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# Faculty of Business Economics

## Master of Management

***Master's thesis***

***Impact of Robotic Process Automation in Business Process Management***

**Micheal Mbunya Foinjia**

Thesis presented in fulfillment of the requirements for the degree of Master of Management, specialization Data Science

**SUPERVISOR :**

Prof. dr. Mieke JANS

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## Abstract

Business process management (BPM) is experiencing a digital transformation that reshapes how organizations improve processes through workflow automation tools. We explore how robotic process automation (RPA) can be integrated into the BPM life cycle and the benefits of adopting RPA as a BPM approach. This study employs Design Science Research (DSR) methodology and utilizes the approach used by Santos et al. (Santos et al., 2019) to evaluate our framework. By conducting a thematic analysis of the state-of-the-art frameworks for implementing RPA in the literature, we propose a guiding framework for implementing RPA that incorporates RPA implementation steps; creation of a center of excellence, development of RPA, testing of RPA, release of RPA, run of RPA, and scaling RPA into the established BPM life cycle; process identification, process discovery, process analysis, process redesign, process implementation, and monitoring and control of Dumas et al., (Dumas et al., 2013). This guiding framework supports decision-making in an agile environment for organizations adopting RPA, fosters alignment among stakeholders, supports sustainable RPA scaling, and ensures efficient processes standardization. Furthermore, this study categorizes the benefits of implementing RPA based on various RPA case studies in the literature into operational efficiency, process optimization and performance, human resource optimization, and strategy and digital transformation, emphasizing the need for managers and practitioners to appreciate the advantages of investing in RPA solutions to enhance business sustainability. Grounded in theory and thematically analyzing the state-of-the-art RPA implementation framework, this study suggests a structured framework for implementing RPA that can be further evaluated and developed in future research.

## Keywords

Business Process Management; Robotic Process Automation; Business Process Management Life Cycle; Design Science Research

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## Abbreviations

| | |
|---|---|
| BPM | Business Process Management |
| RPA | Robotic Process Automation |
| DSR | Design Science Research |
| BPR | Business Process Reengineering |
| GUI | Graphic User Interface |
| ERP | Enterprise Resource Planning |
| IT | Information technology |
| CoE | Center of Excellence |
| BPI | Business Process Improvement |

## 1. Introduction

Business process management (BPM) is currently undergoing digital transformation as organizations transition into the digital era. This trend is attracting interest and changing how organizations can improve processes by optimizing and automating workflows (Mangu, 2020). As BPM evolves in this digital context, it remains grounded in its foundational definition, as a structured set of principles, techniques, methods, and tools designed to manage workflows effectively, thereby adding value to organizations and their customers (Mangu, 2020; Tupa & Steiner, 2019; Dumas et al., 2013; Van Der Aalst, 2013). Traditionally, BPM relies on approaches such as business process reengineering (BPR), continuous process improvement, and implementation of enterprise resource planning (ERP) systems (Nielsen et al., 2023; Dumas et al., 2013; Rohloff, 2011). However, these traditional approaches often have high costs, require an advanced programming language, and lack flexibility. Due to this, organizations are turning to more agile and cost-effective solutions. One such solution is Robotic Process Automation (RPA), which has emerged as a modern workflow management tool to address the challenges of the traditional BPM approach. Unlike the traditional BPM approaches, RPA offers a low or no-programming software solution (Stamoulis, 2022) that utilizes graphical user interface (GUI) adaptors to mimic and replicate highly repetitive and error-prone tasks (Bédard et al., 2024; Herm et al., 2023; Khatib et al., 2023; Dahlia Fernandez & Aini Aman, 2021; Agostinelli et al., 2019; Aguirre & Rodriguez, 2017; Willcocks, 2015). By automating these tasks, RPA improves operational efficiency and enhances customer experience (Bédard et al., 2024; Bellinga et al., 2022; Bu et al., 2022; Hofmann et al., 2020; Radke et al., 2019). Furthermore, it offers organizations a flexible set of tools that can seamlessly integrate with existing legacy systems, including ERP and web-based applications, whether they are running on physical or virtual computers (Boydas Hazar & Toplu, 2023; Hofmann et al., 2020; Siderska, 2020; Anagnoste, 2017). Thereby, bridging functionality gaps in diverse legacy systems (Flechsig et al., 2022).

Given the increasing interaction between RPA and BPM, their integration is becoming more aligned with the BPM lifecycle (Nalgozhina et al., 2023). To effectively implement RPA, it is crucial to incorporate its implementation steps into the BPM life cycle (Flechsig et al., 2019). However, organizations often encounter challenges when integrating RPA into BPM. These challenges come from a lack of in-depth analysis of automated processes, unclear guidelines, and misalignment between business and IT stakeholders (Flechsig et al., 2019; Alotaibi & Liu, 2017). Furthermore, existing frameworks for implementing RPA frequently neglect the strategic alignment required to incorporate RPA into the BPM life cycle. As a result, organizations may find it difficult to fully realize the potential of RPA, particularly in achieving sustainable scalability and fostering agility. To mitigate these challenges, it is necessary to adopt a structured approach when integrating RPA into a BPM initiative. Specifically, there is a need to expand the BPM life cycle to include RPA deployment and scalability, allowing organizations to achieve long-term efficiency. We aim to address this gap by consolidating findings from existing frameworks in the literature related to RPA implementation and incorporating these findings into a well-known BPM life cycle (Dumas et al., 2013). To ensure practical relevance in addressing the challenges of implementing

RPA, we will evaluate the resulting framework through RPA case studies that discuss activities undertaken to implement RPA in the literature. Consequently, this study aims to address these two questions:

**How can RPA be integrated into the BPM life cycle?**

**What are the benefits of using RPA as a BPM approach?**

In addressing these questions, we make three contributions: We provide (i) a thematic analysis of the state-of-the-art RPA implementation frameworks as depicted in the literature. Additionally, we employ the design science research methodology to design and evaluate (ii) a guiding framework (artifact) for integrating RPA into the BPM life cycle. Lastly, we present (iii) evidence through selected RPA case studies in the literature that our framework is practically relevant and highlight the benefits of using RPA as a method for BPM.

The remainder of the paper is structured as follows: Section 2 provides a detailed explanation of the BPM lifecycle, the benefits of implementing RPA, and a thematic analysis of RPA implementation frameworks. Section 3 outlines and justifies the research methodology. Section 4 illustrates our artifact derived from the literature and the BPM lifecycle. In Section 5, we evaluate our artifact using seven RPA case studies identified in the literature. Section 6 discusses the results of our evaluation. Finally, Section 7 presents the conclusion, contributions, limitations, and directions for future research.

## 2. Theoretical Background

This section gives an overview of the BPM life cycle, discusses the benefits of implementing RPA, provides insight into existing frameworks for implementing RPA, and identifies the gap in the literature.

### 2.1 BPM Life Cycle

BPM is a systematic approach to analyzing, optimizing, and automating workflows. The activities involved in a BPM project can be represented through life cycle models, with various scientifically illustrated versions available (for an overview of different models, see Alotaibi & Liu, 2017). For our purposes, we will focus on the BPM life cycle model proposed by Dumas et al., (Dumas et al., 2013). According to their life cycle, BPM follows a continuous cycle that ensures business processes are efficient, aligned with strategic objectives, and adaptable to evolving conditions. The BPM life cycle comprises six essential phases: process identification, process discovery, process analysis, process redesign, process implementation, and process monitoring and control. Each of these phases is vital for the effective management of workflow.

1. Process Identification

The BPM life cycle begins with process identification, during which the BPM team defines and classifies a set of business processes related to a specific operational problem within the company. The processes are categorized based on their importance, potential dysfunction, and feasibility of improvements. This phase results in a process architecture, which is a collection of processes and the relationships among those processes (Dumas et al., 2013).

2. Process Discovery

The next step is process discovery. This phase involves gathering detailed information about how a process is executed within an organization. The techniques used in the discovery process include interviews, workshops, document analysis, observation, and process mining to document workflows, decision points, and key performance indicators (KPIs) related to the operational issues faced by the organization. Process discovery ensures that businesses have an accurate and realistic portrayal of their operations before implementing any improvements. The outcome of this phase is one or more current (as-is) process models (Dumas et al., 2013).

3. Process Analysis

In this third phase, organizations are deeply involved in identifying and assessing the issues and opportunities for process improvement. Problems related to the current (as-is) workflow are identified, classified, documented, and ultimately quantified using performance measures. The outcome of this phase is an organized list of problems in the current process, prioritized according to their impact and the estimated effort required to resolve them. By identifying weaknesses, organizations can determine which aspects of a process should be modified or automated, either by using a BPM system or integrating RPA, depending on the suitability of the process (Dumas et al., 2013). However, some processes might require further analysis before implementing the required modification, leading to the next step.

4. Process Redesign

This phase focuses on identifying necessary modifications in the workflow to address the issues found during the process analysis. To achieve this, various modification options are analyzed and compared based on the established process performance metrics from the process analysis. Ultimately, the most favorable modification options are selected to create a redesigned process. The outcome of this phase is a desired (to-be) process model, which serves as the foundation for the process implementation phase (Dumas et al., 2013). Depending on the organization's objectives, the desired process, if unsuitable for an RPA solution, can be redefined and modified to suit RPA. Such processes must be standardized and simplified with a limited number of decision points (Gharpure & Ghodke, 2022). Processes requiring solutions other than RPA tool will have to proceed to the process implementation step.

5. Process Implementation

The next step is implementation. In this phase, changes are made to transition the current (as-is) process to the desired (to-be) process. Process implementation involves organizational change management and process automation. Organizational change management includes training participants, while process automation requires the organization to develop and deploy IT systems or enhance existing systems that support the process and update standard operating procedures (Dumas et al., 2013).

6. Process Monitoring and Controlling

The final phase in the BPM life cycle is monitoring and controlling. Once the redesigned process is operational, the BPM team collects and analyzes relevant data from the BPM system and RPA tool to assess how well the new processes are performing against key performance metrics. When errors or deviations from intended outcomes are identified, necessary adjustments are made. New problems may arise in the same or a different process, necessitating the continuous repetition of the cycle (Dumas et al., 2013).

### 2.2 RPA Benefits

When implemented properly, RPA can offer numerous benefits. RPA demonstrates robust integration and connectivity capabilities with many software applications (Hofmann et al., 2020), effectively bridging functionality gaps and addressing missing interfaces in diverse ERP systems (Flechsig et al., 2022). Additionally, RPA enables faster and more accurate analysis, improving production planning and increasing customer satisfaction (Flechsig et al., 2022; Gradim & Teixeira, 2022). Furthermore, RPA reduces process cycle times and minimizes idle periods, leading to enhanced productivity, as RPA systems can operate autonomously around the clock (Mangu, 2020). Moreover, RPA is unaffected by personal emotions and produces objective, transparent outcomes based on predefined rules (Huang & Vasarhelyi, 2019). When programmed correctly, RPA can significantly decrease the rate of process errors (Boydas Hazar & Toplu, 2023; Flechsig et al., 2019; Huang & Vasarhelyi, 2019; Naveen Reddy et al., 2019). Organizations facing cost pressure tend to rely on full-time equivalent savings from RPA to efficiently reduce headcount in their departments (Boydas Hazar & Toplu, 2023; Flechsig et al., 2022; Gradim & Teixeira, 2022). This relief from automating monotonous tasks enables professionals to concentrate on more strategic, creative, and valuable activities, such as exception handling (Gradim & Teixeira, 2022; Huang & Vasarhelyi, 2019). In addition, RPA adopters have created new skilled job profiles to develop, maintain, and optimize software bots (Fernandez & Aman, 2018).

According to Hoenderdos & Van Triest, (2024), Gopalakrishnan, (2023), and Gradim & Teixeira, (2022), RPA is a transformative technology capable of automating complex workflows quickly and accurately. By mimicking human interactions with digital systems, RPA eliminates redundant workflows, making it a pivotal tool in the modern digital workplace (Flechsig et al., 2022). Beyond the automation of repetitive tasks, RPA optimizes human resource allocation, allowing employees to focus on areas where their expertise can be better utilized, thus improving job satisfaction (Flechsig et al., 2022; Naveen Reddy et al., 2019). Additionally, RPA enhances document quality and significantly minimizes rework tasks (Hyun et al., 2021; Jovanović et al., 2018). Furthermore, RPA collects data on process performance, facilitating continuous improvement and delivering data-driven insights (Katiyar et al., 2024; Gradim & Teixeira, 2022; Radke et al., 2020). Moreover, it supports the scalability of activities as it can be adjusted to handle high-volume operations and is adaptable for similar processes across multiple business units (Boydas Hazar & Toplu, 2023; Huang & Vasarhelyi, 2019). Additionally, Khatib et al., (2023) highlighted that integrating RPA into existing processes enhances monitoring and control capabilities while inspiring new and improved organizational solutions. As such, it enables project managers to embed technological innovation and prepare for future advancements. If leveraged effectively, RPA presents organizations with immense growth opportunities and long-term success within the digital ecosystem (Koppisetti, 2024).

## 2.3 The State of the Art of RPA Implementation Framework

The literature presents the following frameworks, Flechsig et al., (2019) investigated BPM in conjunction with robotic process automation to realize its full potential. They proposed a four-phase RPA implementation framework consisting of: development, test, release, and run, to integrate into the BPM cycle. Building on the necessity of a structured RPA implementation process, Huang & Vasarhelyi, (2019) proposed a 4-stage framework to guide auditors in adopting RPA in accounting firms. The framework consists of the following steps: selecting appropriate audit procedures, modifying the current procedure, implementing it in-house, and evaluating the performance. Expanding on that, Radke et al., (2020) employed a qualitative approach and proposed a framework for implementing RPA into master data processes, based on the change management model. The framework consists of three phases: unfreeze, change, and refreeze. When expanded, these phases consist of the following: introducing the RPA concept, continuous evaluation of business process, mastering standardized and simplified data, scaling RPA solution, stakeholder and IT collaboration, ongoing development, data tracing reassessment, and implementing solutions.

Likewise, a literature review conducted by Pramod, (2022) suggested a life cycle for implementing RPA: analysis, bot development, testing, implementing the RPA solution, and support and maintenance. Also, they offered a conceptual governance framework for a successful implementation of RPA, which includes the following: technology adoption model, implementation model, sourcing model, risk profile, strategic objectives, the role of RPA, IT infrastructure concerns, challenges and solutions, and awareness and training. Similarly, Crisan et al., (2023) used the context-intervention-mechanism-outcomes approach. They suggested the following methods for implementing robotic process automation: digitizing business processes, performing knowledge work with humans, replacing outsourcing with RPA robots, and developing a new business model. Also, Herm et al., (2023) used a design science research approach to develop a framework for implementing RPA. They proposed a sequential framework consisting of the following stages: demand identification, alignment with business strategy, screening of different RPA technologies, process and software selection, RPA pilot, business case evaluation, RPA rollout, adoption and scaling, RPA support processes, and establishment of a center of excellence. Finally, Koppisetti, (2024) researched robotic process automation to streamline operations in the digital age. The research resulted in a recommended method framework for implementing RPA. This method includes: identifying suitable processes for automation, design and development, implementation and integration, and monitoring and maintenance.

### 2.4 Gap in the literature

Reviewed frameworks by (Koppisetti, 2024; Crisan et al., 2023; Herm et al., 2023; Pramod, 2022; Huang & Vasarhelyi, 2019) highlighted essential steps for implementing RPA, which include identifying automation opportunities, development, testing, deployment, and ongoing support. However, it is crucial to integrate RPA into the BPM lifecycle (Nalgozhina et al., 2023). While Flechsig et al., (2019) have incorporated RPA into the BPM life cycle, a key limitation remains: insufficient focus on RPA scalability and long-term adaptability. Also, despite the extensive research on the benefits of RPA, most studies primarily focus on literature reviews. In this study, we will thematically identify the benefits of RPA reported in case study literature by clustering them into structured benefits categories. Addressing these gaps enhances the sustainability and agility of RPA integration in business operations, ensuring strategic adoption and long-term success of RPA. In addition, increases the desire for practitioners to appreciate the need for implementing RPA.

## 3. Research Methodology

This research employs the design science research (DSR) methodology. This method was first introduced in the engineering field and has spread to other areas of study, such as management information systems and management science (Arnott & Pervan, 2012). DSR differs from natural behavioral science, which focuses on justifying and developing theories to explain and predict variables affecting organizational behavior ( Arnott & Pervan, 2012; Coreil J., 2008; Hevner et al., 2004). Conversely, DSR focuses on the development and evaluation of artifacts designed to meet organizational needs (Hevner et al., 2004). There are different types of artifacts, which include: constructs (these are concepts that make up the vocabulary of the study domain), models (these are collections of claims or assertions that illustrate the connections between various concepts), methods (theses are methods that state a series of actions taken to complete a task), and instantiations (these are actualized information systems, that is, a working system were constructs, models or methods have been built in) (Hevner et al., 2004). We develop a method artifact (framework) as it provides structured steps to achieve a specific goal - in this case, integrating RPA into the BPM life cycle. Furthermore, using selected RPA case studies that discuss activities to implement RPA in the literature, we thematically cluster the reported benefits of RPA as a BPM approach.

To develop this artifact using the DSR, we draw inspiration from the approach used by Santos et al. (Santos et al., 2019). Their approach addresses the development and evaluation of the DSR methodology, leading us to modify it to include problem identification while maintaining the evaluation strategy employed by Santos et al. (Santos et al., 2019). They divide the DSR process into two steps: build (this step involves developing an artifact) and evaluation (determining if the artifact achieved its objectives). The build process is further divided into two steps: construct definition and model construction. Construct definition refers to the list of relevant concepts related to the artifact, while model construction focuses on developing the actual artifact. In contrast, the evaluation process consists of one step: evaluating the artifact. For our research, we modified the build segment into problem identification and the construction of our artifact (a detailed explanation of our approach is provided below). Doing so, we foster awareness of the problem(s) our artifact is designed to solve. Additionally, our modified approach, which was used by Santos et al. (Santos et al., 2019), aligns with the objectives of the DSR framework, which requires us to create awareness of a problem, develop our artifact to address that problem, and evaluate our artifact's performance. This research approach provides a systematic approach that ensures the creation and evaluation of our framework. Furthermore, it allows for a systematic process where an artifact is developed to address a specific problem and rigorously assessed for its effectiveness and usability by organizations.

**Identification of Problem**

This phase of our DSR approach corresponds to creating an awareness of the specific problem our artifact is intended to address. This research aims to solve the absence of clear guidelines, misalignment between business and IT stakeholders, and insufficient process standardization in implementing RPA. To tackle these issues, the study offers organizations a guiding method to integrate RPA into the BPM life cycle. In addition, we will thematically identify the benefits of RPA reported in RPA case study literature by clustering them into structured benefits categories.

**Model Construction**

In the second phase of the DSR approach, we focus on developing the artifact. To develop our artifact, we synthesize and group related steps from the framework for implementing RPA found in the literature and integrate them into the BPM lifecycle model of Dumas et al.. (Dumas et al., 2013). Each step is categorized based on the primary purpose and function of the activity within the proposed RPA implementation frameworks in the literature. Doing so ensures that our artifact is developed from prior research, enhancing its validity and relevance. Incorporating synthesized RPA implementation steps from frameworks in the literature into the BPM lifecycle by Dumas et al., (2013) ensures alignment with best practices while addressing gaps in existing RPA implementation frameworks. The combination of literature-based thematic analysis and established BPM methodologies ensures both rigor (by grounding in theory) and relevance (by addressing emerging BPM challenges).

**Model Evaluation**

In this final phase, we evaluated our method artifact using seven selected RPA case studies that discuss activities undertaken to implement RPA in the literature to verify if our guide can be followed in implementing RPA. This validation technique has been applied by Santos et al. (Santos et al., 2019). In answering our second research question, we thematically cluster the benefits of RPA reported in the literature of RPA case studies. This evaluation technique verifies that our artifact addressed the identified problem. Furthermore, case study literature serves as a source of validation by providing practical illustrations of the activities carried out to implement RPA and the outcomes of successfully implementing RPA.

## 4. A Step-by-Step Guide to RPA Integration into the BPM Life Cycle

RPA is increasingly integrated into BPM to enhance efficiency, reduce operational costs, and streamline workflows. However, there is a lack of clear guidance on integrating RPA into the BPM lifecycle. This section describes RPA implementation steps grounded in the literature that are fundamental to RPA deployment. It presents our guiding framework for integrating RPA into the BPM life cycle by identifying additional considerations crucial for the successful implementation of RPA. It also presents the benefits identified in reported RPA case studies for using RPA in BPM.

### 4.1 Steps in RPA Implementation

Our review of existing literature indicates that research on RPA implementation frameworks is quite fragmented. To improve clarity and organization, we categorize the steps involved in RPA implementation based on each activity's primary purpose and function within the proposed frameworks (see Table 1). This approach contributes to developing a more structured guiding framework (artifact) for integrating RPA into the BPM life cycle.

In Table 1, each row represents activities with the same function across the frameworks identified in the source literature. Furthermore, a cell in a row without activities indicates that no activities related to that function were found in the proposed framework in the literature. Additionally, some cells have a list of activities associated with their respective row (function) in bullet points. We outline seven steps based on their function (as listed in Table 1 and explained below) from the proposed frameworks for implementing RPA: process identification, RPA development, RPA solution testing, RPA release, RPA run/deploy, monitoring and control, and establishing a CoE.

| Source / RPA Implementing Steps | **(Flechsig et al., 2019)** | **(Huang & Vasarhelyi, 2019)** | **(Radke et al., 2020)** | **(Pramod, 2022)** | **(Crisan et al., 2023)** | **(Herm et al., 2023)** | **(Koppisetti, 2024)** |
|---|---|---|---|---|---|---|---|
| **Process Identification** | -BPM Life Cycle | -Select Audit Procedure | -Introduce RPA Concept<br>-Evaluate and standardize processes and data | -Analysis process | -Digitizing Business Process | -Demand Identification,<br>-Alignment with Business Strategy,<br>-Process Selection | -Identifying Suitable Processes for Automation |
| **RPA Development** | -Development | -Modify Procedure | -Ongoing Development | -Bot Development | -Performing Knowledge Work with Human | -Screening of Different RPA Technologies,<br>-Software Selection | -Design and Development |
| **Testing** | -Test | | -Data Tracing Reassesses | -Testing | | -RPA Pilot,<br>-Business Case Evaluation | |
| **Release** | -Release | | | | | -RPA rollout | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Run** | -Run | -Implement in House | -Implement and scale RPA solution | -Implement RPA solution | -Botsourcing | -Adoption and Scaling | -Implementation and Integration |
| **Monitoring and control** | | -Evaluation of performance | | | | -RPA Support Processes | -Monitoring and Maintenance. |
| **Establishing Center of Excellence** | | | -Stakeholder and IT collaboration | | -Developing a New Business Model | -Establishment of a Center of Excellence | |

**Table 1:** Organized steps of RPA Implementation based on Literature

Our analysis indicates that several key steps are consistently highlighted across different studies as essential for RPA implementation. These steps include process identification, RPA development, testing, and RPA run/deploy. The seven RPA implementation steps are explained below.

1. Process Identification

The first step in RPA integration is identifying processes suitable for automation, since not all business processes are ideal for RPA; repetitive, rule-based, and high-volume tasks with structured data tend to be suitable for automation (Bédard et al., 2024; Herm et al., 2023; Koppisetti, 2024; Radke et al., 2020). Also, tasks that are prone to human error are suited for automation because they allow the reduction of costs and the increase of performance, as robots make fewer mistakes than humans. Additionally, tasks that require little or no worker intervention and have low cognitive requirements are crucial, as robots have no analytical and creative skills. Finally, data plays a vital role in ensuring the digitalization and correct execution of tasks (Crisan et al., 2023; Santos et al., 2019). RPA should align with the broader business strategy to ensure meaningful value addition. Organizations must evaluate whether automation supports their goals, such as cost reduction, improved accuracy, or enhanced customer experience (Herm et al., 2023) while taking into account the benefits and drawbacks of implementing RPA (Boydas Hazar & Toplu, 2023; Khatib et al., 2023; Santos et al., 2019).

2. Development

In this second step, the RPA team evaluate various RPA tools based on several factors, including cost, scalability, integration capabilities, ease of use, and compliance with security standards (Herm et al., 2023). It is essential to select an automation platform with the appropriate capacity (Boydas Hazar & Toplu, 2023) since there are several automation tools with diverse capacities, such as Automation Anywhere, Kryon, Rapise, TagUI, UiPath, VisualCron, WinAutomation, WorkFusion, BluePrim, UiPatch, RedWood, and Openspan (Agostinelli et al., 2019; Ghouse & Sipos, 2022). Choosing the right RPA tools is a key factor for the success of the RPA project.

3. Testing

Once processes are optimized and RPA bots are developed, it is tested in a controlled environment before full-scale deployment. This phase involves reconfiguring the bots, running test cases, and refining automation scripts to ensure they perform as expected (Flechsig et al., 2019; Pramod, 2022), especially considering all specifications and proper robot functionality (Flechsig et al., 2019). Thorough testing prevents operational failures and ensures the reliability of the RPA solution. Before full-scale deployment, the RPA team can analyze the cost-benefit of the RPA solution to assess the financial and operational impact of RPA implementation (Herm et al., 2023).

4. Release

At this stage, the RPA team must transfer access rights from the process owner to the robot to partially implement it in the business environment (Herm et al., 2023). Furthermore, the integration is accomplished through the GUI of existing IT systems and does not require changes to the legacy system infrastructure (Flechsig et al., 2019). This stage includes onboarding the software robot in terms of rights management and acceptance by its co-workers. Furthermore, the release can be accompanied by RPA-specific trainings, company-internal newsletters, as well as a general awareness initiative to increase acceptance among employees, resulting in employee proactivity to uncover further potential for automation (Herm et al., 2023).

5. Run

Once RPA has proven successful in initial implementations, businesses can fully implement RPA. This step involves refining automation strategies based on user feedback and expanding RPA adoption across departments (Herm et al., 2023; Radke et al., 2020). The integration of external service providers can provide support for more complex processes as well (Herm et al., 2023). Furthermore, the business should adjust the pace of RPA scaling to match the speed of business adoption (Radke et al., 2020).

6. Monitoring and Maintenance

The monitoring and maintenance require setting up real-time analytics and alerts to detect failures or inefficiencies (Koppisetti, 2024; Pramod, 2022). Ongoing maintenance helps organizations optimize RPA effectiveness and minimize downtime. Ongoing evaluation of RPA performance is essential for identifying areas of optimization. Furthermore, this stage also requires regular analysis of the automation outcomes and making necessary adjustments to optimize effectiveness (Radke et al., 2020).

7. Establishment of a Center of Excellence

Some organizations establish a Center of Excellence (CoE) dedicated to IT strategy and governance. A CoE provides expertise, best practices, and ongoing support for scaling automation. Furthermore, the CoE is also responsible for process innovation, developing new services, improving efficiency, training employees, and implementing awareness programs that drive RPA adoption. Additionally, they utilize their accumulated RPA process knowledge to establish new business lines. For instance, their experience in enhancing internal processes is leveraged to create Business Process Improvement (BPI) services for other organizations or departments. They also initiate “digitization-on-demand” strategies and new business services to replace traditional business process outsourcing services with RPA offerings (Crisan et al., 2023; Herm et al., 2023).

The core steps in the literature emphasize identifying a suitable process for RPA, developing the RPA solution, testing it, and implementing the robot. However, they neglect the need for a comprehensive analysis of the automated processes and alignment between business and IT stakeholders. By adopting a structured approach that integrates these vital steps into the BPM lifecycle, organizations can ensure proper process standardization and effective stakeholder management to maximize the benefits of RPA.

### 4.2 Guide to Integrating RPA into BPM Life Cycle

We established a guiding framework for the implementation of RPA by integrating RPA implementation steps into the BPM lifecycle. Figure 1 illustrates our framework.

Before initiating the RPA automation project, we proposed that it is essential to establish a CoE. This entity ensures that IT projects align with the organization’s strategic goals, comply with legal requirements, and involve all relevant stakeholders. Additionally, the CoE offers ongoing support throughout the project, including providing necessary expertise. Furthermore, the CoE drives process innovation, develops new services, and enhances overall efficiency.

After that, the first four stages are drawn from the BPM life cycle (See subsection 2.1 and Figure 1), and then a case distinction is made (this distinction is made after the process redesign step, See Figure 1) on whether the process is suitable for RPA or not. This decision can be based on the level of process complexity as designed (see Table 2) by Gharpure & Ghodke (Gharpure & Ghodke, 2022). This is objective and extensive because the level of process complexity is self-explanatory and measurable.

Table 2 outlines that process complexity is determined by several factors: the number of applications used in the process, the number of process steps, the type of hosted platforms, the number of business logic involved, the number of business rules involved, and implementation time. These factor levels of process complexity are categorized as simple, medium, and complex (as seen in Table 1). Simple or moderately complex processes are suitable for RPA.

| **Estimation Model** | **Simple** | **Medium** | **Complex** |
|---|---|---|---|
| **Number of Applications** | 1 to 2 | 3 to 4 | 5 to 6 |
| **Number of Process Steps** | Less than 20 | 20 to 40 | More than 40 |
| **Types of Hosted Platforms** | Less than 2 | Less than 3 | More than 5 |
| **Number of Data Fields Involved** | Less than 5 | 5 to 10 | More than 10 |
| **Number of Business Logic Involved** | 3 to 4 | 5 to 7 | More than 7 |
| **Number of Business Rules Involved** | Simple rule and condition statement | Conditional statement and calculation | Complex logic, multilevel validation, and calculation |
| **Types of Applications** | Mainframe, web and No Citrix/Desktop, No Optical Character Recognition (OCR) | Desktop app and No OCR | Max 1 Citrix Template-based structured PDF |
| **Implementation Time** | 4 to 6 weeks | 7 to 10 weeks | More than 10 |

**Table 2**: Process Complexity Estimation Model to Determine for Selection of Business Processes for Robotic Process Automation (Gharpure & Ghodke, 2022).

For simple or moderately complex processes, a decision can be made to bypass the BPM life cycle and proceed directly through the development, testing, release, and run phases (see Figure 1). During the development phase, the RPA tool can be sourced or produced internally. When creating the RPA tool internally, the RPA team must design the automation workflow, code scripts, and configure the bot to perform specific tasks. They must also ensure that the bot adheres to the defined business rules and interacts properly with applications, databases, and other systems. On the other hand, when sourcing the RPA tool, the RPA team needs to select the appropriate RPA supplier while considering the organization's objective.

After the bot is set up or acquired, it undergoes thorough testing to validate its functionality and accuracy. During this phase, the RPA team tests the bot with various scenarios, ensuring it responds effectively to different situations and meets performance standards. When a deviation from expected behavior is detected, it is resolved before deployment begins.

Once testing is completed, the bot is officially deployed in the live business environment. During this phase, the RPA team needs to set up the necessary infrastructure, ensure the bot meets compliance guidelines, and integrate it into existing systems.

The bot is made available for use, often through a phased approach to minimize risks and allow for adjustments. This signifies the operational phase, during which the bot performs its assigned tasks in real-time.

Subsequently, the BPM flow is reactivated to take over monitoring and control. This phase ensures that problems are managed without delay and that automation works properly. Processes that are unsuitable for RPA continue along the established path, leading to process implementation, and will eventually intersect with the RPA flow in the monitoring and control step.

We proposed that when operations increase, the processes assigned to a single software robot are scaled up to accommodate the increased volume, followed by deployment and continuous monitoring. Conversely, if operations related to the same do not increase, the framework cycle restarts for a new process.

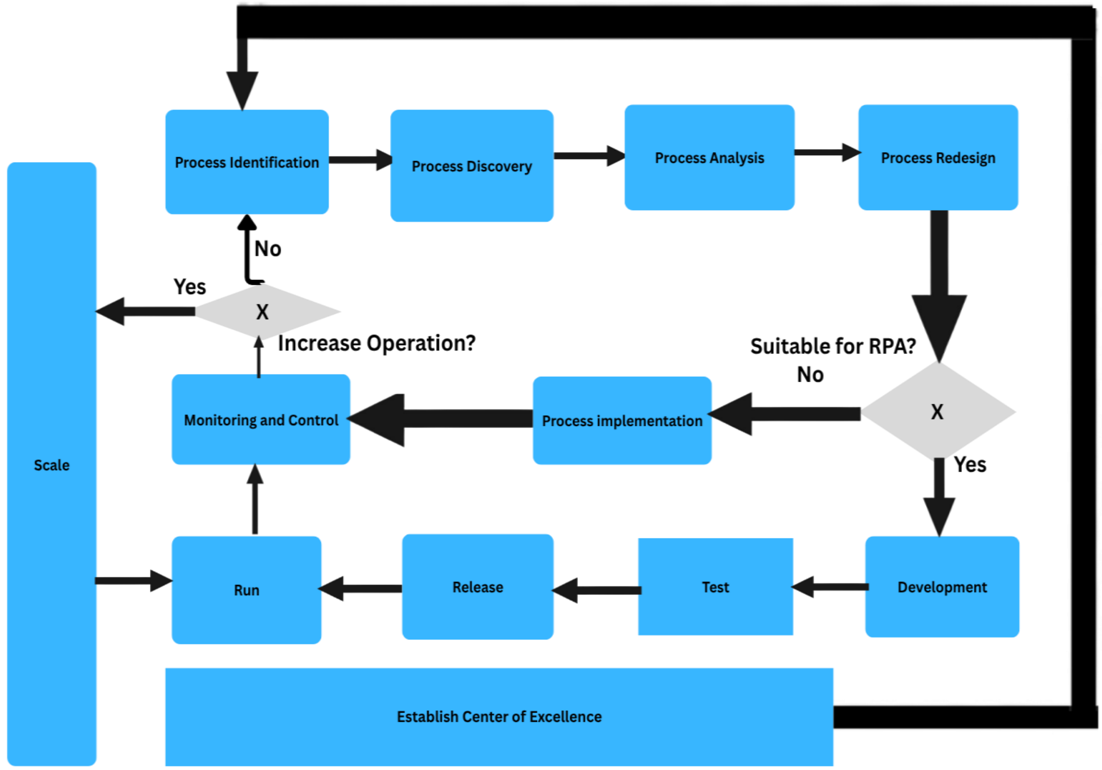


**Figure 1:** The Guide on Integrating RPA into BPM Life Cycle

## 5. Literature Case Study Evaluation

### 5.1 Evaluation of our Framework

We analyzed seven case studies documented in the literature where the RPA project was successfully implemented. The purpose of this analysis is to validate the activities outlined in our framework by comparing them with the activities executed during the RPA implementations in these case studies (see Table 3). As shown in Table 3, it includes an indicator, specifically a check mark, indicating which activities from the framework were present in the case studies where RPA was successfully implemented. Each check mark signifies activities that were completed in the implementation of RPA. The results reveal that some projects involve more or fewer steps than others in implementing RPA. Consequently, this lack of comprehensiveness can be attributed to the previously mentioned absence of methodological guidance on implementing RPA projects.

The activities needed to successfully implement RPA show variation in the practices, as seen in Table 3. We believe that the difference might be due to how mature the company is, what resources are available, and the depth of process knowledge within the organization. Notably, process identification, development, testing, and implementation are commonly performed, demonstrating their significance for successful RPA implementation.

On the other hand, activities like establishing a CoE, monitoring and control, and scaling are less frequently observed. We think this may be attributed to these activities being more focused on long-term maturity and not yet fully developed in every organization. Neglecting these aspects can lead to significant long-term issues, such as a lack of continuous process innovation and a misalignment of the process innovation strategy with the organization's overall objectives.

Kedziora et al.,al., (2021) highlighted that management acted without a clear goal and did not properly implement the RPA tool. Being concerned about not adopting new technology as fast as their rivals made the organization choose to automate processes. They also found that an update in the underlying systems sometimes caused the robot to malfunction. However, compared to Aguirre & Rodriguez, (2017) where the company created a CoE responsible for monitoring, developing new business, and process innovation, RPA leads to a better customer experience and improves organizational performance.

The reports on the "100% Compliance Project" highlighted its successful execution using the RPA tool named Taskt. The activities performed during this project align with all the steps in our guiding framework. This project transformed a fully manual and inefficient process into an efficient digital process, enhancing accuracy and real-time tracking. As a result, the initiative achieved 100% compliance with IRS tax payment rules and avoided penalties (Jeyaraj & Sethi, 2012).

Willcocks, (2015) reported that the company had to build a team specialized in RPA implementation to ensure alignment between business and IT stakeholders. This initiative also helped gain buy-in from all stakeholders, which aligned with one of the goals of our guiding framework for establishing a center of excellence (see Figure 1). Furthermore, Willcocks, (2015) reported that the need to analyze and automate the appropriate process, while considering the level of process complexity, was economically necessary for successful automation. This perspective aligns with our focus on automating low or medium-complex processes, as outlined in Table 1.

Organizations looking to implement RPA should consider this guidance when planning their roadmap to ensure agility and a positive long-term impact from their RPA initiatives.

| **Framework Activities** | **(Kedziora et al., 2021)** | **(Aguirre & Rodriguez, 2017)** | **(Agostinelli et al., 2019)** | **(Asatiani & Penttinen, 2016)** | **(Jeyaraj & Sethi, 2012)** | **(Nielsen et al., 2023)** | **(Willcocks, 2015)** |
|---|---|---|---|---|---|---|---|
| **Establish CoE** | | ✓ | | | ✓ | ✓ | ✓ |
| **Process Identification** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Process Discovery** | | | | ✓ | ✓ | ✓ | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Process Analysis** | | ✓ | | ✓ | ✓ | ✓ | |
| **Process Redesign** | | ✓ | | ✓ | ✓ | ✓ | |
| **Development** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Testing** | | ✓ | ✓ | | ✓ | ✓ | ✓ |
| **Release** | | | ✓ | | ✓ | ✓ | ✓ |
| **Run** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Monitor and Control** | ✓ | | | | ✓ | ✓ | ✓ |
| **Scale** | | | ✓ | | | ✓ | ✓ |

**Table 3:** Case studies evaluation of our framework

## 5.2 Benefits of RPA as an Approach to BPM

We analyzed seven case studies to identify the benefits of using RPA as a BPM approach. Thematically, we grouped these reported benefits into operational efficiency, process optimization and performance, human resource optimization, and strategy and digital transformation (see Table 4).

| **Key Benefits** | **Themes Identified in Case Studies** |
|---|---|
| Operational Efficiency | Agostinelli et al., (2019); Aguirre & Rodriguez, (2017); Jeyaraj & Sethi, (2012); Nielsen et al., (2023); Kedziora et al.," (2021); and Willcocks, (2015)**;** Full-time equivalents (FTE's) cost savings, cost reduction, error reduction, time savings |
| Process Optimization and Performance | Kedziora et al., (2021); Enhance data quality, Jeyaraj & Sethi, (2012); Standardize execution, real-time performance tracking |

| | |
|---|---|
| Human Resource Optimization | Agostinelli et al., (2019); Asatiani & Penttinen, (2016); and Kedziora et al., (2021); Telent reallocation to strategic role.<br>Agostinelli et al., (2019); Employee satisfaction |
| Strategy and Digital Transformation | Nielsen et al., (2023); and Willcocks, (2015); Legal system integration |

**Table 4:** Benefits of RPA

The details of Table 3 are elaborated as follows:

a) Operational Efficiency

The case studies by Agostinelli et al., (2019); Aguirre and Rodriguez, (2017); Jeyaraj and Sethi, (2012); Nielsen et al., (2023); Kedziora et al.,” (2021); and Willcocks, (2015)**,** highlighted that RPA enhances operational efficiency by replacing full-time equivalents with software robots that work 24/7, automate high-volume routine tasks to achieve more in less time, and eliminate mistakes.

b) Process Optimization and Performance

Process optimization is highly linked to data quality and real-time tracking. Kedziora et al., (2021) pointed out that RPA enhances data accuracy and consistency, which is crucial in decision making. Additional. Jeyaraj and Sethi, (2012) found that RPA standardizes execution across departments, making performance more predictable.

c) Human Resource Optimization

The implementation of RPA affects the workforce dynamic. According to Agostinelli et al., (2019); Asatiani and Penttinen, (2016); and Kedziora et al., (2021), RPA frees up human talent for strategic and analytical roles, and the allocation of human resources drives innovation and productivity. Also. Agostinelli et al., (2019) noted that RPA improves employee satisfaction by automating monotonous and manual workload, and enables more fulfilling work.

d) Strategy and Digital Transformation

According to Nielsen et al., (2023); and Willcocks, (2015) RPA integrates with other systems for broader business objectives and acts as a catalyst for innovation. This enables organizations to not only optimize processes but also redefine their strategic direction.

## 6 Discussion and Analysis

This research proposed a guiding framework for implementing RPA, aim to solve the challenges of a lack of clear guidelines, the misalignment between business and IT stakeholders, and insufficient standardization of processes for RPA, while overcoming the key limitation in existing methods related to (Crisan et al., 2023; Flechsig et al., 2019; Herm et al., 2023; Huang & Vasarhelyi, 2019; Koppisetti, 2024; Pramod, 2022). Our approach integrates the well-known BPM life (Dumas et al., 2013) and consolidates findings from existing frameworks in literature to improve upon previous methodology in both theoretical and practical dimensions. We thematically analyze RPA case studies in the literature to properly group the identified benefits of implementing RPA.

Prior research (Radke et al., 2020; Huang & Vasarhelyi, 2019) has established frameworks centered on specific applications for master data and auditing processes. Our research approach, which involves analyzing previously proposed frameworks and integrating our findings into the well-known BPM life cycle, led to a theoretically grounded, robust, and flexible framework that can be employed regardless of the processes within an organization, while accounting for the complexity of those processes.

Additionally, despite the extensive research (Crisan et al., 2023; Naveen Reddy et al., 2019) on the benefits of RPA, most studies primarily focus on literature reviews. In this study, we will thematically identify the benefits of RPA reported in case studies of RPA implementation found in the literature by clustering them into structured benefit categories for a deeper understanding of RPA's advantages. profound understanding of the benefits of RPA.

In contrast to frameworks by (Crisan et al., 2023; Radke et al., 2020; Pramod, 2022) that lack monitoring and control of RPA after deployment, our framework ensures that after RPA has been deployed, it is consistently monitored and controlled to ensure that unexpected malfunctions, as in the case study of (Kedziora et al." 2021) can be handled and taken care of.

Furthermore, frameworks by (Flechsig et al., 2019; Huang & Vasarhelyi, 2019; Koppisetti, 2024; Pramod, 2022) omitted the need to establish a CoE. However, our framework highlighted the need for establishing a CoE that constantly develops new business models and innovative processes to ensure organizations realize the full benefits of implementing RPA. The CoE also ensures all stakeholders support the RPA initiatives and acts as a change management agent to prevent resistance from employees, as in the case study of (Willcocks, 2020). Establishing the CoE ensures that RPA is adaptable to processes as organizations develop to meet digital transformation.

## 7 Conclusion

This research highlights the importance of establishing CoE, monitoring and control, and scalability into a framework for implementing RPA. However, small businesses and start-ups eager to implement RPA may face challenges incorporating these activities into their implementation roadmap due to limited resources. Additionally, organizations may find investing heavily in implementing RPA unprofitable since not all processes are suitable for RPA. In this regard, the presence and absence of these activities can explain why the case study by (Nielsen et al., 2023) completed all the steps to implement RPA and others (Aguirre & Rodriguez, 2017; Asatiani & Penttinen, 2016) did not.

By thematically analyzing the state-of-the-art RPA fragmented implementation frameworks found in the literature and integrating our findings into the well-known BPM life cycle, we propose a theoretically grounded and structured framework that creates opportunities for further investigation into the implementation frameworks of RPA and similar technologies. This proposed framework supports decision-making in an agile environment for organizations adopting RPA, fosters alignment among stakeholders, supports sustainable RPA scaling, and ensures efficient processes standardization. By explicitly grouping the benefits of implementing RPA, organizations and practitioners can better appreciate the necessity of investing in RPA solutions to enhance business sustainability.

This research was limited by time. Due to time constraints, we were unable to conduct a quantitative survey to gain insights from RPA professionals to support the evaluation of our framework.

While organizations and academia may find our framework to be a roadmap to undertake RPA project, some limitations exist. Firstly, our developed guiding framework was based on RPA frameworks in the literature, which might not be practically visible in real-life situations. Second, since our framework was evaluated using RPA case study in the literature, the details provided to evaluate our framework were limited to the authors' research objectives. Finally, this study did not fully establish the criteria for identifying and selecting suitable processes for RPA into our proposed framework, due to time constraints.

To mitigate these research constraints, firstly, we grounded our framework on a well-established BPM life cycle that has been validated in practice. Secondly, we analyze seven different case studies from different authors. Finally, to incorporate criteria for selecting process suitability, we had to focus on the level of process complexity, as it is self-explanatory and measurable and has been grounded in literature.

We proposed some future directions. First, case study research should be carried out using our framework as a methodology for implementing RPA. Secondly, the combination of artificial intelligence (AI) and RPA as an approach to BPM should be evaluated. Lastly, there is a need for a unified framework to assess process suitability and guide the implementation of RPA. Meanwhile, frameworks for process suitability for RPA have been explored, such as the proposed framework by (Gharpure & Ghodke, 2022), further research is needed.

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