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ADOPTING AN END-TO-END BPM FRAMEWORK TO STOCK MANAGEMENT

Case Study in a Padel Sports Club

Rodrigo Tavares Seiça Neves

Master Thesis

presented as partial requirement for obtaining a Master's Degree in Information Management

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by

Rodrigo Tavares Seiça Neves

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

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STATEMENT OF INTEGRITY

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

[Lisbon, July 1st, 2025]

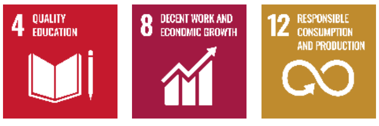
Abstract

This thesis explores the application of a Business Process Management (BPM) framework to optimize stock management in a padel sports club, responding to the operational challenges faced in a rapidly growing and increasingly competitive sports environment. By following the BPM lifecycle-specifically the phases of process identification, discovery, analysis, and redesign, the study aims to improve the efficiency, flexibility, and resilience of the club's inventory operations. A detailed empirical study was conducted, including on-site observations, interviews, workshops, and simulation modeling using BPMN 2.0 tools. The initial "as-is" process was analyzed using qualitative techniques such as value-added and waste analysis, alongside quantitative process simulation to identify inefficiencies and performance bottlenecks. Findings revealed significant non-value-adding tasks, resource overutilization, and process vulnerabilities during staff shortages. A redesigned "to-be" process model was developed using heuristic redesign techniques, incorporating automation, task consolidation, and real-time stock reservation capabilities. Simulation of the redesigned process showed measurable improvements in cycle time, resource utilization, and process throughput. The project demonstrates the practical benefits of BPM for service-oriented organizations like sports clubs, particularly in improving operational effectiveness and customer service. It also highlights the importance of aligning process redesign efforts with digital tools to achieve scalable, data-driven improvements. The results offer a replicable methodology for similar organizations seeking to enhance inventory processes through structured BPM approaches. This work contributes both to the academic understanding of BPM in small-to-medium service contexts and to practical strategies for digital-driven process innovation.

Keywords

Business Process Management (BPM); Stock Management; Process Redesign; Digital Transformation; Inventory Optimization

Sustainable Development Goals (SDG):



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LIST OF ABBREVIATIONS AND ACRONYMS

4IR	Fourth Industrial Revolution
AI	Artificial Intelligence
BVA	Business Value-Adding
BPM	Business Process Management
BPMN	Business Process Model and Notation
BPR	Business Process Reengineering
EPCs	Event-driven Process Chains
I4.0	Industry 4.0
IT	Information Technology
KPI	Key Performance Learning
ML	Machine Learning
NVA	Non-Value-Adding
RPA	Robotic Process Automation
STP	Straight Through Processing
TQM	Total Quality Management
UML ADs	UML Activity Diagrams
VA	Value-Adding

1. Introduction

Since the First Industrial Revolution, advancements in information technology, changes in workplace organization, and the introduction of new technologies have continuously transformed how organizations handle their daily activities (van der Aalst, 2013). In the context of advanced digitalization, the integration of Internet-based technologies with forward-looking innovations (Lasi et al., 2014) seems to be driving a new transition into the Fourth Industrial Revolution (4IR), often called Industry 4.0 (I4.0).

This transition brings about a cyber-physical industrial ecosystem where innovative business models and new methods of value creation emerge (Bonilla et al., 2018; GTAI, 2014). In this setting, Business Process Management (BPM) plays a crucial role, as business processes are increasingly being enhanced through advanced technologies like Artificial Intelligence (AI), Robotic Process Automation (RPA), and Machine Learning (ML). These technologies are transforming the conventional approaches that organizations have relied on for years (Xu et al., 2018).

BPM refers to the *"set of methods, techniques, and tools used to identify, analyze, redesign, execute, and monitor business processes with the goal of improving their performance"* (Dumas et al., 2018, p. 6). Successfully navigating the constantly evolving business environment requires the seamless integration of these processes (Liu et al., 2009).

In today's world, shaped by digital transformation and globalization, many retailers depend on logistics partners to streamline their stock management processes. The increasing complexity and scale of inventory operations have outgrown manual oversight, necessitating the use of advanced technologies (Infosys BPM, 2023). As highlighted by Brenner & Coners (2010), maximizing the potential of inventory management requires aligning corporate strategy, business processes, and IT infrastructure.

This project outlines the implementation of an end-to-end BPM framework in a stock management context. Following the BPM lifecycle outlined by Dumas et al. (2018), the project focuses on (i) discovering, (ii) analyzing, and (iii) redesigning the stock replenishment process for a retailer's inventory operations. By adopting a process-oriented approach, the initiative aims to provide the organization with a platform that facilitates technology integration and process automation. This is expected to result in significant improvements in both operational performance and compliance standards. In line with the theoretical perspectives of Vom Brocke and Rosemann (2015), this also contributes to the BPM body of knowledge by illustrating how BPM capabilities can be applied in a stock management context to enable measurable value creation through improved governance, transparency, and alignment between business and IT.

To achieve these goals, the document begins with a theoretical background, providing the academic foundations that support this project. This is followed by an in-depth analysis of the framework. The results and discussion sections will then present and interpret the empirical evidence gathered during implementation. Lastly, the conclusion will summarize the key findings and insights from the project, as well as highlight potential opportunities for future research.

2. Literature review

2.1. Sectorial Context

Nowadays, to maximize the efficiency of their operations, padel sports clubs must adopt robust stock management strategies to ensure the seamless availability of equipment, apparel, and consumables for their members and players. The increasing popularity of padel, combined with its rapid expansion across global markets, has introduced complexities in managing stock effectively.

As highlighted by McKinsey & Company (2022), disruptions in supply chains often result in inefficiencies and financial losses. They report that, for most organizations, disruptions lasting over a month occur every 3.7 years, potentially costing up to 45% of annual profits over a decade. For a padel sports club, such disruptions might result in delays in stocking essential items, negatively impacting player experience and revenue. Therefore, clubs must develop *"operational resilience"* (McKinsey & Company, 2022, p. 3), which entails adapting to fluctuations in demand while maintaining stable and high-quality services.

Additionally, the rising demand for padel equipment parallels the growth of e-commerce. According to BCG (2023), e-commerce is projected to account for 41% of global retail sales by 2027, a significant increase from 18% in 2017. Martin Barthel notes that *"e-commerce is gradually reverting to its pre-COVID trajectory,"* underscoring the importance of stock management systems capable of meeting the increasing online demand for padel-related products. Padel clubs catering to growing membership bases must ensure they are equipped to manage inventory efficiently to meet both in-person and online orders.

As the world transitions to a digital economy, padel sports clubs can leverage emerging digital technologies from the Fourth Industrial Revolution (4IR). Belhadi et al. (2021) demonstrate a clear correlation between 4IR capabilities and sustainable performance at the supply chain level, emphasizing that integrating digital solutions can drive economic, social, and environmental benefits. For a padel club, this could translate into enhanced stock monitoring, reduced waste, and improved resource allocation.

However, as Bill Gates famously stated, *"The first rule in any technology used in a business is that automation applied to an efficient operation will magnify the efficiency. The second is that automation applied to an inefficient operation will magnify the inefficiency"* (Orr & Orr, 2014). This highlights the importance of optimizing stock management processes before introducing automation. Poorly designed inventory systems can lead to inefficiencies even with advanced technology in place, making the role of Business Process Management (BPM) critical for padel sports clubs.

Ross et al. (2019) emphasize that many organizations lack the necessary business architecture to support digital transformation, underscoring the importance of BPM in redesigning processes for the digital age. For padel clubs, this involves rethinking inventory management to ensure it aligns with both customer expectations and technological advancements.

Laudon & Laudon (2019) argue that integrating information systems and technologies is a key driver of efficiency and productivity, particularly when paired with process improvements. Similarly, Hammer (1990) stresses the importance of reengineering business processes before implementing new technologies. This principle is especially relevant for padel clubs, where optimizing stock management workflows can pave the way for more effective digital solutions.

Finally, Suchy et al. (2018) note that automation alone cannot guarantee efficiency in logistics and inventory processes. This underscores the need for a BPM framework to provide a solid foundation for process automation and IT integration. For padel sports clubs, adopting a BPM approach can create high-performance stock management processes, enabling them to *"deliver on their promise and operate consistently at the level of which they are capable"* (Hammer, 2010, p. 7).

2.2. Process Definition

This project took place at a padel sports club that aimed to redesign its stock management process for inventory handling and distribution. The club operates in a setting where it must efficiently manage a diverse range of padel equipment, apparel, and consumables for its members, including rackets, balls, shoes, and various accessories. The large variety of products and the demand fluctuations throughout the year make inventory management complex and challenging.

On average, the padel sports club manages to restock and organize inventory at a rate sufficient to meet demand for most of the year. However, during peak periods such as holidays, special tournaments, or the start of the season, the demand for specific products surges, making it difficult for the club to keep up with stock requirements. This can lead to shortages, delays in member orders, or excessive overstock, all of which impact the club's ability to maintain smooth operations.

To address such challenges, this stock management process must operate at peak efficiency in terms of time, cost, quality, and flexibility. This would allow the club to adjust quickly to fluctuations in demand, ensure that popular items are always available, and minimize the time spent on reordering and restocking. Comprehensive documentation of the process is key to ensuring that all tasks can be carried out smoothly, especially when adapting to increased demand. This underscores the importance of adopting a Business Process Management (BPM) framework for stock management at the club.

Given the forecasted growth of padel and the increase in demand for related products, the sports club decided to implement an end-to-end BPM framework, which is currently being outlined in this project.

Regarding stock management, the padel sports club is responsible for organizing the inventory and preparing orders for pickup to members. This process occurs during the time the club is open, which is from 9am to 17h.

The club has an Inventory Manager who oversees the available stock and their quality, supervises storage, and ensures the quality of the entire process, also handles the billing for product orders. Additionally, there is a reception team responsible for recording orders and providing feedback to customers about their order status.

In terms of the process flow, the stock management process begins when the club receives orders from members, either through an online platform or in-person requests, and ends with the products packed, invoiced, and ready for collection.

The entire process is supported by an Inventory Management System (IMS), which helps streamline tasks like receiving stock, moving products within the storage areas, and fulfilling orders. The system allows for real-time tracking of every item in the club, ensuring full traceability of all stock, which is vital for keeping accurate stock levels and ensuring timely availability of products.

2.3. THE CONCEPT OF BPM

According to Dumas et al. (2018), who highlight that *"processes are everywhere"* (p. 1), managing business processes is crucial for all organizations, regardless of their size or sector. The authors emphasize that business processes are among the most valuable assets of an organization, as they significantly impact the attractiveness of products and services, the quality of customer experiences, and, ultimately, the organization's revenue.

However, Neubauer (2009) found that while many companies engage in BPM initiatives, only a small number achieve the status of a process-focused organization (PFO), suggesting that comprehensive BPM approaches are not commonly implemented. Despite recognizing the strategic importance of integrated and well-structured business processes, their actual performance often remains a "black box" for both management and process owners (PwC, 2019). Additionally, PwC's (2019) findings reveal that 50% of companies do not utilize advanced methods to gain insights into their processes, highlighting a limited understanding of process flows.

To bridge this gap and establish a holistic understanding of business operations, companies must implement BPM initiatives within their activities. These initiatives encompass the *"concepts, methods, and techniques to support the design, administration, configuration,* *enactment, and analysis of business processes"* (Weske, 2007, p. 5). Consequently, the successful adoption of BPM within an organization relies on the ability to efficiently manage its business processes, ultimately enabling the achievement of its organizational goals (ABPMP, 2013).

To grasp the concept of BPM, it is essential to first understand the meaning of a business process, although various authors define it differently. Hammer (1996) describes it as *"a complete end-to-end set of activities that together create value for the customer"* (p. 7). In contrast, Dumas et al. (2018) offer a more detailed definition, describing it as *"a collection of interrelated events, activities, and decision points that involve a number of actors and objects, which collectively lead to an outcome that is of value to at least one customer"* (p. 6). Despite these differences, there is broad consensus that business processes are a fundamental element of any organization.

Central to these definitions is the concept of an "outcome". According to Dumas et al. (2018), every business process generates one or more outcomes. Positive outcomes add value, whereas negative ones diminish it. Moreover, the authors emphasize that an outcome should ideally provide value to all the actors participating in the process.

Although numerous researchers offer their own definitions (Klun & Trkman, 2018), this project adopts the widely accepted definition of BPM provided by Dumas et al. (2018).

Dumas et al. (2018) define BPM as the *"art and science of overseeing how work is performed in an organization to ensure consistent outcomes and to take advantage of improvement opportunities"* (p. 1). However, they emphasize that BPM is not primarily focused on enhancing the performance of individual activities. Instead, it centers on the ability to manage entire sequences of activities, decisions, and events that collectively constitute a business process.

While BPM is not the only discipline aimed at improving an organization's operational performance, it offers distinct advantages that make it particularly suitable for stock management in a sports club. Other approaches, such as Total Quality Management (TQM), Lean, and Six Sigma, also drive continuous operational improvement. However, Lean and Six Sigma primarily focus on waste reduction and statistical process control, which are more suited for manufacturing and repetitive processes rather than the flexible, service-oriented operations of a sports club. BPM, in contrast, provides a holistic and adaptable framework that integrates process modeling, automation, and continuous improvement, making it better suited for dynamic inventory environments. Additionally, BPM facilitates the alignment of business processes with technology, enabling automation and real-time monitoring—key factors for effective stock management in a fast-paced sports club setting (Dumas et al., 2018). Therefore, BPM was selected as the guiding methodology due to its ability to enhance process visibility, agility, and compliance while seamlessly integrating with digital inventory management systems.

Research on BPM and its practical application in organizations led Rosemann and Vom Brocke (2015) to identify six core elements critical to the success of any BPM implementation: *"strategic alignment, governance, methods, information technology, people, and culture."* The authors highlight the importance of aligning business processes with the organizational environment, as well as ensuring continuous improvement and a proper fit between process tasks and information systems.

In conclusion, BPM is a discipline focused on the modeling, analysis, and redesign of business processes within organizations (Dumas et al., 2018). It is applicable across various types of organizations, including for-profit, nonprofit, and government entities (ABPMP, 2013). Moreover, BPM is deemed essential for organizations striving to meet the increasing demands of globalization, agility, and operational efficiency (Dumas et al., 2018).

The expected benefits of BPM approaches include improved operational efficiency, greater agility, optimized business processes, increased visibility, enhanced customer experience, better compliance, improved collaboration, and ongoing improvement (Dumas et al., 2018).

2.4. Previous Research on BPM

Over time, BPM has become a widely studied topic due to its potential to significantly reduce costs and boost productivity (van der Aalst, 2013). As a result, numerous methods and techniques have been developed to assist in the discovery, analysis, design, and management of business processes (Recker & Mendling, 2016). BPM research has been published in leading journals across various fields, including computer science (Elzinga et al., 1995; Ouyang et al., 2009), information systems (Davenport & Beers, 1995; Kettinger et al., 1997), and management science (Benner & Tushman, 2001; Pentland, 2003) (Recker & Mendling, 2016).

Identifying the precise origins of BPM is challenging, as many of its core ideas are rooted in historical advancements. Adam Smith's theory of division of labor in the 18th century, Frederick Taylor's scientific management in the 19th century, and Henry Ford's production line for mass production all played significant roles in shaping BPM (van der Aalst, 2013). Several researchers view BPM as an evolution of Workflow Management (WFM) (van der Aalst, 2013, p. 1). In the mid-1990s, WFM systems focused on *"Straight Through Processing"* (STP) to reduce manual intervention and enhance efficiency (van der Aalst, 2022, p. 1). However, their limited management focus led to unsuccessful implementations, highlighting the need for a more holistic approach (van der Aalst, 2022). Companies realized that IT investments alone were insufficient for process improvement, leading to the shift from WFM to BPM, which integrates business and IT perspectives to address management challenges (Baiyere et al., 2020; van der Aalst et al., 2016; Dumas et al., 2018).

BPM has deep roots in process-oriented methodologies such as Total Quality Management (TQM), Lean, and Six Sigma, which originated in post-World War II Japanese manufacturing (Deming, 1982; Dahlgaard & Dahlgaard-Park, 2006). Business Process Reengineering (BPR) also played a crucial role in BPM's evolution, as demonstrated by Ford's successful redesign of its accounts payable process, which resulted in a 75% reduction in headcount. Similarly, Mutual Benefit Life's reengineering of its insurance application process reduced processing times to just four hours while doubling its application capacity (Hammer, 1990). These cases underscore the significance of process redesign before automation, a principle reinforced by Davenport (1993) and Hammer & Champy (1993).

BPM has continued to evolve, addressing misconceptions about its relationship with BPR, process redesign, and process improvement. Ho et al. (2009) argue that these methodologies differ in their mission, scope, and approach. BPM has become the umbrella concept encompassing these methodologies (Elzinga et al., 1995). Its maturity is reflected in the increasing number of BPM implementations across industries, as well as the ongoing challenges and opportunities highlighted in Brocke & Mendling (2018). The International Conference on Business Process Management, established in 2003, has significantly contributed to advancing BPM research and practice. Dumas et al. (2018) further structured the discipline by introducing the BPM Lifecycle, a widely adopted framework that guides process improvement initiatives in organizations worldwide.

Recent BPM implementations highlight its relevance in modern business environments. For example, Siemens successfully applied BPM to optimize its global supply chain operations, reducing processing times and enhancing agility. Similarly, IBM implemented BPM to streamline IT service management, achieving a 40% improvement in issue resolution efficiency. These cases demonstrate how BPM continues to drive efficiency and innovation across various industries.

In conclusion, BPM has evolved from foundational management principles and early workflow automation to a robust discipline that integrates technology with business strategy. Its ability to improve efficiency, optimize resource utilization, and enhance adaptability makes it a key driver of digital transformation. As organizations continue to navigate complex operational landscapes, BPM remains a critical tool for achieving long-term success.

3. Methodology - BPM Lifecycle by Dumas et al. (2018)

Morais et al. (2014) describe BPM life cycles as frameworks that outline the steps and activities involved in executing BPM initiatives. Their analysis of seven different BPM lifecycle models revealed a notable alignment toward a standardized BPM approach. Most of these models include key stages such as analysis, design and modeling, implementation, as well as monitoring and control. Similarly, ABPMP (2013) highlights that many of these models follow the Plan, Do, Check, Act (PDCA) Cycle, a methodology introduced by Dr. W. Edwards Deming during his lectures in Japan in the 1950s (Moen & Norman, 2009).

ABPMP (2013) emphasizes that business processes should be managed using a "*closed-loop cycle*" (p. 53) to maintain their integrity and support ongoing improvement. In this context, the BPM Lifecycle proposed by Dumas et al. (2018) was chosen as the framework to guide this project. According to Dumas et al. (2018), this methodology provides a variety of methods and tools to facilitate the identification and effective management of business processes.

Due to certain constraints, especially time to apply changes and measure the effects of it, this BPM implementation is restricted to the first four stages: (i) Process identification, (ii) Process discovery, (iii) Process analysis, and (iv) Process redesign. The phases of Process implementation and Process monitoring and controlling are excluded from the scope of this project.

In conclusion, the next section seeks to provide a more detailed understanding of the BPM Lifecycle outlined by Dumas et al. (2018) (see Figure 1) by thoroughly examining each phase within the framework.

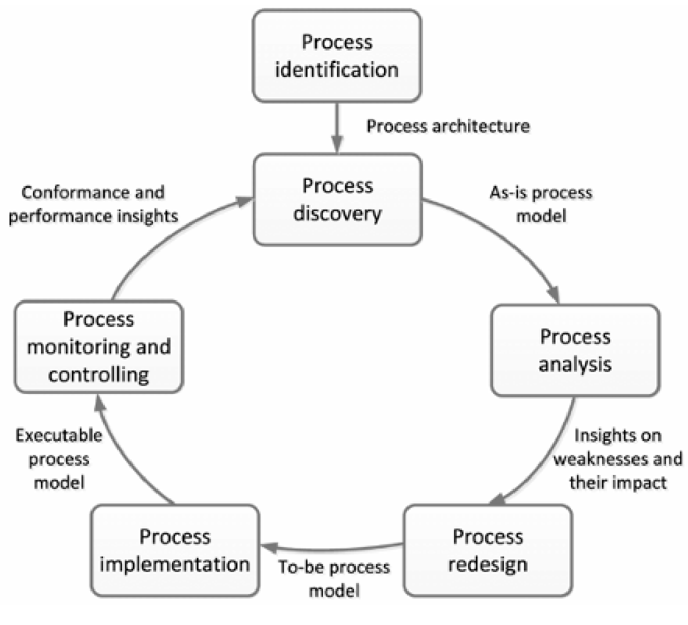

Figure 1 – The BPM Lifecycle (Dumas et al., 2018, p.23)

3.1 First Phase: Process Identification

Process identification is the initial and one of the most critical phases of the BPM Lifecycle (Hammer & Champy, 1993). This phase focuses on defining the organization's business processes and establishing clear criteria to prioritize their management. The outcome is the creation of a process architecture, which outlines all business processes and their interconnections, forming the basis for any BPM initiatives (Dumas et al., 2018). Notably, Mandelburger and Mendling (2013) found a positive relationship between the quality of the process architecture and the success of BPM projects.

To fully grasp the importance of this phase in the BPM Lifecycle, it is essential to understand the strategic context of an organization (Dumas et al., 2018). Today, few companies can implement BPM initiatives across all their business processes due to the significant resources required, including time and money. Therefore, organizations must assess and prioritize the processes on which BPM efforts should focus. Failing to do so can lead to wasted time, resources, and effort (Davenport, 1993). Selecting a critical subset of processes is thus a key factor in the success of any BPM initiative (Cho & Lee, 2011).

According to Dumas et al. (2018), this phase involves two key stages. The first is defining the process architecture (also referred to as the designation phase), which focuses on understanding the business processes and their interconnections. The second is defining a prioritized process portfolio (also known as the evaluation phase), where criteria are developed to prioritize the processes for BPM activities.

In the designation phase, the authors outline three steps that ultimately shape the organization's complexity into a process architecture: (i) categorizing processes, (ii) describing their relationships, and (iii) defining the process landscape. Researchers propose varying approaches to process categorization, as their hierarchical structure can be subjective, and different criteria may determine which processes qualify as independent business processes. Dumas et al. (2018) highlight Porter's Value Chain Model (Porter, 1985) as a particularly influential framework for categorization, which divides processes into core, support, and management processes.

During the designation phase, it is important to recognize the trade-off between impact and manageability. Increasing the number of processes a company chooses to optimize can amplify the overall impact. However, this also makes modeling and redesigning those processes significantly more complex. Conversely, focusing on a smaller number of processes can be advantageous for organizations just beginning their BPM journey, but it results in a lower level of overall impact.

The authors describe the process architecture as consisting of three levels: (i) the first level, called the process landscape, which should be clear and understandable to all key stakeholders and sufficiently comprehensive so that every employee can relate it to their own work; (ii) the second level, represented by abstract process models, which depict business processes with more detail but still in an abstract manner; and (iii) the third level, known as detailed process models, which provide an in-depth view of business processes, including control flows, data inputs, outputs, and other components (Dumas et al., 2018).

In the evaluation phase, the main objective is to determine which processes will be included in the scope of the organization's BPM projects. To achieve this, Dumas et al. (2018) identify three criteria: (i) strategic importance, which assesses the impact of a business process on the organization's strategic objectives; (ii) health, which considers the processes that cause the most issues; and (iii) feasibility, which evaluates how amenable a process is to BPM interventions.

To support the second stage, it is essential to have a clear and accurate assessment of the health of business processes. To this end, Dumas et al. (2018) define four general dimensions for measuring process performance: "time," "cost," "quality," and "flexibility" (p. 59). These broad dimensions can be further refined into Key Performance Indicators (KPIs) based on the specific context of each process. KPIs are defined as *"a quantity that can be unambiguously determined for a given business process"* (Dumas et al., 2018, p. 59).

Overall, process identification is a critical phase in the BPM Lifecycle outlined by Dumas et al. (2018), as it establishes the foundation for all BPM activities within the organization. This significance is emphasized by Davenport (1993), who highlights the importance of achieving success in the early stages of BPM to foster greater investment from the company in this approach to managing business processes.

3.2 Second Phase: Process Discovery

Process discovery is the second phase of this framework and is vital for the success of any process improvement initiative. It involves a series of efforts to collect information and gain an understanding of the activities that make up a business process (Sharp & McDermott, 2009). The result of this stage is typically a detailed representation of the current state of the relevant business processes, usually documented as one or more as-is process models (Dumas et al., 2018).

According to Dumas et al. (2018), process models are essential throughout the different stages of the framework. They help in gaining a clearer understanding of the process, communicating this understanding to those involved, and, most importantly, identifying and addressing potential issues.

Krogstie (2013) highlights three key characteristics of process models based on general model theory (Stachowiak, 1973): first, representation, meaning that models always represent something; second, simplification, as models focus only on the aspects that are relevant to their users, rather than capturing all possible attributes; and third, pragmatic orientation, which means that models serve as substitutes by representing a phenomenon as it is understood by a specific person, at a particular time and place, and with a specific goal or purpose in mind.

ABPMP (2013) describes modeling notations as a *"standardized set of symbols and rules that determine how the symbols represent other elements"* (p. 93). Today, there are numerous languages available for modeling business processes, such as Business Process Model and Notation (BPMN), UML Activity Diagrams (UML ADs), and Event-driven Process Chains (EPCs), among others.

BPMN is a widely used standard for business process diagrams, developed by the Object Management Group (OMG). In 2011, the second version of this standard was introduced, and it will be the modeling language used in this project. BPMN is designed to offer a notation that is easily understandable by all stakeholders, while also being precise enough to allow BPMN diagrams to be converted into software process components (OMG, 2011).

However, not every organization has a detailed description that can be directly transformed into a process model. Before creating an "as-is" model, the company must first collect all relevant information to fully understand the operations of the business process. Therefore, the process model must not only be syntactically accurate but also reflect the actual reality of the process.

Dumas et al. (2018) highlight that process discovery extends far beyond just process modeling and can be quite costly, time-consuming, and labor-intensive, as noted by Ghose et al. (2007).

Dumas et al. (2018) outline four key tasks in process discovery: (i) defining the setting, which involves forming a team responsible for working on the process; (ii) gathering information, aimed at collecting data and building an understanding of the process; (iii) conducting the modeling task, which focuses on creating a process model; and (iv) ensuring process model quality, which ensures that the model meets defined quality standards.

This stage presents several challenges, particularly the gap between domain experts and process analysts. Leopold et al. (2012) note that process modeling is an effective method for documenting and understanding business operations. However, they point out that its validation and implementation may be hindered because only process analysts have the necessary modeling skills, while domain experts possess the process knowledge. The challenge is to combine both types of expertise into an accurate process model that reflects reality, is comprehensible to all key stakeholders, and is syntactically correct.

In relation to the second task of process discovery (gathering information), Dumas et al. (2018) identify three types of discovery methods: (i) evidence-based discovery, where different sources of evidence, such as documents, observations, or automated process discovery, are used to learn about the business process; (ii) interview-based discovery, where multiple domain experts are interviewed to understand how the process is carried out; and

(iii) workshop-based discovery, which allows for gathering process information from several participants simultaneously.

According to Dumas et al. (2018), each of these methods has its own advantages and disadvantages, particularly regarding the objectivity of the information, the depth of the insights collected, the time required, and the immediacy of the feedback (see Table 1).

Table 1 – Relative strengths and weaknesses of process discovery methods (Dumas et al., 2018, p.175)

Aspect	Evidence-based	Interviews	Workshops
Objectivity	High	Medium-high	Medium-high
Richness	Medium	High	High
Time consumption	Low-medium	Medium	Medium
Immediacy of feedback	Low	High	High

As previously mentioned, the third task of this stage involves process modeling. To approach this task systematically, Dumas et al. (2018) propose a five-step procedure. First, the boundaries of the process must be defined to understand its scope, including its starting and ending events. Second, activities and events need to be identified, which allows domain experts to describe their actions, even if they do not fully understand the entire business process. The third step is to identify the resources and their handovers, which helps identify the participants in the process. Next, the control flow must be determined, which explains when and why activities and events take place. Finally, additional elements like artifacts and exceptions can be identified, providing further context to the process model.

In this stage, it is crucial to define a clear purpose for modeling the process to prevent endless modeling, as highlighted by Sharp & McDermott (2009). The authors emphasize that process analysts often overcomplicate the modeling task, instead of moving towards understanding the current state of the process and beginning the redesign phase.

In conclusion, process model quality assurance is the final task in the process discovery phase of the BPM Lifecycle outlined by Dumas et al. (2018). This task involves evaluating the quality of the model, requiring at least one process analyst and several domain experts. Dumas et al. (2018) emphasize three key quality measures: (i) syntactic quality, which refers to how well the process model follows the syntactic rules of the modeling language; (ii) semantic quality, which assesses how accurately the model represents reality; and (iii) pragmatic quality, which focuses on the model's usability.

3.3 Third Phase: Process Analysis

After the organization has a process model, it can be examined from both qualitative and quantitative perspectives to prepare for redesign. This phase, referred to as process analysis, forms the basis for the upcoming redesign activities.

Therefore, process analysis provides valuable insights into the activities within the business process and measures how effectively those activities support the organization's goals and objectives (ABPMP, 2013).

In her thoughtful foreword on process analysis (ABPMP, 2013), Elise Olding emphasizes that this stage *"involves much more than just flowcharts"* (p. 126). It operates on various levels, from a conceptual level that offers a broad overview of the organization, to an execution level that provides specific, actionable steps.

Conger (2010) suggests that because BPM lacks methods and techniques for analyzing and improving processes, Six Sigma techniques are often used for this purpose. The author highlights that these techniques can bring value to BPM efforts by applying a structured approach to improving quality and reducing waste, although they require specialized knowledge and skills to effectively lead redesign initiatives.

Dumas et al. (2018) present various techniques for qualitative analysis aimed at identifying and minimizing waste, such as value-added and waste analysis. They also propose methods like issue registers and root-cause analysis to identify and prioritize problems. In this project, value-added and waste analysis were applied.

According to Dumas et al. (2018), value-added analysis is a method designed to identify and remove unnecessary steps or tasks within a business process. This analysis involves breaking down each activity in the process into smaller tasks, such as preparation, execution, and handoff tasks. Each task is then classified into one of three categories: (i) Value-Adding (VA), if it adds value for the customer; (ii) Business Value-Adding (BVA), if the task is essential for the business to operate, generate revenue, or comply with regulations; and (iii) Non-Value-Adding (NVA), if it doesn't fall into either of the first two categories. The aim is to reduce BVA and eliminate NVA tasks.

In relation to this technique, Shou et al. (2019) define "value" as addressing the customer's needs by delivering the required goods or services on time and at a reasonable cost. The authors highlight the significance of "value-adding activities," which directly contribute to the creation of goods and services that customers want, as opposed to "waste activities," which refer to any input in the system that does not result in a valuable output for the consumers (Thurer et al., 2016).

In contrast to value-added analysis, waste analysis focuses on identifying inefficiencies and unnecessary steps (Dumas et al., 2018). According to Ohno (1988), there are seven types of waste that can occur in production processes: (i) transportation, referring to unnecessary movement of parts during production; (ii) inventory, which includes excess stock of finished goods or unfinished parts; (iii) motion, involving unnecessary movement of workers while handling products; (iv) waiting, which represents preventable delays while waiting for further tasks to begin; (v) overprocessing, which involves performing extra steps that are not necessary for the product; (vi) overproduction, which is the creation of more products than needed; and (vii) defects, referring to products that have defects (Womack & Jones, 1996).

While qualitative analysis can offer useful insights into process performance, it is often subjective and may lack the robustness needed for sound decision-making (Dumas et al., 2018). To address this limitation, various quantitative analysis methods can be used to provide more concrete data.

In this context, Dumas et al. (2018) present three quantitative techniques for process analysis: (i) flow analysis, (ii) queuing analysis, and (iii) process simulation (which is applied in this project). These techniques help organizations derive performance metrics that allow for the evaluation of processes in terms of time, cost, quality, and flexibility, and provide insights into how each step impacts the overall performance.

Although analytical queuing models can offer valuable insights into queuing processes, such as the one in this project, their use is often limited by assumptions related to structure, variability, and steady-state analysis. In cases where business processes are often cross-functional and involve complex structures with varying patterns, process simulation provides a more adaptable approach, enabling a more comprehensive quantitative evaluation (Laguna & Marklund, 2013, p. 267).

Therefore, process simulation is considered *"arguably the most popular and widely supported technique for the quantitative analysis of process models"* (Dumas et al., 2018, p. 279). It is used to predict how a process's performance will change under various conditions and scenarios (ABPMP, 2013). In fact, Greasley (2004) illustrates how process simulation can aid in business process improvement by presenting the redesign of a road traffic accident reporting system through this technique.

The process simulator is employed to generate multiple hypothetical scenarios of a specific business process. Based on predefined assumptions, it simulates the process step-by-step, recording each action taken during the execution. The simulation's output includes detailed logs as well as key performance indicators, such as cycle time, average waiting time, and average resource utilization, which offer valuable insights.

However, the use of process simulation has its limitations. Van der Aalst (2010) highlights several of these, such as the tendency for simulation models to overly simplify the behavior of resources. Additionally, simulation often focuses on the steady-state behavior of business processes, whereas managers are typically more concerned with immediate results to make operational decisions.

3.4 Fourth Phase: Process Redesign

After conducting a thorough analysis of a business process, valuable insights are obtained, which help identify issues and areas that need improvement. To address these, different methods and techniques can be applied to reimagine how business processes are carried out. However, to ensure that no opportunities for redesign are overlooked, these efforts should be carried out systematically rather than in a spontaneous or unstructured manner (Dumas et al., 2018).

According to ABPMP (2013), process redesign involves the actions needed to define a new process state, commonly known as the "to-be" state, along with all the steps required to achieve that state. These efforts will utilize the process models and analyses created in the earlier stages of the framework as their foundation.

Jansen-Vullers et al. (2007) highlight two main approaches to business process redesign: the revolutionary approach, which involves completely rethinking and starting from scratch, and the evolutionary approach, which builds upon the existing process model for improvements. Jarvenpaa & Stoddard (1998) note that business process redesign includes both a design and an implementation phase, and only one of these phases needs to be revolutionary. They also suggest that organizations should evaluate their specific situation to choose the most suitable approach for implementation.

Dumas et al. (2018) present a framework called the Devil's Quadrangle, which helps define the goals and objectives during process redesign. This framework highlights four main dimensions affected by redesign efforts: cost, quality, time, and flexibility (van der Kolk & Brand, 1995). The central concept of this model is that improving one dimension may lead to a decline in another, illustrating the trade-offs that can occur during the redesign process (Dumas et al., 2018).

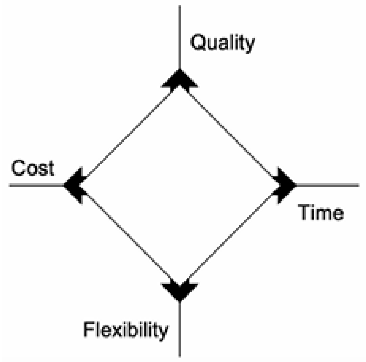

Figure 2 - The Devil's Quadrangle (H. Reijers, 2003, p. 209).

Ideally, a redesigned process should shorten the time required to complete tasks and reduce the costs associated with the workflow, while also improving the quality of the services provided and enhancing the workflow's ability to adapt to changes (H. Reijers, 2003).

Dumas et al. (2018) present a variety of process redesign techniques in a diagram known as The Redesign Orbit (see Figure 3). The vertical axis distinguishes between transactional methods and transformational methods, while the horizontal axis differentiates creative methods from analytical methods. Additionally, the inner circle includes methods that are considered inward-looking, while the methods outside the circle are categorized as outward-looking.

According to Dumas et al. (2018), transactional and transformational methods are differentiated in a similar manner to the earlier discussed revolutionary and evolutionary approaches. The authors further categorize redesign techniques based on their characteristics: analytical methods rely on mathematical and quantitative tools, while creative methods emphasize human creativity and innovation. Lastly, inward-looking methods focus on the perspective of the organization managing the processes, while outward-looking methods adopt an external viewpoint, as described by the authors.

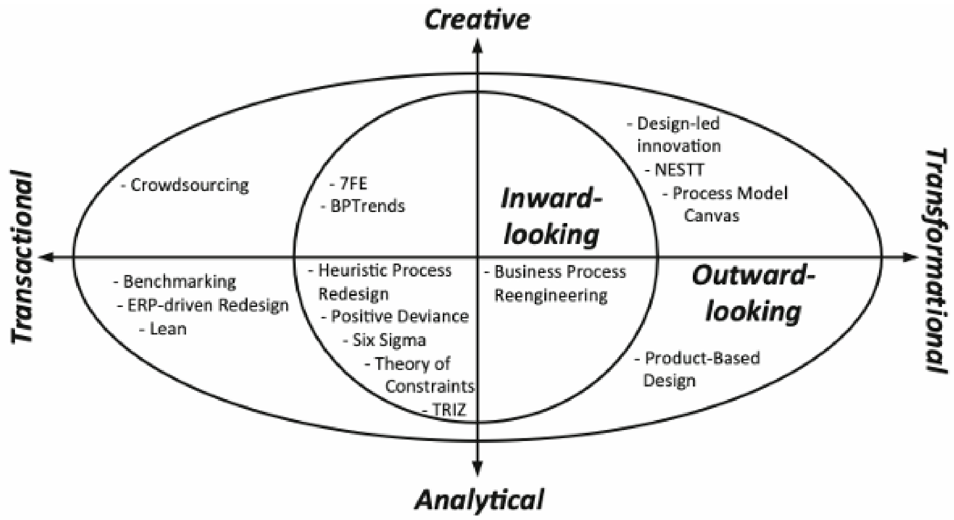

Figure 3 - The Redesign Orbit (Dumas et al., 2018)

For this project, a transactional, analytical, and inward-looking method was chosen for the process redesign phase: Heuristics Process Redesign. Dumas et al. (2018) define heuristics as *"rules of thumb for deriving a different process from an existing one"* (p. 316). Therefore, it is essential to thoroughly assess the redesign heuristics based on the current understanding of the business process and the objectives set for the redesign. Each of the 29 redesign heuristics proposed by Dumas et al. (2018) involves improving one or more dimensions, often at the cost of others.

Reijers and Mansar (2005) refer to these heuristics as "best practices" designed to aid in business process redesign, highlighting their emphasis on the technical aspects of the process rather than its behavioral components. The same researchers confirmed the effectiveness of this framework by applying it in two Dutch organizations (Mansar & Reijers, 2005).

Reijers and Mansar (2005) categorize each "best practice" based on its focus in the following areas: (i) customer, aimed at enhancing customer interaction; (ii) business process operation, which focuses on the execution of the workflow; (iii) business process behavior, concentrating on how the workflow is carried out; (iv) organization, addressing the structure and resources involved; (v) information, related to the information utilized and generated by the process; (vi) technology, emphasizing the role of technology in the process; and (vii) external environment, which highlights the importance of fostering collaboration and communication with external parties.

These heuristics are: task elimination, which involves removing redundant or non-value-adding activities from the process; task composition/decomposition, where smaller tasks are combined into larger ones, or complex tasks are broken down into simpler, more manageable components; resequencing, which refers to changing the order in which tasks are executed to improve efficiency or compliance; parallelism, where tasks are carried out simultaneously to reduce lead time; specialization, which involves assigning tasks to resources with specific expertise to improve quality or performance; resource optimization, which focuses on better allocation of resources to reduce costs or bottlenecks; and communication optimization, which aims to reduce unnecessary communication or streamline information flow between process participants (Reijers & Mansar, 2005).

4. Empirical Study

The following section presents the results of implementing the proposed BPM framework in a sports club, specifically for optimizing the process of managing stock in order to attend to the customers needs.

To support this implementation, Bizagi, a multi-tenant business process modeling tool, was utilized. This platform provides a collaborative environment where business processes can be modeled using various notations while ensuring best practices through automated validation, process documentation, and report generation. Additionally, its process simulation capabilities enable forecasting of future process states and quantification of the impact of proposed changes.

4.1 Process Identification

Before initiating this project, multiple meetings were held with the company's board to define its scope. Since the organization already had an established process architecture, it was possible to assess its business processes based on three key criteria: health, feasibility, and strategic importance.

Initially, several core processes were considered for reengineering. However, the stock management process at the padel sports club was ultimately selected due to its strategic importance. This process plays a crucial role in ensuring the availability of padel equipment, apparel, and consumables for members and players. Additionally, the club frequently faced challenges in managing inventory efficiently, especially during peak periods such as holidays, tournaments, and seasonal demand fluctuations. These issues highlighted concerns about process performance and reliability. Lastly, the club's management identified multiple opportunities for improvement and deemed the redesign both necessary and feasible.

Given these considerations, it was decided that this process would be the focus of the end-to-end BPM framework implementation.

4.2 Process Discovery

As highlighted in the literature, the process discovery phase was likely the most time-intensive stage of the BPM Lifecycle.

Following the framework outlined earlier (see Second Phase: Process Discovery), Dumas et al. (2018) define four key steps to be undertaken in this phase. The first step involves establishing the context in which the project will be executed, which includes forming a dedicated team. Ideally, this team should consist of both process analysts and domain experts to ensure a comprehensive understanding of the process.

Table 2 provides an overview of the stakeholders involved in this project, along with their respective roles within the process discovery phase.

Table 2 – Stakeholders of the Process

Stakeholder	**Role**	**Function**
Club Director	Management Team	Strategic Decision-Maker
Facilities and Operations Manager	Management Team	Oversees Club Operations
Head Coach	Management Team	Training and Player Development
Tournament and Events Coordinator	Project Manager	Manages Competitions and Events
Membership and Customer Relations Manager	Project Owner	Domain Expert
BPM Team	Process Analysts	Process Analyst
Reception and Booking Coordinator	Process Participant	Domain Expert
Equipment and Stock Manager	Process Participant	Domain Expert
Court Maintenance Staff	Process Participant	Domain Expert
Finance and Billing Officer	Process Participant	Domain Expert
Club Members and Tournament Participants	Client	End Users

After defining the setting, the next step was to gather detailed information to develop a precise understanding of the process. To achieve this, the BPM team conducted a three-month on-site assessment at the warehouse. This allowed them to observe operations not only during the off-peak season but also during some busiest times of the year. Since order volumes increase significantly during these periods, experiencing both peak and off-peak conditions was crucial to comprehensively understand the process.

During these visits, the team followed an evidence-based approach, which included document analysis and direct observation. Regarding documentation, the padel sports club provided a warehouse map, which helped in visualizing the operational layout. Additionally, the team received dashboards and Excel files containing key data, such as volume metrics and forecasts.

In terms of observation, the BPM team took a passive role, carefully watching process participants as they performed their tasks. Simultaneously, an interview-based approach was used to ask operators questions about their work. The primary goal of these informal interviews was to identify key challenges faced by employees during the process. Additionally, the team measured the time taken for different activities to later use in process simulation. Given the importance of accuracy, a significant sample size was collected to ensure reliable results.

Furthermore, a workshop was organized, bringing together all stakeholders, including client representatives and process participants. This collaborative approach allowed different perspectives on the process to be explored, providing valuable insights. By this stage, the team had gathered enough data to develop a process model that accurately represented the current operational workflow.

The following weeks were dedicated to creating this model using Bizagi, in accordance with BPMN 2.0 standards. This phase adhered to the systematic procedure outlined by Dumas et al. (2018) in the Process Discovery phase. First, the team established the process boundaries, which had been clearly defined from the beginning. One way to confirm these boundaries is by identifying the business objects required as inputs and outputs of the process (Dumas et al., 2018).

After mapping out the process activities and events, the next step involved identifying the resources involved and analyzing how responsibilities were distributed across roles. In the context of the padel sports club, four key roles were identified: Reception and Booking Coordinator, Equipment and Stock Manager, Court Maintenance Staff and Finance and Billing Officer. Following this, the fourth and fifth steps focused on defining the control flow of the stock management process and identifying any additional supporting elements, such as system interactions and decision gateways, to ensure a comprehensive understanding of the operational dynamics.

At this stage, an initial version of the “As-Is” process model was drafted. The next step was to verify and validate its accuracy, following the guidelines of Dumas et al. (2018). Syntactic verification was conducted through consensus among process analysts, assisted by the Bizagi automated validation feature, which ensures compliance with modeling standards. For semantic validation and completeness, a meeting with domain experts was scheduled to confirm that the model accurately reflected real operations and included all necessary details (Dumas et al., 2018).

Additionally, this meeting provided an opportunity to assess the model’s practical usability, ensuring it was easy to understand, maintain, and use for learning purposes (Dumas et al., 2018).

In conclusion, the meeting resulted in the final validation of the “As-Is” model by all relevant stakeholders. This process model was structured into two levels: a high-level overview consisting of eight processes (as shown in Figure 4) and a second, more detailed level breaking down each subprocess. For clarity, only the high-level version is presented in this section (Figure 4), while further details can be found in Appendix A.

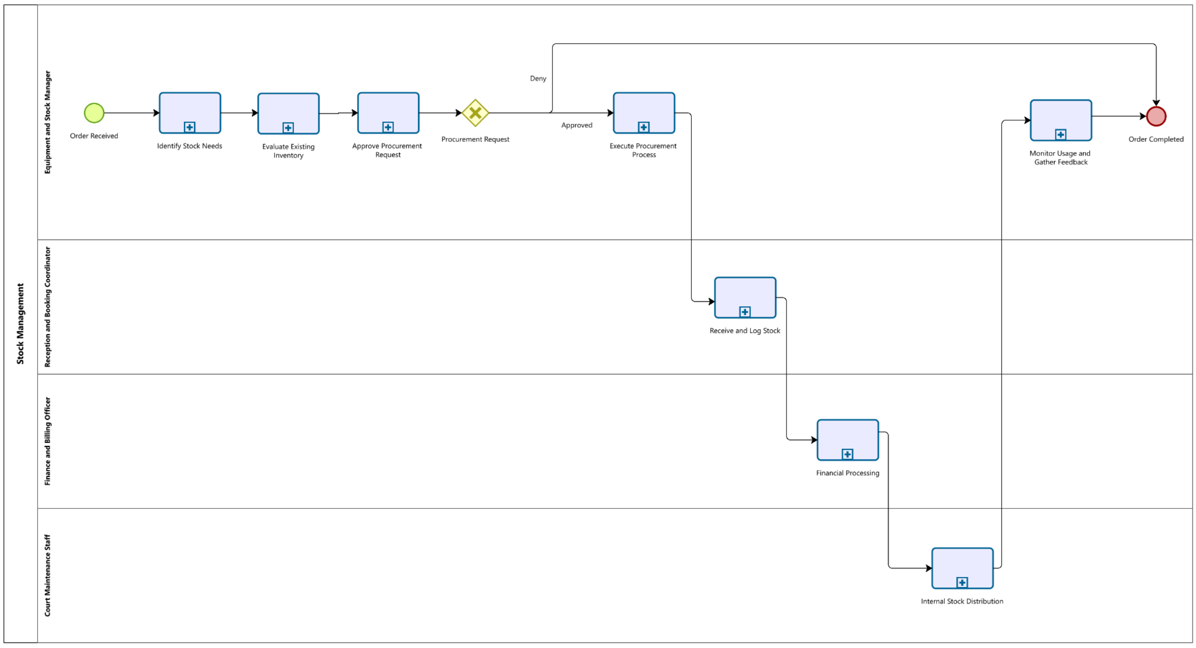

Figure 4 – “As-Is” Process Model: Stock Management (Level 1)

4.3 Process Analysis

The next phase aimed to collect insights from both qualitative and quantitative perspectives, enabling us to identify weaknesses in the process and assess their impact. These findings also served as the foundation for the subsequent process redesign efforts.

4.3.1 Qualitative Analysis

For the qualitative analysis, two techniques were chosen: Value-Added Analysis and Waste Analysis. These methods helped distinguish activities that directly contributed to value creation from those that did not.

Value-Added Analysis

To apply this technique, as outlined in the framework chapter (see Third Phase: Process Analysis), each activity within the business process was categorized into one of three groups:

Value-Adding (VA), if it directly contributes to customer value; Business Value-Adding (BVA), if it is necessary for business operations, revenue generation, or regulatory compliance; and Non-Value-Adding (NVA), if it falls into neither of the previous categories. This analysis was conducted across both levels of the "As-Is" process model. The results of the value-added analysis are presented in Tables 3 to 10 below.

Table 3 – Value-Added Analysis: Stock Management (Level 1)

Activity	**Rationale**	**Type**
Identify Stock Need	Detects required resources to continue service.	VA
Evaluate Existing Inventory	Ensures stock accuracy and prevents over/under-stocking.	VA
Approve Procurement Request	Ensures budget and authorization control.	BVA
Execute Procurement Process	Directly fulfills stock needs.	VA
Receive and Log Stock	Enables utilization and tracking of stock.	VA
Financial Processing	Required for financial and legal compliance.	BVA
Internal Stock Distribution	Delivers resources to operational areas.	VA
Monitor Usage and Gather Feedback	Supports continuous service quality.	BVA

Table 4 – Value-Added Analysis: Identify Stock Need (Level 2)

Activity	**Rationale**	**Type**
Observe Low Stock	Triggers the need for replenishment.	VA
Report Stock Need	Enables the process to start.	VA
Log Request	Helps with traceability and auditing.	BVA

Table 5 – Value-Added Analysis: Evaluate Existing Inventory (Level 2)

Activity	**Rationale**	**Type**
Review Inventory Records	Assesses current stock status.	BVA
Analyze Usage Trends	Supports informed decision-making.	BVA
Decide on Replenishment	Directly influences action to re-stock.	VA

Table 6 – Value-Added Analysis: Approve Procurement Request (Level 2)

Activity	**Rationale**	**Type**
Review Request	Necessary for financial oversight.	BVA
Approve/Deny Procurement	Ensures alignment with organizational priorities.	BVA

Table 7 – Value-Added Analysis: Execute Procurement Process (Level 2)

Activity	**Rationale**	**Type**
Contact Supplier	Necessary to acquire items.	VA
Place Order	Execution of restocking	VA
Confirm Delivery Schedule	Helps coordinate internal expectations.	BVA

Table 8 – Value-Added Analysis: Receive and Log Stock (Level 2)

Activity	**Rationale**	**Type**
Receive Shipment	Makes stock available for use.	VA

Inspect and Verify Items	Prevents quality issues.	BVA
Log Inventory	Required for internal control.	BVA
Store Items	Makes resources accessible.	VA

Table 9 – Value-Added Analysis: Financial Processing (Level 2)

Activity	**Rationale**	**Type**
Receive and Review Invoice	Ensures financial accuracy.	BVA
Process Payment	Complies with vendor agreements.	BVA
Record Expense	Required for accounting.	BVA

Table 10 – Value-Added Analysis: Internal Stock Distribution (Level 2)

Activity	**Rationale**	**Type**
Distribute Stock to Areas	Enables operational use.	BVA
Use or Provide Stock to Members	Supports member services.	VA

Table 11 – Value-Added Analysis: Monitor Usage and Gather Feedback (Level 2)

Activity	**Rationale**	**Type**
Report Feedback on Stock Use	Provides performance insight.	BVA
Review Trends	Supports future improvements.	BVA

Waste Analysis

As outlined in the literature (see Third Phase: Process Analysis), Waste Analysis evaluates process steps from a negative perspective (Dumas et al., 2018). Following the classification proposed by Ohno (1988), various types of waste were identified within the process, as shown in Table 12.

Table 12 – Waste Analysis: Stock Management

Category	Type of Waste	Activity
Transport	Transportation	Transporting stock from suppliers to storage manually without scheduling optimization
		Moving equipment between central storage and courts multiple times per day
Move	Motion	Staff walking to multiple locations due to poor stock layout
		Rechecking storage manually when items are not where expected
		Physically filing approval forms or procurement requests
Hold	Waiting	Waiting for managerial approval for low-cost or frequent stock items
		Delays due to supplier confirmation or delivery scheduling
		Delays in financial officer's payment authorization due to batching of tasks
	Inventory	Overstocking of slow-moving supplies due to lack of demand forecasting
		Keeping buffer stock

		without a defined reorder strategy
Overdo	Defects	Receiving incorrect or damaged stock from suppliers
		Errors in manual stock entry, requiring reconciliation later
		Financial mismatches due to incorrect invoice or PO matching
		Incomplete feedback on stock usage and missing or inconsistent issue reporting
	Overprocessing	Manual logging of stock levels even when digital systems are available
		Repeated verification of payment documentation
		Over-approval: managers reviewing all orders, even for routine restocks
	Overproduction	Ordering excessive quantities to “avoid shortages,” leading to storage and expiry issues

As emphasized by Dumas et al. (2018), while some waste is easily identifiable in specific steps, other forms remain hidden throughout the process, often occurring between steps. Consequently, some of the identified waste does not correspond to a particular activity within the business process but rather to occurrences before, during, or after it.

4.3.2 Quantitative Analysis

The previous qualitative analysis offered valuable insights into the process's quality. However, since these insights can sometimes be subjective, conducting a quantitative analysis was essential. To address this, a process simulation was carried out, enabling the identification of potential bottlenecks or other issues that could reduce the volume of orders by the end of the process.

“As-Is” Process Simulation

The following tables present all the assumptions and parameters established for the process simulation. First, the duration of each activity was determined (refer to Table 13). To obtain these timing metrics, the BPM team meticulously measured each process and subprocess, recording the duration in minutes and seconds.

Table 13 – “As-Is Scenario” Process Simulation: Durations

Activity	Performer	Execution Time (mm:ss)
Identify Stock Needs	Equipment and Stock Manager	Normal Truncated Distribution; Avg: 01:00, Deviation: 00:30, Min: 00:10, Max: 01:50
Evaluate Existing Inventory	Equipment and Stock Manager	Normal Truncated Distribution; Avg: 01:45, Deviation: 00:40, Min: 00:25, Max: 03:05
Approve Procurement Request	Equipment and Stock Manager	Normal Truncated Distribution; Avg: 02:00, Deviation: 00:45, Min: 00:30, Max: 03:30
Execute Procurement Process	Equipment and Stock Manager	Normal Truncated Distribution; Avg: 04:30, Deviation: 01:15, Min: 02:00, Max: 07:00
Receive and Log Stock	Reception and Booking Coordinator	Negative Exponential; Mean: 04:30
Financial Processing	Finance and Billing Officer	Negative Exponential; Mean: 03:00
Internal Stock Distribution	Court Maintenance Staff	Normal Truncated Distribution; Avg: 01:30, Deviation: 00:45, Min: 00:10, Max: 02:50
Monitor Usage and Gather Feedback	Equipment and Stock Manager	Normal Truncated Distribution; Avg: 01:00, Deviation: 00:30, Min: 00:10, Max: 01:50

Regarding resource allocation (refer to Table 14), each shift includes three Reception and Booking Coordinator, two Equipment and Stock Managers, one Court Maintenance Staff and one Finance and Billing Officer.

Table 14 – "As-Is Scenario" Process Simulation: Resources

Role	Number of Resources	Work Schedules
Reception and Booking Coordinator	3	Monday – Sunday, 09h00 – 17h00
Equipment and Stock Manager	2	Monday – Sunday, 09h00 – 17h00
Court Maintenance Staff	1	Monday – Sunday, 09h00 – 17h00
Finance and Billing Officer	1	Monday – Sunday, 09h00 – 17h00

With respect to the start event frequency and the execution probability of the procurement request gateway (see Table 15 and Table 16), an average volume of 20 orders was considered, as this reflected the typical number of orders processed per shift during the three months preceding the implementation of this framework.

Table 15 – "As-Is Scenario" Process Simulation: Start Frequency

Start Event	Day	From	To	Frequency
Order Received	Monday - Sunday	9h00	17h00	20

Table 16 – "As-Is Scenario" Process Simulation: Procurement Request Gateway Execution Probability

Gateway	Probability
Procurement Request Gateway Execution Probability	
Approved	80%
Deny	20%

Once the parameters were established, the simulation was executed under the scenario named the “As-Is Scenario”. This simulation covered a single workday, specifically the shift from 09:00 to 17:00.

The results of the simulation are presented in Table 17. From these findings, several key insights emerged. From the 20 orders received, 13 were approved, indicating that the company approved 65% of the orders.

Regarding execution times (refer to Table 17), the results detail the average execution time, including waiting periods. This metric reflects the duration required to complete each activity within the defined working schedule, without factoring in resource availability. The simulation calculated an average completion time of 13:28 (mm:ss) per instance.

Table 17 – “As-Is Scenario” Process Simulation: Results

Activity	Completed Instances	Average Execution Time (mm:ss)
Identify Stock Needs	20	01:08
Evaluate Existing Inventory	20	01:43
Approve Procurement Request	20	01:50
Execute Procurement Process	13	04:48
Receive and Log Stock	13	04:06
Financial Processing	13	01:54
Internal Stock Distribution	13	01:29
Monitor Usage and Gather Feedback	13	01:09

Regarding resource consumption (see Table 18), the Court Maintenance Staff had the lowest utilization, while the Equipment and Stock Manager had the highest.

Table 18 – “As-Is Scenario” Process Simulation: Resource Consumption

Role	Resource Consumption
Reception and Booking Coordinator	13.86%
Equipment and Stock Manager	44.64%
Court Maintenance Staff	5.04%
Finance and Billing Officer	6.44%

What-If Analysis

After simulating the “As-Is Scenario”, a what-if scenario was tested to assess the process resilience when subject to workforce constraints.

The scenario (“What-if Scenario 1”) simulates reduced staff availability due to unexpected absences, a common occurrence in day-to-day operations. In this simulation, one of the two Equipment and Stock Managers is unavailable (50% reduction), along with one of the three Reception and Booking Coordinators (33% reduction). The volume of work remains unchanged at 20 stock-related requests per day. The goal is to understand whether the current resource allocation is robust enough to sustain process performance under staffing disruptions.

The results of the simulation revealed a decrease in performance metrics across multiple dimensions. The average cycle time per instance remained steady at 13:28 (mm:ss).

From a resource consumption perspective, the Equipment and Stock Manager role showed a more moderate utilization level of 22.32%, reflecting a well-balanced workload with no signs of overburden. The Reception and Booking Coordinator maintained a stable usage rate of 9.24%, while the Court Maintenance Staff and Finance and Billing Officer showed utilization levels of 5.04% and 6.44%, respectively. These values indicate that all key roles operated well within resources limits.

This analysis highlights an improvement in workload distribution and operational resilience. With no roles approaching critical utilization thresholds, the process demonstrates greater flexibility and reduced vulnerability to staff availability issues. This setup strengthens service continuity and ensures reliable inventory management, which is especially critical in a dynamic sports club environment where consistent stock availability directly supports smooth training sessions and scheduled events.

Table 19 – “What-if Scenario 1”: Resource Consumption

Role	Resource Consumption
Reception and Booking Coordinator	9.24%
Equipment and Stock Manager	22.32%
Court Maintenance Staff	5.04%
Finance and Billing Officer	6.44%

Additionally, a second scenario, the “What-if Scenario 2”, was simulated to evaluate the peak season, where the number of orders to be approved rises significantly. In this case, the volume was increased from 20 to 40 orders. The objective is to assess whether the existing resources and their allocation are sufficient to handle periods of high demand.

The results revealed the same number of incomplete instances, with 33 daily orders successfully approved compared to the 13 in the baseline As-Is scenario. The average cycle time decreased slightly, from 13:28 (mm:ss) to 13:21 (mm:ss), indicating a modest efficiency gain.

Despite this improvement, the simulation revealed higher resource utilization for all the active roles in the process (Table 20), this reflected a more active involvement in managing a higher volume of orders. Nevertheless, the overall workload distribution became more balanced, with fewer process disruptions, smoother handovers, and no instances of resource overutilization.

This scenario demonstrates the effectiveness of the current team capacity in handling a substantial increase in demand, doubling the number of orders from 20 to 40, without requiring additional staff. While the improvements in processing time were moderate, the ability to maintain smooth operations and eliminate failed instances under higher volume conditions reflects a significant strategic advantage for the club, enhancing both service quality and customer satisfaction.

Table 20 – “What-if Scenario 2”: Resource Consumption

Role	Resource Consumption
Reception and Booking Coordinator	17.91%
Equipment and Stock Manager	45.43%
Court Maintenance Staff	6.15%

Finance and Billing Officer	8.93%

4.4 Process Redesign

Following the simulation and performance analysis of the “As-Is Scenario”, several qualitative and quantitative insights were gathered. These insights were instrumental in supporting a structured transformation of the process through a redesign effort. In line with the Fourth Phase, Process Redesign, the changes were guided by the Heuristics Process Redesign methodology proposed by Reijers & Mansar (2005), which helped turn the current process into a more effective and optimized version, referred to henceforth as the “To-Be” process.

Heuristics Process Redesign

The first redesign heuristic applied was task elimination, focused on removing non-value-adding or redundant activities within the stock management process. One of the most noticeable inefficiencies observed was the frequent manual need to observe low stock, which required the Equipment and Stock Managers to seek clarification or corrections. These observations were deemed unnecessary. With the implementation of a real-time stock verification system, these reactive steps were eliminated, allowing the process to flow uninterrupted and reducing the likelihood of miscommunication or stock-related delays.

The heuristic of task composition was also applied. Previously, the Reception and Booking Coordinators performed log inventory and store items as separate actions, resulting in time wasting and non-effective procedures. These two activities were consolidated into a single, more efficient task: “Log and Store Items”. This reduced unnecessary transitions and improved the overall processing speed.

Through the application of parallelism, tasks that were originally carried out in a linear sequence were modified to be performed concurrently. Once stock was received and then verified, previously handled one after the other, were enabled to run in parallel. This optimization was particularly beneficial in reducing time wasting, and in logging faster the items, resulting in more real-time data in the club database.

The use of process automation brought significant time-saving benefits. The task of manually contacting the supplier in order to place an order, was transformed in place an order directly to the database of the supplier. Instead of relying on manual activity, the Equipment and Stock Manager now contacts directly with the database of the supplier in order of placing orders, and invoice entries in real-time. This not only decreases processing time but also improves data accuracy and reduces the risk of billing errors.

Finally, the task elimination heuristic was applied once more on the “Approve Procurement Request” process. As a result of the other applied heuristics, this process had become redundant due to repeated steps and inefficiencies that disrupted the streamlined flow.

All of these enhancements are reflected in the redesigned “To-Be” process model for the padel sports club. The model integrates task elimination, task consolidation, parallel execution, and automation, resulting in measurable gains in both execution time and resource utilization. These improvements ensure the process is better equipped to handle fluctuating workloads and set the foundation for further digital integration. The complete BPMN diagram illustrating the redesigned process can be found in Appendix B.

“To-Be” Process Simulation

Once the process was redesigned, a new simulation scenario referred to as the “To-Be Scenario” was executed to evaluate the quantitative improvements resulting from the application of the selected redesign heuristics. This simulation aimed to measure performance enhancements in terms of cycle time reduction, resource optimization, and process efficiency.

With the implementation of the redesigned process model, it was essential to define a new set of simulation parameters. These were informed by insights from the earlier performance analysis and the anticipated benefits of task elimination, task composition, parallelism, and process automation. Specifically, it was expected that several subprocesses would demonstrate shorter cycle times due to the removal of redundant activities and the automation of previously manual tasks.

Accordingly, Table 21 presents the updated execution times and distribution assumptions used in the simulation of the “To-Be” process model. All other elements, including resource availability, frequency of order events, and the probability of execution at gateway points, remained constant when compared to the “As-Is Scenario”, ensuring a fair comparison and clear visibility into the impact of the redesign initiatives.

Table 21 - “To-Be Scenario” Process Simulation: Durations

Activity	**Performer**	**Execution Time (mm:ss)**
Identify Stock Needs	Equipment and Stock Manager	Normal Truncated Distribution; Avg: 00:50, Deviation: 00:25, Max: 01:30, Min: 00:10
Evaluate Existing Inventory	Equipment and Stock Manager	Normal Truncated Distribution; Avg: 01:30,

		Deviation: 00:35, Max: 02:40, Min: 00:20
Execute Procurement Process	Equipment and Stock Manager	Normal Truncated Distribution; Avg: 04:00, Deviation: 01:00, Max: 06:00, Min: 02:00
Receive and Log Stock	Reception and Booking Coordinator	Negative Exponential; Mean: 02:40
Financial Processing	Finance and Billing Officer	Negative Exponential; Mean: 01:45
Internal Stock Distribution	Court Maintenance Staff	Normal Truncated Distribution; Avg: 01:15, Deviation: 00:35, Max: 02:20, Min: 00:10
Monitor Usage and Gather Feedback	Equipment and Stock Manager	Normal Truncated Distribution; Avg: 00:50, Deviation: 00:25, Max: 01:30, Min: 00:10

Once the assumptions were defined, the simulation of the redesigned stock management process was executed. Similar to the previous configuration, the simulation covered a one-day period, focusing on a single operational shift from 09:00 to 17:00.

The results obtained from the simulation are outlined below. The cycle time experienced a significant improvement. The average cycle time per instance was reduced to 9:29 (mm:ss), measured from the initiation of stock needs to the final monitoring and feedback stage.

These findings highlight the efficiency gains achieved through process redesign.

Table 22 - "To-Be Scenario" Process Simulation: Results

Activity	Completed Instances	Average Execution Time (mm:ss)
Identify Stock Needs	20	00:48
Evaluate Existing Inventory	20	01:18
Execute Procurement Process	13	04:00
Receive and Log Stock	13	02:44

Financial Processing	13	01:12
Internal Stock Distribution	13	01:15
Monitor Usage and Gather Feedback	13	00:46

As for resource consumption (see Table 23), it was observed that the Equipment and Stock Manager remains the role with the highest workload, operating at 26.54% of shift capacity. On the other hand, the Finance and Billing Officer exhibited the lowest usage, averaging 4.01%. These results highlight a more efficient and evenly distributed workload compared to the "As-Is Scenario", although the Equipment and Stock Manager still represents a potential workload concentration that may warrant future monitoring.

Table 23 - "To-Be Scenario" Process Simulation: Resource Consumption

Role	**Resource Consumption**
Reception and Booking Coordinator	9.04%
Equipment and Stock Manager	26.54%
Court Maintenance Staff	4.16%
Finance and Billing Officer	4.01%

5. Results and Discussion

5.1 Theoretical Implications

After analyzing the business process through both qualitative and quantitative methods, a "To-Be" state was developed, tailored to the specific needs of the padel sports club. As suggested by existing literature (see Literature Review), a successful BPM initiative should result in the creation of a “To-Be” state that enhances efficiency, speed, and flexibility in the club’s operations.

While there are many examples of successful BPM implementations, several key takeaways emerge. For instance, Reisert et al. (2018) highlighted how implementing BPM in SAP was a crucial step in overcoming various challenges and complexities that hindered optimal performance in core business processes. According to the authors, the success of the initiative was largely due to the “strategic alignment of BPM with top management support” (Reisert et al., 2018, p. 22).

Similarly, Kovačič et al. (2018) demonstrated how BPM adoption by Snaga transformed the company into one of the most efficient municipal utility providers in Europe. Their work emphasized the shift from a “functional” to a “process-oriented” organization (p. 78), leading to a greater focus on customer needs. Like in other successful cases, the authors pointed out that top management involvement was a key factor in this transformation (p. 78).

To fully capitalize on the benefits of the BPM implementation, the padel sports club’s top management prioritized active involvement from day one. As literature suggests, this proactive engagement was a critical success factor in the process.

On the operational side, all proposed changes are expected to affect daily activities within the padel sports club. Woliński & Bala (2018) noted that companies like Siemens often face resistance when introducing process changes. To overcome this, the authors recommend maintaining flexibility and providing ongoing support across the organization. Similarly, in this case, it’s expected that some employees may resist certain changes, especially given that operators tend to perform tasks in different ways, each believing their own method is the most effective. Therefore, some variation in task execution can be anticipated after process changes are implemented.

Moreover, several of the proposed process changes involve automation and modifications to the club’s order registration software. Becker et al. (2018) highlighted a similar BPM initiative, which included replacing outdated IT systems. They cautioned that “merely placing process models on the company’s intranet does not guarantee that they will be understood or used effectively” (p. 414), stressing the importance of training and developing the operators within the padel sports club.

5.2 Practical Implications

Although the scope of this project did not include the physical implementation or post-deployment monitoring of the redesigned “To-Be” process, its potential benefits can be effectively assessed through the outcomes of the process simulation. The results indicate that this redesigned process can significantly improve two of the most critical performance indicators: cycle time and resource utilization.

When evaluating cycle time, the improvements were significant. The average process completion time per instance dropped from 13 minutes and 28 seconds to 9 minutes and 29 seconds, representing a 29.57% reduction. These results clearly demonstrate the effectiveness of applying structured process redesign heuristics, particularly in streamlining activities, reducing waste, and improving resource efficiency in a dynamic operational setting like a padel sports club.

Table 24 provides a side-by-side comparison of average execution times per instance, for both the “As-Is” and “To-Be” scenarios, along with their respective percentage variations.

Table 24 - Process Simulation Results: “As-Is Scenario” vs. “To-Be Scenario”

Activity	**Average Execution Time (mm:ss) “As-Is”**	**Average Execution Time (mm:ss) “To-Be”**	**Variation (mm:ss)**
Identify Stock Needs	01:08	00:48	-00:20
Evaluate Existing Inventory	01:43	01:18	-00:25
Approve Procurement Request	01:50	-	-01:50
Execute Procurement Process	04:48	04:00	-00:48
Receive and Log Stock	04:06	02:44	-01:22
Financial Processing	01:54	01:12	-00:42
Internal Stock Distribution	01:29	01:15	-00:14
Monitor Usage and Gather Feedback	01:09	00:46	-00:23

The reduction in execution time across all activities reflects the efficiency gains achieved through the application of the Heuristics Process Redesign methodology. According to the simulation results, the most significant improvement occurred in the "Approve Procurement Request", "Receive and Log Stock", driven by a combination of task simplification and system improvements.

These improvements were largely attributed to the elimination of redundant actions, more cohesive task design, and fewer manual bottlenecks, ultimately contributing to the streamlined performance of the redesigned To-Be process.

Table 25 presents a comparison of resource consumption between the "As-Is" and "To-Be" scenarios. The most notable change was found in the Equipment and Stock Manager, whose workload decreased by 18.10%, reflecting their enhanced responsibility in a more decentralized and non-optimized flow. Conversely, the Reception and Booking Coordinators and Court Maintenance Staff experienced slight decreases in their workload, due to streamlined logging and distribution steps. The Finance & Billing Officer also saw a decrease in shift utilization.

Overall, these findings highlight how the redesigned process not only enhances operational performance but also rebalances workload distribution across key roles, reducing pressure on supporting staff while aligning resource use with value-added tasks.

Table 25 - Process Simulation Resource Consumption: "As-Is Scenario" vs. "To-Be Scenario"

Role	**Resource Consumption "As-Is"**	**Resource Consumption "To-Be"**	**Absolute Variation (%)**
Reception & Booking Coordinator	13.86%	9.04%	-4.82%
Equipment & Stock Manager	44.64%	26.54%	-18.10%
Court Maintenance Staff	5.04%	4.16%	-0.88%
Finance & Billing Officer	6.44%	4.01%	-2.43%

Despite the promising outcomes demonstrated by the "To-Be Scenario" simulation, there are several limitations inherent to the simulation model that could impact the precision and reliability of the conclusions drawn.

Firstly, while the execution times used in the model were carefully estimated based on process observations and refined through discussions with stakeholders, the accuracy of the simulation ultimately depends on how completely the process model reflects real-world operations. Even though the process flow was validated by participants, there remains a possibility that certain nuances, informal steps, or edge-case variations were not fully captured in the model, which could introduce discrepancies between simulated and actual performance.

Secondly, the simulation assumes continuous and standardized human performance, which doesn’t always hold true in practice. As previously noted by the BPM team, one of the core challenges in the current stock management environment is the lack of consistent execution standards among staff, where individuals adapt tasks to their own habits or preferences. The simulation, however, does not account for such behavioral variability.

These constraints should be taken into account, when interpreting the results and considering the feasibility of the “To-Be Scenario” in a live operational setting.

6. Conclusions and Future Research

This project focused on examining the impact and effectiveness of implementing a structured Business Process Management (BPM) framework within the context of a padel sports club's stock management process, which was identified as lacking in both efficiency and flexibility. Given the club's exposure to fluctuating demand patterns, especially during peak seasons, and the increasingly dynamic nature of its operational environment, the organization recognized the strategic importance of developing a detailed "As-Is" documentation of its stock-related activities. This baseline documentation served as a foundation for identifying improvement opportunities and guiding a future-oriented process redesign.

In parallel, this initiative was also intended to support the integration of information technology into day-to-day operations. As digital transformation accelerates across industries, including sports and recreation, the padel club aims to align itself with the principles of Industry 4.0 by enhancing the digital maturity of its internal processes. The increasing demand for real-time stock visibility and automated replenishment capabilities, driven by both on-site customer needs and future e-commerce integration, underscored the need for a more agile and scalable system.

The main goal of the project was to discover, analyze, and redesign the club's stock management process. In the discovery phase, the existing operational flow was studied and modeled in detail to establish an accurate representation of the current ("As-Is") process. This was followed by a thorough analysis phase, which highlighted key inefficiencies and bottlenecks. These findings directly informed the development of the redesigned ("To-Be") process, with the support of established process redesign heuristics. Despite certain simulation tool limitations, what-if scenarios enabled a quantitative evaluation of the proposed improvements, allowing the club to assess the potential impact of changes prior to implementation.

Although the final stage of the BPM lifecycle, monitoring and continuous improvement, were not executed within the scope of this project (as outlined by Dumas et al., 2018), the initiative succeeded in achieving its objectives. A set of well-founded recommendations was provided, each aimed at increasing process performance, reducing cycle time, and balancing resource allocation more effectively.

Looking ahead, the club would greatly benefit from pursuing the final stages of the BPM lifecycle. This would involve systematically monitoring process performance, collecting execution data, and ensuring alignment with service quality and operational compliance standards. Given the variability of demand and the evolving needs of sports customers, embedding continuous optimization into the stock management process will be essential.

In the context of digital transformation, the adoption of a process mining solution could offer considerable benefits. By leveraging actual process data from the club's inventory and booking systems, the organization could gain deeper visibility into how processes are executed in real-time. As suggested by Kipping et al. (2022) and Cuomo (2023), such tools offer a powerful way to visualize, analyze, and monitor performance, enabling the club to move from reactive problem-solving toward proactive and data-driven process improvement.

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8. Appendix A

"As-Is Scenario" Process Model

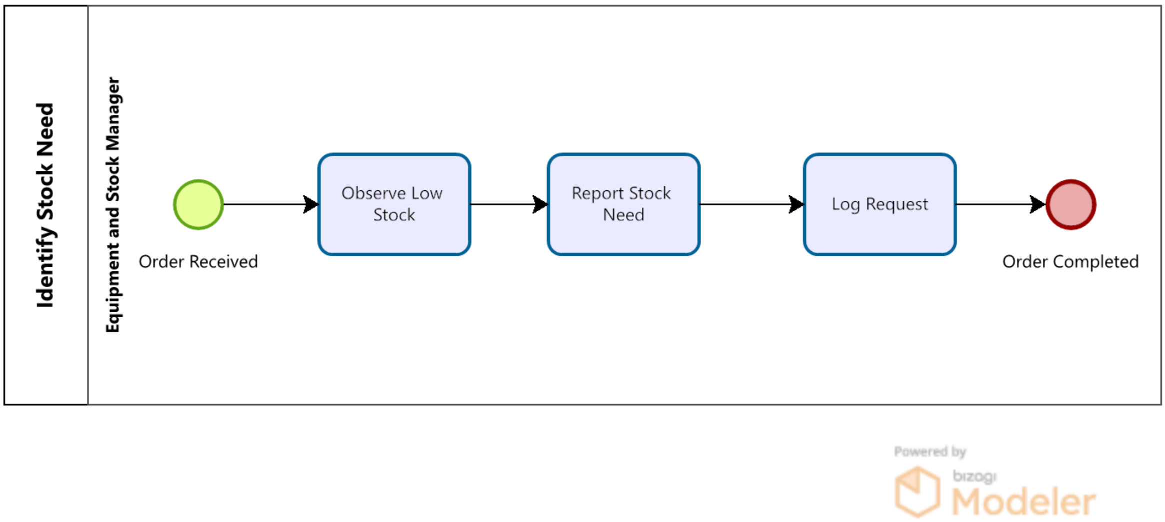

Figure A1 - "As-Is Scenario": Identify Stock Need subprocess (Level 2)

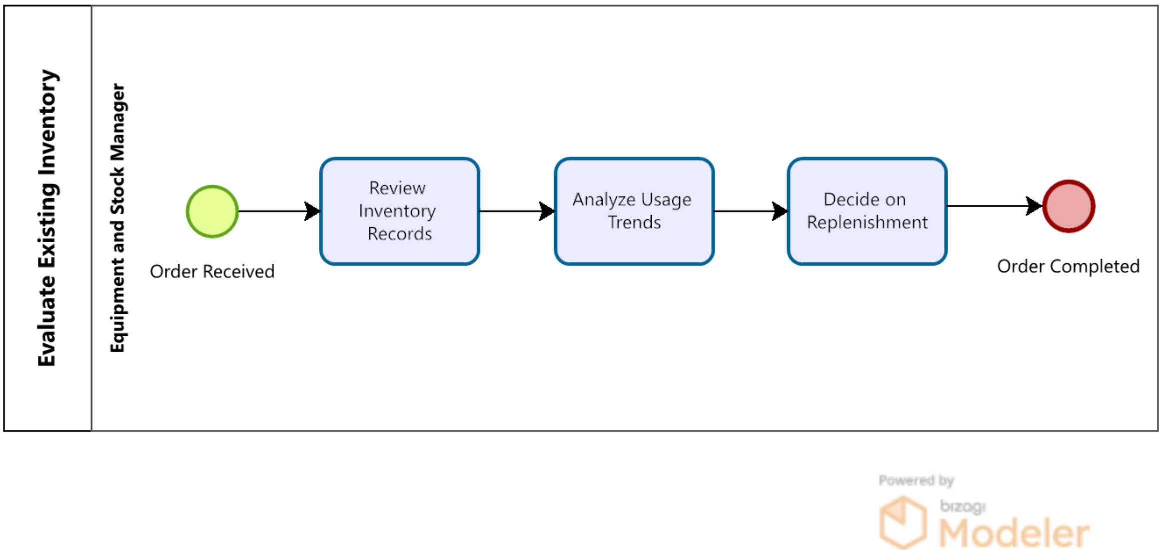

Figure A2 - "As-Is Scenario": Evaluate Existing Inventory subprocess (Level 2)

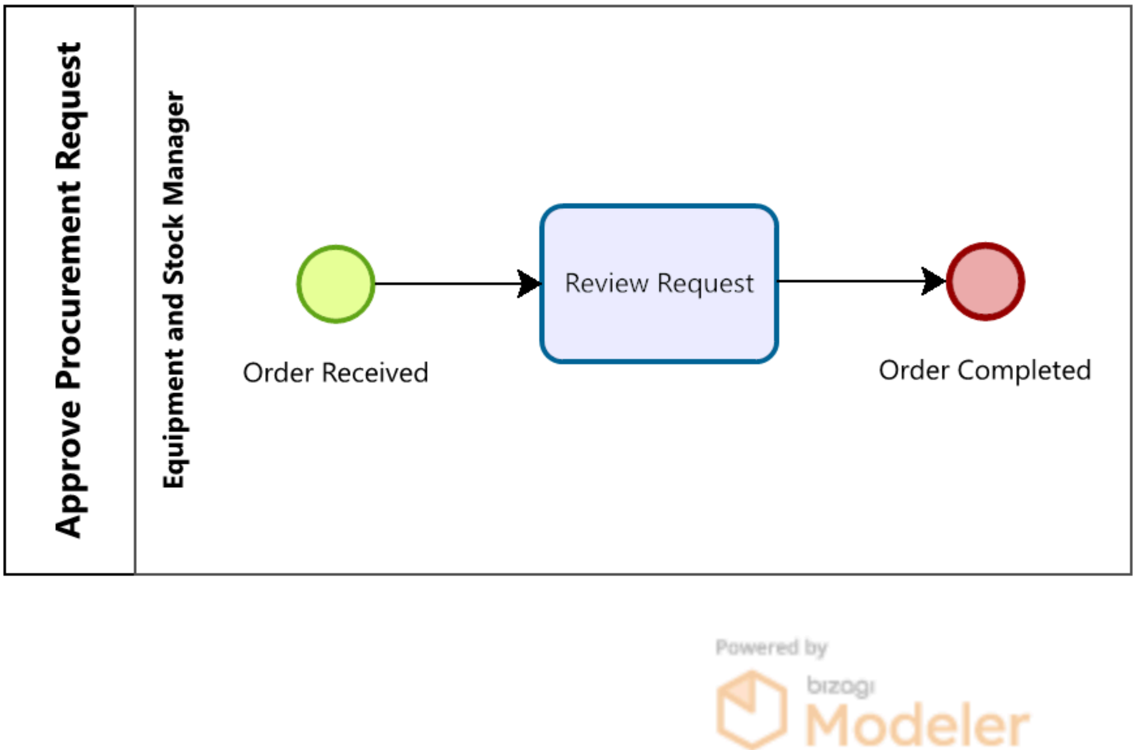

Figure A3 - “As-Is Scenario”: Approve Procurement Request subprocess (Level 2)

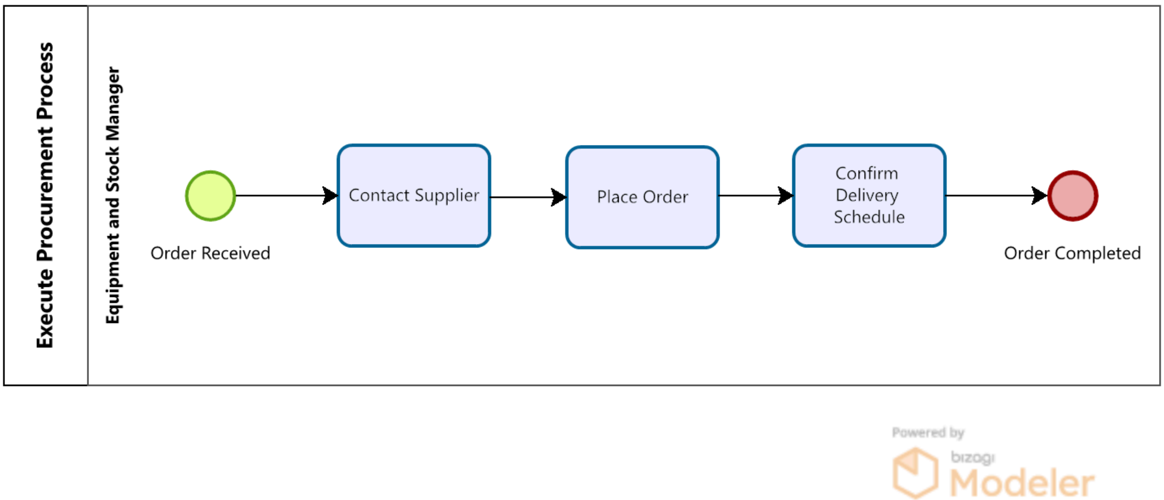

Figure A4 - “As-Is Scenario”: Execute Procurement Process subprocess (Level 2)

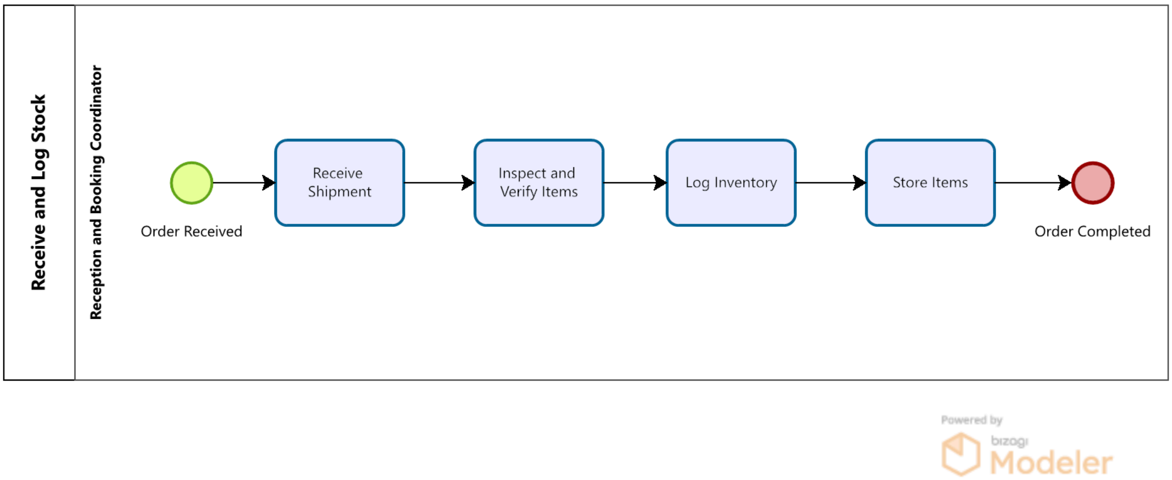

Figure A5 - “As-Is Scenario”: Receive and Log Stock subprocess (Level 2)

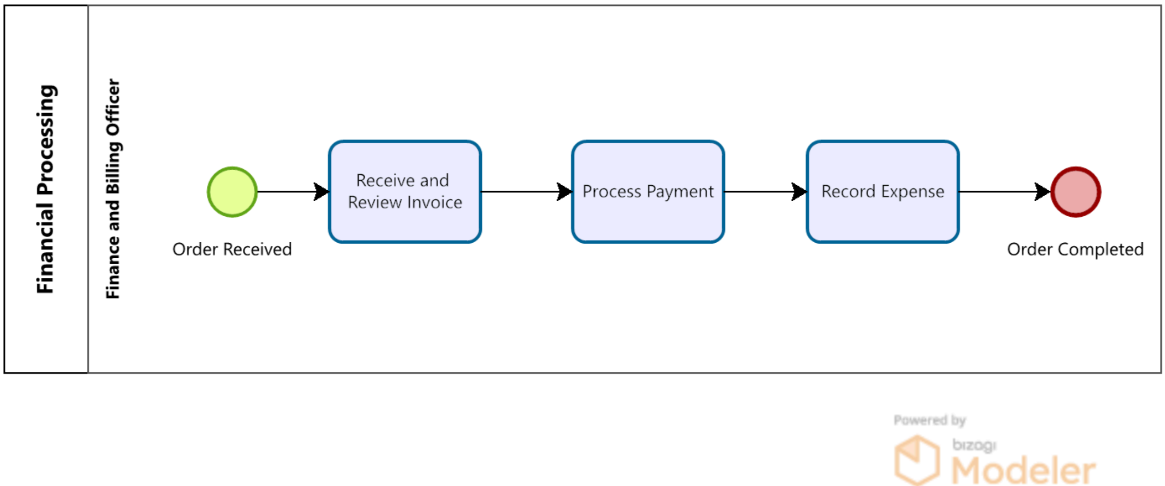

Figure A6 - “As-Is Scenario”: Financial Processing subprocess (Level 2)

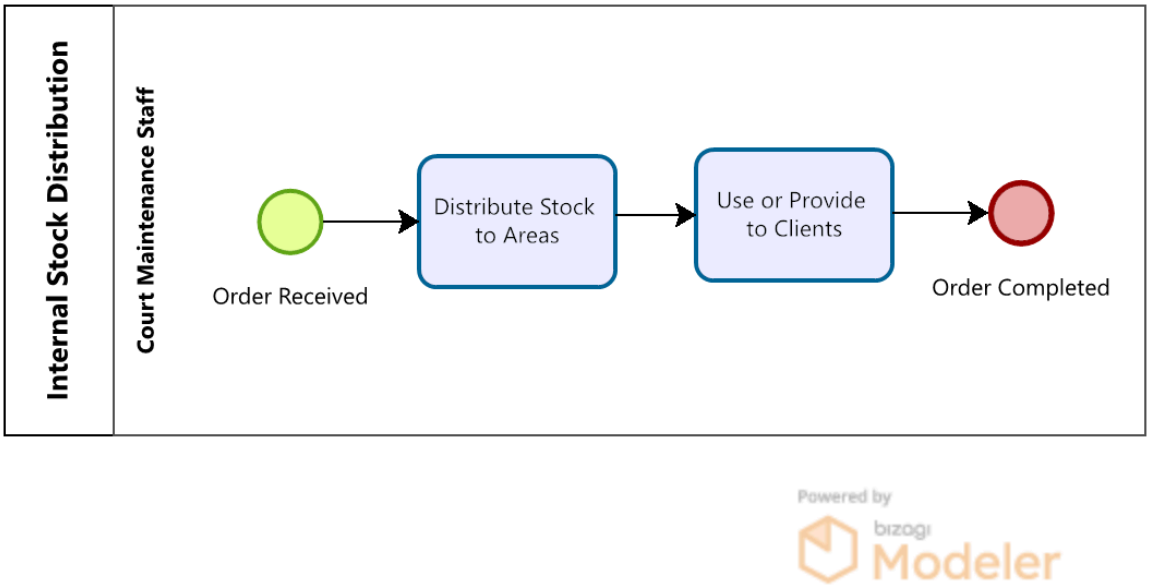

Figure A7 - “As-Is Scenario”: Internal Stock Distribution subprocess (Level 2)

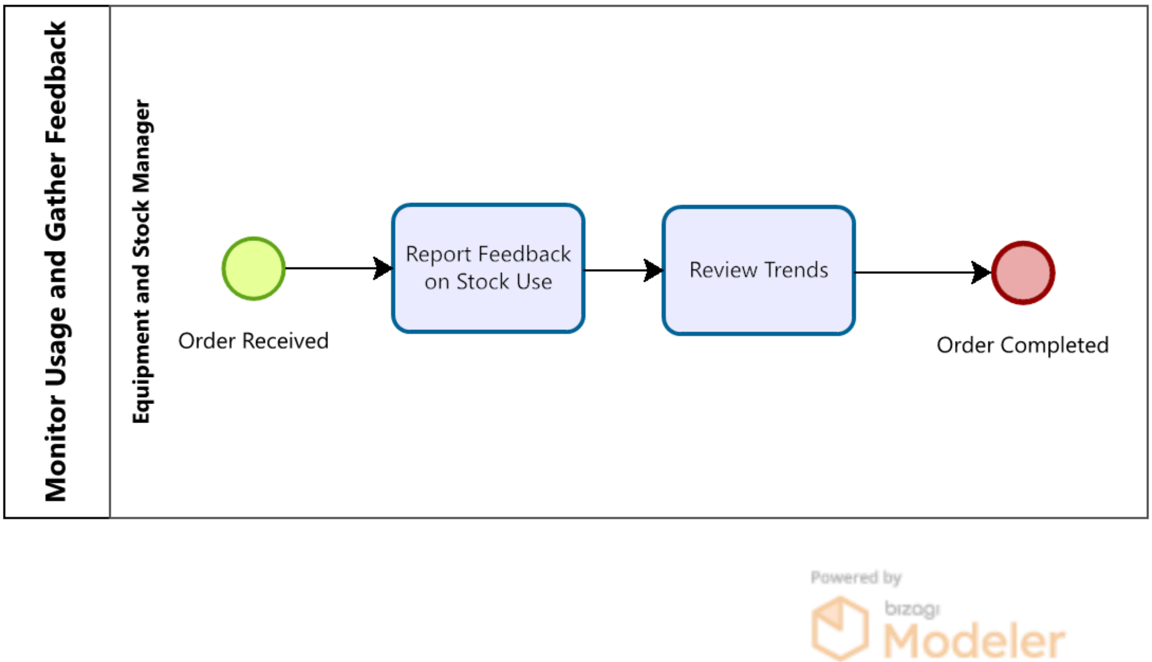

Figure A8 - “As-Is Scenario”: Monitor Usage and Gather Feedback subprocess (Level 2)

9. Appendix B

“To-Be” Process Model

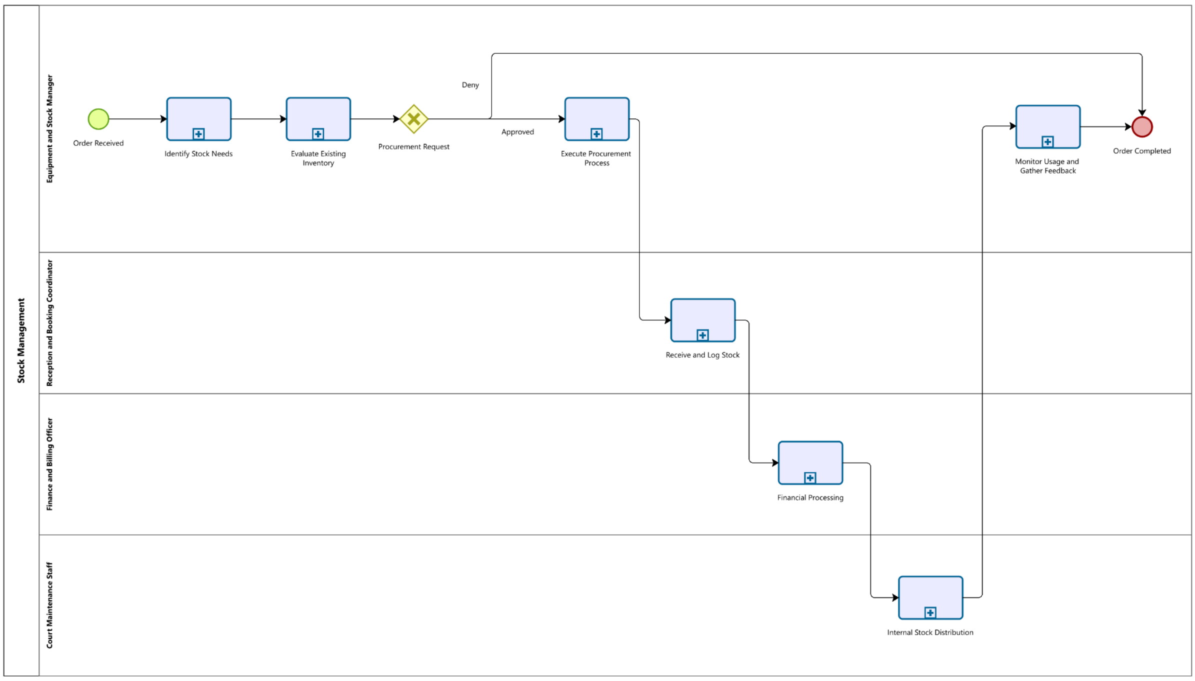

Figure B1 – “To-Be” Process Model: Stock Management (Level 1)

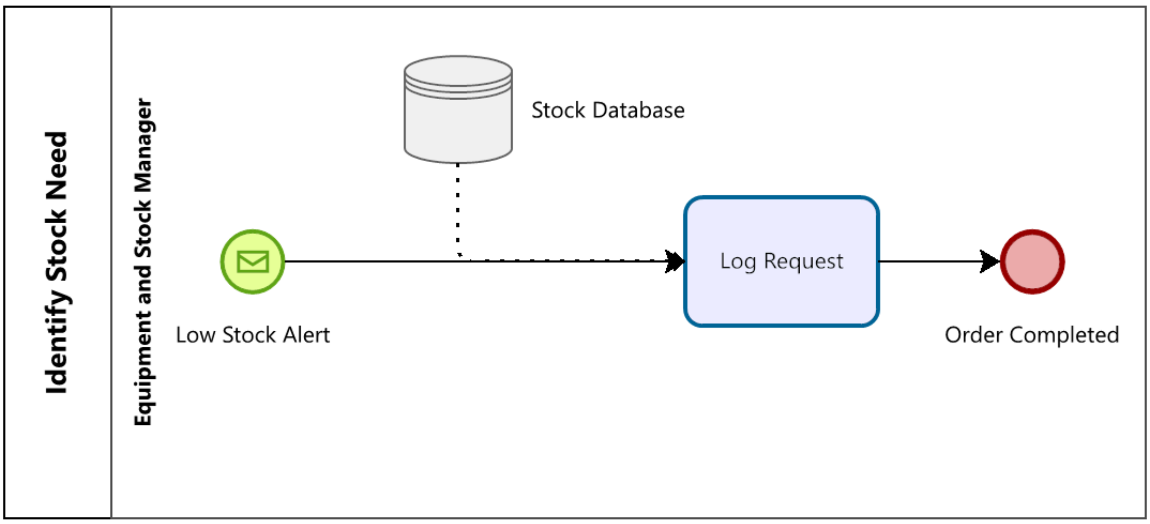

Figure B2 - “To-Be Scenario”: Identify Stock Need subprocess (Level 2)

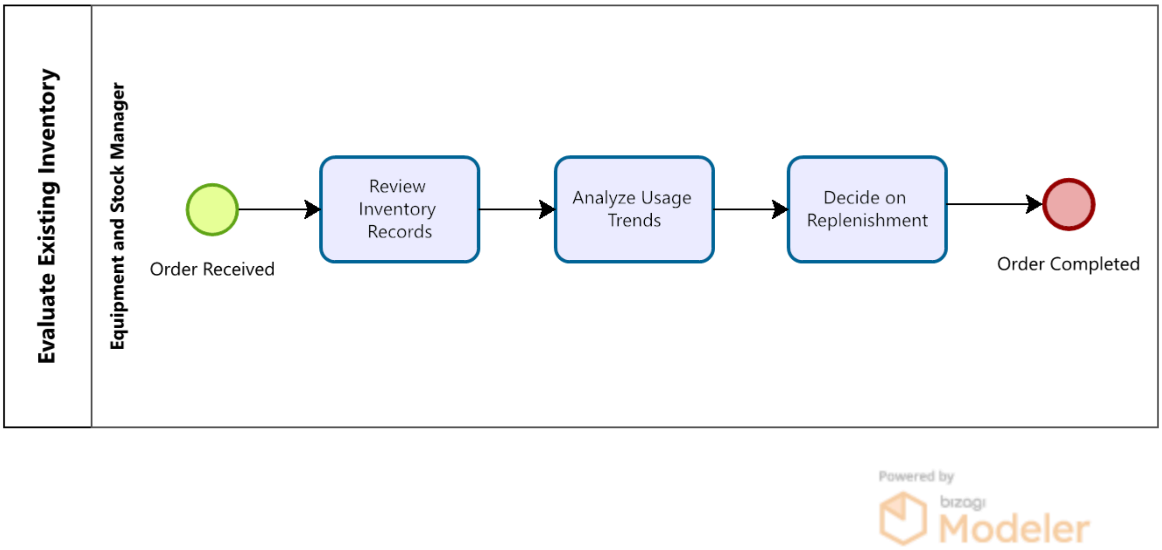

Figure B3 - “To-Be Scenario”: Evaluate Existing Inventory subprocess (Level 2)

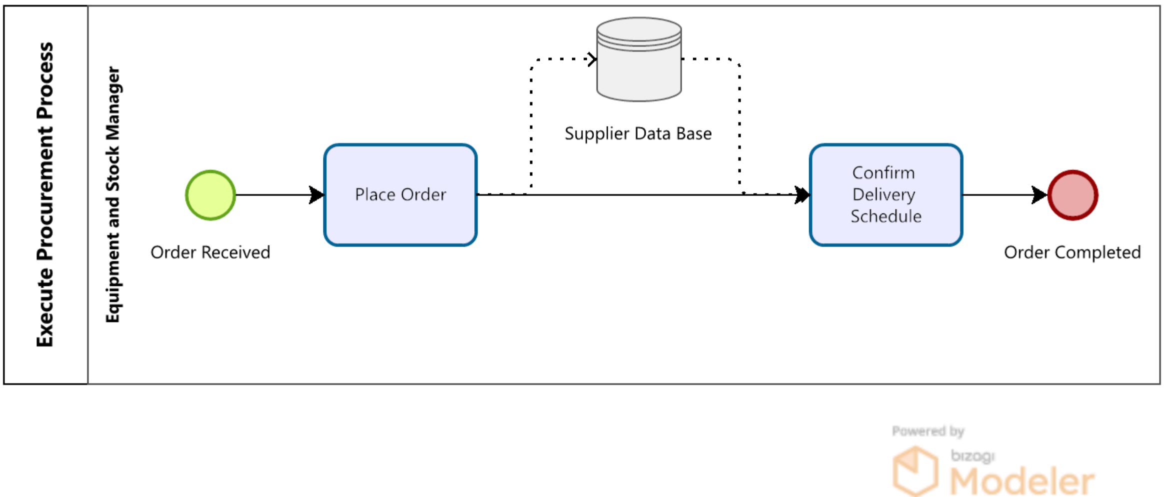

Figure B4 - “To-Be Scenario”: Execute Procurement Process subprocess (Level 2)

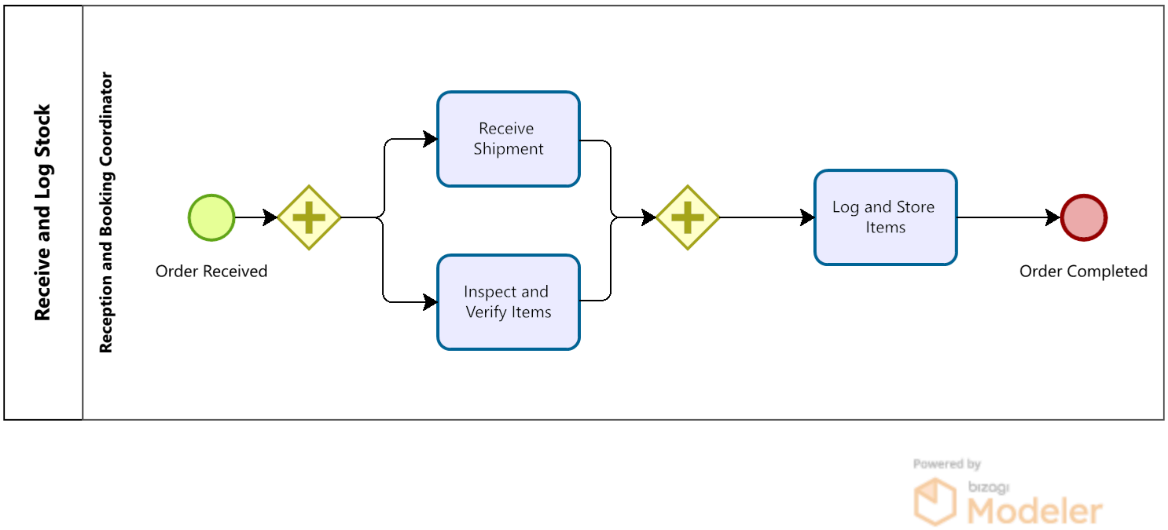

Figure B5 - “To-Be Scenario”: Receive and Log Stock subprocess (Level 2)

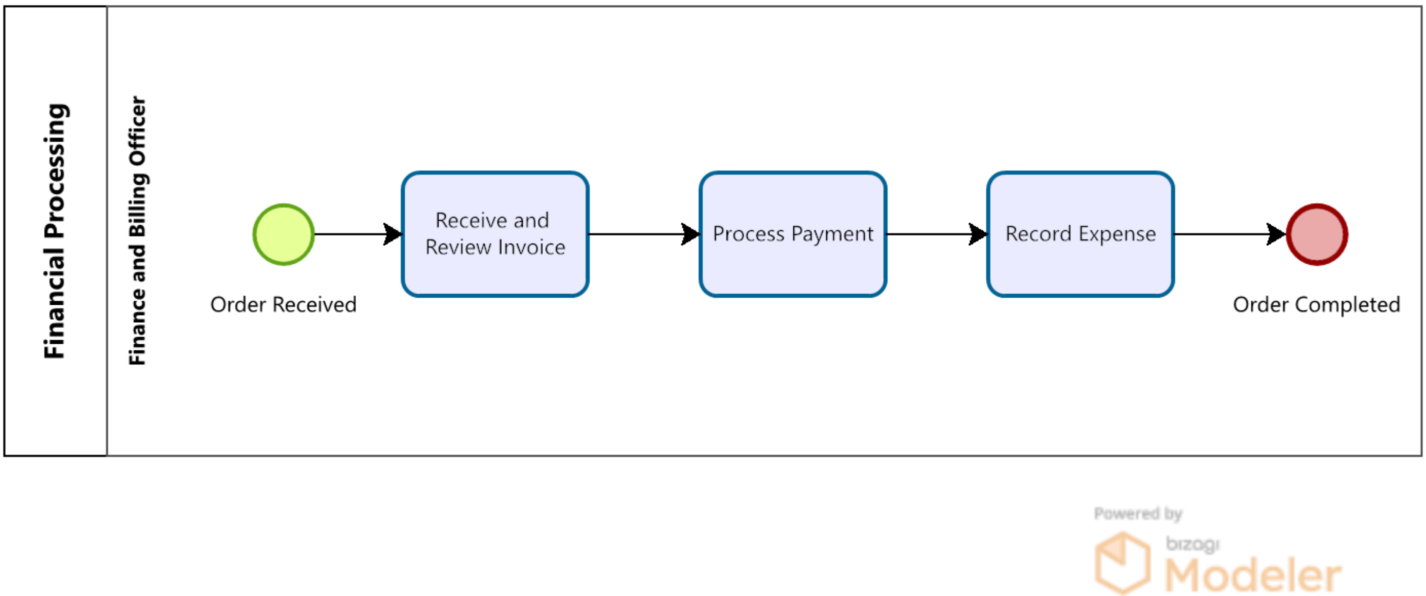

Figure B6 - “To-Be Scenario”: Financial Processing subprocess (Level 2)

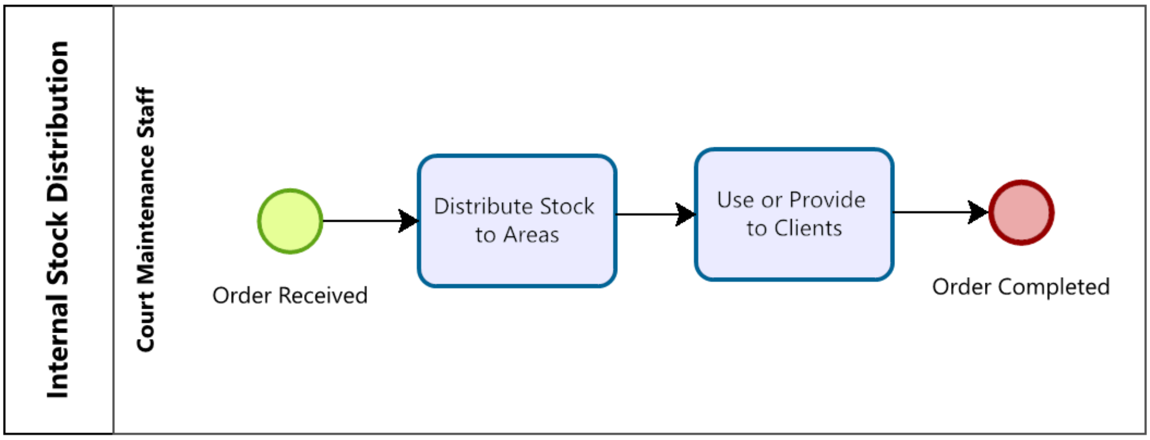

Figure B7 - “To-Be Scenario”: Internal Stock Distribution subprocess (Level 2)

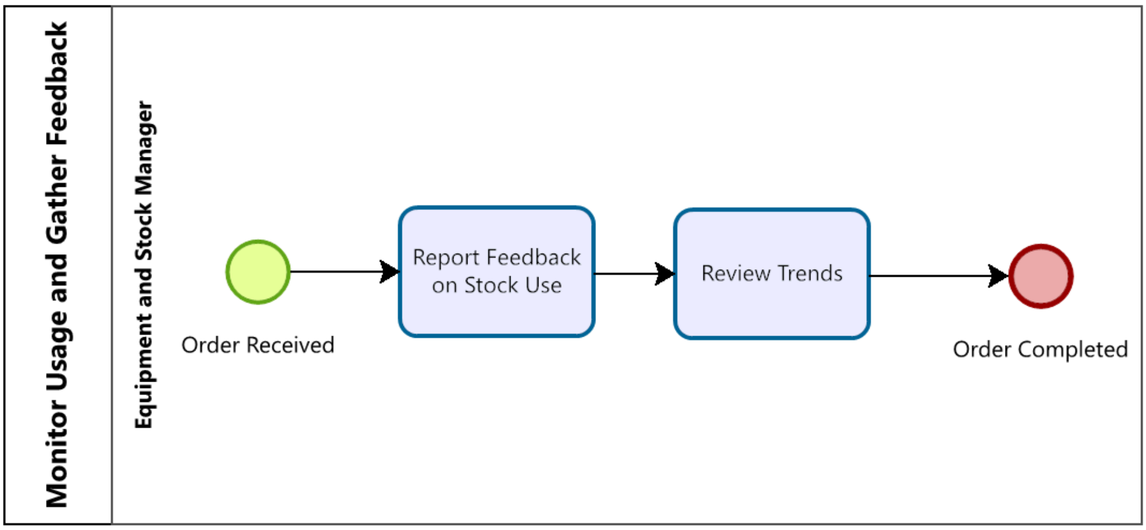

Figure B8 - “To-Be Scenario”: Monitor Usage and Gather Feedback subprocess (Level 2)

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