundamental principle, aligning Supply Chain (SC) visibility research with sustainable objectives in the circular economy context. Employing bibliometric analysis and thematic clustering, the paper elucidates current research contours and future directions, envisioning a cohesive understanding of data sharing's role in SCs, particularly in the transition towards I5.0.
(Dossou, 2019)	Using industry 4.0 concepts and theory of systems for improving company supply chain: the example of a joinery	This paper states that the integration of Industry 4.0 and logistics 4.0 concepts has become imperative for enhancing the competitiveness of European companies amid global challenges, such as increased taskforce costs. This paper also applies simulation to present and test changes required by a joinery company in this context.
(Isaksson et al., 2018)	The impact of digitalization on the future of control and operations	This paper states that the emergence of the Internet of Things (IoT) promises increased integration and connectivity across corporate functions, paving the way for a second digital revolution in industry. This paper delves into ongoing developments and predicts future changes, emphasizing the value of supporting tools for agile and efficient reactions to dynamic environments. It highlights the growing importance of operational optimization and the need for synergistic process control, where operations and control functions coexist seamlessly. It argues that while industry tends to prioritize short- or mid-term product development, academia plays a vital role in inventing, refining, and implementing long-term strategic solutions, guided by research agendas and a willingness to explore risks. Finally, the authors expose that collaboration between academia and industry is essential for addressing practical challenges and driving innovation in the evolving landscape of process control and automation.

(Parker & Grote, 2022)	Automation, Algorithms, and Beyond: Why Work Design Matters More Than Ever in a Digital World	This paper argues that the integration of digital technologies into work environments necessitates a central focus on work design to understand their varied impacts. It states that the implementation of new technologies must consider proactive work design choices, aligning with sociotechnical systems principles and human-centred design - Organizational intervention strategies should be supported by macro-level policies, emphasizing training in work design for stakeholders. The paper continues by exposing that the evolving relationship between humans and AI underscores the need for a renewed focus on creating healthy and productive work environments through joint consideration of technology, people, and organizations.
(Mukherjee & Ahmad, 2023)	Impact of Digital Transformation in Sourcing & Tender Management Processes on Employee Job Satisfaction - A Study on Malaysian Multinational Electricity Company	According to this study, digital transformation entails leveraging emerging technologies to reshape business processes, culture, and user experiences to meet evolving global demands. It states that Job satisfaction is crucial for employee well-being, and directly relates to work-life balance, performance management, job rotation, and skill management. This research focuses on analysing the impact of digital transformation and business process reengineering on employee job satisfaction examining how digital technologies such as business process management, robotic process automation, and natural language processing influence job satisfaction among sourcing and category managers in a Malaysian multinational electricity and utility company. The findings of this study underscore the importance of aligning IT objectives with business strategies and fostering collaboration between business and IT divisions to ensure successful digital implementation and improved employee satisfaction in the procurement sector.
(Chandrasekara & Wickramarachchi, 2020)	A Literature-Based Survey on Industry 4.0 Technologies for Procurement Optimization	This literature-based survey defends that in today's competitive landscape, industries must invest in advanced technology to remain relevant. However, it argues that many falter due to inadequate integration of technology into their supply chain processes. The study continues to affirm that while various Industry 4.0 concepts have been explored across different industrial sectors, limited research has been conducted on their application in procurement. This study conducts a

		thorough literature review spanning 2000 to 2019, identifying emerging technologies like IoT, RPA, Big Data analytics, AI, and cloud technologies relevant to procurement processes. The findings reveal that while web-based applications dominate current procurement practices, interoperability issues persist among systems, especially in cloud environments. Additionally, achieving procurement optimization requires considerations beyond technology, such as technological capabilities, best practices, and supplier and customer capabilities.
(Singh et al., 2020)	The Role of Artificial Intelligence and Machine Learning in Supply Chain Management and its Task Model	This study proposes an optimization technique based on AI to address supply chain management challenges. According to the same, the adoption of deep-learning architectures is poised to revolutionize supply chain processes. Through qualitative research employing document analysis, the study explores the impact of AI on modern supply chains, revealing its pivotal role in enhancing revenue and cost savings : Chatbots streamline procurement processes, while predictive analytics improve market forecasting and reduce operational costs. Smart warehouses enabled by AI technologies contribute to revenue growth, and genetic algorithms optimize logistics chains. The study underscores AI's potential to address complex supply chain challenges and highlights its role in enhancing warehouse operations and logistics management.
(Tripathi & Gupta, 2020)	A framework for procurement process re-engineering in Industry 4.0	This study explores the significance of procurement in supply chain management amid the Industry 4.0 transformation, highlighting the emergence of Procurement 4.0. By amalgamating various technologies, the study proposes a systematic framework for redesigning the procurement process, employing a Business Process Reengineering (BPR) approach. The findings of this study unveil a re-engineered procurement framework promising radical improvements across cost, cycle time, automation, and information availability. The study concludes that Procurement 4.0 heralds a paradigm shift in supply chain operations, necessitating a redefined role for humans and interdisciplinary competencies.
(Impedovo et al., 2023)	Intelligent Robotic Process Automation for	This study starts by stating that E-procurement platforms serve as pivotal marketplaces where buyers engage with numerous suppliers, presenting inherent

	Supplier Document Management on E-Procurement Platforms	risks due to potential misinformation. It argues that supplier document management is a critical aspect of procurement, prompting the adoption of Intelligent Robotic Process Automation (RPA) empowered by Machine Learning (ML) to streamline operations. This study proposes a novel approach leveraging RPA with ML models to automate supplier document management, fostering intelligent procurement practices.
(Takeda Berger et al., 2018)	Pull-production system in a lean supply chain: a performance analysis utilizing the simulation-based optimization	This study uses a Simulation-based optimization (SBO) approach to navigate the complexities of modern supply chains. This study evaluates the implementation of pull-production systems within a lean supply chain, comparing it to the existing push-production approach. The findings indicate that SBO significantly outperforms the current scenario, showcasing its potential for enhancing operational efficiency. It states that integrating lean practices throughout the supply chain, organizations can bolster responsiveness and reduce logistical costs.

Having completed the search for the information needed for the study, the author now moves on to analysing the results of that search. Next, we present the analysis of each of the articles included, with the aim of recovering the main contribution of each work and finding the answers to the research questions.

RQ1 - How can companies enhance their recognition and understanding of the value of Procurement processes?

Florien Bienhaus and Abubaker Haddud (2018) conducted a survey revealing that respondents perceive Procurement activities as capable of assuming an expanded role within organizations. This expanded role involve the collection, analysis, and processing of data across both internal and external environments (Bienhaus & Haddud, 2018). The survey participants considered Procurement to be strategically positioned as an interface contributing to organizational efficiency, effectiveness, and profitability. Additionally, Bienhaus & Haddud (2018) underscored the benefits of digitizing procurement processes, which include improved decision-making, strategic alignment, and increased organizational efficiency.

Thus, Mukherjee & Ahmad (2023) discussed the impact of digital transformation on employee job satisfaction, stressing the importance of aligning IT objectives with business strategies. According to these authors, digital transformation entails leveraging emerging technologies to reshape business processes, culture, and user experiences to meet evolving global demands. By focusing on analysing

the impact of process digitization, using technologies such as RPA, BPM, NLP, in job satisfaction levels in procurement roles, a positive impact is evaluated. According to these authors, in the aftermath of the Covid-19 pandemic, Procurement Digitalization will become increasingly crucial as organizations seek enhanced operational efficiency while managing costs effectively (Mukherjee & Ahmad, 2023).

In today's globalized era, Sourcing & Procurement isn't a one-off endeavor but an ongoing process crucial for strategic organizations (Mukherjee & Ahmad, 2023) . Therefore, sourcing must evolve into a strategic initiative, ensuring it's executed in the most optimized manner to foster long-term growth (Mukherjee & Ahmad, 2023). Chams-Anturi et al. (2022) highlighted the importance of implementing Business Process Management (BPM) models, which can lead to reductions in lead times and costs. This is a clear step towards process improvement within an organization and a clear sight where technological frameworks can enhance the value of procurement processes.

Optimizing procurement will aid in minimizing material waste and enhancing inventory management efficiency (Chandrasekara & Wickramarachchi, 2020). It is important to understand the management role in enhancing the company's recognition and understanding of the value of digitizing Procurement processes. It is crucial to acknowledge that when there is no clarity and stability of the process , automation and digitization becomes more costly, not bringing as high benefits as it could with process standardization (Ore et al., 2021).

The Procurement's variance - Electronic procurement, also known as e-procurement - is the business-to-business (B2B) requisitioning, ordering and purchasing of goods and services over the internet (Chandrasekara & Wickramarachchi, 2020). E-procurement platforms serve as pivotal marketplaces where buyers engage with numerous suppliers, presenting inherent risks due to potential misinformation (Impedovo et al., 2023).

The primary goal of procurement is typically to reduce purchasing costs while optimizing total procurement expenses, streamlining internal processes, ensuring a secure supply chain, and enhancing transparency in cost structures and quality guidelines (Chopra, 2018). Furthermore, in the advent of Robotics Process Automation (RPA) and Artificial Intelligence (AI), procurement stands on the brink of significant transformation.

Even though several authors state that digitizing procurement is beneficial to the organization, and there is a acknowledge of the employees on that, there are still some barriers to be overcome, namely the fact that the majority of the employees do not have the required resources or capabilities to support digital transformation (Bienhaus & Haddud, 2018)

Companies can enhance their recognition and understanding of procurement value through digitization, BPM implementation, and aligning IT objectives with business strategies. These initiatives empower companies to optimize procurement processes, drive operational excellence, and deliver value across the supply chain. Moreover, "*in order to succeed in this area, organisations need to provide training and define a common mindset towards the digital transformation*" (Bienhaus & Haddud, 2018).

RQ2 - Which value does having procurement processes optimized to the organization?

Having procurement processes optimized to the organization offers significant value in terms of operational efficiency, cost savings, informed decision-making, and employee satisfaction.

Flechsig (2021) emphasizes that Intelligent Process Automation (IPA) simplifies operations, saving time and costs, enabling informed decision-making, and enhancing data analysis. IPA's versatility extends to various procurement tasks, promoting standardization, efficiency, and quality while enhancing employee satisfaction. Furthermore, Bag et al. (2020) discuss the impact of Procurement 4.0 on optimizing business processes within the organization context. The authors found that Procurement 4.0 positively influences buyers' intentions to optimize processes, emphasizing sustainable development goals. This underscores the value of aligning procurement strategies with organizational objectives and long-term sustainability goals (Bag et al., 2020).

On other half, Isaksson et al. (2018) delve into the emergence of the Internet of Things (IoT) and its potential for operational optimization in industry. In this case, the authors highlighted the importance of supporting tools for agile reactions to dynamic environments and emphasized the role of academia and industry collaboration in driving innovation. This indicates that optimized procurement processes leverage technology and collaboration to enhance operational agility and efficiency (Isaksson et al., 2018). However, Flechsig also highlights challenges in technologies adoption, including technological, organizational, and environmental hurdles (Flechsig, 2021).

Takeda Berger et al. (2018) highlighted the effectiveness of simulation-based optimization (SBO) in enhancing operational efficiency within supply chains. By integrating lean practices and optimizing production systems in the process simulation, organizations can reduce logistical costs and improve responsiveness. This is an example of procurement process optimization application.

Tripathi & Gupta (2020) explore the significance of Procurement 4.0 in supply chain management, proposing a systematic framework for redesigning procurement processes. Their findings reveal radical improvements across cost, cycle time, automation, and information availability, highlighting the transformative value of aligning procurement with Industry 4.0 principles (Tripathi & Gupta, 2020).

The importance of implementing Business Process Management (BPM) models into organization environment is becoming to be critical and helpful as it can lead to reductions in lead times and costs (Chams-Anturi et al., 2022). In most cases transition is triggered by inefficiency of current model expressed in business results (Ore et al., 2021). Maintaining current process maps and utilizing business analytics, enables the anticipation of risks associated with the effects of change decisions on dependent processes.

Having the procurement processes optimized, is critical for faster data processing and exchange, time savings, productivity gains and cost savings as well it allows the organization to anticipate risks and costly inefficiencies.

RQ3 - Which value does having procurement processes automated to the organization?

Automating procurement processes brings significant value to organizations by enhancing efficiency, reducing costs, and improving decision-making. Several studies highlighted the opportunities and challenges associated with business process automation in procurement.

Lazareva et al. (2022) emphasizes the potential for automation in retail procurement, particularly in activities like processing purchase orders, invoices, and managing inventory. However, they also identify challenges such as standardization issues and change management (Lazareva et al., 2022).

On other approach, Ylä-Kujala et al. (2023) presented a structured method for evaluating investments in Robotic Process Automation (RPA), offering executives and managers a systematic approach to quantify costs and benefits. This contributes to better decision-making regarding RPA adoption – a type of automation - and its impact on organizational relationships (Ylä-Kujala et al., 2023).

Chandrasekara & Wickramarachchi (2020) underscore the importance of integrating advanced technologies like IoT, RPA, and AI into procurement processes. They emphasize that while these technologies offer significant benefits, their successful implementation requires considerations beyond technology, including technological capabilities and best practices (Chandrasekara & Wickramarachchi, 2020).

Singh et al. (2020) discussed the transformative impact of AI on supply chain management, including procurement processes. AI technologies such as chatbots and predictive analytics streamline procurement tasks and improve market forecasting, leading to cost savings and revenue growth. Furthermore, Chopra (2018) stressed that the primary objective of digitizing procurement is to remove physical barriers and streamline stakeholder interactions, ultimately freeing up resources for more valuable tasks. The aim of digitization in procurement is to eliminate physical barriers and streamline interactions among stakeholders, thus freeing up resources for more valuable tasks. (Chopra, 2018)

As several authors defend and prove, automating procurement processes with the use of a variety of technologies, brings tangible benefits to organizations, including increased efficiency, cost savings, and improved decision-making capabilities.

RQ4 - Which are the Procurement processes that cannot be automated or semi-automated?

The procurement processes that cannot be fully automated or semi-automated include those that lack standardization, involve significant change management, or require a high level of subject matter expertise.

In the study by Lazareva et al. (2022), it is emphasized that in Retail Procurement, processes such as processing purchase orders, invoices, and inventory management are identified as opportunities for automation. However, the paper also highlights challenges related to the lack of standardization and change management in automation projects. These challenges suggest that certain procurement processes may not be easily automated or semi-automated due to their complexity and variability (Lazareva et al., 2022).

Moreover, Ore et al. (2021) discuss that without clarity and stability in processes, automation can become more costly and may not yield the expected benefits. This implies that complex procurement processes requiring flexibility and adaptability may be less amenable to full automation.

Parker & Grote (2022) discussed the integration of digital technologies into work environments and emphasize the importance of considering proactive work design choices. They highlight the need for human-centred design principles and organizational intervention strategies to create healthy and productive work environments amidst the evolving relationship between humans and AI.

2.3. DISCUSSION

Based on this analysis, it can be inferred that certain procurement processes may resist full automation or semi-automation due to their complexity, reliance on human judgment, or dynamic nature. Processes that involve nuanced decision-making, negotiation, and strategic supplier relationships may require human intervention and expertise that cannot be entirely replicated by automated systems. Additionally, tasks that involve creative problem-solving, adaptability, and interpersonal skills may also be challenging to automate fully. While many procurement processes can benefit from automation, there are aspects of procurement that inherently require human involvement and cannot be fully automated or semi-automated. These include tasks that demand human judgment, strategic thinking, and interpersonal interaction, highlighting the continued importance of human involvement in procurement processes.

The literature review reveals a consensus among researchers regarding the transformative potential of digitizing procurement processes. Bienhaus & Haddud (2018) assert that companies perceive procurement as strategically positioned for organizational efficiency, effectiveness, and profitability. Mukherjee & Ahmad (2023) further elaborate on the benefits of digital transformation in procurement, emphasizing the alignment of IT objectives with business strategies and the adoption of technologies such as RPA and BPM. This underscores the importance of organizations recognizing and understanding the value of digitizing procurement processes to drive operational excellence and adaptability. Despite the evident benefits, challenges in technology adoption and organizational change management, as also highlighted by Flechsig (2021) and Ore et al. (2021), underscore the need for a systematic approach to implementation. Successful optimization requires not only technological integration but also cultural and organizational alignment to ensure effective outcomes.

Successful automation implementation necessitates considerations beyond technology, as emphasized by Chandrasekara & Wickramarachchi (2020). Organizational capabilities, change management, and stakeholder engagement play critical roles in ensuring the successful adoption and integration of automated procurement processes.

While digitization and automation offer significant opportunities for enhancing efficiency and driving organizational success, they also present challenges that require careful consideration and strategic planning. By aligning technological investments with organizational objectives, fostering a culture of innovation and collaboration, and prioritizing human-centred design principles, organizations can leverage the synergy of RPAS and BPM to achieve optimized efficiency in procurement processes.

3. METHODOLOGY

Aiming to develop a framework utilizing Business Process Management (BPM) to model a Procurement process and Robotic Process Automation (RPA) to automate it while ensuring compliance and efficiency, the study will employ the Design Science Research (DSR) Methodology. Likewise, this thesis aims to obtain an artifact as output.

Design Science Research Methodology (DSRM) is a systematic approach aimed at developing and evaluating artifacts tailored to address specific problems (Peffers et al., 2007). This methodology, widely acknowledged in research, utilizes design as a core tool to advance both practical outcomes in the form of solutions and theoretical knowledge, thus enhancing design processes (Suero Montero & Kapinga, 2019).

DSRM underscores the creation of tangible solutions that can be implemented and tested in real-world settings, focusing on resolving concrete problems through the design of artifacts (Knauss, 2021). Its structured process aligns with the principles of design science, emphasizing innovation and the evaluation of solutions to practical challenges (Baghi et al., 2014).

By adhering to the principles of DSRM, the development of innovative solutions that contribute not only to the advancement of knowledge but also to the creation of valuable artifacts aimed at addressing real-world problems (Cronholm & Göbel, 2015) can be fostered. This approach ensures the rigor and relevance of research endeavors, ultimately enhancing understanding and application of design science principles in various domains.

3.1. DESIGN SCIENCE RESEARCH METHODOLOGY (DSRM)

Design science strives to enhance solutions for practical challenges, ultimately aiming to achieve utility (Cleven et al., 2009).

DSRM provides a structured framework for the development and evaluation of artifacts tailored to address specific problems, making it a suitable approach for creating innovative solutions (Peffers et al., 2007). By adhering to the principles of DSRM, researchers can design and implement artifacts aimed at improving procurement processes through the integration of Business Process Management (BPM) and Robotic Process Automation (RPA), aligning with the critical role of design-science research in expanding Information Systems capabilities into new domains (Hevner et al., 2004).

Real-world case studies illustrate the practical applicability of action principles and present research opportunities in the adoption of RPA within procurement, thereby contributing to the empirical research landscape on RPA in supply chain management (van Hoek et al., 2022)

By exploring the implications of RPA and BPM using DSRM, valuable insights into the transformative potential of automation technologies within procurement processes (Khan & Abonyi, 2022) can be gain. This structured approach enables researchers to systematically investigate and understand the role of RPA in optimizing procurement operations, thereby contributing to both theoretical knowledge and practical applications in the field.

Design science research has a fundamental objective: to generate prescriptive knowledge capable of guiding the development of practical solutions and informing decision-making processes across various domains (Lange et al., 2017). This research paradigm focuses on creating and evaluating artifacts that provide tangible solutions to real-world problems, with a strong emphasis on utility, innovation, and the advancement of scientific knowledge. Central to Design Science Research Methodology (DSRM) is the development of constructs, models, methods, and instantiations specifically tailored to address identified problems. Researchers adhering to the principles of DSRM strive to design innovative solutions capable of being implemented and tested in real-world settings. This structured approach ensures that the outcomes of design science research are not only theoretically sound but also practically applicable, contributing to meaningful advancements in various fields (Sangupamba Mwilu et al., 2016).

The methodology applied in this thesis consists of Peffers et. al (2007)'s DSR Methodology, namely, a "structured process, though nominally sequential "consisting of six activities (Table 8).

This referred nominally structured process, however, can be initiated at "almost any step and move outward" (Peffers et al., 2007). A problem-centered approach starts with Activity 1, alternatively, an objective-centered approach would start on Activity 2, design and development-centered approach would start on Activity 3 and client-/context-initiated would start on Activity 4.

Table 8 - DSR Method Activities (Peffers et al., 2007)

ACTIVITY	DESCRIPTION
1	Problem identification and motivation.
2	Define the objectives for a solution.
3	Design and development
4	Demonstration.
5	Evaluation.
6	Communication.

Regardless of these steps will be adjusted to this research, this section contains a brief description of each stage.

Activity 1 - Problem identification and motivation

This activity involves identifying and motivating the problem. The goal is to define the research problem and justify the need for a solution. The aim is to conceptually break down the problem to ensure the solution captures its complexity. Resources needed include knowledge of the problem's status and its significance (Hevner et al., 2004).

Activity 2 - Define the objectives for a solution

This activity involves defining solution objectives. These objectives can be quantitative or qualitative, aiming for improvements or addressing previously unmet needs where rational inference from the problem specification is crucial. Resources needed include knowledge of existing problems, current solutions, and their effectiveness (Peffers et al., 2007).

Activity 3 - Design and development

This activity involves the design and development of the artifact, which can be constructs, models, methods, or instantiations. In essence, it's any designed object with embedded research contribution. Resources include theoretical knowledge applicable to the solution's development (Eekels & Roozenburg, 1991; Hevner et al., 2004; Peffers & Tuunanen, 2005).

Activity 4 - Demonstration

This activity aims to exhibit the artifact's utilization in solving problem instances, through experimentation, simulation, case studies, or proofs. Essential resources encompass proficient knowledge on effectively applying the artifact to address the problem at hand previously defined (Eekels & Roozenburg, 1991; Peffers & Tuunanen, 2005).

Activity 5 - Evaluation

In this activity the goal is to assess the artifact's effectiveness in addressing the problem by comparing solution objectives with observed results from artifact utilization, utilizing relevant metrics and analysis techniques. Researchers may iterate back to activity 3 for artifact enhancement or proceed to communication based on evaluation outcomes (Eekels & Roozenburg, 1991; Peffers & Tuunanen, 2005).

Activity 6 - Communication.

In this activity, it is expected to convey the problem's significance, the artifact's utility and novelty, its rigorous design, and effectiveness to relevant audiences, including researchers and professionals (Hevner et al., 2004). In this step, the thesis document will be the main communication result.

Furthermore, the DSRM model as a structured approach is represented in Figure 2, for reference.

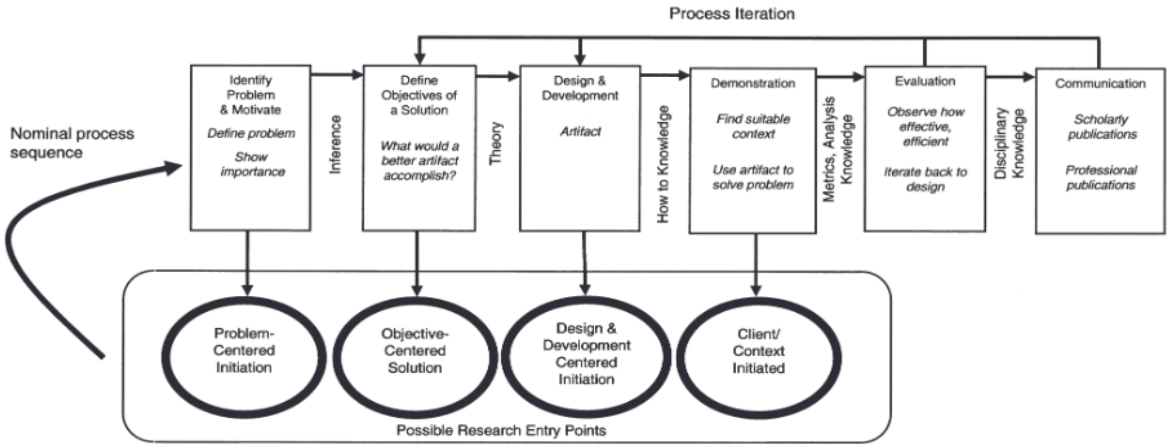

Figure 2 - DSRM Process Model (Peffers et al., 2007)

3.1.1. Research Model

The preceding discussions delved into the broad utilization of DSR and DSRM. This section, however, is dedicated to elucidating how DSR will be implemented in this thesis.

Thereby, firstly, it was necessary to **define the problem** as well its **motivation**. Furthermore, it was required to **design** the **objectives for a solution** concerning the main problem recognized. This exposer was made under Chapter 1.2 in the present document as elucidated in Figure 4.

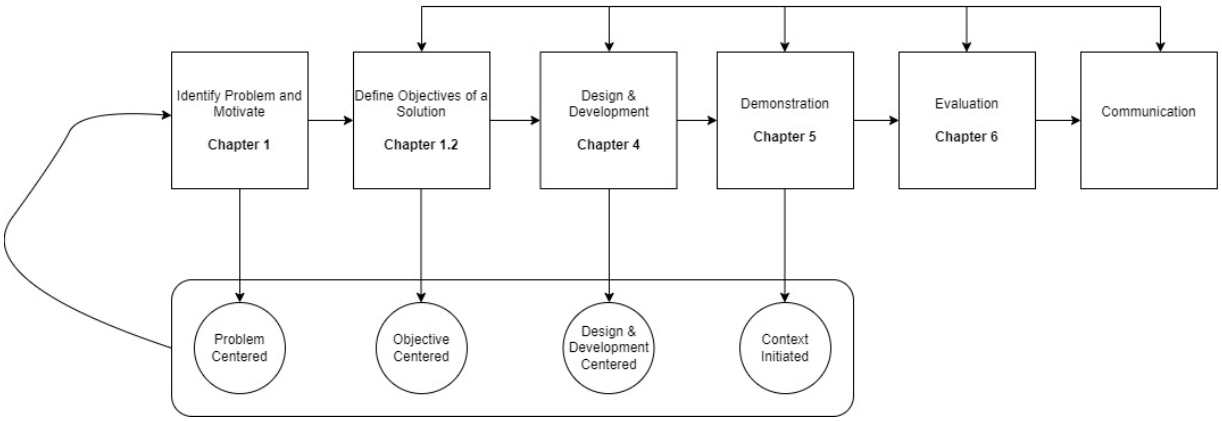

Figure 3 -DSRM applied in this thesis (Peffers et al., 2007)

In the context of Activity 3 – **Design and Development** the artifact creation will be performed using the instruments Bizagi and UiPath, where it is expected to firstly design a BPM framework where heuristics will be employed into its improvement, and secondly fully automate the proposed process using RPA.

In the **Demonstration** activity it is expected to experiment and to provide proofs of the working framework created.

In the **Evaluation** activity, an assessment of the artifact's effectiveness in addressing the problem will be held by comparing solution objectives with observed results from artifact utilization.

Communication stage will be held once the publication of this Thesis takes place.

4. DESIGN AND DEVELOPMENT

In this chapter, the design and development of the artifact will be reported. As a first step, a process contextualization will be held, and the Process Design Document will be elaborated.

Essentially, it will be deployed a BPM analysis, followed by its heuristic's application, and finalized by an automation framework orchestration.

4.1. PROCURE-TO-PAY PROCESS

In mature organizations, the objectives of the procurement function go beyond acquiring goods or services to meet internal demand. Excellence management of procurement involves several key objectives, including ensuring a continuous supply, developing a pool of qualified suppliers, aligning objectives with other internal functions, and continuously improving the Procure-to-Pay process. This involves active management participation, thorough process analysis, ongoing stakeholder training, and a deep understanding of various departments' procurement needs (Monczka et al., 2021)

The Procure-to-Pay process, integral to procurement operations, encompasses all activities related to fulfilling the organization's goods and services requirements. Despite its universal presence, this process poses ongoing challenges in maintaining desired service levels for internal customers, ensuring efficient communication with suppliers, accurately matching accounting documents with purchase orders, and timely supplier payments. Consequently, the absence of a formalized Procure-to-Pay process and failure to meet its functional requirements lead to errors and deviations from the operational model, resulting in financial implications for the organization (Monczka et al., 2021).

Although the Procure-to-Pay process may not offer significant strategic value, its proper formulation and standardization are crucial for ensuring an efficient and measurable operational framework. Moreover, streamlining Procure-to-Pay activities enables organizations to redirect resources towards more value-added endeavors, fostering innovation and setting them apart from competitors (Monczka et al., 2021).

The Procure-to-Pay process proposed as a linear model by Bäckstrand, represents purchasing as a linear sequence of six steps divided into a tactical part and an operational part as depicted in Figure 5 (Bäckstrand et al., 2019). From Figure 5, we can retrieve the six mentioned steps as below.

Specification, selection, and contracting and ordering, monitoring, and evaluation.

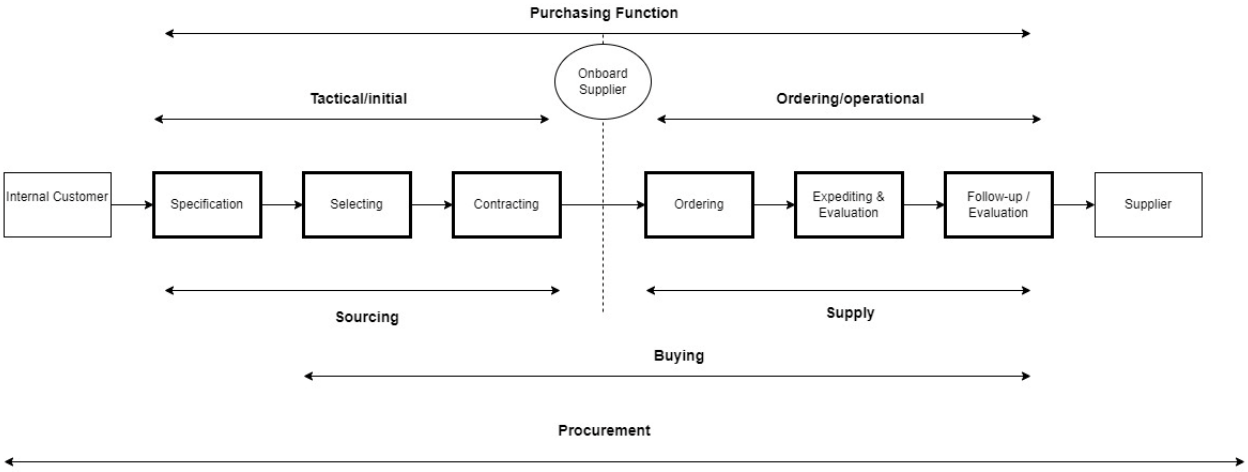

Figure 4 -Procure-to-pay process as a linear model (adapted from Bäckstrand et al., 2019).

After receiving an internal requisition, the identified requirement can be fulfilled in two ways: either through an existing contract or predetermined pricing arrangement with a supplier, which is often linked to recurrent purchases, or by engaging with a new supplier that meets the organization's criteria (Monczka et al., 2021)

In the latter case, conducting a market search for new suppliers becomes necessary. This search involves evaluating various suppliers through requests for quotations and negotiation procedures. Moreover, to assess the suitability of a potential new supplier, the organization should consider factors such as price, quality, and level of service, as per its predefined criteria (Monczka et al., 2021).

The Specification phase entails defining procurement strategies while the Selection phase entails evaluating proposals based on a predefined criterion. The Contracting part, in the tactical strain on the Procure-to-Pay process, includes negotiation of terms and finalizing agreements with suppliers. Before the ordering activity, the supplier, once the agreement is finalized, needs to be onboarded into the company's system. In this way, all the vendor's information is storage making possible to initiate the ordering process.

This Master Thesis will focus in automating the last-mentioned step – the vendor onboarding process into the company's system.

4.2. DESIGN

Automating a flawed process can make existing problems worse and create additional negative outcomes. When a flawed process is automated, it can spread errors more quickly and on a larger scale (Marcilly et al., 2015). If automation is applied to flawed processes without proper validation and correction, it can uncover more defects but might not improve the overall quality or reliability of the system (Sivaji et al., 2011).

The need to have an improved process emerges as a faulty automated process aggravates the negative outcome as stated.

4.2.1. Process Design Document

The importance of having documentation that records and specifies all information related to the automated process has been highlighted in the literature (Anagnoste, 2017). This document is referred to as the Process Definition Document (PDD), and creating this document should be the first step in the process (Yatskiv et al., 2020)

According to Blue Prism (2021), the PDD is a manual that gathers information about the business process and should have the following characteristics: clarity, precision, detail, explicitness, and thoroughness (BluePrism, 2021). The PDD describes the sequence of steps necessary for the business processes, the conditions, and rules of the process before automation, and forecasts its operation, serving as a basis for RPA developers (UiPath, 2024b) Its usefulness is justified by the following reasons:

- It helps estimate the work involved in automating a process, allowing the evaluation of the process's complexity and the necessary interface components.
- It enables the developer to build the robot, helping align the manual execution of the process with the automated execution.

Based on the templates recommended by the RPA providers mentioned, a PDD proposal was developed to meet the usage and application within the proposed framework. Table 9 presents the PDD proposal with the topics and subtopics and their respective descriptions.

Table 9 - Process Design Document Proposal

(Prepared by the author)

INDEX	DESCRIPTION
1. INTRODUCTION	• Brief process description, mentioning how is it manually executed.
2. ROLES AND RESPONSABILITIES	• Actors' identification of the manual and automatized process. Brief roles description
3. PROCESS FRAMEWORK	• Process details. • Execution tools.
4.1 AS-IS PROCESS DISCOVERY	• Identification and description of the activities and tasks of the process, with a high level of detail; use of screenshots whenever necessary, specifying data handling or uploading;
4.2 AS-IS PROCESS MODELLING	• Insertion of the process model in BPMN 2.0
4.3 PROCESS REDESIGN	• BPM's Heuristics application
4.4 TO-BE PROCESS MODELLING	• Insertion of the process model in BPMN 2.0 created in step 4.3 of the current PDD and identification of automated and non-automated activities.
5. MANUALLY PERFORMED TASKS	• Set of activities that must be performed manually due to RPA limitations

4.2.2. Introduction

a) Input: request with specifications made by email
b) Output: submitting a ticket to the specialized Supplier Data Management team and advise requestor its completion.
c) The AS-IS process can be shortened in 4 main aspects.
    i. The process input is made by an internal requestor via email without following a specific format.
    ii. The Ticket-to-Resolution process is performed by 2 teams.
    iii. The input comes via email, then a ticket is open by Digital & Support Team and finally the ticket is actioned by Supplier Data Management Team
    iv. The completion of the process is reached once Supplier Data Management Team performs all the requested actions.

4.2.3. Roles and Responsibilities

In this sub-chapter, the process participants will be stated. The roles and responsibilities in the process, as its denomination, are figured in Table 10 below.

Table 10 -Roles and Responsibilities (Prepared by the author)

Denomination	Role	Responsibility	Scope	Contact
D&S team	Process Owner	Process Management	Digital & Support Team	xxxx
D&S team	Process Executor	Process Execution	Digital & Support Team	xxxx
Requestor	Requestor	Requests Placement	Any internal Procurement colleague	xxxx
SDM team	Process Intervenient	Takes part of the process	Supplier Data Management Team	xxxx

4.2.4. Process Framework

The proposed process to be modelled and improved is detailed in Table 11 below.

Table 11 - Process details (Prepared by the author)

ITEM	DESCRIPTION
PROCESS NAME	Vendor Creation into organization's system
DEPARTMENT	Procurement – Tactical Sourcing Channels
SHORT PROCESS DESCRIPTION	Consists of creating new suppliers in the organization's internal system
REGULARITY	Daily
SERVICE LEVEL AGREMMENT	2 business days
# OF REQUESTS PER REFERENCE REGULARITY	15
MONTHLY REQUESTS VOLUME (22 BUSINESS DAYS)	330
INPUT	Requestor's email
OUTPUT	Ticket completion

It is also important to refer which applications will be used in the process by the automation itself. These are exposed in Table 12.

Table 12 - Applications used in the process (Prepared by the author)

Tool	Type of tool	Comments
Outlook	Windows Application	NA
Power Apps	Windows Application	SDM team ticketing tool

4.2.5. AS-IS Process Discovery

The AS-IS activities are represented in Table 13 below.

Table 13 - Activities Description - AS-IS (Prepared by the author)

#	Activity Name	Actor	Activity description	Average Execution Time	Risks
1	Send the request information to the D&S Team inbox	Requestor	The requestor sends an email with the request to D&S Team.	N/A	N/A
2	Open the request and analyze the request type	D&S team	The D&S team analysis the request and filters if it is a vendor creation type of request.	30 seconds	N/A
3	Validate the request information	D&S team	The D&S team checks all the provided information for vendor creation.	1 minute	N/A
4	Send an email to validate request information	D&S team	In case there is missing or faulty information, the D&S Team clarifies by sending an email to the Requestor.	1 minute	N/A
5	Corrects information	Requestor	The Requestor proceeds to correct the information.	N/A	Possibility of receiving incorrect

					information again
6	Save requestor's email in .msg format	D&S team	The D&S team saves the received email with the request to a local folder.	30 seconds	Possibility of not saving in the correct format.
7	Access SDM team ticketing tool	D&S team	The Power Apps based ticketing tool is accessed.	15 seconds	N/A
8	Fill the required fields with the provided information	D&S team	All required fields are filled with the information provided by the requestor.	4 minutes	Humam error possibility;
9	Attaches the previous saved email	D&S team	The email containing request information and (if that is the case) the corrections, is attached.	15 seconds	Possibility of forgetting to attach the email.
10	Submit the ticket to SDM team	D&S team	The ticket is submitted to SDM team.	N/A	N/A
11	Retrieve Ticket ID and send to the requestor	D&S team	The Ticket ID is retrieved and sent in the email chain to the requestor.	1 minute	N/A
12	Request Fulfillment	SDM team	A period of 72 working hours is allowed to the ticket to be fulfilled by SDM team.	24h-72h (working hours)	N/A
13	Send completion status to the requestor	D&S team	The completion status of the request is communicated to the Requestor.	1 minute	N/A

4.3. TOOLS

In the previous chapter, the process AS-IS was described. In this chapter, the design tools used in this Master thesis will be referred and presented. The tools will be described to enable further researchers to replicate this study and to provide transparency and rigor to the document.

The innovative methods and technologies used in this artifact's design, contribute to the advancement of Procurement by showcasing new approaches or applications that others might adopt or refine. In the artifact design phase of this thesis, Bizagi Modeler and UiPath Studio were employed to model the subsequent described business process and automate repetitive tasks. These tools were selected due to their robust features, ease of use and industry acceptance in BPM and RPA.

The current processes were first mapped using Bizagi Modeler. Key inefficiencies and bottlenecks were identified through this detailed visualization and optimized. Tasks within the optimized processes that were repetitive and rule-based were identified for automation. UiPath Studio was used to create automation scripts that executed these tasks.

4.3.1. UiPath

According to the 2023 Gartner report, the most important RPAs players are: Automation Anywhere, UiPath, SS&C Blue Prism, Microsoft and NICE (Gartner, 2023).

According to Gartner (2023), evaluations of the top RPA solutions were outlined in the 2023 Gartner Magic Quadrant for Robotic Process Automation report. This evaluation considered factors such as market impact, vision, and capability, as depicted in Figure 5.

Figure 5 -Gartner Magic Quadrant for RPA (08/2023)

UiPath, initially founded in Romania in 2005, now headquartered in New York, has become the world's leading RPA platform. By 2024, it boasted to 2,000,000 users (UiPath, 2024a) .

This solution primary objective is to assist its customers in automating manual and repetitive tasks swiftly and cost-effectively.

While UiPath offers a wide range of products, the focus of this thesis will be on UiPath Studio, a development tool.

4.3.2. Bizagi

According to numerous studies, Bizagi significance in both modelling business processes and executing process enhancements makes it a widely utilized software tool renowned for business process modelling and enhancement across diverse sectors (D'avila et al., 2023; Maukar & Fiasta, 2023; Pamungkas & Fajar, 2022; Panduwinasari et al., 2021).

Bizagi has been instrumental in crafting process models, conducting simulations, and generating diagrams to visualize and optimize workflows (D'avila et al., 2023; Pamungkas & Fajar, 2022). The software empowers dynamic business process modeling and simulation based on rules and context, enabling flexible and efficient business process management (Vasilecas et al., 2016).

Bizagi is a Low-Code platform which empowers users enabling companies to organize systems, people, bots, and data, increasing efficiency and agility throughout the enterprise (Bizagi.com, 2024). According to the 2024 February released Software Review of Info Tech Research Group for Business Process Management, Bizagi BPM had a 8.5 composite score out of 10, positioning itself as a market leader in this category (Figure 7) (SoftwareReviews, 2024).

Figure 6 -BPM Data Quadrant (02/2024). Source: InfoTech Research Group website

Bizagi Process Modeler was selected as the preferred tool for the modeling stages due to its ability to meet all thesis requirements. It was chosen for its user-friendly interface, availability at no cost, and capability to model processes using BPMN standards. While Bizagi is powerful for process

modeling, it does not execute processes, necessitating integration with other tools, namely UiPath, for process automation.

4.4. AS-IS Process Modelling

This chapter focuses on modeling the current state, or AS-IS process, using BPMN 2.0. This is a phase that provides the detailed representation of how activities, decisions and interactions currently occur within the process itself.

With this representation, it is possible to gain insights into inefficiencies and areas of improvement. The structure and subsequent chapters in this thesis are outlined, previewing how the AS-IS process model will be used to derive the TO-BE model and propose recommendations for process enhancement.

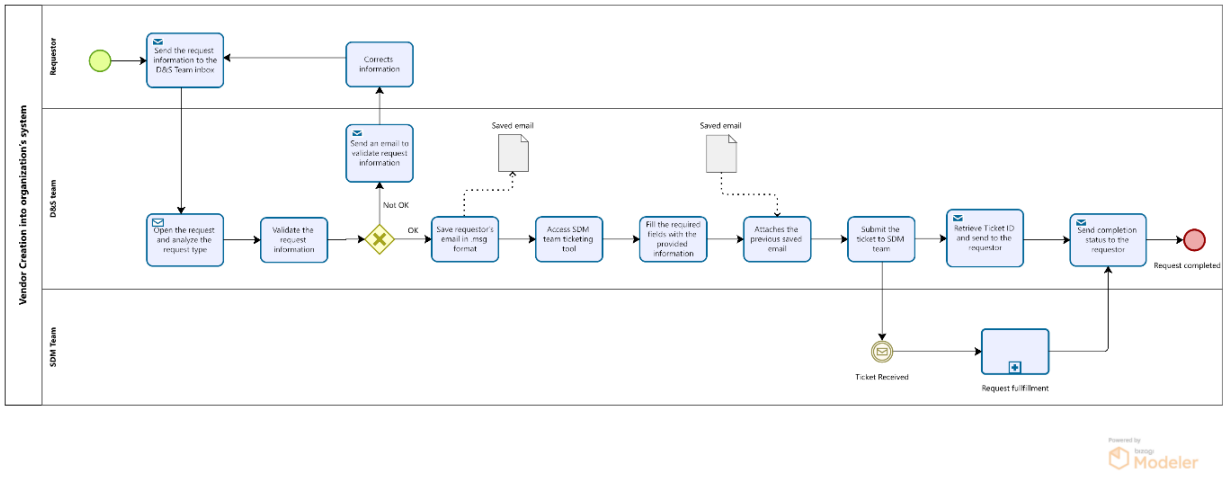

Figure 7 -BPMN 2.0 Model - AS-IS (Prepared by the author)

For better reading, Figure 7 is also available in Annex 1.

4.5. PROCESS REDESIGN

In this phase the author will summarize the used heuristics application into the process redesign and propose a new framework to the process.

A heuristic can be considered a rule of thumb for redesigning a process.

- Used Task-Level Redesign Heuristic:
    - Elimination: Eliminate non-value-adding steps wherever these can be isolated. This heuristic will be applied to the “Send completion status to the requestor” task. By including the requestor’s email into the Camunda’s loop message on ticket progress, the author will eliminate the necessity of informing parallelly the requestor about the raised ticket status.

- Used Flow-Level Redesign Heuristics:
    - Parallelism Enhancement: Introducing parallel processing of tasks to reduce lead times and enhance throughput. “Retrieve Ticket ID and send to the requestor” and “Request Fulfilment” activities will be processed parallelly preceding the request completion.
- Used Process-Level Redesign Heuristics:
    - Automation: Implementing automated solutions to repetitive or manual tasks to increase speed and accuracy. Considering the characteristics of the process, it was proposed to automate nearly the entire process.
    - Standardization: Tailoring processes to specific needs while standardizing common elements to ensure consistency and quality: A form will be launched for the D&S Team to fill in with the requestor's provided information, which will then be saved as variables for the robot. The fields will always appear in the same order and contain the necessary information to proceed. This approach reduces the likelihood of missing information.

In Table 14, we can find the proposed framework with heuristics application, here on TO-BE.

Table 14 - Activities Description - TO-BE (Prepared by the author)

#	Activity Name	Actor	Activity description	Risks
1	Send the request information to the D&S Team inbox	Requestor	The requestor sends an email with the request to D&S Team.	N/A
2	Open the request and analyze the request type	D&S team	The D&S team analysis the request and filters if it is a vendor creation type of request.	N/A
3	Validate the request information	D&S team	The D&S team checks all the provided information for vendor creation.	N/A
4	Send an email to validate request information	D&S team	In case there is missing or faulty information, the D&S Team clarifies by sending an email to the Requestor.	N/A
5	Corrects information	Requestor	The Requestor proceeds to correct the information.	Possibility of receiving incorrect information again
6	Save requestor's email in .msg format	D&S team	D&S team saves the received email with the request to a local folder saving as a variable to be used by the robot	N/A
7	Fill the Robot's input form	D&S team	A form will be launched to be filled with requested information which will then be saved as variables for the robot	Human Error Possibility
8	Access SDM team ticketing tool	Robot	The Power Apps based ticketing tool is accessed by the robot.	N/A
9	Fill the required fields with the provided information	Robot	Robot fills all required fields with the information provided by the requestor.	N/A

10	Attaches the previous saved email	Robot	The email containing request information and (if that is the case) the corrections, is attached by the robot.	N/A
11	Submit the ticket to SDM team	Robot	Robot submits the ticket to SDM team.	N/A
12	Retrieve Ticket ID and send to the requestor	D&S team	The Ticket ID is retrieved and sent in the email chain to the requestor.	N/A
13	Request Fulfillment	SDM team	A period of 72 working hours is allowed to the ticket to be fulfilled by SDM team.	N/A
14	Send completion status to the requestor	D&S Team	The completion status of the request is communicated to the requestor.	N/A

4.5.1. TO-BE Process Modelling

Building upon the foundation established in chapter 4.4, this section focuses on modeling the future state, or TO-BE process, using BPMN 2.0. The TO-BE modelling phase is pivotal as it envisions optimized workflows and improved outcomes based on identified opportunities and insights gathered by redesign with heuristics, performed in the beginning of chapter 4.5. Based on Table 14, the TO-BE model was designed and is exposed on Figure 8 below.

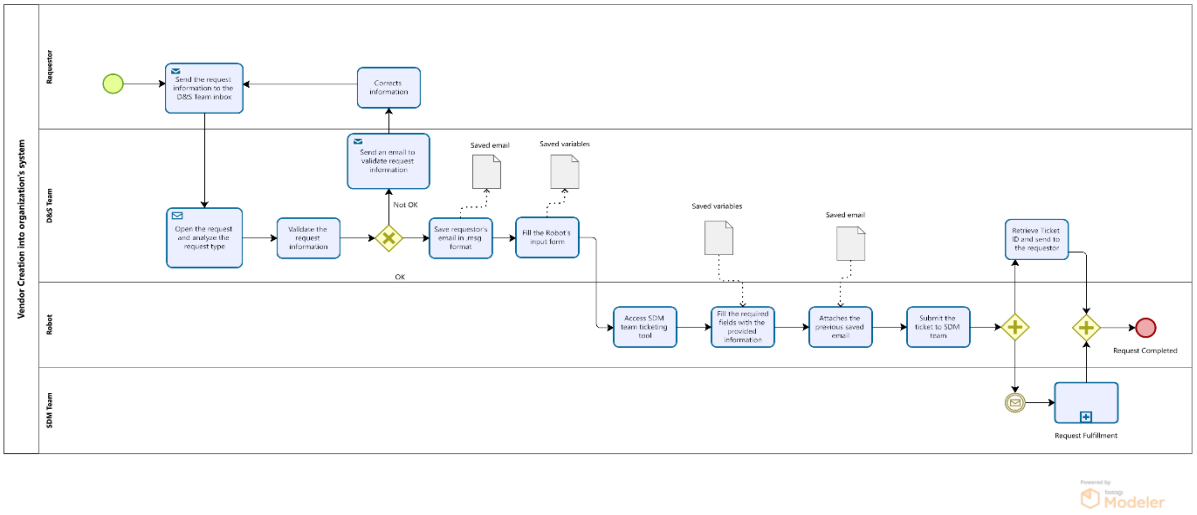

Figure 8 -BPMN 2.0 Model - TO-BE (Prepared by the author)

For better reading, Figure 8 is also available in Annex 1.

4.5.2. Manually Performed tasks

Following the conceptual design of the TO-BE process this chapter shifts focus to the practical implementation. The reasons and comments for manually performed tasks is detailed in Table 15, emphasizing a hands-on approach to simulate real-world scenarios. The significance of this practical exposing exercise is underscored, as it provides insights into operational feasibility, resource requirements and potential barriers to successful implementation, aiming to bridge the gap between theoretical design and practical application.

Table 15 - Manually Performed Tasks

Activity	**Reason**	**Comments**
Send the request information to the D&S Team inbox	It is up to the requestor to make the request by sending an email to the inbox shared by the D&S team.	Only D&S Team has access to it
Open the request and analyze the request type & Validate the request information & Send an email to validate request information & Corrects information	These tasks must be performed by a Human as they required critical thinking and evaluation.	The used technology will not cover NLP.
Save requestor's email in .msg format	The access to the shared inbox of the organization is confidential. Due to data privacy reasons, the management did not allow the robot to have access to it.	Only D&S Team has access to it
Fill the Robot's input form	The input must be provided by a Human to later be used as variables to the robot.	The email is a non-structured request, and the used technology will not cover NLP.
Retrieve Ticket ID and send to the requestor & Send completion status to the requestor	The access to the shared inbox of the organization is confidential. Due to data privacy reasons, the management did not allow the robot to have access to it.	Only D&S Team has access to it
Request Fulfillment	This task is performed by Supplier Data Management Team entirely (Process Intervenient).	Lack of knowledge of the process

4.6. AUTOMATION – RPA

The Ticket-to-Resolution process entails handling 330 monthly requests. Commencing upon receipt of an email in the shared inbox of the D&S Team, this process addresses unstructured requests, which may vary in format but must contain essential information.

Essential Information:

- Supplier Legal Name: The legal name of the vendor.
- Supplier Country: The base country of the vendor.
- System: The organization's internal system used for vendor creation.
- Organization's Country: The country of the internal paying entity (since the organization is multinational).
- Organization's Company: The company code of the internal paying entity.
- Supplier Contact: The person of contact at the vendor's end.
- Business Approver: The individual responsible for approving the vendor creation process.
- Organization's Primary Contact: The liaison between the organization and the vendor.
- Market: The region where the supplier is based.
- Master Category: The master procurement category.
- Category: The vendor's services/products category.
- Purchase Organization: The internal paying entity code.

Attachment Requirement: Additionally, adherence to internal protocol mandates attaching an Excel form containing supplier details, such as bank information, VAT number, and other pertinent data, to the request email. This Excel file must accompany the request for vendor creation.

Following the provision of all required information, the D&S Team proceeds to utilize PowerApps to fill in the fields of the ticket.

This referred process, as exposed on chapter 5.2.5 in Table 13, takes on average 4 minutes to be performed and has an inherent risk of Human failure.

As the TO-BE model, detailed on chapter 5.2.8, this process will be now performed by a robot. In the next chapters the design of the RPA will be elaborated.

4.6.1. Input Form

In the pursuit if enhancing operational efficiency and automating business process in procurement, this chapter, and the following ones, delves into the creation of the automation using UiPath resources.

The development of an input form marks the initial step towards streamlining data entry facilitating seamless interaction between users and automated workflow.

The significance of creating tan input form is underscored as it aligns with the objective of reducing manual effort mitigating human errors.

The form was built to be filled with the required information, in specific fields, which will then be saved as variables for the robot (Figure 9 and Figure 10). The input is later inserted into dialog box by D&S Team or by the requestor (in a future state) with the exposed layout in Figure 11.

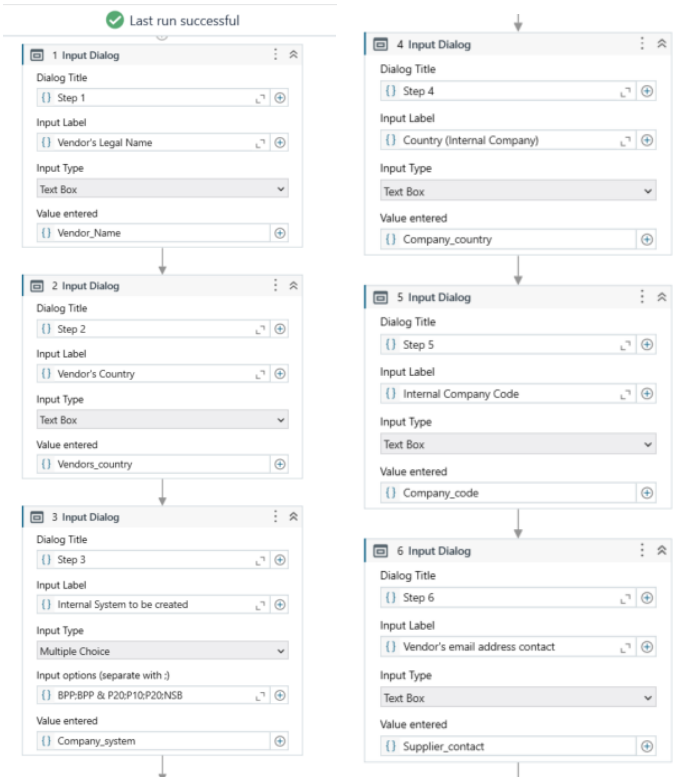

Figure 9 -Input Dialogue set-up (1)

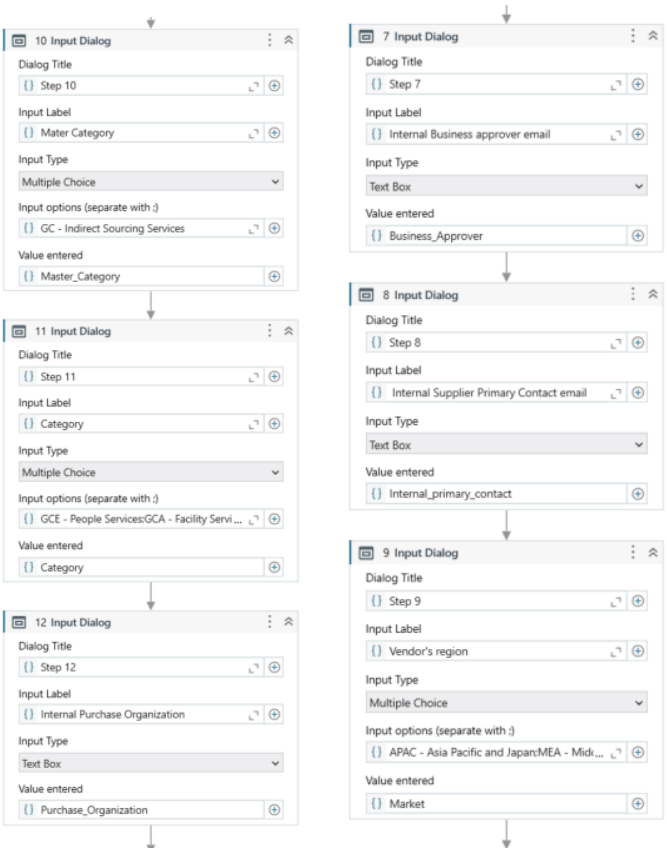

Figure 10 -Input Dialogue set-up (2)

In Figure 11, the user-view of the Input Dialogue box is exposed. It is possible to acknowledge that the fields have clear instructions regarding the necessary information to input.

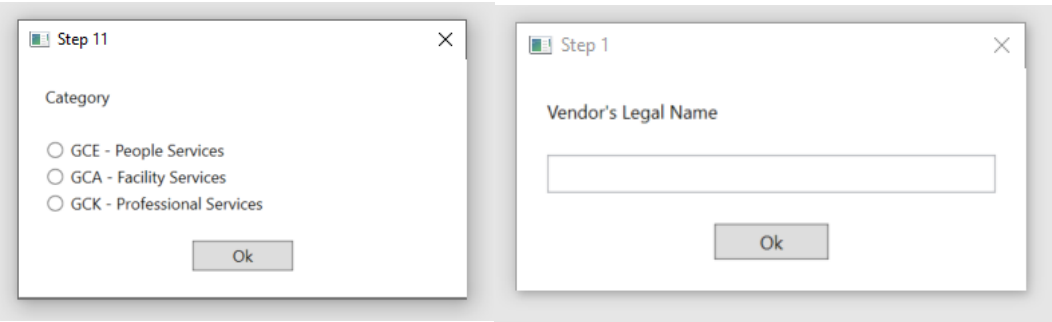

Figure 11 -Dialog Box layout examples

4.6.2. Save the latest email as a variable

As mentioned in Chapter 5.2.9, accessing the D&S Team's Outlook shared inbox directly is not permitted due to data privacy and confidentiality concerns. To address this, the Team must first save the email to a local folder. Then, the automation process will incorporate the email into the workflow.

In Figure 12, it is exposed the building of the condition that allows the robot to bring from the designated local folder, the latest saved file path and store it as a variable to be later used.

Two variables were created to perform this task as clarified in Table 16.

Table 16 - New Variables creation

Variable name	**Variable Type**	**Default value**
latestFileDate	System.DateTime	01/01/1753
latestFile	String	N/A

In table 17, the used VB code is demonstrated.

Table 17 - VB code demonstration

Activity name	**Sub-activity name**	**VB code**
IF	Condition	CurrentFile.CreationTime > latestFileDate
Set Variable Value	Save to	latestFile
Set Variable Value	Value to save	CurrentFile.FullName
Set Variable Value (1)	Save to	latestFileDate
Set Variable Value (1)	Value to save	CurrentFile.CreationTime

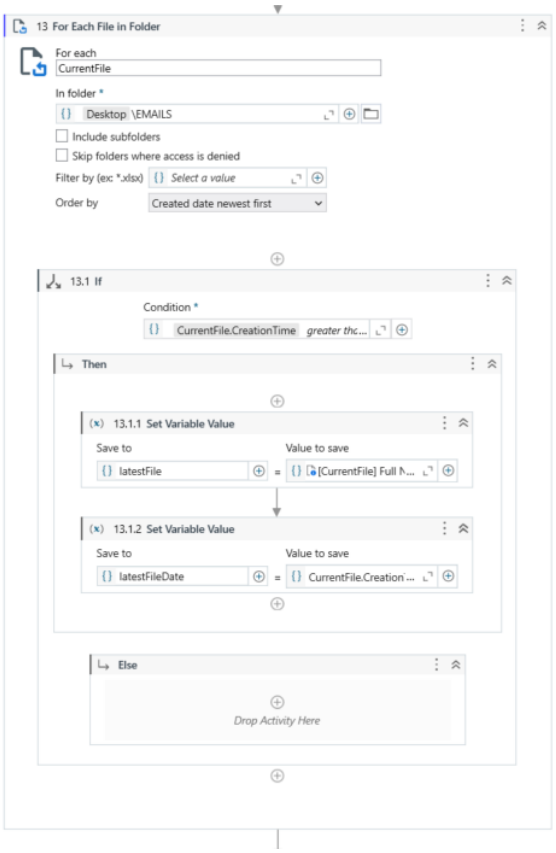

Figure 12 -Retrieving latest email from local folder

4.6.3. Use browser application and perform activities

In this chapter some of the performed key automation activities within UiPath are exposed and described with focus on its applications and integration within the automation workflow. Specifically, delving into the Click, Type Into, Keyboards Shortcuts and Delay activities, elucidating their roles in pursuing accuracy and scalability in the business process.

The “Click” (Figure 14), “Type into” (Figure 15), “Keyboards shortcuts” (Figure 16) and “Delay” (Figure 17) activities were used inside the “Use Browser Chrome” (Figure 13) activity.

The “Use Browser Chrome” activity sets the context for subsequent actions to be performed within a Google Chrome browser window.

The “Click” activity serves to simulate a mouse click on specific User Interface elements within the web browser application. It is instrumental in interacting with buttons, links, checkboxes, and other clickable elements triggering actions or navigating through interfaces.

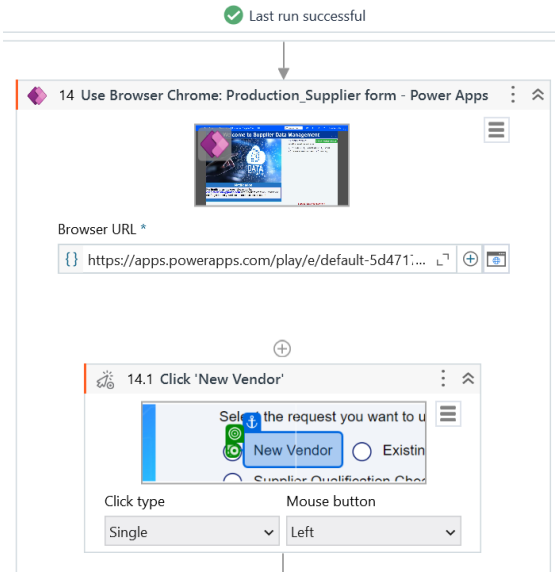

Figure 13 -“Use Browser Chrome” Activity example

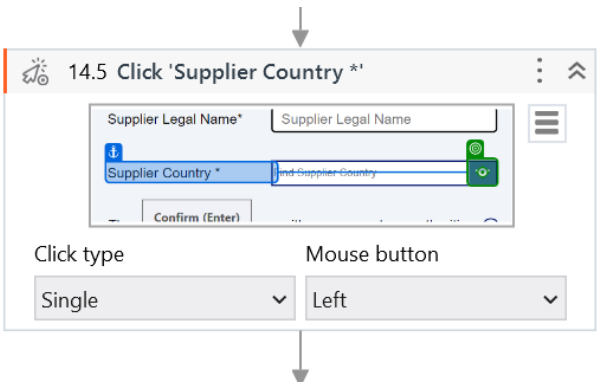

Figure 14 -"Click" Activity example

The “Type Into” activity facilitates the simulation of keyboard input by sending keystrokes to specified User Interface elements, employed for entering text, or in this use case, variables previously saved entered in the input dialog, within applications or web forms.

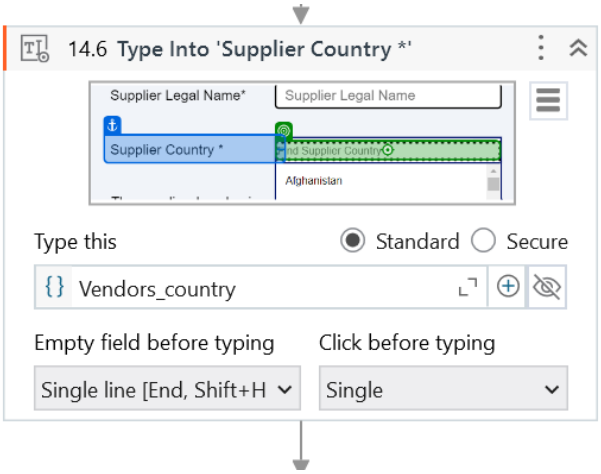

Figure 15 -"Type into" Activity example

The “Keyboard Shortcut” activity enables the automation of keyboard combinations within active applications. Used extensively in this workflow to perform actions that are typically executed via keyboard shortcuts.

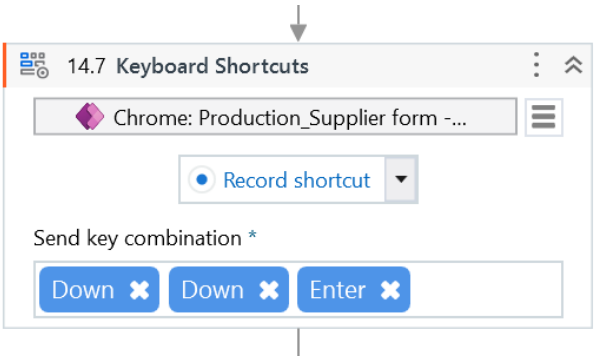

Figure 16 -"Keyboard Shortcuts" Activity example

The “Delay” activity introduces a pause in workflow execution for a specified duration, measured in milliseconds. This activity is essential for managing timing requirements within automation processes, allowing synchronization with application loading times or external process dependencies.

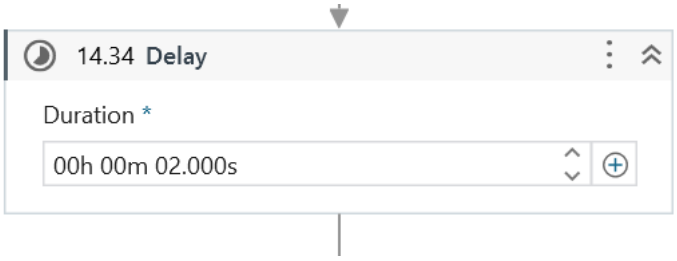

Figure 17 --"Delay" Activity example

5. DEMONSTRATION

The aim of this chapter is to demonstrate how the artifact can be utilized to solve problem instances through methods such as experimentation or proofs. Essential resources include in-depth knowledge on effectively applying the artifact to address the previously defined problem (Eekels & Roozenburg, 1991; Peffers & Tuunanen, 2005).

5.1. CYCLE TIME USING FLOW ANALYSIS

To calculate the Cycle Time of the process, the calculation method proposed by Dumas et al. (Dumas et al., 2013) was used where '*T*' is the time spent carrying out the activity or " the set of tasks with an index *i*" and define:

$$CT = \sum_{i=1}^{n} Ti$$

For XOR-block Dumas et.al (2013, p257), where 'p' is the probability of passing a certain point in the circuit, defined:

$$CT = \sum_{i=1}^{n} pi \times Ti$$

For AND- block Dumas et.al (2013, p258) defined:

$$CT = Max\ (T1, T2, \ldots Tn)$$

For Rework block Dumas et.al (2013, p260), where '*r*' is the rework probability, defined:

$$CT = \frac{T}{1 - r}$$

Thus, using the time averages indicated when the process was analyzed for 330 monthly requests, and considering activity #12 in exposed in Table 13 as 48 hours the AS-IS process execution time is:

CT = (0) #1 + (30 seconds) #2 + (60 seconds / 1 – 0,35) #3 + (60 seconds x 0,35 + 30 seconds x 0,65) #4, #6 + (15 seconds) #7 + (240 seconds) #8 + (15 seconds) #9 + (0) #10 + (48 hours) #11, #12 + (60 seconds) #13 = 493 minutes + 48hours = 48 hours, 8 minutes, and 13 seconds.

Calculating now the after-automation Cycle Time, considering Table 14 as a reference, taking into consideration that the robot takes 20 seconds to perform all the scheduled activities and that activity #13 in exposed in reference table as 48 hours, the TO-BE process execution time is:

CT = (0) #1 + (30 seconds) #2 + (60 seconds / 1 – 0,35) #3 + (60 seconds x 0,35 + 30 seconds x 0,65) #4, #6 + (20 seconds) #7, #8, #9, #10, #11 + (48 hours) #12, #13 + (60 seconds) #14 = 48 hours, 4 minutes, and 3 seconds.

If we disregard the activity performed by SDM team, which is not actually part of the D&S Team scope, we have the results exposed in Table 17.

Table 18 - Cycle Time Results

Cycle Time before heuristics and automation (1)	8 minutes and 13 seconds (493 seconds)
Cycle Time after heuristics and automation (2)	4 minutes and 3 seconds (243 seconds)
Monthly requests # (3)	330
(3) x (1)	45 hours, 1 minute, and 30 seconds (162 690 seconds)
(3 x (2)	22 hours, 36 minutes, and 30 seconds (80 190 seconds)
Monthly cycle time difference	22 hours, 25 minutes (82 500 seconds)

We can state that this new process is set to save up to 82 500 seconds in the process monthly which is 22 hours and 25 seconds.

It is possible to assume that the gap between the Cycle Time before heuristics and automation and after heuristics and automation increases, as the monthly requests' also increases, as exposed on Chart 1.

This demonstrates the flexibility of this proposed solution.

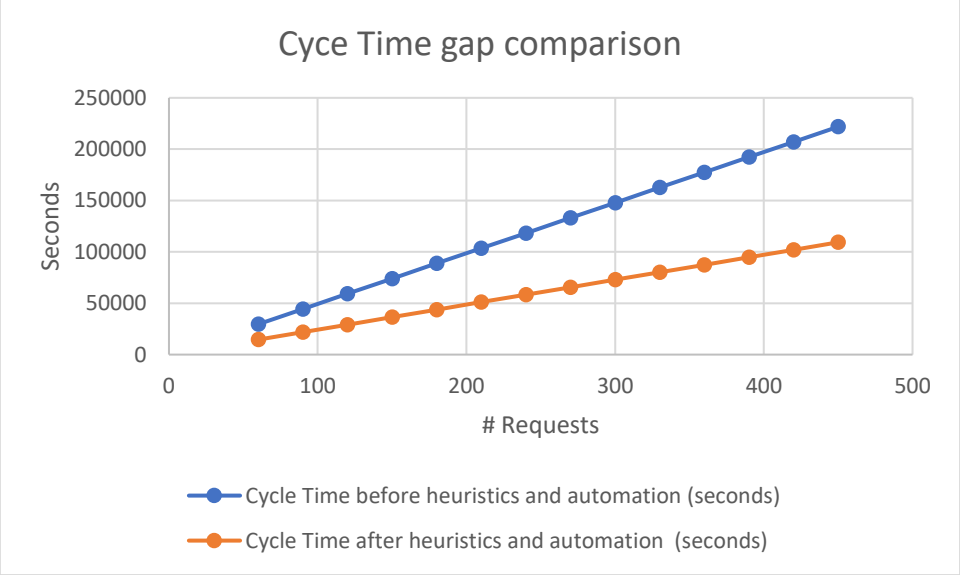

Chart 2 - Cycle Time gap comparison.

6. EVALUATION & DISCUSSION

In this chapter, the aim is to evaluate how well the artifact solves the identified problem by comparing the desired outcomes with the actual results obtained from using the artifact (Eekels & Roozenburg, 1991; Peffers & Tuunanen, 2005).

Focus groups are commonly used in various research fields to explore new ideas. Design science research consists of two main phases: developing an artifact and evaluating it. A design researcher not only creates an artifact that serves a practical purpose but also demonstrates that it effectively addresses a real problem (Hevner et al., 2004).

In this chapter, a field test of the design artifact will be conducted using Confirmatory Focus Groups (CFGs). This approach will help verify the artifact's utility in real-world applications.

6.1. FORMULATE RESEARCH QUESTION

In this phase, confirmatory focus groups' (CFGs) research questions that will be asked to assess the utility of the designed artifact in a field setting are formulated.

The goal is to cover the objectives exposed in Table 18.

Table 19 – CFG's Objectives

Objective 1	Understand the artifact's utility in the daily work tasks.
Objective 2	Understand the artifact's viability.
Objective 3	Get any criticism and/or suggestions

Based on the defined objectives, 3 research questions were formulated as described in Table 19.

Table 20 – CFG's Research Questions

RQ1	Do you find the proposed framework useful? Why or why not?
RQ2	Would you consider implementing the proposed framework? Please explain your reasons.
RQ3	Do you have any recommendations or suggestions for improving the proposed framework?

6.2. IDENTIFY SAMPLE FRAME AND MODERATOR

Given that the D&S Team consists of 5 members, the author of this dissertation decided to conduct a single session gathering all the team. The sample frame is detailed in Table 20.

Table 21 – CFG's Sample Frame

Groups Number	**1**
Group Size	5
Source of participants	Digital & Support Team - P2P Department
Moderator	Dissertation's Author

6.3. QUESTIONING ROUTE DEVELOPMENT

The Confirmatory Focus Group was conducted via Teams meeting, with 5 members of the Digital & Support Team and will have a duration of 45 minutes.

The topics to be discussed will be ordered by importance, and within those topics, the questions will be ordered from general to specific as referred in Table 19.

As a first interaction, the artifact will be triggered and showed to the group. Following this first interaction, the questions will be performed, and the answers will be reported.

6.4. RESULTS AND DISCUSSION

The focus group meeting provided a wealth of insights regarding the proposed framework. This section synthesizes each participant's responses to the research questions outlined in Table 19. For a complete record of the meeting, including detailed discussions and individual comments, please refer to Annex II.

Concerning Research Question 1 - Do you find the proposed framework useful? Why or why not?

Consensus: The framework is considered very useful by all participants.

The proposed framework was considered by unanimous voting as useful. Reasons such as efficiency, clarity and automation used makes it reduce the workload to D&S Team. The framework reduces back-and-forth emails and automate the field filling which saves time as per consensus. The current used tools were compared, and it was concluded that the proposed framework is more responsive and user-friendly compared to existing tools.

Detailed feedback:

One participant specifically pointed out that the framework would eliminate the need for vendor creation requests via email, thus reducing the workload on the D&S Team. Other participant

mentioned that the automated process would allow team members to focus on checking and verifying information rather than spending time on manual data entry.

Overall, the feedback was overwhelmingly positive, with participants appreciating the potential of the framework to enhance their workflow and reduce operational inefficiencies.

Concerning Research Question 2 - Would you consider implementing the proposed framework? Please explain your reasons.

Consensus: All participants would consider implementing the proposed framework.

By unanimous opinion, the proposed framework should be implemented. Reasons such as value addition and future use were mentioned. Participants also expressed strong support, indicating a consensus agreement on its potential benefits. Notably, a desire among participants to use the framework in their daily operations was registered, suggesting a high level of acceptance and readiness for adoption.

Detailed Feedback:

One participant emphasized that the framework seemed to offer a clear value-add to their current processes, making it worth considering for implementation. Another participant agreed, expressing confidence in the framework's potential benefits, and stating that they would like to see it in use as soon as possible. The unanimous agreement and positive outlook on the framework's implementation reflect its perceived utility and the participants' readiness to adopt it.

Concerning Research Question 3 - Do you have any recommendations or suggestions for improving the proposed framework?

The participants suggested to add a "Comments" section as an input field to be later reflected in the PowerApps form to provide additional information when necessary. There was a concern about requestors properly filling the required fields. It is suggested to make the process as intuitive as possible to ensure accurate and complete information. Some participants also recommended further developing the tool to enhance its functionality and address any potential issues that might arise from improper field completion.

Detailed Feedback:

One participant noted that the framework should include a "Comments" field to allow for additional input, which could be crucial for certain requests. Another participant mentioned that while the framework makes it obligatory to fill in required fields, it should also guide users on how to fill them correctly to avoid errors. The recommendation for further development was seen as a proactive approach to ensuring the tool remains effective and user-friendly over time.

As a result, it is possible to say that the participants recognize the proposed framework benefits. The proposed framework was met with unanimous support, with participants keen on seeing it implemented and further refined. The positive reception and constructive feedback provide a solid foundation for moving forward with the framework's deployment and continuous improvement.

7. CONCLUSIONS AND FUTURE WORK

By the application of the proposed framework, the process has become faster and more efficient due to the created innovation accelerator, decreasing substantially the Cycle Time of the same. The feedback collected at Evaluation phase suggest a high level of acceptance of the created automation, among the target team.

It is important to refer at this point, that all objectives previously defined in this project were reached.

7.1. SYNTHESIS OF THE DEVELOPED WORK

By applying a Systematic Literature review strategy, that allowed the author to narrow the search scope and defining the research topic, it was revealed a consensus among researchers regarding the transformative potential of digitizing procurement processes as well as a potential for synergies between RPAs and BPM in leveraging procurement processes.

By deploying the Design Science Research methodology, an artifact was built having as an output an automated process in organizational context.

This project began with the goal of helping the D&S Team to enter the world of RPAs. This team has a great amount of manual workload, so decreasing it by automating it, was an objective. The chosen process was considered the one that is critical, which have the most requisitions, and the one who have the most manually repetitive tasks: a Ticket-to-Resolution process of Vendor Creation into a company's system in the Procurement Department (Procure-to-Pay).

In order to understand the process that the targeted team had in hands, the author was completely responsible to running it manually, daily. In this way, the author managed to have a strong AS-IS design defined using BPMN 2.0 . Before automating any process, it is necessary to optimize it, and the proposed framework takes this statement into account. A TO-BE process was designed, and 4 Redesign Heuristics used in Business Process Management were taking into account at Task, Flow and Process Level. The final TO-BE process became faster and more efficient – the proposed framework is set to save up to 82 500 seconds, in the current process, monthly, which can be translated into 22 hours and 25 seconds of savings on cycle time.

Using UiPath software, it was possible to reflect the TO-BE process into reality and to build the proposed automation of the optimized process. Activities such as "Type into" and the creation of variables using VB code were used to create it.

The feedback collected at Evaluation phase with the use of a Confirmatory Focus Group (CFG), was self-explanatory, allowing questions such as "Would you consider implementing the proposed framework?" being replied with positivity and desire among participants to use it in their daily operations as soon as possible.

7.2. LIMITATIONS

Referring to limitations of the present developed work, it is important to refer that the artifact was staged and is still in pre-production phase. Some recommendations gathered in the CFG must be taking into consideration and later implemented. Future work needs to be developed.

The economic strand in terms of actual savings was not concluded, therefore not demonstrated, once this evaluation can't be performed in production state, only once in published state of the artifact. The inexistence of comprehensive RPA evaluation metrics in this context revealed as a limitation.

Even though the Exploratory Focus Group was constituted with former D&S Team members and all current D&S Team members, and that the possibility to find more members that have worked with the proposed process to be optimized and automated was low given that they have leaved the company, the small number of participants (5) and small number of groups (1), was a limitation in Evaluation phase.

The secrecy of the company's data and participants identification was limited by the management itself.

7.3. FUTURE WORK

Regarding challenges and future work, one factor to be consider is the Change management. Even though there was a high acceptance of the proposed artifact by all the targeted team members, the change of work habits and ways of doing, must be addressed correctly and phased in order to successfully implement the proposed framework into the organization.

In terms of future work to be developed, the author wants to incorporate Natural Language Processing (NLP) into the workflow, decreasing the need of most of the manual inputs, ultimately decreasing even more the cycle time of the same.

The fact that the artifact is still on developing stage, didn't allowed to apply it in real-life scenarios neither to collect financial data from it, so it was considered that it should be done as a future work.

The performance of more and bigger Focus Groups will be held in the future.

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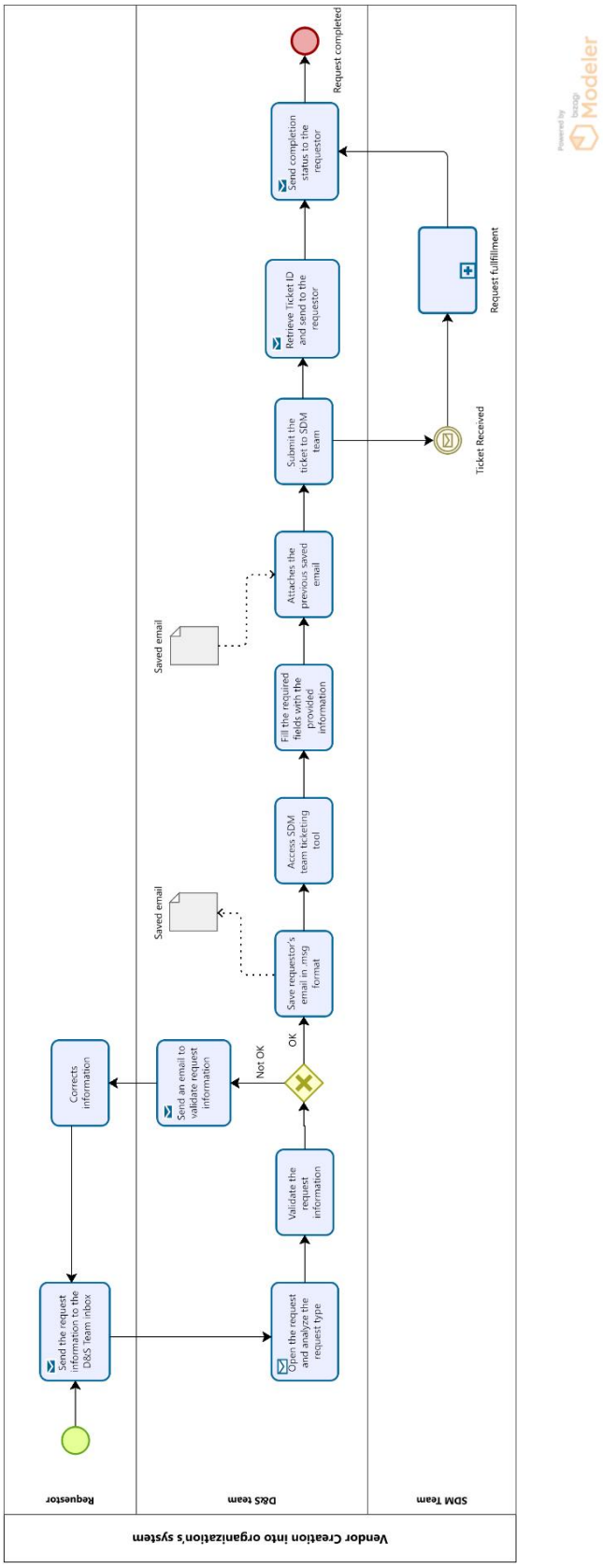
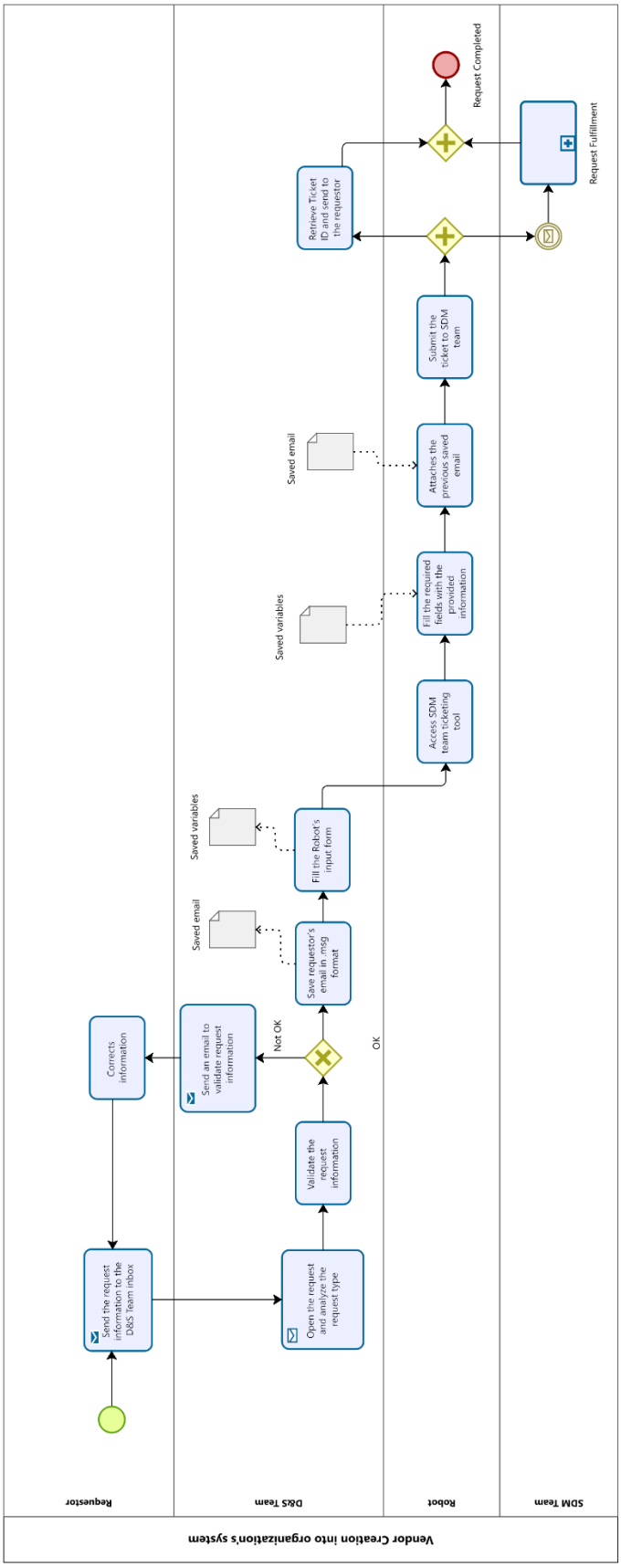
ANNEX I

1. BPMN 2.0 Model - AS-IS (Prepared by the author)



2. BPMN 2.0 Model – TO-BE (Prepared by the author)



ANNEX II

Focus Group meeting transcription

Participants	
D&S Team member	Operational Sourcing Specialist 1
D&S Team member	Operational Sourcing Specialist 2
Ex - D&S Team member	Sourcing Specialist 1
Ex - D&S Team member	Sourcing Specialist 2
Ex - D&S Team member	Sourcing Specialist 3
Moderator	Simão Santos (Author)

(after artifact demonstration)

Sourcing Specialist 1: Simão, thank you for this demo. I'm really impressed. First, this is really great. So, congrats on what you did. I wanted to ask you, how will it work? I mean, for example, from the beginning we receive the request. I'm just thinking you received the request through email. Or, uh, would it work, the requesters have to go to a certain platform and fill all those fields that you were filling in? Or I didn't really understand that part? So how? How would the requesters start from their end? And then from ours?

Moderator: The idea would be to publish on UiPath Orchestrator and form there, there would be no need for vendor creation request via email anymore, and both requestors and D&S Team members would use it, decreasing the workload on D&S team with regards to this type of ticket request.

Well, I can then start with pre-defined research questions.

Do you find the purpose framework useful? Why and why not?

Sourcing Specialist 1: Yeah, I think in terms of what we get from the requesters, it's much easier.

We don't have to go with back-and-forth emails and you're really asking for the required information which we need to fill in. So, in this sense is definitely useful. I assume they would be obliged to fill in these fields. Sometimes it can happen that they are not sure of what to put in the fields and in those cases D&S Team is there. Maybe you can add a “Comments” filed button to input into the form? Having this said, having this done automatically or right there for them to fill in, it's right on point. And I mean, it's helpful in the in this way and yeah, definitely the fact that this is shown there for them and that we need that information is much more clear. I have one other question. Where would they upload the form the suppliers email? How would that work?

Moderator: Yeah, they would save the email into a folder in their own computer and this will automatically bring the latest email saved to the workflow and attach it to the form.

Sourcing Specialist 1: Yeah. Overall, my opinion is definitely this would be helpful. I mean, it's clearer and faster since the fields are being filled in automatically so we can end. While that's done, we can just be checking and double checking in case anything else is required. But I mean it's pretty simple and the and I think it would be helpful this being done automatic in instead of manually.

Moderator: Thank you for your feedback.

Operational Sourcing Specialist 1: I like it. I think it's a really good idea and it's going to be a lot faster. Just implement and create the vendor. I hope this will be implemented. And I agree that, if possible, a comments section should be implemented. I really like it.

Sourcing Specialist 2: It's definitely a more responsive than the power apps that we use like that website isn't very user-friendly. I think that this app is easier, like it's less frustrating sometimes when you have a lot of requests. It gets frustrating because it lags a lot and all that, so here you can solve those issues.

Sourcing Specialist 3: I think it is very useful app that you have built. Also, it is a time saving interface. So yeah, I think you should go ahead with it.

Operational Sourcing Specialist 2: So, I like the idea it this tool looks like an Excel macro for Windows. It's very good what you can create this. I like the idea.

I just get a bit afraid how Catarina said and about the person that's filling the field must fill it properly and sometimes we know that even the requestors don't know what they want.

So yes, at least with this option, the requestors must be able to know what they want. So, it will make them more interested to have the right information, so I think it would be good at this point.

And I think with more development on this tool, it would be a good idea to implement it to would be faster and avoid the kind of creation that we have today. Please proceed and provide it to me!

I think it has a future and I would like to use it.

Moderator: Well, that's a lot of inputs. Thanks a lot! So, I guess we have replied to our third question also, which was: "Do you have any recommendations or suggestions for improving the proposed framework?" so let's move on to the second question. And the second one is the only one that remains. Would you consider implementing the proposed framework? And please explain your reasons.

Sourcing Specialist 2: Yeah, definitely. It seems like a value add to the current process, so I think it's worth considering for sure.

Sourcing Specialist 1: Yeah, I agree.

Sourcing Specialist 3: Yes, totally.

Operational Sourcing Specialist 1: Yes, for sure.

Operational Sourcing Specialist 2: Please do so!

Moderator: OK, then we can finalize this focus group. I have gathered all your feedback, and I will transcribe it. Of course, I will not put your names into it because of confidentiality reasons. Once again Thank you very much for your availability to participate on this Confirmatory Focus Group and talk to you soon.

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