

Article

Optimization of Business Processes Through BPM Methodology: A Case Study on Data Analysis and Performance Improvement

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Abstract: This study explores the application of the BPM lifecycle to optimize the market analysis process within the market intelligence department of a major energy company. The semi-structured, virtual nature of the process necessitated careful adaptation of BPM methodology, starting with process discovery through data collection, modeling, and validation. Qualitative analysis, including value-added and root-cause analysis, revealed inefficiencies. The redesign strategy focused on selective automation using Python 3.10 scripts and Power BI dashboards, incorporating techniques such as linear programming and forecasting to improve process efficiency and quality while maintaining flexibility. Post-implementation, monitoring through a questionnaire showed positive results, though ongoing interviews were recommended for sustained performance evaluation. This study highlights the value of BPM methodology in enhancing decision-critical processes and offers a model for adaptable, value-driven process improvements in complex organizational environments.

Keywords: BPM; BPMN; process automation; process standardization; Power BI; data extraction



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1. Introduction

Business Process Management (BPM) methodologies are crucial in both scientific disciplines and business applications. The increasing complexity of modern, virtual processes has amplified the importance of BPM. This case study focuses on a leading company in the energy sector, engaged in the fuel market and renewable energies. This case study delves into the analysis of the market intelligence department's processes, which provides decision-making support to other departments and primarily to the executive committee (strategic level), where significant challenges in market analysis processes have been identified. These issues, if unresolved, could severely impact the efficiency of the supply chain network. Applying BPM to these unstructured and virtual processes aims to enhance decision-making and operational performance. This research is both timely and necessary, addressing critical issues that could affect strategic objectives.

Digital transformation is reshaping operations, business models, services, and IT structures across various sectors [1]. Industry 4.0 technologies are pivotal in improving supply chain efficiency and adaptability [2]. BPM, particularly through tools like BPM Notation (BPMN), is essential for formalizing procedural knowledge and enhancing knowledge management [3]. However, evolving business processes present challenges in modeling responses to unforeseen deviations [4]. Integrating knowledge management with digitalization, facilitated by BPMN, can enhance decision-making and economic sustainability, improving operational efficiency and achieving organizational goals through repeatable processes involving human resources, machinery, and information systems, with a strong emphasis on transparency [5,6]. It integrates discovery, modeling, analysis,

and automation, enabling data-driven decision-making aligned with evolving technologies and strategies [7].

Due to the importance of BPM, various authors have explored the application of BPM, and more specifically, the BPM lifecycle as a methodology for optimizing organizational processes and aligning business strategies. Some examples of research on this theme are addressed in [8–13].

Kovach et al. [8] investigates how Design for Six Sigma (DFSS) can complement BPM lifecycle implementation. Using the mandatory elements of a method (MEM) framework, the study highlights DFSS's maturity as a process redesign approach. Through action research case examples, it illustrates how DFSS can be applied to design, implement, and test redesigned processes, ensuring they address BPM challenges and meet participant needs effectively.

Ammirato et al. [9] demonstrates how a structured BPM approach can drive significant performance improvements in the context of a public university, despite the challenges of bureaucratic structures. By examining and redesigning a selected process using the BPM lifecycle framework, the research modeled the AS-IS and TO-BE states with BPMN 2.0 notation and assessed outcomes through both quantitative and qualitative methods, providing strategies to facilitate a smoother transition to digital workflows.

Morais et al. [10] reviews and analyzes various BPM lifecycle models to understand their structure and alignment with business strategy. Using the BPM lifecycle model as a reference, the research compares steps across seven lifecycle models, highlighting convergences, variations, and gaps, particularly in strategic alignment and process architecture definition. The study proposes a new framework incorporating activities to better align business strategy with BPM processes.

Bernardo et al. [11] developed a conceptual framework that integrates external factors into the BPM lifecycle using dynamic capabilities (DCs). By analyzing the relationship between BPM and DCs, the research identifies how sensing, seizing, and transforming meta-capabilities can enhance BPM performance and facilitate organizational adaptation to environmental changes. The proposed framework enables a dynamic, outside-in approach to BPM.

Looy & Devos [12] investigates the role of organizational culture and structure in the successful adoption of BPM, specifically within non-profit organizations transitioning to process-oriented work. Using a positivist case study approach with pattern-matching comparing process lifecycle theories, organizational design theories, and cultural theories. The findings reveal that cultural and motivational factors are more crucial than structural design in driving BPM success, introducing a process capability success model, providing a roadmap and best practices for effectively implementing BPM.

Mahendrawathi et al. [13] developed a comprehensive model for assessing BPM implementation throughout the entire BPM lifecycle, particularly in the context of Enterprise Resource Planning (ERP) projects. By examining three Indonesian companies that have implemented ERP for over five years, the research highlights strengths in process identification, implementation, monitoring, and control, but identifies weaknesses in process discovery and redesign. The model offers practical guidance for companies to pinpoint and address deficiencies in BPM practices and serves as a tool for continuous BPM assessment and improvement during ERP implementations.

While BPM offers many benefits, it faces challenges in dynamic, knowledge-intensive environments [14]. The literature underscores the importance of supportive cultures and strategic alignment for success [15,16]. Technologies like IoT, AI, and blockchain enhance BPM, driving innovation and competitive advantages in Industry 4.0 [17,18].

Unified Modeling Language (UML), like BPMN 2.0, serves as a crucial tool for modeling complex systems, initially designed for software engineering, has evolved to model business processes and organizational structures. Key diagrams such as class, sequence, and activity diagrams provide various perspectives for system analysis and design, helping bridge the gap between business requirements and technical implementation [19,20]. Its

standardized notation and adaptability make UML 1.0 a valuable tool across industries, supporting collaboration and iterative development in both software and business process modeling [21].

This research addresses the gap in applying BPM to highly variable and semi-unstructured virtual processes, especially in Portugal. Additionally, the topic of biofuels and the targets set by the Portuguese government is underrepresented in academic literature. The authors' interest in BPM and the Portuguese energy sector, combined with prior engagement with this company, provides a strong foundation for this study, which aims to address practical challenges and opportunities.

This study aims to apply BPM methodologies to virtual and unstructured market analysis processes, identifying and addressing specific challenges using modern technological tools. The key research questions include:

- RQ1—How can BPM methodologies be effectively applied to virtual and unstructured processes?
- RQ2—What specific challenges exist within the company's current market analysis process?
- RQ3—How can these challenges be mitigated or resolved using modern technological solutions?
- RQ4—What measurable improvements can be achieved in process efficiency and effectiveness after implementing BPM-driven changes?

This research bridges the gap between theory and practice, demonstrating BPM's applicability in virtual contexts and offering insights into its implementation in the Portuguese energy sector, particularly regarding biofuels.

The fuel sector plays a critical role in global economies by supplying energy essential for transportation, industry, and residential needs. As this sector evolves, aligning with the United Nations' Sustainable Development Goals (SDGs) becomes increasingly important. Goals such as Affordable and Clean Energy (SDG 7), Climate Action (SDG 13), and Responsible Consumption and Production (SDG 12) are pivotal in mitigating environmental impacts and promoting sustainable practices [22].

In Portugal, the biofuels market is heavily influenced by national and EU legislation aimed at integrating sustainable fuels into the road transport sector. Regulations mandate significant biofuel incorporation into gasoline and diesel, promoting energy security and reducing greenhouse gas emissions [23]. Producers, importers, and regulatory bodies like the National Laboratory of Energy and Geology (LNEG) ensure biofuels meet stringent sustainability criteria before issuance of Biofuel Titles (TdB), certifying their environmental performance [24].

2. Materials and Methods

The chosen methodology to improve the process was the BPM (Business Process Management) lifecycle proposed by Dumas [25]. This systematic framework enables thorough analysis, strategic improvement identification, and ongoing refinement of business processes. Its adaptability ensures optimized workflows and a culture of continuous enhancement. The BPM lifecycle includes stages such as process identification, analysis, redesign, implementation, monitoring, and optimization. This methodology helps organizations identify inefficiencies, streamline operations, and enhance overall performance. It fosters collaboration and communication among stakeholders, ensuring a shared understanding of process goals and objectives. By continuously monitoring and optimizing processes, organizations can adapt to changing market conditions, customer needs, and technological advancements. This iterative approach ensures that processes remain aligned with organizational objectives and responsive to evolving business requirements. Additionally, documenting processes and performance metrics promotes transparency and accountability, fostering a culture where individuals take ownership of their roles and responsibilities in achieving process excellence.

2.1. Process Identification

This chapter is dedicated to process identification, which has been divided into two main parts: process architecture and process selection [25]. Firstly, process architecture was explored, aiming to uncover the interconnected web of processes within an organization. This provided insights into the workflows and dependencies. Following that, process selection was delved into, where strategic discernment was used to prioritize processes for management and improvement efforts [25].

To define the architecture of the processes, a process landscape model was developed using three phases: process registration, process categorization, and process relationships, as proposed by [25].

In the initial phase, a theoretical analysis was conducted through structured and semi-structured interviews with department employees and other related departments, providing a comprehensive view of the department's operations. This was complemented by a documentary analysis of procedure manuals, organizational policies, and existing flowcharts, which helped identify gaps or inconsistencies in the documented processes.

It is important to note that the duration of the work carried out was seven months. During this period, weekly meetings were held with direct collaborators (ranging from 2 to 6 maximum employees from the department), as well as monthly meetings involving at least one representative from each department directly connected to the market intelligence department, with a focus on the executive committee member. Additionally, ad hoc meetings were organized to address any questions that might impede progress. This structured approach ensured that all interactions with collaborators occurred within the designated timeframe.

Following this, a practical analysis was performed involving direct observation in the workplace. This validated the previously identified processes and uncovered any overlooked ones. Interviews were conducted weekly, while practical observations were continuous throughout the company's presence, resulting in a detailed compilation of the process list.

In a second phase, the identified processes were categorized according to a variation of Porter's Value Chain model [26], adding the two proposed base categories: support processes and core processes. All relationships among the processes were identified, thus enabling the creation of the process landscape model presented in Figure 1.

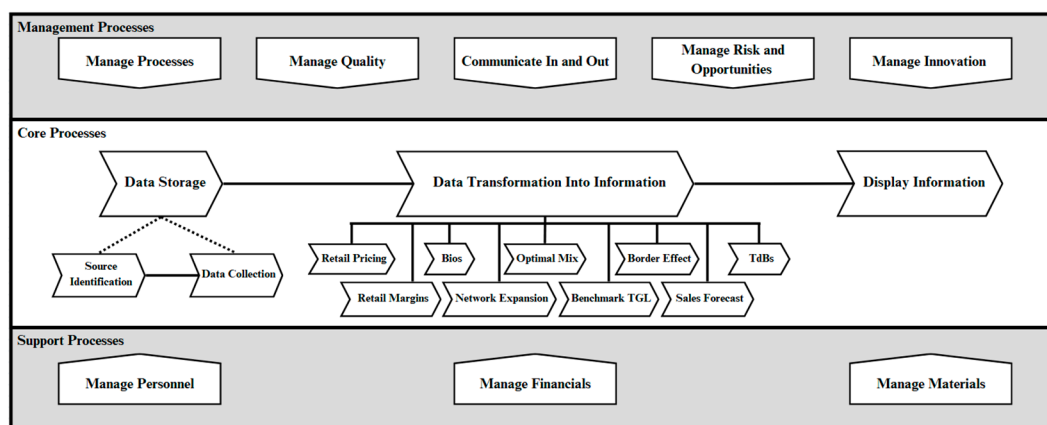


Figure 1. Process Landscape Model.

The process selection aimed to establish criteria for evaluating business process effectiveness, focusing on performance metrics. Three primary metrics were defined: strategic importance, health, and feasibility. However, due to the complexity of the “health” category, it was initially divided into four subcategories: time, cost, quality, and flexibility. Since the processes analyzed did not predominantly involve cost components, this evaluation category was removed, leaving only the remaining three subcategories.

The Analytic Hierarchy Process (AHP) was adopted for prioritizing processes. It was decided that the criteria of strategic importance and feasibility would be evaluated using AHP's standard comparison matrix. Strategic importance was evaluated by one of the members of the executive committee during each of the monthly meetings, and the feasibility was evaluated by the authors in collaboration with the department collaborators. Meanwhile, the subcriteria under "health" were assessed independently by the department collaborators on a scale from 1 to 10. This approach was necessary to encourage a deeper reflection on the evaluation methods. For example, the fact that Process X takes twice as long as Process Y does not necessarily indicate it is less efficient, as the expected durations for the processes may differ significantly.

Based on AHP outcomes, the top three prioritized subprocesses, plus one additional due to resource availability, were selected for improvement, Table 1.

Table 1. AHP Result.

Subprocesses	Value	Position
Retail Pricing	0.0970	5°
Retail Margins	0.0902	6°
Bios	0.1765	2°
Network Expansion	0.0462	9°
Optimal Mix	0.2176	1°
Benchmark TGL	0.0601	8°
Border Effect	0.1005	4°
Sales Forecast	0.0706	7°
TdBs	0.1366	3°

2.2. Process Discovery

Process discovery was broken down into four distinct tasks:

- **Defining the Setting**—Building a team within the company that includes process analysts responsible for analyzing and modeling processes using BPMN. Domain experts, who have practical knowledge but may lack modeling skills, also play a crucial role;
- **Gathering Information**—Employing three main methods: evidence-based discovery, interview-based discovery, and workshop-based discovery. Document analysis and observation provide initial insights, complemented by interviews with various stakeholders to capture different perspectives and scenarios;
- **Conducting the Modeling Task**—Creating the initial AS-IS BPMN model to capture process boundaries, activities, control flow, and additional elements like business objects and exceptions. This prototype serves as a foundational structure for further refinement;
- **Assuring Process Model Quality**—Ensuring compliance with BPMN syntactic rules and behavioral rules to prevent anomalies like deadlocks. Validating the model against real-world processes for semantic accuracy and ensuring it is pragmatic for end-users. Continuous improvement cycles refine the model based on feedback and new information.

This systematic approach to process discovery ensures that the resulting process model accurately reflects real-world operations, supporting informed decision-making and process improvements within the organization. After several iterations of the cycle, the AS-IS model depicted in Figure 2 was obtained. The model was created adhering to the rules and symbols suggested by BPMN, utilizing the tool provided by SAP Signavio. Although this tool allows for the simulation of the process, it was not carried out due to the high variability in task execution times.

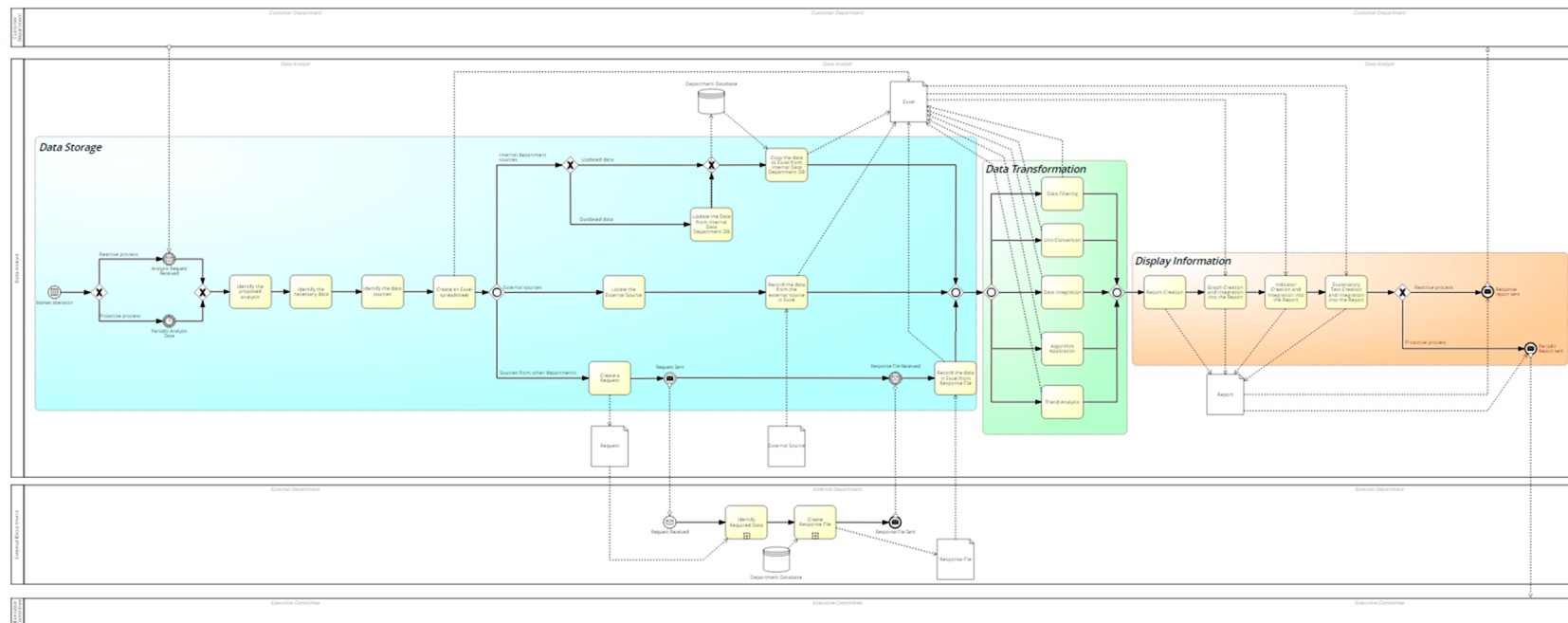


Figure 2. BPMN AS-IS.

2.3. Process Analysis

This stage identifies and documents process issues, prioritizing them based on impact and effort needed for resolution [25]. Due to the non-operational nature of the process, the focus was on qualitative analysis using methodologies like Value-Added Analysis and Waste Analysis.

Value-added analysis classified steps as value-adding (VA), business value-adding (BVA), or non-value-adding (NVA), highlighting areas for improvement (Table 2). The steps that directly contributed to positive outcomes for the customer were identified and categorized as value-adding (VA) steps. Additionally, steps that, while not directly adding value to the customer, were necessary for the business operation were recognized and categorized as business value-adding (BVA) steps. Finally, steps that neither added value to the customer nor were necessary for business operations were identified and categorized as non-value-adding (NVA) steps [25].

Table 2. Value-Added Analysis.

BPMN Process	BPMN Activity	Performer	Class
Data Storage	Identify the proposed analysis	DA (Data Analyst)	BVA
	Identify the necessary data	DA	BVA
	Identify the data sources	DA	NVA
	Create a request	DA	BVA
	Record the data in Excel from response	DA	BVA
	Locate the external source	DA	NVA
	Record the data from the external source in Excel	DA	BVA
	Update the data from Internal Data Department DB	DA	BVA
Data Transformation	Copy the data to Excel from Internal Data Department DB	DA	NVA
	Data Filtering	DA	VA
	Unit Conversion	DA	VA
	Data Integration	DA	VA
	Algorithm Application	DA	VA
Display Information	Trend Analysis	DA	VA
	Report Creation	DA	BVA
	Graph Creation and Integration into the Report	DA	VA
	Indicator Creation and Integration into the Report	DA	VA
Identify Required Data	Explanatory Text Creation and Integration into the Report	DA	VA
	-	ED (External Department)	NVA
Create Response File	-	ED	BVA

Waste analysis focused on identifying inefficiencies throughout the process using principles as proposed by Dumas et al. [25] based on Ohno Muda, categorizing waste into:

- Move wastes (e.g., unnecessary document exchanges);
- Hold wastes (e.g., work-in-process delays); and
- Overdo wastes (e.g., defects and overprocessing).

2.4. Process Redesign

Process redesign plays a pivotal role in enhancing business operations by introducing changes, whether incremental or radical, to existing processes. It encompasses adjustments across operational and behavioral dimensions, as well as interactions with organizational, external environmental, information, technological, and customer product factors [25].

In business process redesign, the Devil's Quadrangle framework helps outline improvement goals across four key dimensions: time, cost, quality, and flexibility. While the ideal scenario involves enhancing all dimensions simultaneously, improvements in one dimension often come at the expense of others. For instance, improving quality might increase time, and enhancing flexibility could raise costs. Achieving effective redesign ne-

cessitates balancing these dimensions to align with strategic objectives, ensuring sustainable improvements in overall performance (Figure 3).

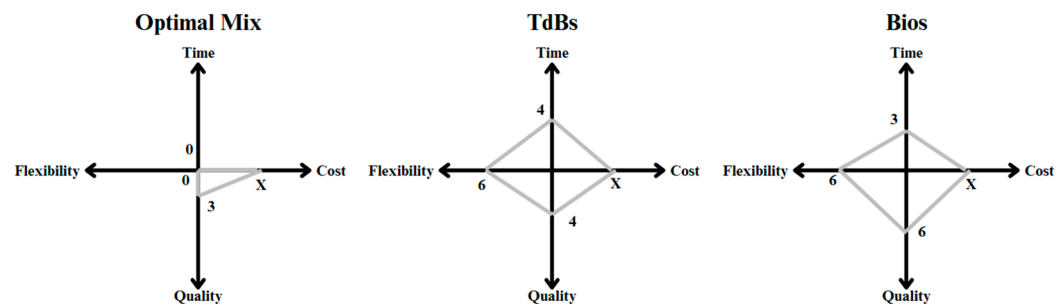


Figure 3. Devil's Quadrangle of the selected specialized processes.

The BPMN TO-BE model illustrates the future state of a business process after re-design, acting as a blueprint for improvements in efficiency, cost-effectiveness, quality, and flexibility. By comparing the TO-BE model with the current AS-IS process, organizations can pinpoint required changes and measure the benefits of optimization. The new model reflects the implemented process improvements, as shown in Figure 4.

2.5. Process Implementation

The process implementation phase is key to turning strategic plans into actionable steps. It involves detailed planning and coordination to ensure smooth execution [25]. After process improvements, data is collected from various internal and external sources in different formats (e.g., websites, Excel, images, PDFs). Data is stored manually or automatically using Python scripts, then standardized into CSV files linked to descriptions. Power BI integrates these CSV files for visualization, and reports can be converted to static PDFs if needed.

Unified Modeling Language (UML) was used for structured visual representation, helping to describe system behavior and identify improvement opportunities. A use case diagram (Figure 5), helped to outline actors, goals, and interactions, guiding the development of focused tools. A sequence diagram (Figure 6), helped to visualize interactions between users and the system, allowing for analysis of system behavior in a specific scenario.

Although Power BI was initially used for visualization, specific needs led to external interfaces in Excel due to Python's complexity and user familiarity issues. A package diagram (Figure 7) shows the organization of system components, while a component diagram (Figure 8) details interactions between software elements like Power BI 2.12, CSV data, and Python 3.10 scripts.

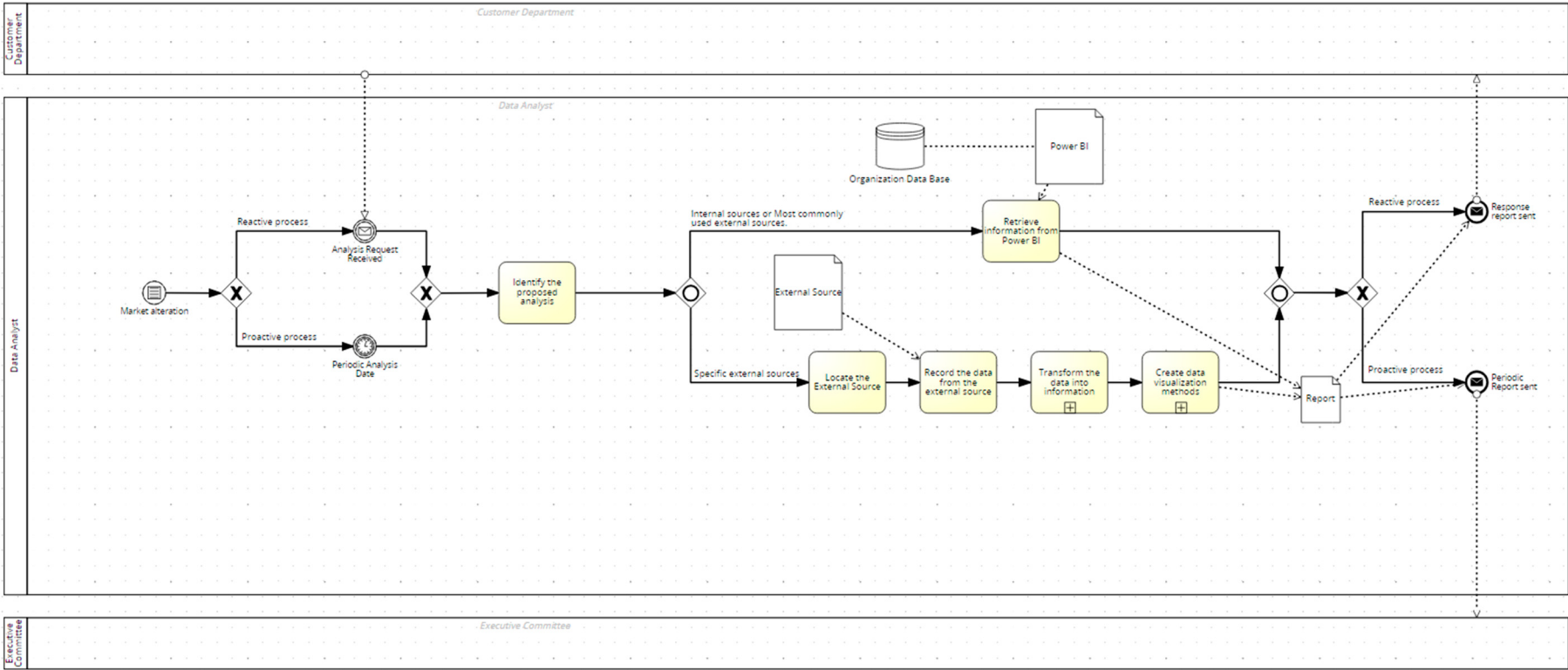


Figure 4. BPMN TO-BE.

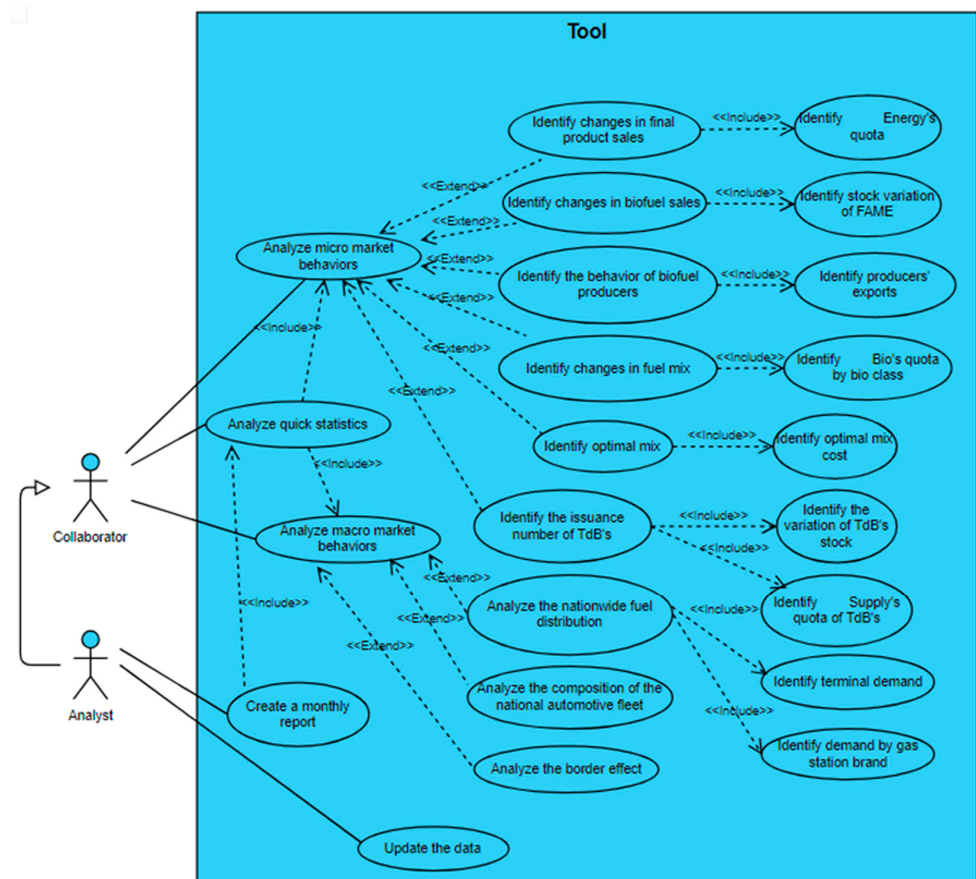


Figure 5. Use Case Diagram.

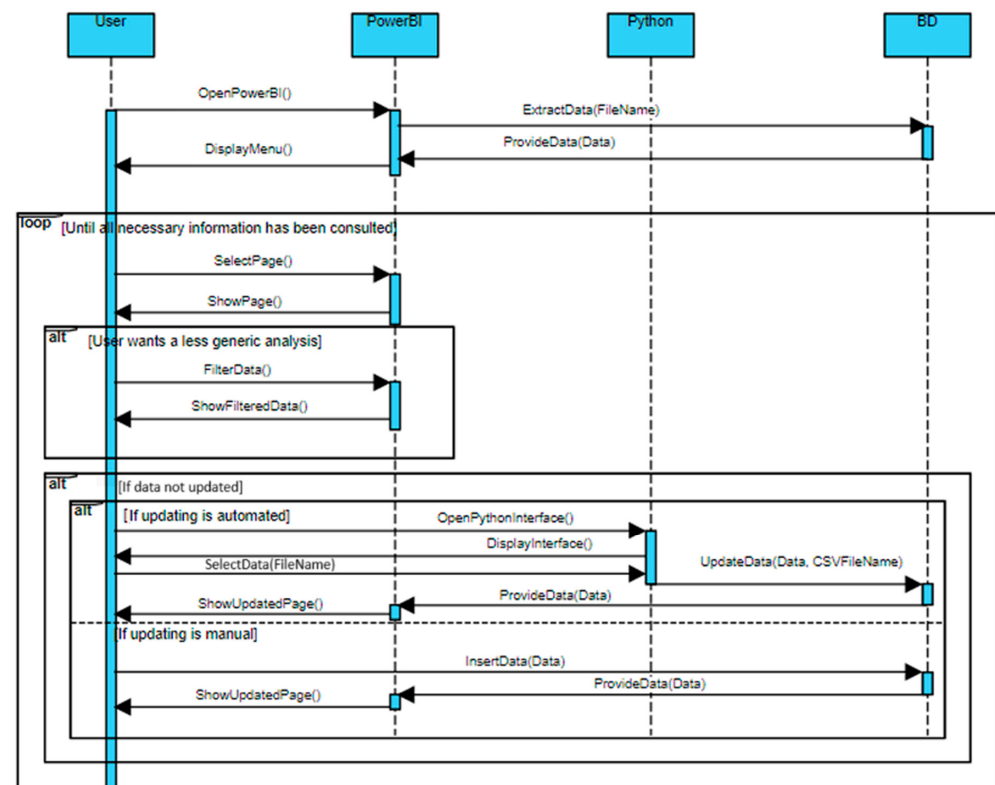


Figure 6. Sequence Diagram.

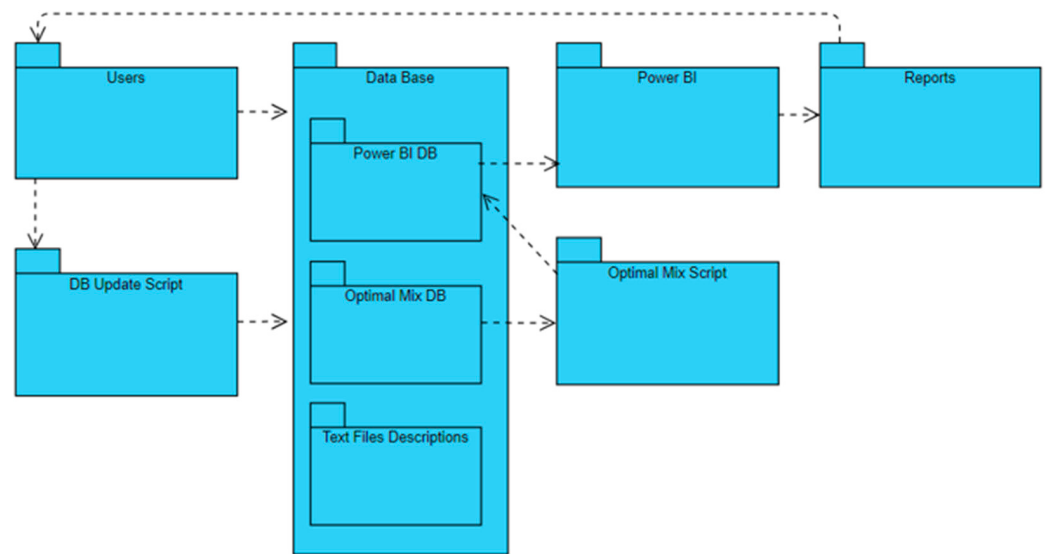


Figure 7. Package Diagram.

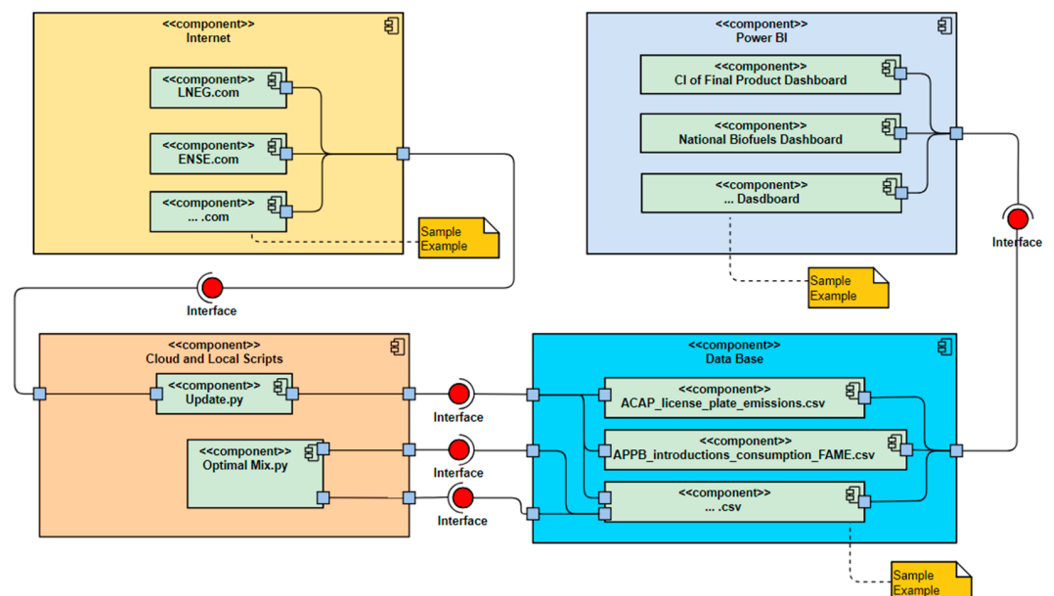


Figure 8. Component Diagram.

2.6. Tool Development

The tool was developed with key components such as database structure, Power BI dashboards, automated data collection, data transformation techniques, and user interfaces. The development was divided into two steps:

1. Data Storage: Focuses on designing and implementing an efficient database to support reliable data processing and analysis, ensuring accuracy and accessibility; and
2. Data Transformation and Display: Covers methods for transforming raw data into insights and creating interactive Power BI dashboards for data exploration and manipulation.

The initial phase focused on identifying key data sources for the market analysis process. These sources were categorized into two types: those suitable for automated collection and those requiring manual extraction due to formatting inconsistencies or lack of automation. For automated sources, Python scripts were developed using libraries like PyPDF2, Pandas, Requests, Pillow, and Pytesseract to handle various data formats. Figure 9 shows an example using an image as the initial source format.

The final database architecture consists of multiple CSV files stored in a centralized directory. This approach contrasts with previous methods that relied on a single Excel file, significantly enhancing data accessibility and processing efficiency. Dimensional modeling was crucial for establishing connections between CSV files, ensuring data integrity and supporting temporal window functionalities.

After having demonstrated the data storage implementation, this section focuses on showcasing the results and the means of achieving them, utilizing Power BI in combination with Python programs and Excel interfaces in the data transformation and display of information subprocess.

Thus, a total of 16 dashboards were developed, containing various pertinent business analyses identified in previous steps. The dashboard underwent several updates through interactions with various stakeholders to ensure it had the best possible design and information content. This process involved multiple iterations, as evidenced by Figures 10 and 11, which show an earlier version and the final version of one of the dashboards (some information is not visible in the figures for security reasons of the case study company).

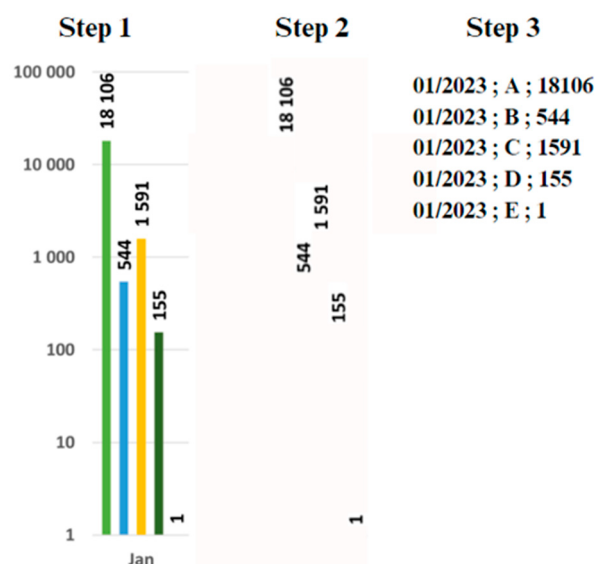


Figure 9. Data Storage, ENSE Example.

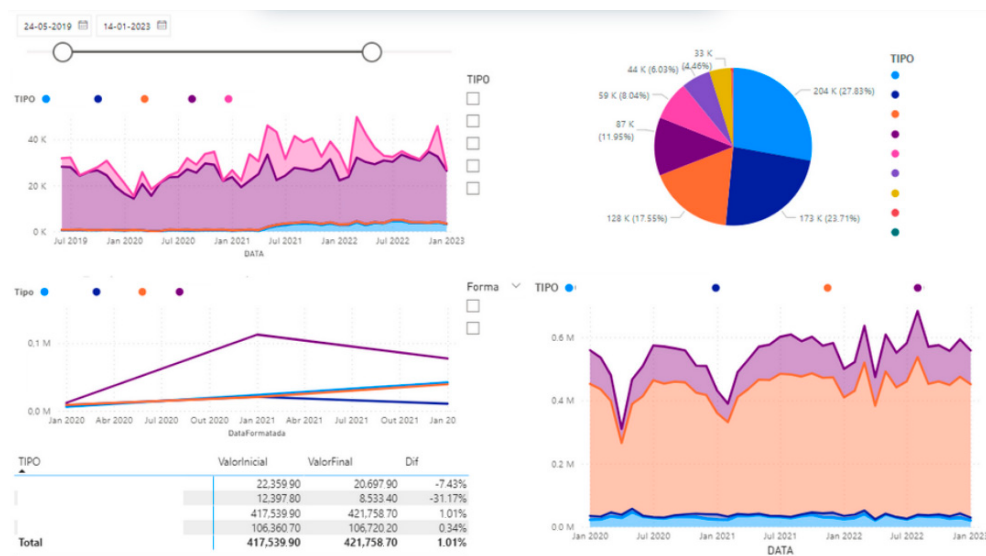


Figure 10. Dashboard Initial Version.

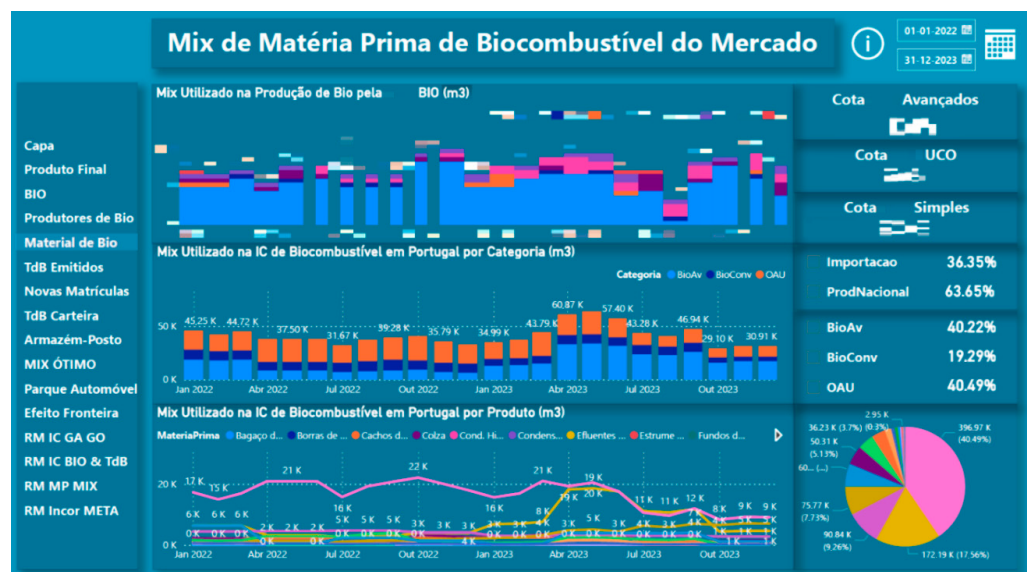


Figure 11. Dashboard Final Version.

3. Results

3.1. Validation

The validation of the developed Power BI tool is essential to ensure its reliability, effectiveness, and alignment with intended objectives. This chapter details the rigorous process undertaken to assess various aspects of the tool, including functionality, performance, usability, and user satisfaction. Due to the significant time losses experienced by collaborators during the quantitative analysis, a decision was made to conduct only a qualitative analysis.

Qualitative evaluation was pivotal in understanding user perceptions and experiences with the Power BI tool. A comprehensive questionnaire comprising 22 items was administered to department employees (Table 3), evaluating the items on a scale from 1 (very bad) to 10 (very good). This qualitative approach allowed for a deeper exploration of dimensions such as system quality, information quality, data quality, perceived benefit, and user satisfaction. Overall, the findings revealed high levels of satisfaction among users, highlighting Power BI's perceived flexibility, reliability, ease of use, and its ability to integrate new data seamlessly. Despite minor concerns about response times and meeting expectations, users expressed confidence in the tool's accuracy and comprehensiveness of data, contributing significantly to decision-making processes.

Due to the high variability of execution times for different tasks, the flexible sequencing of these tasks, and the time constraints along with the busy schedules of employees, only a limited number of questions could be included in this evaluation. Nevertheless, despite these limitations, the results obtained are significant and provide valuable insights into the impact of Power BI on task completion times.

The questionnaire (Table 4) consisted of 5 relatively simple questions to ensure shorter response times, minimizing the impact on employees' workload.

Overall, the findings indicate significant time savings when using Power BI compared to traditional methods without the tool. Tasks such as analyzing stock variations, determining quotas, and tracking market trends can be completed in a fraction of the time when using Power BI.

Specifically, the analysis reveals that tasks such as calculating stock variations and identifying market trends are completed much faster with Power BI. Tasks requiring complex data analysis, such as assessing quotas and tracking market trends, demonstrated considerable time savings, with average time reductions of 1 to 9 min per task, representing an average time reduction of 96%.

Table 3. Qualitative Evaluation Questionnaire.

Topic	BPMN Activity	Average Score
System Quality	Is Power BI flexible?	7
	Is Power BI reliable?	9
	Is Power BI easy to use?	9
	Does Power BI allow the integration of new data?	9
	Is Power BI's response time acceptable?	8
Information Quality	Is the information provided by Power BI useful?	10
	Is the information provided by Power BI easily accessible?	8
	Is the information provided by Power BI understandable?	9
	Is the information provided by Power BI understandable?	8
	Is the information provided by Power BI relevant for decision-making?	9
Data Quality	Are the underlying data in Power BI accurate (scale)?	10
	Are the underlying data in Power BI correct?	10
	Are the underlying data in Power BI consistent?	10
	Are the underlying data in Power BI comprehensive?	10
Information Quality	Does Power BI increase individual productivity?	8
	Does Power BI improve individual performance?	8
	Does Power BI improve the quality of decisions?	8
	Does Power BI allow individuals to perform tasks more quickly?	9
Information Quality	Did Power BI meet expectations?	9
	What is the level of satisfaction with the efficiency of Power BI?	8
	What is the level of satisfaction with the effectiveness of Power BI?	9
	What is the overall satisfaction level with Power BI?	9

Table 4. Quantitative Evaluation Questionnaire.

Question	Time Without Power BI	Time with Power BI
What is the stock variation of TdBs in August 2022?	56 s	7 s
How much is the company quota in the use of advanced raw materials in the production of Biofuel?	170 s	5 s
Did the company follow the market's diesel CI in the first semester of 2023 compared to the first semester of 2022?	583 s	7 s
What are the top 3 raw materials used in Portugal in 2023 to produce biofuel?	302 s	7 s
Which biofuel producers in Portugal exhibit export behavior from 2022 to 2023?	141 s	3 s

Although these reductions may not seem impactful, when the process is analyzed from a macro perspective, the accumulation of these time savings generates greater profitability for the employee and increases their motivation by relieving them from performing repetitive tasks that do not contribute to the outcome.

3.2. Process Monitoring

Post redesign, data collection and analysis assess the process's alignment with set objectives. Identifying issues prompts corrective action. As the system evolves, a continuous cycle of analysis and improvement ensures ongoing optimization across interconnected processes [25].

Quarterly evaluation meetings have been proposed for the tool, allowing process collaborators to discuss its results and determine future steps for improvement to better align with reality.

An additional dashboard (Figure 12) was created to display the tool's average assessments, considering the qualitative questionnaire used for evaluation. It is suggested that this questionnaire be periodically filled out during analyses to track the tool's capacity evolution.



Figure 12. Tool Evaluation Dashboard.

4. Discussion

4.1. Implications for Practitioners

The application of the BPM Lifecycle methodology presented in this study provides valuable practical insights for industry professionals, particularly those aiming to optimize and enhance their business processes. By focusing on the market analysis process—recognized as strategically significant and distinct from routine transactional activities—this research underscores key strategies for process improvement. Emphasizing adaptability, UML diagrams were incorporated from the user perspective, ensuring that the tool not only allows data filtering but also supports future modifications without losing previous advancements, achieved through the implementation of Power BI.

Practitioners should understand that while automation is vital, maintaining flexibility is equally important for processes with strategic significance, especially in dynamic market environments. The redesign strategy, which emphasizes selective automation and efficiency enhancements, has yielded positive results in prototype applications, including improved process efficiency and output quality. This approach serves as a valuable model for organizations considering BPM methodologies to address inherent challenges in virtual processes, as exemplified by the study's resolution of repetitive data collection through process separation and reorganization.

Nonetheless, the study also highlights practical challenges, such as time constraints and unclear execution sequences, which limited the depth of the analysis and the comprehensiveness of the BPM lifecycle implementation. These findings suggest that practitioners should anticipate such complexities and invest in systematic information gathering during the initial phases of the BPM lifecycle. This can be facilitated through periodic meetings and an emphasis on stakeholder feedback, employing a more qualitative approach if quantitative analysis proves infeasible or insufficient, as demonstrated in the case study.

4.2. Implications for Research

From a research perspective, this study identified limitations in existing BPM approaches, underscoring the necessity for further academic investigation to address these challenges. The primary issue encountered was the adaptation of BPM methodologies to virtual and semi-structured processes, which demanded additional customization and refinement. This highlights a gap in current BPM frameworks and suggests a need for future research aimed at developing more flexible and adaptable BPM approaches suitable for complex and dynamic organizational environments.

While the adaptation of the BPM lifecycle is not a novel concept, several authors have tailored it to various contexts. Calçado et al. [27] demonstrated that the BPM lifecycle can guide the overall improvement process, while lean management (LM) tools can intervene at critical points, especially during the process analysis and implementation phases. This combination of BPM and LM has been shown to yield substantial process improvements. Similarly, in the digital domain, Ammirato et al. [9] focused on the human impact, illustrating how applying the BPM framework to case studies significantly improved process quality and analyzed the organizational transition to digitalization.

However, this research introduces a novel step specifically designed to address the challenges of data and information transition in virtual environments. The proposed approach emphasizes understanding and visualizing these transitions using UML diagrams, which, in the case study, effectively mitigated the difficulties associated with process invisibility. This addition ensures a clearer representation of workflows, enhancing the adaptability of BPM methods for virtual contexts.

4.3. Future Research

Future research could benefit from exploring how agile principles can be integrated into BPM methodologies to enhance responsiveness and adaptability in process management. Agile methods, characterized by iterative development and continuous feedback, could complement the structured BPM lifecycle approach, allowing for more dynamic and responsive process management strategies.

Moreover, advancements in technology, such as low-code development platforms and process mining tools, present new opportunities for streamlining BPM implementation. These technologies warrant further investigation to understand their full potential and impact on BPM practices. Low-code platforms enable rapid deployment of process improvements, making them a subject of interest for future research focused on efficiency and scalability. Similarly, process mining tools could be explored for their ability to provide deep insights into process performance and uncover opportunities for optimization based on real-world execution data.

The integration of artificial intelligence (AI) and machine learning also presents a promising avenue for enhancing market analysis processes. Future research could explore how neural networks and predictive analytics can improve organizations' ability to anticipate market trends and make proactive decisions. This shift toward predictive and data-driven decision making has the potential to transform market analysis and enable organizations to swiftly adapt to evolving market dynamics. Research in this area could focus on developing and validating AI-based models that enhance predictive capabilities, thereby empowering organizations to capitalize on emerging opportunities.

5. Conclusions

In summary, this research demonstrates the effective application of BPM lifecycle methodology in enhancing virtual and unstructured processes, particularly within the context of the company's market analysis process. In response to RQ1, the BPM lifecycle was successfully employed as a systematic framework to identify, analyze, and redesign processes. By structuring workflows and establishing clear communication channels among stakeholders, BPM methodologies foster a culture of continuous improvement and adaptability, enabling the organization to navigate the complexities inherent in unstructured process environments. The application of UML diagrams—such as use case, sequence, package, and component diagrams—provides a clearer understanding of the processes. This visual representation is particularly beneficial in addressing the difficulties associated with virtual processes, where the workflow may not be immediately apparent. The case study presented illustrates how these UML tools can enhance visibility and comprehension, ultimately leading to more effective process management.

For RQ2, the analysis identified specific challenges within the current market analysis process, notably inefficiencies related to unstructured data handling, communication barriers,

ers, and the absence of standardized procedures. These issues significantly impeded the department's capacity to provide timely and accurate market insights, thereby affecting strategic decision making. The revised process structure introduced a separation into two distinct phases, eliminating the need to collect data on an as-needed basis. Instead, data is gathered and stored once it becomes available, thereby reducing project execution time. This shift in mentality addressed the previous tendency toward individual project efficiency, which negatively impacted cross-departmental projects that required integrated data. The delays in accessing essential data, often necessitating a request to the owning department that went unanswered for over a week, were thus mitigated.

To address the challenges identified in response to RQ2, RQ3 emphasizes the potential of modern technological solutions. The integration of tools such as Power BI, along with automated data collection methods, significantly enhanced the data processing capabilities of the market analysis team. In this context, Python scripts were employed to interact with internal department documents, as well as with the documents from other departments necessary for projects related to market intelligence. Furthermore, these scripts facilitated interactions with national websites that provide relevant information. Such solutions not only improved data accuracy and accessibility but also streamlined the reporting process, enabling stakeholders to derive insights swiftly and effectively.

Finally, addressing RQ4, measurable improvements in process efficiency and effectiveness were observed following the implementation of BPM-driven changes. Despite the limitations of the quantitative analysis, which was constrained by time pressures and the busy schedules of employees, the results were positive (96% time reduction) and are supported by employee perceptions in the qualitative analysis (an average score of 8.81 on a scale of 1 to 10). This suggests that even with a weaker quantitative framework, the qualitative insights reflect a strong appreciation for the improvements brought about by the implementation of Power BI and BPM methodologies.

The findings underscore the critical role of BPM in transforming unstructured and virtual processes within organizations. This transformation is particularly pertinent as the prevalence of such processes continues to rise; they often require adaptation to each client's specific needs, even when they are not the end user. Furthermore, the virtual nature of these processes offers significant advantages in cost efficiency and the ability to analyze large volumes of data simultaneously, a capability that has been enhanced by ongoing improvements in processing power. By leveraging modern technological solutions and fostering a culture of continuous improvement, companies can not only overcome existing challenges but also position themselves for future success in an increasingly dynamic business landscape.

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