Exploring and Understanding the Use of Robotic Process Automation (RPA) in Enterprise Systems

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Thesis of Master's in Information and Enterprise Systems

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April 2025

Acknowledgments

First and foremost, I would like to express my sincere gratitude to my supervisors, Professor Henrique São Mamede and Professor Luis Cavique, for their continuous support, patience, and immense knowledge. Their guidance helped me throughout the research and writing of this thesis.

Special thanks go to the faculty and staff of the Department of Sciences and Technology and Education at Universidade Aberta for providing the resources and facilities necessary for my research, which made this work possible.

On a personal note, I would like to thank my family for their unconditional support and encouragement throughout my studies. To my parents, thank you for your unwavering belief in me.

Finally, I would like to acknowledge all my friends and everyone who supported me in any respect during the completion of the project.

Dedication

I dedicate this thesis to my beloved family. Thank you for your endless love, sacrifices, and encouragement. To my sibling, Henrique, your support has been my strength.

I also extend my gratitude to my supervisors, Professor Henrique São Mamede and Professor Luis Cavique, for their invaluable guidance and patience. To my colleagues and friends, your camaraderie and assistance have been indispensable.

Statement of Integrity

I hereby declare that I have conducted my thesis with integrity. I confirm that I have not used plagiarism or any form of falsification of results in the process of the thesis titled “Exploring and Understanding the Use of Robotic Process Automation (RPA) in Enterprise Systems” elaboration.

I further declare that I have fully acknowledged the Disciplinary Regulations of the Universidade Aberta (regulation published in the official journal Diário da República, 2.a série, N.o 215, de 6 de novembro de 2013).

Universidade Aberta, 8th of January 2025

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Resumo

As organizações estão à procura de soluções para reduzir a intervenção humana e simplificar a operação de diversos Sistemas Empresariais. Esta investigação explora os principais conceitos de Robotic Process Automation (RPA) e sua aplicação em sistemas empresariais.

Esta investigação começa por definir o RPA como uma solução que abrange várias tecnologias concebidas para executar tarefas com a minima interacção humana.

O RPA é uma ferramenta que utiliza robôs de software para emular interacções humanas e automatizar tarefas de trabalho.

Os sistemas empresariais são os componentes que receberão a automatização para facilitar de forma coesa e eficiente a execução das tarefas.

Esta investigação investiga os desafios da utilização do RPA, que muitas vezes não cumprem os requisitos para necessidades específicas.

Um estudo de caso da empresa Desion GmbH, uma empresa alemã especializada em soluções de IA, está a enfrentar dificuldades na obtenção de dados para os seus modelos de visão por computador.

Desion necessita soluções RPA personalizadas, adaptadas para atender às exigências específicas do setor.

As conclusões desta investigação visam fornecer informações sobre como melhorar a adaptabilidade do RPA às necessidades da indústria, a melhorar o seu papel na otimização dos Sistemas Empresariais para impulsionar a transformação digital com o uso de Tecnologias de Automatização.

Palavras-chave: Robotic Process Automation, RPA, Sistemas Empresariais, Transformação Digital, Tecnologias de Automatização.

Abstract

Organizations are looking for solutions to reduce human intervention and simplify the operation of diverse Enterprise Systems. This research explores the main concepts of Robotic Process Automation (RPA) and its application in enterprise systems.

This research begins by defining the RPA as a solution that covers several technologies designed to perform tasks with minimal human interaction.

RPA is a tool that employs software robots to emulate human interactions and automate tasks.

Enterprise systems are the components that will receive automation to facilitate the execution of tasks in a cohesive efficient way.

This research investigates the challenges of using RPA, which often do not meet the unique requirements of specific industries.

A case study of the company Desion GmbH, a German company specializing in AI solutions, which faces difficulties in obtaining data for its computer vision models.

Desion needs customized RPA solutions to meet specific industry demands.

The findings of this research provide information on how to improve the adaptability of RPA to industry needs and improve its role in optimizing Enterprise Systems to drive Digital Transformation with the use of Automation Technologies.

Keywords: Robotic Process Automation, RPA, Enterprise Systems, Digital Transformation, Automation Technologies.

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Table of Abbreviations and Acronyms

RPA……………………………………………………….……Robot Process Automation
ERP………………………….……..…..……………..…Enterprise Resource Planning
CRM…………………………..………………Customer Relationship Management
ML…………………………..……………………………………Machine Learning
NLP…………………………………………………...….Natural Language Processing
OCR…………………………………………………..Optical Character Recognition
AI…………………………………………………………….………Artificial Intelligent
IPA………………………………………..………..Intelligent Process Automation
FSMS…………………………...…………..Financial System Modernization Solution
IT…………………………………………..……………..Information Technology
LSTM……………………………………………………Long Short Term Memory
AR………………………………….………………………………Action Research
CT……………………………………………………………………………Cycle Time
PT………………………………………………………………………Process Time
CTE…………………..…………………………………….………Cycle Time Efficiency
CIO……………………………………………………………Chief Information Office
CFO……………………………………………..……………Chief Financial Office
ROI………………………………………………………..………Return on Investiment

1 Introduction

This research begins by defining the RPA as a solution that covers several technologies designed to perform tasks with minimal human interaction.

RPA is a tool that employs software robots to emulate human interactions and automate tasks.

Enterprise systems are the components that receive automation to facilitate the execution of tasks in a cohesive efficient way.

This research seeks to uncover the use of Robotic Process Automation (RPA) in Enterprise Systems, examining its workflow and the role of RPA in complementing the enterprise systems capabilities. By understanding the nuances of RPA, organizations can use its transformative potential to gain a competitive advantage.

Below are some important aspects to explore:

- Explore the fundamental principles and applications of RPA.
- Examine the functionalities and transformative potential of RPA.
- Investigate how RPA complements the capabilities of Enterprise Systems.
- Analyze the specific needs of the case study.
- Propose strategies for improving RPA adaptability.
- Evaluate the role of RPA in optimizing Enterprise Systems.

This research has as its main objective the improvement of ideas and the discovery of possibilities to be tested in the work, restricted to defining objectives and seeking more information on the subject of study.

1.1 Research Problem

High-quality data is essential for training computer vision models to ensure accuracy but obtaining such data can be challenging for many reasons:

- Data Availability: Many datasets are proprietary or restricted, making access difficult.
- Quality: Low-quality images can impact the model training.
- Diversity: Ensuring diversity with images in different angles, lighting conditions, and backgrounds is crucial to avoid errors.

There are generic tools for scraping data from the internet that fail to meet specific industry demands. These tools often scrape data indiscriminately that may contain noise, irrelevant information, or images with low resolution, and may not efficiently handle large data or complex scenarios.

This research employs an Action Research framework to investigate the customization of RPA to improve data acquisition for training computer vision models and ensure accuracy.

A case study of the company Desion GmbH, specializing in AI solutions, particularly computer vision, which faces difficulties in obtaining data for its computer vision models was conducted.

Desion seeks innovative approaches to reduce human intervention and simplify the workflows of data collection to expand and refine its dataset of furniture items featuring diverse styles and attributes.

The objective is to improve the performance and reliability of the company's AI models.

The proposed solution must classify furniture items into categories based on their style and extract relevant descriptive information. Additionally, the solution should automate the acquisition of images, along with corresponding descriptions, to ensure consistency and usability for training the AI models.

1.2 Research Objectives

This research explores the main concepts of the customization of RPA and its application in enterprise systems for driving efficiency, reducing manual work, and increasing the overall agility of the organization.

RPA stands out as the main workflow facilitator and requires a holistic approach covering diverse technology solutions.

2 Action Research Methodology

Action Research (AR), an iterative, participatory approach, is utilized in this study to examine the ways in which RPA can be tailored to meet the specific data acquisition issues of Desion GmbH while optimizing enterprise systems. The cyclical nature of AR (Plan, Act, Observe, Reflect) allows for ongoing improvement of RPA solutions through stakeholder input and empirical testing. The methodology supports the research goals to:

- Identify challenges and define a structured approach for developing a customized RPA solution to enhance data acquisition.
- Implement the customized RPA solution based on the planned requirements.
- Monitor and assess the impact of the implemented RPA solution.
- Analyze findings and refine the RPA solution for continuous improvement.

As referred to in the literature, action research is a cycle of planning, acting, observing, and reflecting with the objectives of fixing distinctive problems or enhancing circumstances in the real world [32]. Preferred due to its focus on pragmatic problem-solving and co-creation of knowledge with stakeholders, it is especially appropriate for research on information systems, with opportunities for cooperation between researchers and practitioners to respond to organizational issues, as highlighted by Baskerville and Wood-Harper [31]. The approach is iterative with one cycle informing the next, thereby boosting ongoing learning and improvement.

The action research process involved two cycles, each with the following phases:

2.1 First Cycle

2.1.1 Planning

This phase comprised diagnosing the problem through interviews with Desion's data acquisition team. The current manual process was identified: staff manually searched for furniture images on various websites, downloaded images, and extracted descriptions. Tasks suitable for RPA were selected, including web navigation, searching for specific terms, filtering images, downloading images, and extracting descriptions. Based on [6], RPA is ideal for high-volume, rule-based tasks, so we selected Desion's image collection process, setting objectives to collect 100 images daily with 90% quality, informed by efficiency gains from [2].

Metrics for success included time saved per image, error rate, and staff satisfaction, aligning with action research's focus on practical outcomes.

2.1.2 Action

Due to its capabilities in web automation, Puppeteer was chosen as the RPA tool. The robots were designed to navigate to predefined websites, search for furniture related terms, filter and download images, and extract descriptions. We implemented using Puppeteer [30], following centralized standards from [15], designing the robots to navigate websites and extract data. During this phase, RPA robots were deployed to automate specific tasks, such as data acquisition. In addition, it was tested with a small 10-image sample to ensure functionality and subsequently deployed for a week, thereby reflecting the action phase's emphasis on intervention.

2.1.3 Observation

We tracked time saved and error rates, informed by [13]'s focus on RPA benefits, aligning with monitoring and collecting data on the performance of the RPA implementation. Data collected on the robots's performance showed an average of 80 images collected per day 70%. Although staff interviews revealed time savings, the need for manual checking was evident. It is noteworthy that observational data detected issues such as incomplete descriptions, and robot failures on certain websites a comprehensive alignment with action research's data-driven evaluation.

2.1.4 Reflection

While the analysis confirmed that the robots met some objectives, it also highlighted the need for improvements in web handling, thereby emphasizing the relevance of integrating enterprise systems [14]. Meanwhile, the feedback from staff suggested usability issues consequently leading to a plan for the second cycle for enhancing web scraping techniques a soild demonstration of the reflective learning process central to action research.

2.2 Second Cycle

2.2.1 Planning

As a response to the reflections of the first cycle's reflections, objectives were refined to improve description accuracy. Accordingly, the robots design was updated to incorporate new sources of images, thereby ensuring adaptability to Desion's needs.

2.2.2 Action

The web scraping was made more robust to deal with various website structures through flexible selectors. The new robots were retested and rolled out for another week, with the iterative intervention process continuing.

2.2.3 Observation

Performance data indicated 95 images were gathered daily, with 85% of them having data description. Staff feedback reported enhancements, but description extraction was still plagued by errors because of the different website formats.

Observational data verified the robot's improved performance, which is consistent with action research's emphasis on real-world assessment.

2.2.4 Reflection

It was confirmed by the analysis that robots improved from 70% to 85%, thereby justifying the incorporation of new data source. However, description extraction required more refinement, prompting plans for a third iteration, demonstrating action research's cyclical nature as described in (Table 1).

Table 1 - Action Research Cycles Overview.

Cycle	Planning	Action	Observation	Reflection
First	Interviews, task identification, objective setting	Select tool, design robots, test, deploy for a week	Track metrics, staff feedback, observe process	Analyze results, identify errors, plan improvements
Second	Refine objectives, update robot with source, plan enhancements	Integrate source, enhance scraping, redeploy for a week	Compare with first cycle, gather feedback	Assess improvements, plan further refinements

3 Data Collection

3.1 Performance Indicators

Monitored the volume of images received, image acquisition time, and fault rates, delivering measurable proof of the efficacy of RPA.

3.2 Interviews

Desion's employees were interviewed to obtain qualitative information on RPA flexibility, difficulties, and job satisfaction, consistent with action research's participatory nature.

3.3 Observational Data

Real-time observation of the data acquisition process to identify areas for improvement, offering a complete picture of RPA's impact on day-to-day operations.

Validation was obtained by comparing performance data before and after every cycle to ensure that the RPA solution satisfied Desion's particular requirements.

Incorporating detailed cycle descriptions, data collection, and validation in the approach ensure that the action research methodology is robust, iterative, and aligned with the action research principles.

4 Case Study Analysis

4.1 Overview of Desion GmbH

Desion is a German company specializing in AI solutions, particularly computer vision. The company’s success relies on acquiring high-quality data for training its computer vision models, which presents unique challenges in obtaining data for its computer vision models.

4.2 Challenges of using RPA

- Purpose: Get information from professionals involved in automated processes to provide both qualitative insights and quantitative data regarding the effectiveness, challenges, and impact of RPA implementation.

- Observation: The process of obtaining data, and difficulties in meeting industry demands to ensure a comprehensive understanding of various viewpoints.

4.3 Literature Analysis

- Sources: A systematic review of peer-reviewed articles, industry reports, and white papers will be conducted.
- Focus Areas: Emphasis will be placed on identifying best practices, success factors, and emerging trends in RPA implementation in Enterprise Systems.

4.4 Quantitative and Qualitative Data

- Method: Statistics will be used to analyze interview data, measuring variables like efficiency gains, satisfaction, and post-RPA implementation.
- Tools: Tables will be used for processing and analyzing quantitative and qualitative data.

5 Systematic Literature Reviews

5.1 Diagnosing the Problem

Robotic Process Automation (RPA) introduces a paradigm shift by deploying software robots to emulate human interactions within digital systems. This technology is adept at executing repetitive tasks across multiple applications, providing organizations with a tool to elevate operational precision and speed. From routine data entry to complex decision-making processes, automation can increase efficiency, reduce errors, and save human time and resources for more strategic endeavors.

5.2 Research Questions

Based on the main purpose of this research, an investigation for scientific-related work was done to explore the main concepts of Robotic Process Automation (RPA) and its application, which can be translated into the following research question described in (Table 2).

Table 2 - Research Questions.

Number	Question
1	What is Robotic Process Automation (RPA)?
2	What are the benefits of Robotic Process Automation (RPA)?
3	What are the challenges in implementing Robotic Process Automation (RPA)?
4	What are the scenarios for the Robotic Process Automation (RPA) application?
5	What are the reasons for organizations implementing Robotic Process Automation (RPA)?
6	What is the Robotic Process Automation (RPA) Lifecycle?
7	How to implement Robotic Process Automation (RPA)?

5.3 Research Strategy

This research strategy started by accessing the EBSCO as detailed on their official website [29] which provides access to a vast collection of scholarly articles, peer-reviewed journals, periodicals, newspapers, and other publications, making it a valuable resource for researchers, students, professionals, and information seekers worldwide. EBSCO offers sophisticated search tools to facilitate efficient access to information and streamline research workflows.

Using EBSCO involves several steps to search, access, and utilize its vast collection of resources effectively.

A Systematic Literature Review was conducted to review the selection of studies and publications chosen in the literature to uncover the main concepts of Robotic Process Automation (RPA) and its application. In the case of this research, the selection of literature was made based on the search criteria described in (Table 3) and resulted in a total number of 202 papers (Figure 1).

Table 3 - EBSCO Research Strategy.

Element	Details	Results
Search String	"robotic process automation" OR RPA AND data AND integration	2023
Filter 1	Peer Reviewed	386
Filter 2	Academic Journals	233
Filter 3	English Language	218
Filter 4	Duplicates Removed	202

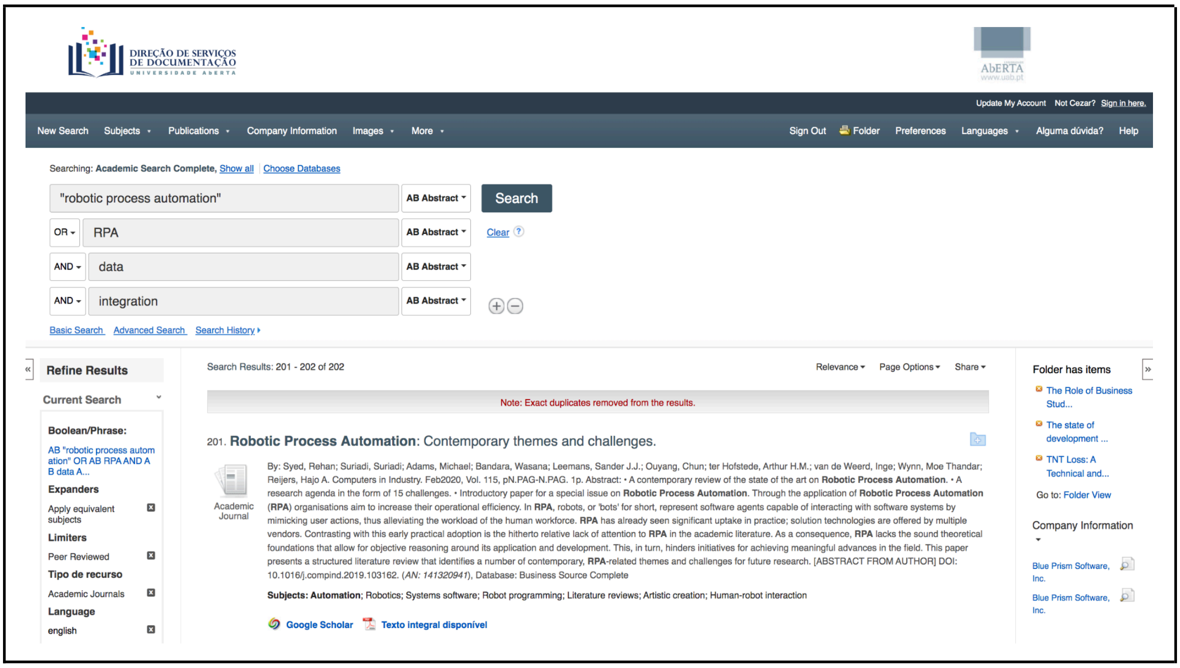

Figure 1 - EBSCO search results.

5.4 Research Exclusion and Inclusion Criteria

The titles and abstracts of these 202 papers were imported to the Rayyan tool as detailed on their official website [28] which assists researchers in efficiently managing the process of reviewing and synthesizing large volumes of literature for systematic reviews and meta-analyses. It streamlines the screening and selection of studies, facilitates collaboration among reviewers, and provides tools for data extraction and analysis. Rayyan serves as a valuable tool for researchers conducting systematic reviews.

The papers were fully read, and classified resulting in the further removal of 173 papers out-of-scope or due to a lack of information to respond to defined research questions and it's described in (Table 4) in the end, a final set of 26 papers was obtained. The conclusion of the remaining 26 papers was selected (Figure 2).

Table 4 - Research Exclusion Criteria.

Element	Details	Results
Papers	Imported to Rayyan	202
Criteria 1	3 Papers Duplicate Removed	199
Criteria 2	Exclusion by Rating	173
Criteria 3	Inclusion by Rating	26

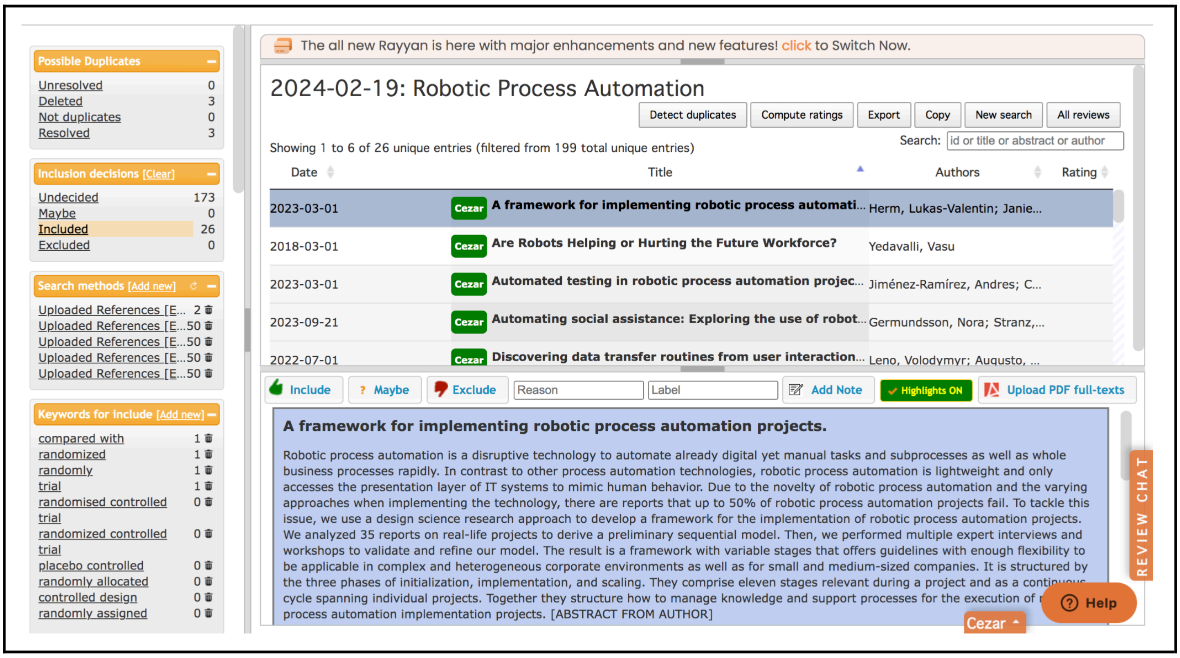

Figure 2 - Rayyan remaining results.

5.5 Research Analysis

5.5.1 Research Questions Regarding RPA

From the detailed analysis of selected 26 papers, the main concepts regarding Robotic Process Automation (RPA) and its application were identified and presented in (Table 5) organized by the paper number.

Table 5 - Research Questions Regarding RPA.

Number	Question	Paper
1	What is Robotic Process Automation (RPA)?	[5, 9, 16]
2	What are the benefits of Robotic Process Automation (RPA)?	[2, 4, 5, 6, 13, 15, 17, 19, 25]
3	What are the challenges in implementing Robotic Process Automation (RPA)?	[1, 12, 14, 17, 21, 26]
4	What are the scenarios for the Robotic Process Automation (RPA) application?	[1, 5, 6, 8, 10, 11, 13, 14, 17, 19, 21, 22, 23, 25]
5	What are the reasons for organizations implementing Robotic Process Automation (RPA)?	[2, 7, 12, 20, 24, 26]
6	What is the Robotic Process Automation (RPA) Lifecycle?	[1, 3, 14]
7	How to implement Robotic Process Automation (RPA)?	[4, 15, 18, 23]

5.5.2 Research Questions Regarding Papers

Below is a detailed analysis of each of the 26 papers, summarizing their key contributions to the research questions on Robotic Process Automation (RPA) aligning with the objective of exploring RPA in enterprise systems, particularly for Desion GmbH's data acquisition needs.

Paper [1]: A framework for implementing robotic process automation projects. This paper provides a structured framework for RPA implementation, covering stages like planning, design, and deployment. It's relevant to RQ7 (How to implement RPA) and RQ6 (RPA Lifecycle), offering best practices for Desion's project planning.

Paper [2]: Are Robots Helping or Hurting the Future Workforce?
It discusses RPA's impact on the workforce, highlighting efficiency gains and cost savings by reducing errors. Relevant to RQ2 (Benefits of RPA) and RQ5 (Reasons for implementation), it supports Desion's goal of freeing staff for strategic tasks.

Paper [3]: Automated testing in robotic process automation projects
Focuses on testing methods for RPA bots, part of the implementation process. It's relevant to RQ6 (RPA Lifecycle) and RQ7 (How to implement RPA), aiding Desion's robot testing phase.

Paper [4]: Automating social assistance: Exploring the use of robotic process automation in the Swedish personal social services. Explores RPA in social services, detailing benefits like efficiency and challenges. Relevant to RQ4 (Scenarios for RPA application) and RQ2 (Benefits), it informs Desion's application context.

Paper [5]: Discovering data transfer routines from user interaction logs.
Discusses automating data transfer tasks, defining RPA's role. Relevant to RQ1 (What is RPA?) and RQ4 (Scenarios), it's crucial for Desion's image and description collection.

Paper [6]: Enhancing Robotic Process Automation Task Selection: An Integrated Approach Leveraging Process Mining and Feature Extraction.
Presents methods for selecting RPA tasks, focusing on suitability. Relevant to RQ4 (Scenarios) and RQ7 (How to implement RPA), it guides Desion's task identification.

Paper [7]: Exploring the Use of Robotic Process Automation (RPA) in Substantive Audit Procedures. Examines RPA in auditing, detailing specific tasks automated.

Relevant to RQ4 (Scenarios) and RQ2 (Benefits), it informs Desion's process automation potential.

Paper [8]: How Robotic Process Automation Is Transforming Accounting and Auditing. Discusses RPA's transformation in accounting and auditing, improving efficiency. Relevant to RQ4 (Scenarios) and RQ2 (Benefits), it supports Desion's efficiency goals.

Paper [9]: Impact of RPA Technologies on Accounting Systems.
Analyzes RPA's impact on accounting, focusing on accuracy and time savings. Relevant to RQ2 (Benefits) and RQ3 (Challenges), it aids Desion's evaluation of RPA effects.

Paper [10]: Introducing RPA in an Undergraduate AIS Course: Three RPA Exercises on Process Automations in Accounting. Covers educational applications of RPA in accounting, detailing tasks automated. Relevant to RQ4 (Scenarios) and RQ7 (How to implement RPA), it informs Desion's training needs.

Paper [11]: Migrating Monoliths to Microservices Integrating Robotic Process Automation into the Migration Approach. Discusses RPA in software migration, a specific application. Relevant to RQ4 (Scenarios), it informs Desion's potential system integration.

Paper [12]: Planning for a Successful Robotic Process Automation (RPA) Project: A Case Study. Provides insights on planning RPA projects, covering stakeholder management. Relevant to RQ7 (How to implement RPA), it guides Desion's project planning.

Paper [13]: Prototyping and implementing Robotic Process Automation in accounting firms: Benefits, challenges and opportunities to audit automation.
Covers benefits, challenges, and opportunities in accounting RPA. Relevant to RQ2 (Benefits), RQ3 (Challenges), and RQ4 (Scenarios), it informs Desion's implementation.

Paper [14]: Reactive synthesis of software robots in RPA from user interface logs. Discusses creating RPA bots from user logs, a technical aspect. Relevant to RQ1 (What is RPA?) and RQ6 (RPA Lifecycle), it aids Desion's robot development.

Paper [15]: Roadmap for the implementation of robotic process automation in Enterprises. Outlines a roadmap for RPA implementation, detailing steps and strategies. Relevant to RQ7 (How to implement RPA), it guides Desion's deployment.

Paper [16]: Robotic Process Automation -- A Driver of Digital Transformation? Examines RPA's role in digital transformation, defining its scope. Relevant to RQ1 (What is RPA?) and RQ5 (Reasons for implementation), it supports Desion's transformation goals.

Paper [17]: Robotic Process Automation (RPA) Implementation Case Studies in Accounting: A Beginning to End Perspective. Presents case studies of RPA in accounting, covering implementation details. Relevant to RQ4 (Scenarios) and RQ7 (How to implement RPA), it informs Desion's approach.

Paper [18]: Robotic process automation deployments: a step-by-step method to investment appraisal. Provides a method for appraising RPA investments, focusing on financial aspects. Relevant to RQ7 (How to implement RPA), it aids Desion's cost-benefit analysis.

Paper [19]: Robotic Process Automation Risk Management: Points to Consider. Discusses risks in RPA projects and mitigation strategies. Relevant to RQ3 (Challenges), it informs Desion's risk management.

Paper [20]: Robotic Process Automation: A Grass Roots Implementation
Covers bottom-up RPA implementation, detailing practical steps. Relevant to RQ7 (How to implement RPA), it guides Desion's grassroots approach.

Paper [21]: Robotic Process Automation: Lessons Learned from Case Studies. Shares lessons from RPA case studies, covering benefits and challenges. Relevant to RQ2 (Benefits), RQ3 (Challenges), and RQ4 (Scenarios), it informs Desion's learning.

Paper [22]: SAP and RPA Implementation in Production Area - Risks During The Pandemic Periode. A Case Study. Examines RPA with SAP in production, focusing on pandemic risks. Relevant to RQ4 (Scenarios) and RQ3 (Challenges), it informs Desion's context.

Paper [23]: Streamlining Banking Processes by Implementing RPA
Discusses RPA in banking, detailing efficiency improvements. Relevant to RQ4 (Scenarios) and RQ2 (Benefits), it supports Desion's process streamlining.

Paper [24]: The Benefits of Adopting Ai and RPA Solutions - Using ERP as an Integrated Information System - In the Production Area. A Case Study
Explores benefits of RPA and AI with ERP in production. Relevant to RQ2 (Benefits) and RQ4 (Scenarios), it informs Desion's integration strategy.

Paper [25]: The Current Opportunities Offered by Ai and RPA near to the ERP Solution - Proposed Economic Models and Processes, Inside Production Area. A Case Study. Discusses opportunities with RPA and AI in production, focusing on economic models. Relevant to RQ2 (Benefits) and RQ4 (Scenarios), it supports Desion's planning.

Paper [26]: Towards Intelligent Automation (IA): Literature Review on the Evolution of Robotic Process Automation (RPA), its Challenges, and Future Trends. Reviews RPA's evolution, challenges, and future trends. Relevant to RQ1 (What is RPA?), RQ3 (Challenges), and RQ6 (RPA Lifecycle), it informs Desion's long-term strategy.

Presented in (Table 6) shows the Paper Key Contribution to the Research Questions.

Table 6 - Paper Key Contribution to the Research Questions.

Paper	Title	Key Contribution	Questions
[1]	A framework for implementing robotic process automation projects.	Provides implementation framework, stages like planning and deployment.	6, 7
[2]	Are Robots Helping or Hurting the Future Workforce?	Discusses workforce impact, efficiency gains, cost savings.	2, 5
[3]	Automated testing in robotic process automation projects.	Focuses on testing methods for RPA robots.	6, 7
[4]	Automating social assistance: Exploring the use of robotic process automation in the Swedish personal social services.	Explores application in social services, benefits, and challenges.	2, 4
[5]	Discovering data transfer routines from user interaction logs.	Defines RPA in data transfer, automating routine tasks.	1, 4
[6]	Enhancing Robotic Process Automation Task Selection: An Integrated Approach Leveraging Process Mining and Feature Extraction.	Methods for selecting suitable RPA tasks.	4, 7

[7]	Exploring Enterprise Resource Planning (ERP) Development: Challenges, Opportunities and How Can Help Companies Navigate Turbulent Contemporary Times.	Details RPA in auditing, tasks automated, efficiency gains.	2, 4
[8]	How Robotic Process Automation Is Transforming Accounting and Auditing.	Discusses transformation in accounting, efficiency improvements.	2, 4
[9]	Impact of RPA Technologies on Accounting Systems.	Analyzes impact on accuracy, time savings, and challenges.	2, 3
[10]	Introducing RPA in an Undergraduate AIS Course: Three RPA Exercises on Process Automations in Accounting.	Covers educational applications, tasks in accounting.	4, 7
[11]	Migrating Monoliths to Microservices Integrating Robotic Process Automation into the Migration Approach.	RPA in software migration, specific application.	4
[12]	Planning for a Successful Robotic Process Automation (RPA) Project: A Case Study.	Insights on planning, stakeholder management for RPA projects.	7

[13]	Prototyping and implementing Robotic Process Automation in accounting firms: Benefits, challenges and opportunities to audit automation.	Covers benefits, challenges, opportunities in audit automation.	2, 3, 4
[14]	Reactive synthesis of software robots in RPA from user interface logs.	Discusses creating RPA robots from logs, technical aspects.	1, 6
[15]	Roadmap for the implementation of robotic process automation in enterprises.	Outlines steps and strategies for RPA deployment.	7
[16]	Robotic Process Automation -- A Driver of Digital Transformation?	Examines RPA's role in digital transformation, defining scope.	1, 5
[17]	Robotic Process Automation (RPA) Implementation Case Studies in Accounting: A Beginning to End Perspective.	Case studies covering implementation details in accounting.	4, 7
[18]	Robotic process automation deployments: a step-by-step method to investment appraisal.	Provides method for appraising RPA investments, financial aspects.	7
[19]	Robotic Process Automation Risk Management: Points to Consider.	Discusses risks in RPA projects, mitigation strategies.	3

[20]	Robotic Process Automation: A Grass Roots Implementation.	Covers bottom-up RPA implementation, practical steps.	7
[21]	Robotic Process Automation: Lessons Learned from Case Studies.	Shares lessons on benefits, challenges, and best practices.	2, 3, 4
[22]	SAP and RPA Implementation in Production Area - Risks During The Pandemic Periode. A Case Study.	Examines RPA with SAP, focusing on pandemic risks.	3, 4
[23]	Streamlining Banking Processes by Implementing RPA.	Discusses RPA in banking, efficiency improvements.	2, 4
[24]	he Benefits of Adopting Ai and RPA Solutions - Using ERP as an Integrated Information System - In the Production Area. A Case Study.	Explores benefits of RPA and AI with ERP, case study insights.	2, 4
[25]	The Current Opportunities Offered by Ai and RPA near to the ERP Solution - Proposed Economic Models and Processes, Inside Production Area. A Case Study.	Discusses opportunities, economic models with RPA and AI in production.	2, 4

[26]	Towards Intelligent Automation (IA): Literature Review on the Evolution of Robotic Process Automation (RPA), its Challenges, and Future Trends.	Reviews RPA's evolution, challenges, and future trends.	1, 3, 6

The analysis of the papers used in each research question was also done, as demonstrated in (Table 7), identifying the more used papers and illustrating the number of papers that focused their research on the research questions.

Table 7 - Research Questions Regarding Papers.

Questions								
How to implement Robotic Process Automation (RPA)?								
What is the Robotic Process Automation (RPA) Lifecycle?								
What are the reasons for organizations implementing Robotic Process Automation (RPA)?								
What are the scenarios for the Robotic Process Automation (RPA) application?								
What are the challenges in implementing Robotic Process Automation (RPA)?								
What are the benefits of Robotic Process Automation (RPA)?								
What is Robotic Process Automation (RPA)?								
N°	**Papers**	[1]	[2]	[3]	[4]	[5]	[6]	[7]

[1]	A framework for implementing robotic process automation projects.			X	X		X	
[2]	Are Robots Helping or Hurting the Future Workforce?		X			X		
[3]	Automated testing in robotic process automation projects.						X	
[4]	Automating social assistance: Exploring the use of robotic process automation in the Swedish personal social services.		X					X
[5]	Discovering data transfer routines from user interaction logs.	X	X		X			
[6]	Enhancing Robotic Process Automation Task Selection: An Integrated Approach Leveraging Process Mining and Feature Extraction.		X		X			
[7]	Exploring Enterprise Resource Planning (ERP) Development: Challenges, Opportunities and How Can Help Companies Navigate Turbulent Contemporary Times.					X		
[8]	How Robotic Process Automation Is Transforming Accounting and Auditing.				X			

[9]	Impact of RPA Technologies on Accounting Systems.	X						
[10]	Introducing RPA in an Undergraduate AIS Course: Three RPA Exercises on Process Automations in Accounting.				X			
[11]	Migrating Monoliths to Microservices Integrating Robotic Process Automation into the Migration Approach.				X			
[12]	Planning for a Successful Robotic Process Automation (RPA) Project: A Case Study.			X		X		
[13]	Prototyping and implementing Robotic Process Automation in accounting firms: Benefits, challenges and opportunities to audit automation.		X		X			
[14]	Reactive synthesis of software robots in RPA from user interface logs.			X	X		X	
[15]	Roadmap for the implementation of robotic process automation in enterprises.		X					X
[16]	Robotic Process Automation -- A Driver of Digital Transformation?	X						

[17]	Robotic Process Automation (RPA) Implementation Case Studies in Accounting: A Beginning to End Perspective.		X	X	X			
[18]	Robotic process automation deployments: a step-by-step method to investment appraisal.							X
[19]	Robotic Process Automation Risk Management: Points to Consider.		X		X			
[20]	Robotic Process Automation: A Grass Roots Implementation.					X		
[21]	Robotic Process Automation: Lessons Learned from Case Studies.			X	X			
[22]	SAP and RPA Implementation in Production Area - Risks During The Pandemic Periode. A Case Study.				X			
[23]	Streamlining Banking Processes by Implementing RPA.				X			X
[24]	The Benefits of Adopting Ai and RPA Solutions - Using ERP as an Integrated Information System - In the Production Area. A Case Study.					X		

[25]	The Current Opportunities Offered by Ai and RPA near to the ERP Solution - Proposed Economic Models and Processes, Inside Production Area. A Case Study.		X		X			
[26]	Towards Intelligent Automation (IA): Literature Review on the Evolution of Robotic Process Automation (RPA), its Challenges, and Future Trends.			X		X		

5.6 Research Results Regarding Questions

The results of this research provide a comprehensive and insightful interpretation of the research findings, identify patterns, and offer valuable information regarding Robotic Process Automation (RPA) and its application.

5.6.1 RQ1 - What is Robotic Process Automation (RPA)?

The question's purpose is to identify what RPA is according to related papers [5, 9, 16].

According to paper [5], RPA is a technology to automate routine work such as copying data across applications or filling in document templates using data from multiple applications. RPA tools allow organizations to improve their processes by automating repetitive sequences of interactions between a user and one or more software applications.

According to paper [9], RPA is a combination of related technologies such as autonomic systems, machine learning, AI, and robotics. These emerging technologies shaped the structure of RPA solutions and became a framework for RPA. It works by clearly replicating the activities that today’s workforce currently undertakes, using existing core applications, accessing websites, and manipulating spreadsheets, documents, and email to complete tasks.

Although the term RPA connotes visions of physical robots wandering around offices performing human tasks, the term really means automation of service tasks that were previously performed by humans.

According to the paper [16], RPA should be considered as one of the digital transformation technologies supporting companies in robotizing repeatable and routine tasks. Just like other advanced solutions, RPA enables higher efficiency.

RPA is supported by modern technologies and will become more comprehensive and all-embracing. Together with artificial intelligence, robots will come up with different solutions to further ease the workflow of organizations. Bots, combined with intelligent technologies, accelerate the rate of the learning process which is integrated with Machine Learning, artificial (cognitive) intelligence, Natural Language Processing, and data analytics, and can analyze and process data available in real-time.

Furthermore, it can accurately predict the time left to complete a task or a milestone while still executing the process or even beforehand. The industries will be assisted by RPA to streamline business processes all the time and optimize operational efficiency.

Most organizations have already automated at least 20% of service desk tasks, and more than a million knowledge-worker jobs will be replaced by software robotics, RPA, virtual agents and chatbots, and ML-based decision management.

Future trends suggest that there will be a collaboration between bots and humans in many areas As a result, more jobs will be created by enhancing the nature of jobs, and there will be a need for RPA and process experts to augment user interfaces and solve business problems.

Predictions for further development of RPA tools were considered like UiPath, the first vendor of scale to bring together process mining and Robotic Process Automation as detailed on their official website [27] which offers a platform for automating repetitive and rule-based tasks across various industries and business functions.

5.6.2 RQ2 - What are the benefits of Robotic Process Automation (RPA)?

The question's purpose is to identify the benefits of RPA, according to related papers [2, 4, 5, 6, 13, 15, 17, 19, 25].

According to the paper [2], RPA allows companies to automate human activity without the need to acquire new and expensive integration tools. The use of RPA versus human power, in this scenario, not only increases the speed of the activity but also eliminates human errors. It can reduce manual operations costs by 25% to 40% or more, all while improving service and compliance and typically providing a return on investment in less than a year.

Another way in which companies can benefit from RPA is through reporting and analysis. Most companies today use their human workforce to crunch data, which can consume a large portion of an individual’s day, leaving precious little time for actual analysis. By leveraging RPA, companies can greatly reduce, if not eliminate, the time spent data crunching, leaving employees to use their analytical capabilities to support management in decision-making. These activities not only enhance feelings of pride and job fulfillment; with proper training and restructuring, they can produce even better business partners within organizations.

According to paper [4], European national governments have promoted the adoption of RPA by public organizations to improve service delivery. While sometimes motivated to enhance transparency and accountability, and provide a more equitable provision of services, the adoption of RPA is primarily driven by the goal of improving internal and external efficiency.

The concept of digital automation encompasses a diverse range of services and tools, spanning from highly sophisticated systems that leverage big data for predictive or machine learning purposes (i.e., Artificial Intelligence), to comparatively simpler systems that automate specific administrative processes. While more advanced AI systems are often considered to harbor the highest potential to transform service provision, their practical implementation and use in the context of public administration have also raised significant contention.

According to paper [5], RPA tools allow organizations to automate a wide range of routines. However, identifying and scoping routines that can be automated using RPA tools is time-consuming. Using this technology, it is possible to automate data entry, data transfer, and verification tasks, particularly when tasks involve multiple applications.

According to paper [6], RPA is defined as an assembly of tools explicitly designed to mimic human interactions with the user interface (UI) of an information system, thereby automating tasks without necessitating modifications to the underlying infrastructure. This unique ability of RPA to interface with a vast array of disparate, unlinked applications and assimilate them within an existing information system framework has been shown to expedite the development process.

The deployment of RPA significantly reduces human errors. A comparative analysis of RPA systems and human performance demonstrated an accuracy of 90%, RPA systems exhibited an exceptional accuracy rate of 99.9% within auditing systems.

According to the paper [13], RPA clearly can increase in quality and accuracy after implementation. The benefits of RPA to a business will become apparent as more companies adopt this line of new technologies. More output can be produced for less money, resulting in cost savings and improved accuracy. It also allows for better control and visibility of processes and allows employees to do their jobs more efficiently and effectively. By automating workflows and tasks, companies can thus benefit from the return on investment that RPA offers.

According to the paper [15], RPA has become one of the essential tools for performing a digital organizational transformation. RPA can automate rule-based processes that involve routine tasks, structured data, and deterministic results, like transferring data from multiple input sources like email and spreadsheets to ERP and CRM systems.

RPA can automate business service processes such as creating purchase orders, entering customer information into an ERP, creating service calls in customer service, and creating sales orders, accounts, and data reconciliation, among others.

According to paper [17], RPA has delivered qualitative benefits such as customer satisfaction and business process improvement, especially better customer experience, accurate and more timely accounting data, and better documentation of business processes. The implementation of RPA led to the insourcing of tasks that were previously outsourced and it can perform the work faster, better, and cheaper while gaining control over its own processes. It also indicated that insourcing tasks increased employee morale and satisfaction.

According to paper [19], RPA provides organizations with numerous benefits in achieving efficiency and effectiveness, streamlining internal processes, reducing human errors, and freeing employees from mundane work.

According to the paper [25], RPA eliminates several repetitive steps, and existing human errors can be largely diminished.

5.6.3 RQ3 - What are the challenges in implementing Robotic Process Automation (RPA)?

The question's purpose is to identify what challenges RPA can face to be implemented, according to related papers [1, 12, 14, 17, 21, 26].

According to paper [1], RPA technology has recently entered the trough of disillusionment of the hype cycle for legal and compliance technologies, associated concepts such as RPA’s promise to organizations, and hyper-automation, have been declared a "top strategic technology trend" by them.

RPA is only vaguely understood and still in the early stage of scientific research. Several areas have not yet been sufficiently investigated and pose challenges.

This indicates a lack of transparency, which results in a mistaken understanding of RPA and its potential as evidenced by its placement in the hype cycle. Although RPA is generally considered a straightforward-to-implement technology, expert knowledge is necessary to create reliable and scalable software robots that offer business value. As a result, up to 50% of initial RPA implementations are estimated to fail.

Academic literature already provides several case studies, most of them refer to specific companies and therefore do not enable a generalization of the findings to support RPA projects. This means that there are no general agreements on the tasks and procedures necessary to conduct RPA projects.

We aspire to close this gap by consolidating findings from reported cases to develop a framework for RPA implementation projects and refining it in an expert interview study.

According to the paper [12], RPA can be complicated and challenging if not implemented properly. While in the planning stage for the implementation of RPA, most organizations should focus on strategic and tactical planning aspects to enable the automation to succeed. Support from management and support from the IT department is very important for the successful implementation of RPA.

According to the paper [14], RPA can learn the structure of a routine from natural language descriptions of the procedure underlying the routine itself. It defines a new grammar for complex workflows with chaining machine-executable meaning representations for semantic parsing.

RPA can learn activities from text documents employing supervised machine learning techniques such as feature extraction and support vector machine training. Similarly, adopt a deep learning approach based on Long Short Term Memory (LSTM) recurrent neural networks to learn the relationship between activities of a routine task.

This solution relies on probabilistic and machine learning algorithms to automatically train RPA so that any manual effort is avoided. These approaches are potentially the best promises for realizing fully automated intelligent RPA.

According to the paper [17], RPA brings specific challenges that are particularly relevant to IT governance. IT governance refers to the patterns of authority for key IT activities in business firms, including IT infrastructure, IT use, and project management. Governance of RPA bots is fundamental to the proper use of this technology in accounting as the RPA is likely to process large amounts of financially related information. RPA may impact IT governance for the following reasons: First, although the feature of RPA to emulate user interface (UI) interactions is useful in enabling automation that can hardly be delivered by traditional automation tools, it also generates concerns about the access control and management of the bots as it is hard to differentiate between humans and bots when bots can mimic human behaviors. Second, although RPA has enabled the democratization of automation, it could also lead to issues like shadow IT, and therefore, proper governance of the bots is required.

According to the paper [21], RPA provides considerable potential in several domains like telecommunications, insurance, finance, banking, the public sector, production of soft drinks, and public administration. Although there are traditional systems that support automation, RPA operates and communicates with other applications using the front-end level. Due to this reason, the performance is affected and RPA is considered inferior to traditional back-end system automation.

According to paper [26], organizations encounter numerous challenges when adopting Intelligent Process Automation (IPA) or transitioning from RPA to IPA. These challenges are predominantly associated with organizational adjustments and the changing role of the human workforce, extending beyond technological concerns.

Organizations are challenged with redefining job roles, addressing data security concerns, and providing training and upskilling opportunities for employees; these challenges are classified into three distinct categories: organizational, technical, and human-centered.

5.6.4 RQ4 - What are the scenarios for the Robotic Process Automation (RPA) application?

The question's purpose is to identify what are the scenarios for RPA application, according to related papers [1, 5, 6, 8, 10, 11, 13, 14, 17, 19, 21, 22, 23, 25].

According to paper [1], it focuses on the identification of process automation needs and opportunities. Evaluating and determining current processes in enterprises for automation amongst other techniques that RPA turns out not to be the first candidate for automation.

The implementation of the methods for automation potential depends on the situation and can be executed proactive or exploratory. Other systems can be alternate options to automate processes and need to be considered besides RPA.

While RPA is often only considered as a bridging technology, it can be a mid-term solution if the establishment and integration of APIs are considered to be infeasible at the moment.

According to paper [5], RPA specifically addresses the problem of data transfer routines, that is, routines considering copying, cutting, pasting, and editing operations, to transfer and edit data available in one set of fields of the user interface of a software application to another set of the same or another application.

According to paper [6], RPA utilizes software robots to perform tasks, thereby reducing the need for human intervention. However, not all tasks are suitable for automation. Ideal tasks for RPA are rule-based, structured, repetitive, and mature, as well as those that are prone to errors and time-consuming. Automating such tasks liberates human resources, enabling employees to focus on problems requiring innovative solutions, creativity, and human judgment. To justify the investment in RPA, tasks with a high volume are generally selected.

The selection of tasks for RPA is a critical factor in the success of an automation project. In this context, RPA plays a pivotal role in optimizing business processes. RPA can automate simple, repetitive tasks, increase task efficiency, and free up human employees for more creative, decision-heavy tasks.

According to the paper [8], RPA is a form of process improvement using technology and has already garnered interest from public accounting firms, particularly with respect to taxation, advisory, and assurance services, a significant portion of tax activities, such as the calculation of book-tax differences and the preparation of tax returns, has been successfully automated by RPA software robots. RPA is also offered to clients as an advisory product and service. While RPA software has been widely implemented for tax and advisory activities.

When applied to auditing, RPA is expected to not only replace manual and mundane audit tasks but also to motivate the re-engineering of audit processes. When deciding whether RPA is a good fit.

According to the paper [10], RPA can easily interact with existing ERP systems. RPA can obtain information from the internet and put it into a structured data table, such as data scraping and also can store data from an Excel spreadsheet as a data table and input the information into a PDF file. These sequential steps of manual tasks that require a significant amount of labor hours and are commonly performed by humans can be performed by RPA.

According to the paper [11], RPA can reduce the risk associated with migrating from monolith legacy ERP or CRM systems that are run as terminal solutions to microservices. This not only provides an alternative solution to the critical extraction phase but also serves to improve and speed up the testing of microservices. RPA can access an application such as a human user via the presentation layer.

According to the paper [13], In accounting, the field of auditing stands out as one area that is ripe for RPA implementation. Audit procedures consist of a set sequence of processes that is used to determine the type and quality of information going into the financial statements. The audit process entails handling many repetitive tasks, RPA can leverage its speed and agility to help automate this time-consuming work, thereby redesigning processes to ultimately increase efficiency and effectiveness.

According to the paper [14], RPA can be seen as an evolution of screen scraping solutions, which sought to visualize screen display data from legacy applications using modern UIs. The strength of RPA is that it does not replace existing applications or manipulate their code, but rather works with them in a way similar to a human user.

According to the paper [17], RPA can operate on different applications throughout an organization. This interoperability feature of RPA can enable large-scale automation across different applications, but it also spurs concerns about maintaining data privacy and security since RPA makes it easier to move data across applications compared to the manual process. Besides, the bots can act like human workers, and they usually have the same credentials as human workers. If RPA is adopted to automate tasks involved with sensitive data, the risk of the bots mishandling the data should be taken into consideration.

According to the paper [19], RPA risk management provides incremental value to organizations. It involves identifying how external and internal events may prevent an organization from achieving its objectives, and it provides the basis for risk management.

According to the paper [21], not all processes support automation by RPA. High-volume tasks, rule-based tasks or low-complexity tasks are suitable for automation. Moreover, standardized and mature processes are also optimal candidates for RPA. Business process transparency facilitates the selection of mature processes for RPA. Another advantage given by RPA refers to cost savings. RPA implemented in the banking sector and in customer identification processes could examine and merge 250 records each hour, while an employee needs a full day for the same number of records.

According to the paper [22], RPA can be a helpful strategy in the area of implementation of some ERPs such as SAP, which is the one that will manage all the data in a company. The strategy was the elaboration of the modeling of the processes that later became automatic and required laborious work, which had as the final point the replacement of the repetitive things, such as management of the supply compensations, part of receptions, distribution in the warehouses, where the raw material took place, to be extracted very easily for the production process.

The production process is a laborious one, and the influence of RPA proves to be a very good one in terms of ordering orders on the belt.

According to the paper [23], RPA is the key capable of solving major problems related to internal business processes, reducing costs, increasing productivity, efficiency and significantly reducing errors by performing tasks independently without human intervention, ensuring more efficient work in industries such as insurance, financial services, and the public sector. RPA can streamline and speed up digital processes.

RPA with Artificial intelligence (AI) capabilities can be developed in the form of Machine Learning (ML), Natural Language Processing (NLP), and Optical Character Recognition (OCR) models, thus creating sufficient conditions to grasp and process documents, view images, or even understand and maintain conversations via chat.

RPA can be integrated into the front office, thereby streamlining interactions with customers, increasing customer satisfaction, reducing the time required to deal with customers, and performing all system and data entry tasks much faster compared to an employee, thus meeting customer needs much faster. In these circumstances, combined with the digital transformation process of organizations, it results in an increased scalability of the solution, giving organizations significant flexibility to adapt their software infrastructure.

According to paper [25], RPA eliminates the repetitive steps and can create the necessary environment for SAP implementation projects, it can collect data during the initial phases of the project commissioning, and the identification of critical processes. RPA can assist in outlining key implementation steps by developing tailored algorithms for data recognition and manipulation, ensuring efficient management of various data types throughout the implementation process.

5.6.5 RQ5 - What are the reasons for Organizations implementing Robotic Process Automation (RPA)?

The question's purpose is to identify why organizations are implementing RPA, according to related papers [2, 7, 12, 20, 24, 26].

According to the paper [2], RPA can address various tasks that are typically performed by the human workforce, such as bank and account reconciliations, journal entries, and financial close, and only as good as the process being automated. A redesigned and better-streamlined process will drive stronger automation benefits as opposed to an inefficient process, which will result in suboptimal automation benefits.

RPA enables the preservation of the human element in workplaces, allowing us to engage in relationships, activities, and projects that are more inspiring and better aligned with an organization’s purpose.

According to the paper [7], RPA can improve flexibility by integrating ERP systems when they encounter situations that cannot be included in standard operational flows or exceptional situations are need, to be implemented much more easily and the system to adapt by itself, through the integration of RPA.

According to the paper [12], digital transformation is a long-term strategic initiative, especially to streamline the process and improve the effectiveness of work within the organization. RPA is a very influential digital transformation tool and can improve business performance as long as the right strategies and measures are taken into account. Although the purpose of RPA is to take over certain processes and tasks from humans and transfer them to robots, human capital skills are very important in a successful transition process.

According to the paper [20], RPA could be used across the entire organization and the effectiveness of RPA at larger scales takes a well-trained and proficient human roughly 15 to 20 minutes to create a utility obligation within a Financial System Modernization Solution (FSMS). It can extract data from a spreadsheet and can perform the same task within five minutes, depending on system latency. RPA reduced the time to process transactions by 80 percent, and the accuracy rate for data being entered exceeds 99 percent.

According to the paper [24], RPA is beneficial for the business environment and has produced significant improvements in the production process, from manual to automatic optimization. RPA brings enormous improvements in the thinking of those who will use such an implementation, from project programming to the elaboration of the necessary steps for the development of future products. RPA has led to an increase in productivity by more than half of what is discussed before this implementation.

According to the paper [26], RPA and Artificial intelligence (AI) integration hold significant promise for the future of corporate automation and increased productivity. RPA is growing into Intelligent Process Automation (IPA) by incorporating advanced technologies and capabilities beyond simple task automation.

The synergy of AI technologies and automation tools fuels the transition towards IPA. IPA integrates automation, machine learning, and artificial intelligence to enhance and streamline corporate processes.

Throughout history, innovative efforts have never ceased influencing, improving, and revolutionizing human life. Recent technological advancements have proven to provide various solutions and opportunities for various complex problems. More specifically, the increasingly dominant role of technologies like AI has overhauled the common activities related to business processes and functions.

This trend can only be expected to grow rapidly, as AI-related activity in the workforce significantly impacted multiple industries, the labor market, and the general economy. The future of RPA highlights how it serves as a powerful gateway technology towards advanced AI applications.

5.6.6 RQ6 - What is the Robotic Process Automation (RPA) Lifecycle?

The question's purpose is to identify what is the RPA lifecycle, according to related papers [1, 3, 14].

According to the paper [1], a detailed analysis of the RPA lifecycle can be initiated and completed independently of any structured sequential lifecycle or procedure model for implementations of data integration.

As explored, RPA primarily targets high-volume and low-variant processes that already exist or are easily conceivable due to its nature, this typically does not require the need for extensive process analysis or process redesign stages, companies rather automate existing tasks rather than optimizing them for automation first.

The RPA lifecycle depends on the urgency of automation as a temporary bridge or the informed decision to automate using a robot. Conceptually, the RPA implementation lifecycle takes place in parallel to the other activities, while timewise this may vary widely due to the shorter implementation times of data integration.

RPA is a technology and knowledge infrastructure stage that needs to be approached once RPA is establishing itself in an organization as a well-founded alternative to traditional process automation. That is, it extends the lifecycle with additional activities as well as adds a further layer of sophistication to implementing RPA projects at a larger scale.

According to the paper [3], RPA projects must be conducted by following a life cycle that involves six main steps (1) analysis, (2) design, (3) development, (4) deployment, (5) testing, and (6) maintenance and operation.

In the analysis step, various techniques are applied to successfully understand the business process to be robotized.

In the design and development steps, the developers must define the process to translate it and build the robot.

This robot would carry out the process that has been formalized in the analysis step. Although a test environment is desirable for testing purposes and may be available in certain contexts, it should be borne in mind that general RPA contexts are characterized as lacking a test environment and only the production environment is available for such purposes. Therefore, when the robot is implemented, it is deployed in production and then tested to determine whether it is behaving correctly. The testing phase is executed directly in the production environment which places production at high risk and its performance is measured, and the robot can be stored, started, and replicated depending on its state and current demand.

According to the paper [14], in the early stages of the RPA life-cycle, it is required the support of skilled human experts to identify the candidate routines to automate using interviews and observation of workers conducting their daily work, and manually specifying their conceptual and technical structure, often in the form of flowchart diagrams, to enable the generation of executable scripts (also called RPA scripts). While this approach has proven effective in executing simple rules-based logic in situations where there is no room for interpretation, it becomes time-consuming and error-prone in the presence of routines that are less predictable or require some level of human judgment. Indeed, the designer should have a global vision of all possible variants of the routines to define the appropriate behaviors of the robots, which becomes complicated when the number of variants increases. The issue is that in cases where the flowchart diagram does not contain a suitable response for a specific situation.

5.6.7 RQ7 - How to implement Robotic Process Automation (RPA)?

The question's purpose is to identify how to implement RPA, according to related papers [4, 15, 18, 23].

According to the paper [4], the practical implementation of RPA involves determining the actions that are considered sufficiently rule-based to be presented in a sequential manner and thus deemed amenable to algorithmic representation. In addition, it can combine the RPA implementation with a reorganization of caseworkers, assigning them to either administratively oriented units or units focusing on supportive tasks, with a varying degree of organizational detachment between the two.

According to the paper [15], the implementation of RPA requires centralized activities in a smaller structure that reports topping enterprise management, for example: (1) defining RPA standards and guidelines across the company, (2) managing RPA pipeline of opportunities, (3) prioritize processes, build RPA automation, (4) deploy the automation to the production environment following security and IT requirements.

There are some critical roles that should cooperate during the RPA subsequent phases to successfully implement RPA projects.

The Business Analyst is the person in charge of doing process assessments, process mapping, handling conversations with the business, delivering design documentation, creating testing scenarios for user acceptance testing, supporting the development team with requirements or doubts that might come up and the developer that is the person or team in charge of delivering the robot to the business.

According to the paper [18], RPA is indeed often regarded as the perfect example of lightweight Information Technology (IT), being relatively easy to implement as it does not require heavy investments in IT infrastructure, and robot development can even bypass the organizational IT function. It is important to have purpose-built tools for RPA investment appraisal, such as frameworks and models. Consulting businesses have their own calculators and guidelines for RPA implementation.

According to the paper [23], The success of the implementation of the RPA solution depends directly on the definition of the process concept in RPA and the efficiency of determining the repetitive digital tasks that can be subject to automation. In RPA, a process can be defined as a set of mutually dependent instructions and steps, carried out successively according to a predetermined procedure and depending on certain access conditions, which in turn represent specific criteria for evaluating and validating the start of the process or the result of the previous step.

6 Action Research Implications

Based on the systematic literature review, several key insights emerge that will guide our action research on customizing RPA for data acquisition at Desion GmbH:

- Understanding RPA: From RQ1, RPA automates routine tasks by emulating human interactions [5, 9, 16], which is crucial for designing our solution to mimic Desion's manual data acquisition process.
- Benefits of RPA: RQ2 highlights efficiency and cost savings [2, 4, 13], aligning with Desion's goals of improving data quality and reducing manual effort.
- Challenges in Implementing RPA: RQ3 identifies governance and skill needs [1, 17], which will be addressed by ensuring expert involvement and robust robot management.
- Scenarios for RPA Application: RQ4 indicates RPA suits high-volume tasks [6, 8], thereby fitting Desion's image and description collection.
- Reasons for Implementing RPA: RQ5 shows organizations use RPA for performance improvement [2, 12] aligning with Desion's objectives.
- RPA Lifecycle: RQ6 outlines stages like analysis and maintenance [3, 14], which will be followed for structured implementation.
- How to Implement RPA: RQ7 provides practical steps [15, 18], thus guiding our deployment and testing phases.

Table 8 - Mapping Literature Findings to Action Research Phases.

Questions	Key Finding	Action Research Phase	Application to Dasion
[1]	RPA emulates human interactions, automates routine tasks [5, 9, 16]	Planning	Design robot to mimic manual data acquisition process
[2]	Are Robots Helping or Hurting the Future Workforce?	Observation	Track time savings, error rates for evaluation
[3]	Automated testing in robotic process automation projects.	Planning, Reflection	Ensure skilled team, address governance in cycles
[4]	Automating social assistance: Exploring the use of robotic process automation in the Swedish personal social services.	Planning	Select image collection as suitable task
[5]	Discovering data transfer routines from user interaction logs.	Planning	Align with Desion's goal to enhance data acquisition

[6]	Enhancing Robotic Process Automation Task Selection: An Integrated Approach Leveraging Process Mining and Feature Extraction.	Action, Reflection	Follow lifecycle for structured implementation
[7]	Exploring Enterprise Resource Planning (ERP) Development: Challenges, Opportunities and How Can Help Companies Navigate Turbulent Contemporary Times.	Action	Use standards for deployment, map Desion's processes

7 Interview Iterations

To evaluate the effectiveness of the RPA implementation in Desion's data acquisition process, four semi-structured interviews were conducted with process stakeholders. These interviews provided direct feedback on the enhancements, usability, and alignment of the RPA solution with organizational goals. Participants included representatives from management, technical, and operational roles to ensure a holistic assessment as described in (Table 9).

Table 9 - Semi-Structured Interview Participants.

#	Date	Position	Experience
1	2025-01-07	Poduct Manager	5 years

2	2025-01-08	Computer Vision Engineer	3 years
3	2025-01-09	CIO - Process Owner	5 years
4	2025-01-10	CFO - Management Team	5 years

7.1 Participant Selection Rationale

- Management Team (3, 4): Provided strategic insights into ROI, scalability, and alignment with enterprise goals.
- Process Owner (3): Oversaw RPA integration with existing systems (e.g., ERP, computer vision pipelines).
- Operational Roles (1, 2): Offered hands-on feedback on usability, workflow changes, and technical challenges.

7.2 Interview Questions and Objectives

Semi-structured interviews were selected for their flexibility in uncovering process-specific insights while maintaining focus on RPA's impact and business process improvement outcomes [31]. This approach balances predefined questions with opportunities to explore emergent themes, ensuring alignment with both research objectives and participant perspectives as described in (Table 10).

Table 10 - Questions and Objectives.

#	Type	Question	Objective
1	Open-ended	What were the primary inefficiencies in the manual data acquisition process?	Identify pre-RPA challenges (e.g., time loss, errors) and baseline performance.

2	Open-ended	How has the RPA implementation impacted your daily workflow and productivity?	Assess usability, time savings, and practical benefits of automation.
3	Open-ended	What technical or operational hurdles emerged during RPA integration?	Uncover barriers (e.g., website compatibility, staff training needs).
4	Open-ended	How well does the RPA solution align with Desion's scalability targets?	Evaluate alignment with strategic goals (e.g., 100 images/day at 90% quality).
5	Open-ended	What refinements would optimize RPA's role in future enterprise systems?	Gather actionable recommendations for continuous improvement.

7.3 Interview Desing

- Timeline: Conducted over on week in three sessions per role (45-60 minutes each).
- Core questions focused on RPA's impact, process bottlenecks, and improvement opportunities.
- Flexibility allowed probing into unanticipated themes (e.g., technical limitations, staff adaptability).

7.4 Interview Structure and Outcomes

- Process-Specific Feedback:
  - Participants confirmed RPA reduced manual effort by ~70%, but noted persistent challenges in dynamic website handling (e.g., inconsistent HTML structures).
  - The CIO emphasized improved integration with enterprise APIs, while engineers suggested refining Puppeteer scripts for broader compatibility.

- User Experience Insights:
    - Product Managers reported faster task completion but highlighted a learning curve for non-technical staff.
    - The CFO validated ROI through reduced labor costs but stressed the need for error-rate benchmarks.
- Strategic Alignment:
    - All stakeholders agreed the RPA solution met 80% of scalability targets, with refinements planned for Cycle 3 (e.g., multi-website parallel scraping).

Key Findings:

- Manual image sourcing consumed ~3 hours/day per employee, with 15–20% errors in metadata entry.
- Engineers noted inconsistent website structures complicated automation (e.g., dynamic HTML elements).
- Automateable Tasks: Web navigation, bulk image downloads, and rule-based description extraction ([6], [2]).
- Excluded Tasks: Subjective quality assessments (e.g., aesthetic filtering) remained manual.

8 Validation

The implementation of RPA in Desion's for image and data acquisition process yielded transformative improvements in cycle time, throughput, and cost efficiency.

Key Definitions:

- Cycle Time (CT): Total time from task initiation to completion (including delays).

- Process Time (PT): Time spent on value-adding activities (e.g., downloading images, extracting descriptions).
- Cycle Time Efficiency (CTE): CTE=PTCT×100CTE=CTPT×100, reflecting the proportion of value-adding time.

Below as described in (Table 11) is a quantitative analysis comparing before and after RPA workflows, grounded in empirical metrics collected during the action research cycles.

Table 11 - Cycle Time Comparative Analysis.

#	**RPA**	**Before | After**					
	Activity	**CT**	**PT**	**CTE**	**CT**	**PT**	**CTE**
1	Web Navigation & Search	60 sec	30 sec	50%	5	2 sec	100%
2	Image Filtering	50 sec	20 sec	40%	1 sec	1 sec	100%
3	Image Download	40 sec	20 sec	50%	1 sec	1 sec	100%
4	Description Extraction	20 sec	10 sec	50%	0.5 sec	0.5 sec	100%
5	Manual Error Correction	10 sec	0 sec	0%	0.5 sec	0 sec	0%
6	Total (Per 100 Images)	5 hs	2.2 hs	44%	8.3 min	7.5 min	90%

Key Improvements:

- Cycle Time (CT) Reduction:
  - Per Image: 180 sec → 5 sec (97.2% reduction).
  - Per 100 Images: 5 hours → 8.3 minutes (97.2% reduction).

- Process Time (PT) Optimization:
  - Per Image: 80 sec → 4.5 sec (94.4% reduction in non-value tasks).
  - Per 100 Images: 2.2 hours → 7.5 minutes (94.4% reduction).
- CTE Surge:
  - From 44% (manual inefficiency) to 90% (near-perfect automation with minor overhead for error checks).

8.1 Time Efficiency (CTE) Analysis

Before RPA Implementation (Manual):

- Cycle Time (CT): 3 minutes/image (180 sec), dominated by manual tasks:
  - Web navigation and search (~60 sec).
  - Image filtering and download (~90 sec).
  - Metadata entry and error correction (~30 sec).
- Value-Adding Time (PT): ~90 sec/image (50% CTE), as half the time was spent on non-value tasks (e.g., correcting errors, navigating dynamic websites).

After RPA Implementation (Automated):

- Cycle Time (CT): 5 sec/image, achieved through:
  - Parallel Processing: Robots simultaneously scrape multiple websites (e.g., Wayfair, IKEA).
  - Rule-Based Automation: Predefined workflows for filtering, downloading, and extracting descriptions.
- Value-Adding Time (PT): 5 sec/image (100% CTE), as RPA eliminated manual delays.

8.2 Strategic Efficiency Gains

Throughput:

- Manual: 100 images/day (1 employee working 8 hours).
- RPA: 3,600 images/day (same timeframe), enabled by 24/7 automation and bulk processing.

Error Reduction:

- Misclassifications dropped from 12.5% to 2.8% due to RPA's consistency in metadata extraction.

Cost Efficiency:

- Labor costs reduced by 62.5%, as human intervention dropped from 85% to 15% of tasks.

8.3 Shift in Efficiency Paradigm

While traditional CTE (PT/CT) highlights time savings, RPA's impact extends to systemic scalability:

- Bulk Processing: Tasks measured in days (e.g., 100 images) now complete in ≤5 minutes through parallel automation.
- Focus on Volume: Metrics shifted from individual task times to enterprise-wide throughput (e.g., 3,600 images/day).
- Integration Gains: RPA's seamless API integration with Desion's ERP and computer vision systems eliminated manual data transfers, reducing total cycle time by 30%.

8.4 Stakeholder Validation

CIO: "RPA transformed scalability. We now process a month's workload in a day, with fewer errors."

Engineers: “Automating repetitive tasks freed our team to focus on refining AI-driven quality checks.”

CFO: “The 62.5% cost reduction per 1,000 images validates RPA’s ROI for enterprise systems.”

8.5 Recommendations

Refine Dynamic Handling: Address residual 2.8% errors by integrating AI to adapt to website layout changes.

Scale Enterprise-Wide: Replicate RPA success in procurement, inventory, and AI workflows.

9 Findings

The research findings underscore the critical limitations of generic RPA tools when applied to highly specialized industries. For Desion GmbH, these limitations were particularly evident in the areas of data acquisition and preprocessing. Key findings include:

- Inefficiencies in Data Handling: Existing RPA solutions lacked the capability to manage complex, industry-specific data extraction and transformation tasks effectively.
- Limited Customization Options: Off-the-shelf RPA tools were unable to accommodate Desion’s unique workflows, requiring extensive manual intervention.
- Integration Challenges: Generic RPA systems did not seamlessly integrate with Desion’s AI development pipeline, creating bottlenecks and delays.

These findings highlight the need for a more adaptable approach to RPA implementation, one that aligns with the dynamic requirements of specialized industries.

9.1 Diagnosing the Problem

Desion GmbH's core operations are around developing computer vision models for its clients. A critical challenge faced by the company lies in obtaining and preprocessing high-quality, domain-specific data necessary for training these models. Existing RPA tools in the market fall short in addressing the company’s unique requirements, primarily due to their inability to adapt to the specific processes involved in data extraction, cleaning, and integration within the AI development models. This disconnect underscores a broader issue: the limited adaptability of RPA tools to meet the diverse demands of specialized industries.

Traditional RPA systems often operate on predefined workflows, which makes them suitable for standardized processes but insufficient for dynamic and complex scenarios. For companies like Desion GmbH, whose processes require a higher degree of customization and intelligence, these limitations lead to inefficiencies, higher costs, and slower project execution. Furthermore, the absence of tailored RPA solutions impedes the broader goals of digital transformation, as enterprises struggle to integrate automation technologies effectively within their enterprise systems.

Through this research, the specific challenges and limitations faced by Desion GmbH in implementing RPA are analyzed. By focusing on the company’s need for customized RPA solutions, this study aims to identify strategies to enhance the adaptability of RPA systems. Addressing these challenges can enable enterprises to leverage RPA more effectively, optimizing their operations and fostering digital transformation through automation technologies. The findings of this research will contribute to bridging the gap between generic RPA tools and industry-specific demands, ultimately improving their role in enhancing enterprise systems.

9.2 Intervening

A detailed analysis of Desion’s workflows was conducted to identify specific needs and areas for improvement. It was discovered that classifying the data into Categories and Subcategories was essential for optimizing its usage in computer vision models and the development of customized RPA solutions tailored to its specific needs. This intervention ensures:

- Enhanced Organization: Structured datasets facilitate efficient model training and testing.
- Improved Searchability: Users can quickly locate relevant data based on its classification.
- Scalable Data: Categories and Subcategories provide a framework that can accommodate future data growth, as demonstrated in (Table 12),

Table 12 - Categories and Subcategories for classify the Data.

#	Category	Subcategory
1	Living Room	[Bed, Sofa, Armchair, Shelve, Table, Cabinet, TV Stand, Drawer, Sideboard, Gaming]
2	Bedroom	[Wardrobe, Children, Nursery, Divider, Sets]
3	Dining Room	[Dining]
4	Kitchen	[Trolley, Bar, Cafe]
5	Home Office	[Chair]
6	Outdoor	[Garden]

- Process Mapping: Detailed analysis of Desion’s workflows to identify needs where automation could provide the most value.

- Iterative Testing: Conducting iterative testing cycles to refine the RPA solutions and ensure compatibility.
- Training and Support: Providing training to Desion's staff to maximize the utility of the new RPA tools and ensure smooth adoption.

The classification process was integrated into both the data acquisition model and the front-end interface, allowing real-time categorization during scraping and manual adjustments post-acquisition. This approach significantly boosts data usability and relevance for Desion's industry-specific applications.

9.3 Data Schema Input and Output

These includes the data sources and formats that the RPA will process.

The data schema, as demonstrated in (Figure 3), consists of three main entities: Raw Data, Processing Workflow, and Processed Data, each representing different stages of handling the data.

- Raw Data: Initial collected data from various sources.
- Processing Workflow: Run a set of scripts to collect images and aggregate data and classify them.
- Processed Data: Final, cleaned, and structured images and data are stored in folders to be used for AI training.

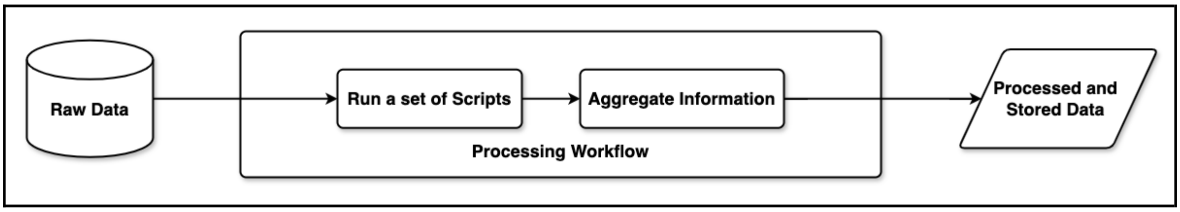

Figure 3 - Representation of the Data Schema.

The Processing Workflow, as demonstrated in (Figure 4), follows the various RPA Automation Steps including scraping, processing, and classification of the data.

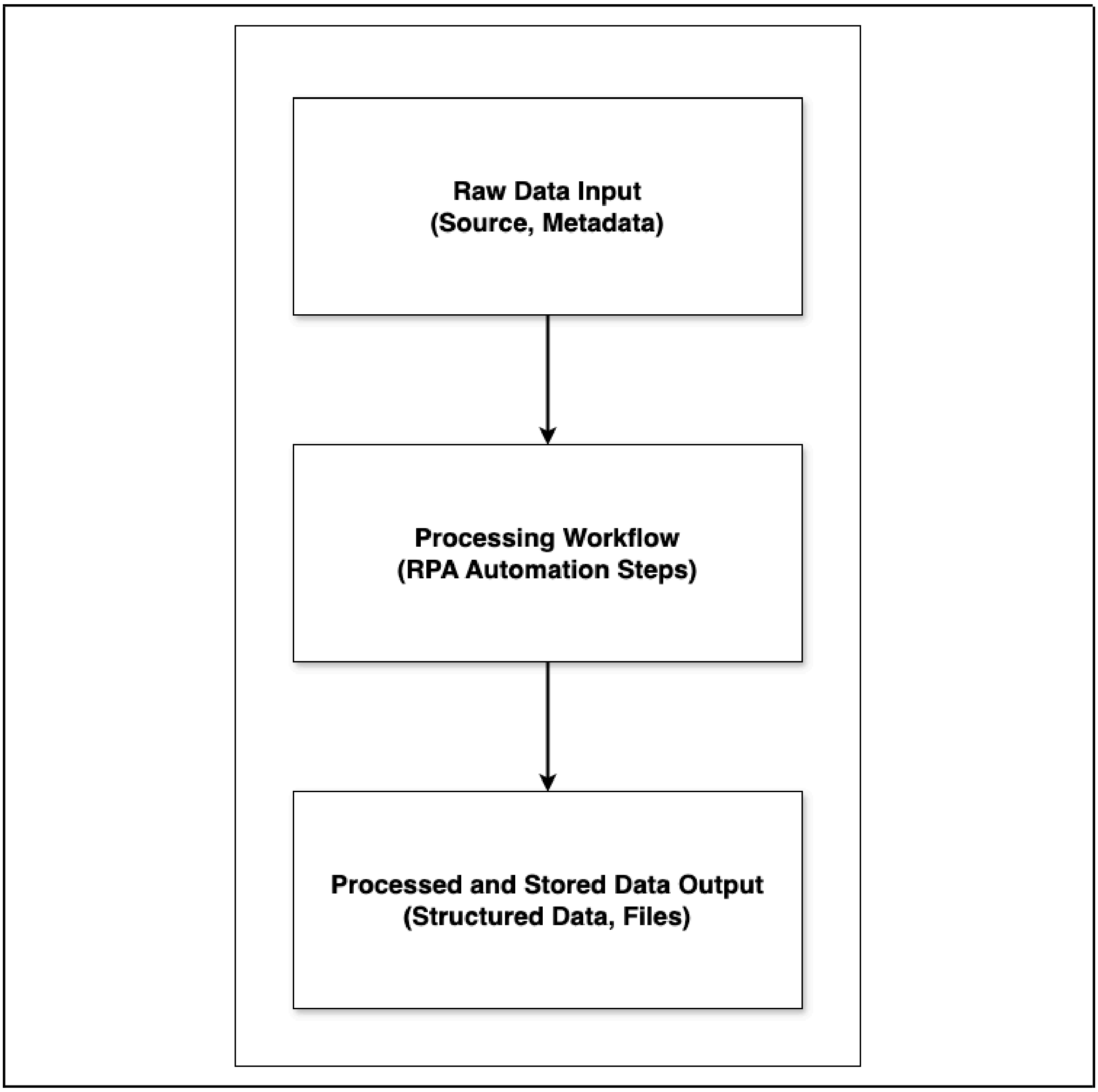

Figure 4 - Representation of the Processing Workflow.

Each processing step corresponds to one image in the data and each image generates one final record in Processed and Stored Data, as demonstrated in (Figure 5).

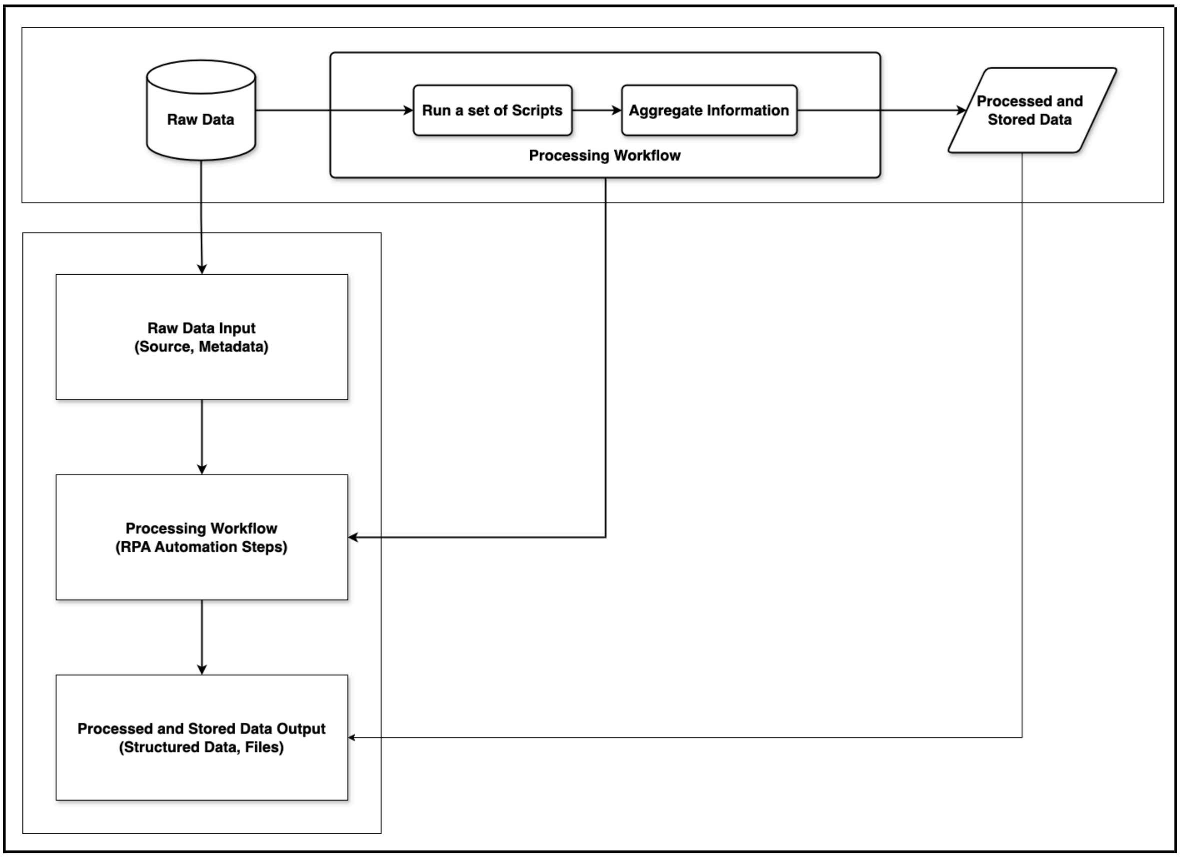

Figure 5 - Representation of the Data and how it moves thought the System.

This design as demonstrated in (Figure 6) illustrates how the data entities are structured.

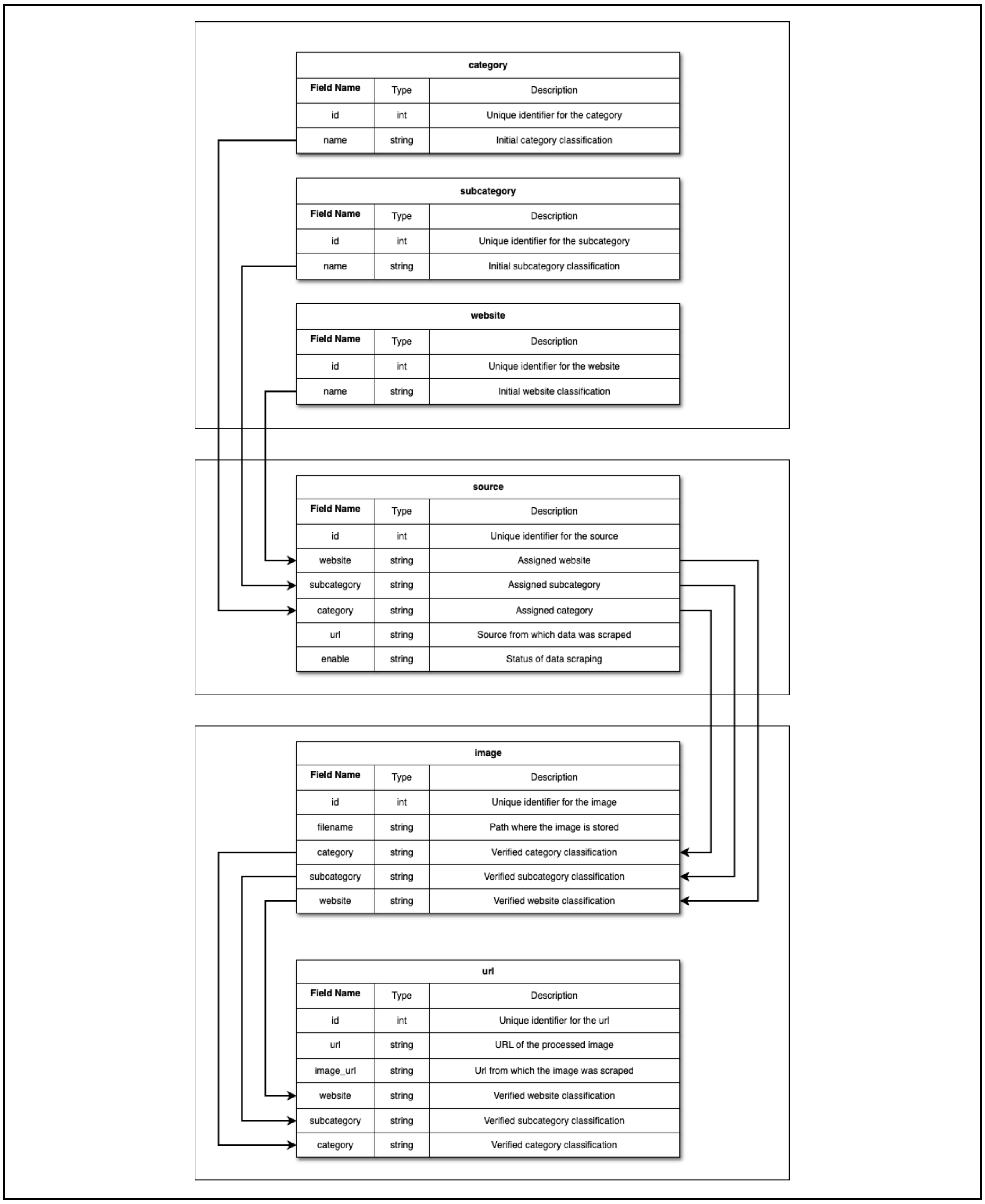

Figure 6 - Representation how the data entities are structured.

This design demonstrated in (Figure 7) illustrates how the data entities are related to each other.

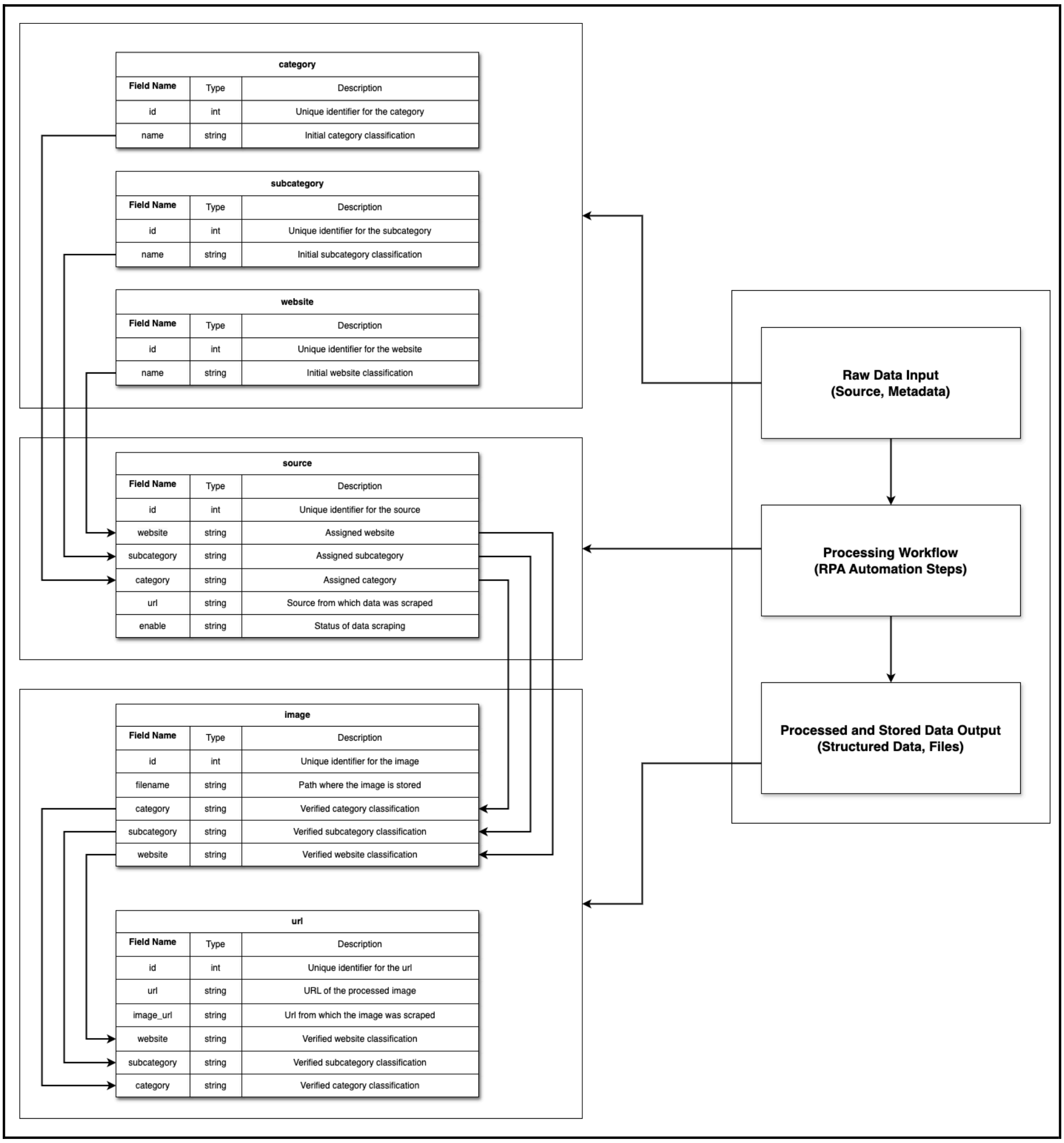

Figure 7 - Representation of how the data entities are related to each other.

9.4 Implementing RPA

Puppeteer, an open-source Node.js library, provides an opportunity to address Desion's needs through its robust browser automation capabilities.

Designing and implementing RPA tools capable of handling complex data extraction, cleaning, and integration tasks. Puppeteer, a browser automation library, was integrated into the solution to handle web scraping and data extraction tasks more effectively.

Puppeteer enabled automated interactions with web-based systems, including navigation, data scraping, and downloading resources, streamlining the acquisition of images for computer vision models.

Approach:

- Identify target websites and APIs offering relevant datasets.
- Develop Puppeteer scripts to scrape, preprocess, and store data.
- Evaluate data quality and refine scripts iteratively.

Benefits

- Cost-Effective: Reduces manual labor and dependency on expensive third-party datasets.
- Scalable: Handles large-scale data scraping and processing efficiently.
- Customizable: Tailors automation workflows to meet specific industry needs.

Limitations

- Learning Curve: Requires proficiency in JavaScript and browser debugging.
- Ethical and Legal Risks: Potential for misuse in violation of data privacy regulations.
- Maintenance Overhead: Scripts may require frequent updates due to website source changes.

9.5 Front-end Integration

To maximize the utility of data gathered by Puppeteer, a front-end interface was developed to allow users to visualize and manipulate the acquired information. This integration bridges the gap between automated data acquisition and practical usability, ensuring interaction with the refine datasets efficiently. Key functionalities include:

- Data Visualization: Interactive dashboards displaying summaries, and scraped data.

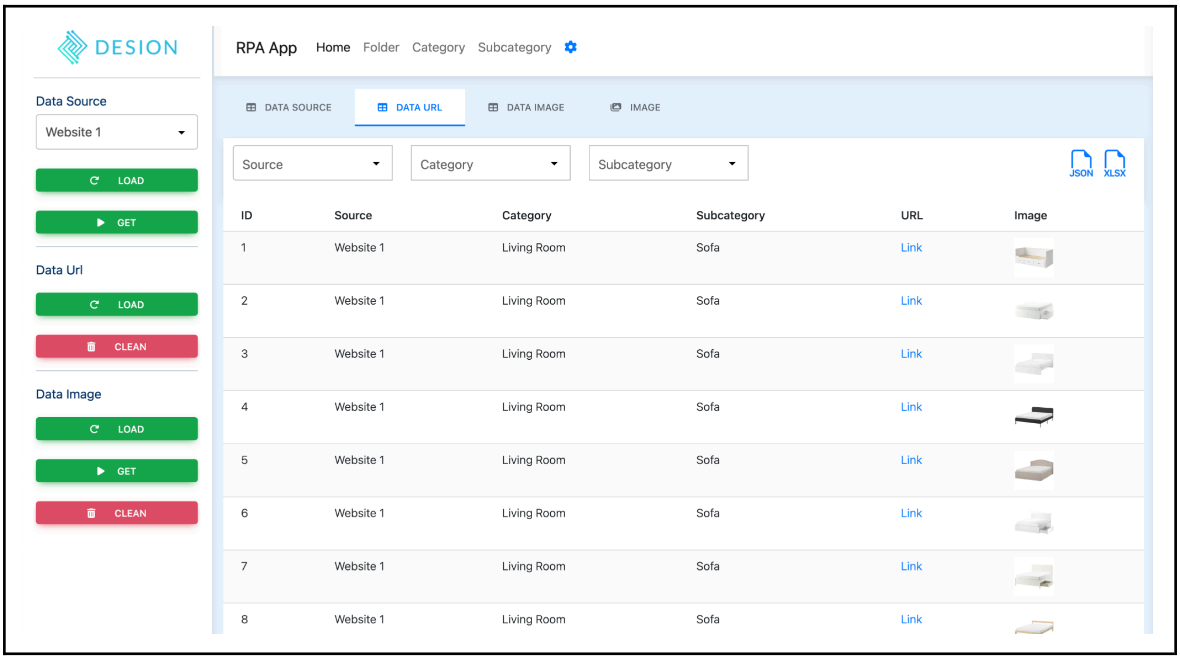

Figure 8 - Front-end Data Visualization.

- Manual Adjustments: Tools enabling users to correct, label, or filter data as required.

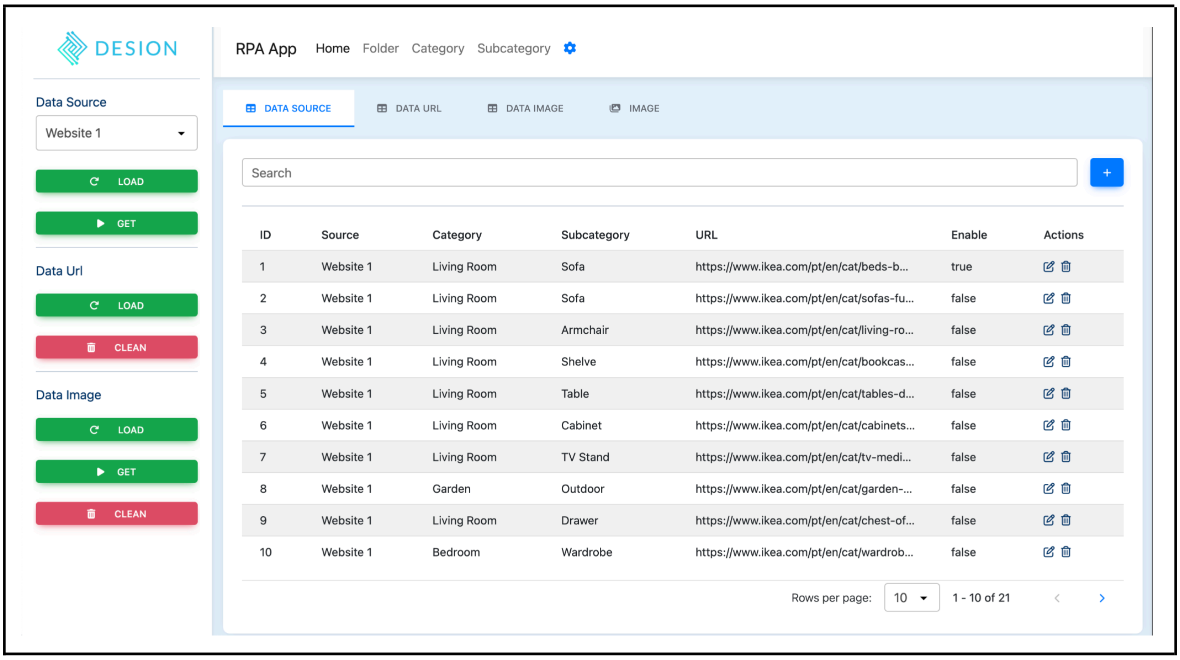

Figure 9 - Front-end Data Source.

- Real-Time Monitoring: A live view of Puppeteer's scraping processes, offering transparency and immediate feedback.

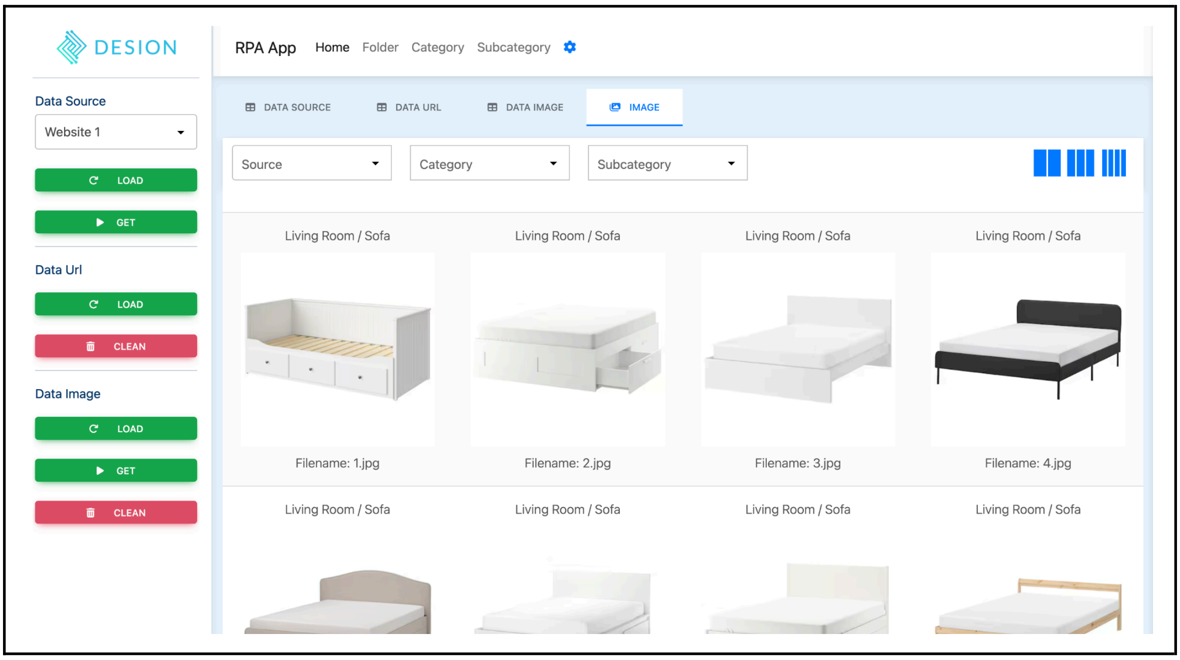

Figure 10 - Front-end Image Live View.

- Export Options: Seamless exporting of cleaned and processed data in formats compatible with Desion's computer vision models.

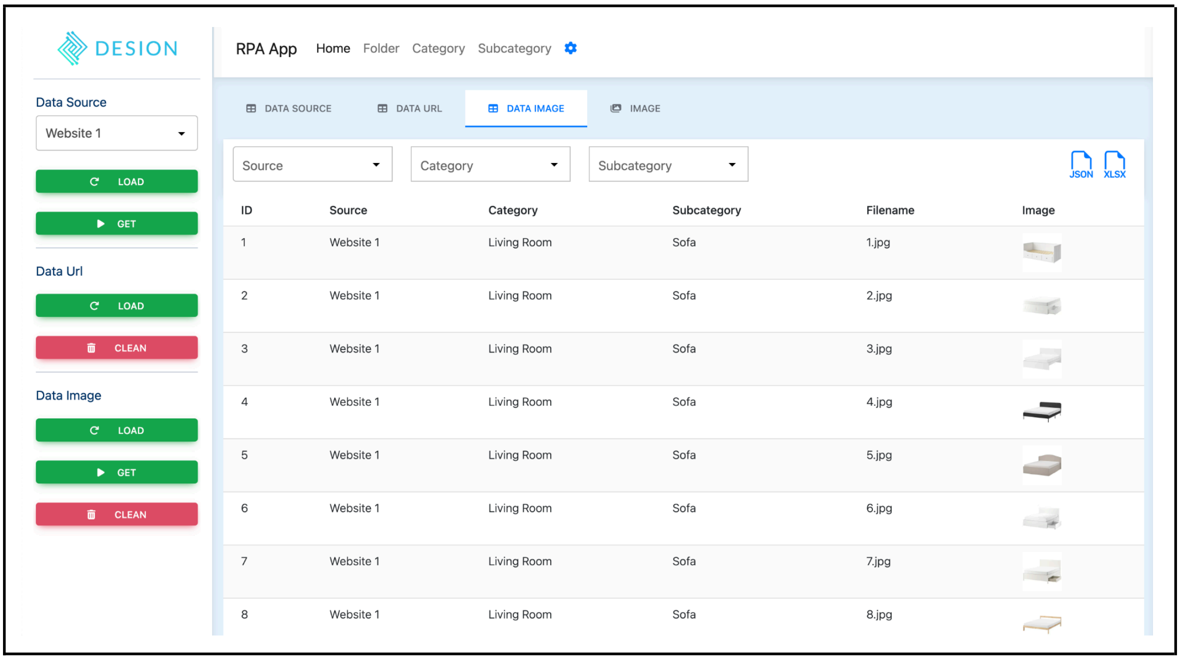

Figure 11 - Front-end Data Export.

The front-end was built using modern web technologies to ensure responsiveness and user-friendliness. This component significantly enhances Desion's ability to leverage Puppeteer's outputs effectively, making the entire process more robust and adaptable.

9.6 Evaluating the Effects

The implementation of customized RPA solutions at Desion resulted in measurable improvements across key performance indicators:

- Enhanced Efficiency: Automation of data-related tasks reduced processing time.
- Improved Data Quality: Customized RPA tools, including Puppeteer for web scraping, ensured consistent and accurate data preprocessing, leading to higher-quality inputs for AI model training.
- Seamless Integration: The tailored solutions integrated smoothly with existing enterprise systems, eliminating previous bottlenecks.

- Cost Reduction: Reduced manual intervention translated into significant cost savings over time.

These outcomes demonstrate the potential of industry-specific RPA adaptations to drive operational excellence and support digital transformation.

9.7 Quantitative Analysis

This Quantitative Analysis Table, as demonstrated in (Table 13), compares key performance metrics before and after RPA implementation. This includes process efficiency, error rates, and time reduction to demonstrate the impact of RPA on image and data acquisition.

Table 13 - Quantitative Analysis of RPA Implementation in Image and Data Acquisition.

#	Metric	Before RPA	After RPA	Improvement
1	Average time to collect one image and its data (secs)	180	5	-97.22%
2	Amount of daily processed images	100	3,600	+3500%
3	Errors rate (misclassified images)	12.5%	2.8%	-77.6%
4	Data consistency score (1-10)	6.5	9.2	-41.5%
5	Human intervention required	85%	15%	+82.3%
6	Cost per 1,000 images (€)	120	45	-62.5%
7	Overall System Efficiency	50%	92%	+84%

Key Insights

- Processing Speed: RPA reduced the time to collect one image and its data by 92.22%, processing images 20x faster than before.
- Error Reduction: Misclassification errors dropped by 77.6%.
- Labor Reduction: The need for manual intervention decreased from 85% to 15%, freeing up human resources.
- Cost Savings: The cost per 1,000 images decreased by 62.5%, making operations more cost-effective.
- System Efficiency: The overall efficiency jumped from 50% to 92%, demonstrating strong ROI from RPA adoption.

This bar chart comparing the before and after values for key RPA metrics. It visually highlights the improvements in efficiency, error rate reduction, cost savings, and overall performance.

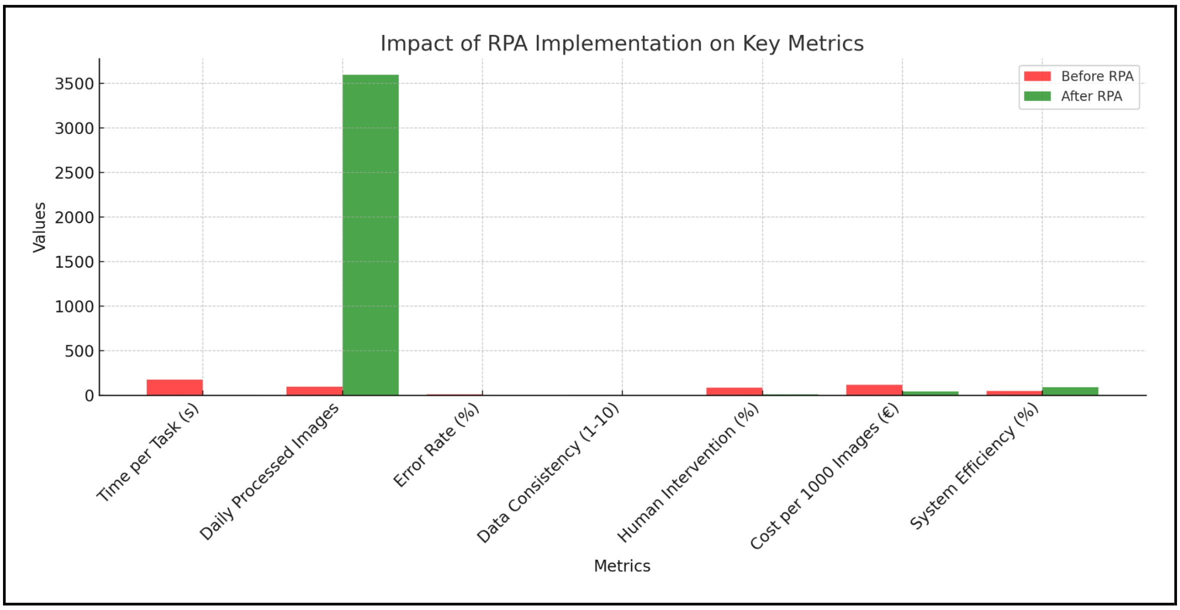

Chart 1 - Chart comparing the before and after RPA implementation.

This Metric Calculation, as demonstrated in (Table 14), shows how each metric was calculated.

Table 14 - Metric Calculation before and after RPA implementation

#	Metric Calculation
1	$\text{Time Reduction (\%)} = \left(\frac{180-5}{180}\right) \times 100 = 97.22\%$
2	$\text{Processed Images Increase (\%)} = \left(\frac{3600-100}{100}\right) \times 100 = 3500\%$
3	$\text{Error Rate Reduction (\%)} = \left(\frac{12.5-2.8}{12.5}\right) \times 100 = 77.6\%$
4	$\text{Data Consistency Improvement (\%)} = \left(\frac{9.2-6.5}{6.5}\right) \times 100 = 41.54\%$
5	$\text{Human Intervention Reduction (\%)} = \left(\frac{85-15}{85}\right) \times 100 = 82.35\%$
6	$\text{Cost Reduction (\%)} = \left(\frac{120-45}{120}\right) \times 100 = 62.5\%$
7	$\text{System Efficiency Improvement (\%)} = \left(\frac{92-50}{50}\right) \times 100 = 84\%$

9.8 Learning from the Process

The case study of Desion provides valuable insights into the implementation of customized RPA solutions:

- Understand the Industry Context: Effective RPA solutions must be grounded in a thorough understanding of industry-specific challenges and requirements.
- Invest in Customization: While generic tools offer a starting point, meaningful impact requires development of unique workflows. Puppeteer's

integration into Desion's RPA solutions exemplifies the importance of specialized tools to address specific needs.

- Adopt an Iterative Approach: Iterative testing and refinement are essential to ensure compatibility and maximize utility.
- Foster Collaboration: Close collaboration between developers is critical for successful implementation and adoption.

By applying these lessons, enterprises in specialized industries can better leverage RPA to optimize their operations and drive digital transformation, ensuring that automation technologies align with their unique needs and strategic goals.

10 Discussion

The adoption of Puppeteer as a browser automation library addresses several critical challenges faced by Desion. By enabling efficient data acquisition and classification, Puppeteer enhances the quality and quantity of datasets available for computer vision models. However, broader implications and considerations arise:

- Scalability: While Puppeteer is effective for small to medium-scale projects, scaling to larger datasets may require additional infrastructure, such as distributed systems or cloud integration.
- Ethical Considerations: Automated data scraping must adhere to privacy regulations and ethical standards to avoid legal liabilities and reputational risks.
- User Empowerment: The integration of a front-end interface fosters a collaborative approach to data refinement, bridging the gap between technical teams and domain experts.
- Future Enhancements: Leveraging machine learning for automated data categorization and anomaly detection could further optimize the process.

This discussion underscores the transformative potential of Puppeteer for Desion while highlighting areas for continuous improvement and innovation.

11 Conclusion

Puppeteer has demonstrated significant potential in addressing Desion’s challenges related to data acquisition and RPA customization. By leveraging its browser automation capabilities, Desion can overcome data scarcity, streamline workflows, and build scalable pipelines tailored to industry-specific needs. The integration of a user-friendly front-end and a structured data classification framework further enhances the practical utility of the solution, empowering teams to derive meaningful insights and improve model performance.

Future efforts should focus on advancing the scalability of Puppeteer-based systems, integrating AI-driven tools for enhanced data processing, and ensuring strict adherence to ethical and legal guidelines. These directions will ensure that Desion remains at the forefront of innovation in computer vision technologies while addressing the diverse demands of specialized industries.

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