NOVA IMS Information Management School

MGI

Mestrado em Gestão de Informação
Master Program in Information Management

Using Business Process Management practices to improve the processes of a Portuguese City Hall

The case of the Forestry Office at the Viana do Castelo Municipality

Gonçalo Silva Ferreira

Project Work report presented as partial requirement for obtaining the Master's degree in Information Management

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação
Universidade Nova de Lisboa

NOVA Information Management School

Instituto Superior de Estatística e Gestão de Informação
Universidade Nova de Lisboa

USING BUSINESS PROCESS MANAGEMENT PRACTICES TO IMPROVE THE PROCESSES OF A PORTUGUESE CITY HALL:

THE CASE OF FORESTRY OFFICE AT THE VIANA DO CASTELO MUNICIPALITY

by

Gonçalo Silva Ferreira

Project Work report presented as partial requirement for obtaining the Master's degree in Information Management, with a specialization in Information Systems Management

Advisor: Vitor Duarte dos Santos

Advisor: Maria Fabíola dos Santos Oliveira

November 2021

DEDICATION

I dedicate this work to my mother, father, and sister.

Mom, you will always be the most important person in my life serving as, not only the capacitor for my decisions, but also as an example of work ethic, professionalism, and love. I would not be here writing this dissertation without your belief, guidance, and support, and I am proud to finish the education that you provided me. Know that I feel extremely blessed, lucky, and honored to be your son and, despite the road leading here being rather difficult, your constant presence and faith in me made everything possible and worth it. You made me the man that I am today, and I will carry your love forever.

Dad encompasses everything that a great man is. You have been a pillar for moderation in the worst moments, and your constant joy is something that I wish to have at your age. Know that you proved to me countless times that a great man is not defined by his stature or gullible achievements, but by his presence and endless belief in his children. When I was born, we passed through tough times and, although I cannot imagine how you felt, I believe it was your perseverance and spirit that drove us to surpass those troubles. I'm sincerely grateful for your guidance and life teachings and know that there is no better role model than you.

Mery, you provided me with the love of a sibling. Since you were born, I have strived to make you better, and I know that I am not the best role model but believe me when I say that I have tried throughout my life to provide you with an example to follow. Without you, I would not bring myself to do better, study more, and improve as a person. I wish you all the best in your life. Know that I will always be available when you need me.

I hope this can make you proud as it presents the culmination of years of support and principles. Know that I could not have asked for better mentors in my life.

ACKNOWLEDGEMENTS

I would like to thank my thesis advisors, Professor Doctor Vitor Duarte dos Santos and city councilor Engineer Maria Fabíola dos Santos Oliveira for their guidance, availability, and time. Without their support, this project work would not be possible. The professor's contributions improved my working methods and developed my practical skills, and I am grateful that we share the same mindset and interest on this subject. The councilor proved to be essential to ascertain contact with the office and arrange for meetings with the different involved staff members. The information and knowledge that she provided were paramount and constituted a basis for the whole project. I am particularly grateful for her openness and eagerness to work with me and glad for her promotion to a city councilor. I am honored to call her a friend.

I would also like to recognize the availability and support of the ones who participated in the interviews. They provided key information, and their opinions were reflected on the project development. The curiosity on the subject and eagerness to learn was very welcoming. They are Sandra Nunes (Forestry Engineer), Teresa Menezes (Social Assistant), and Marlene Peres (IT Engineer). I would also like to extend my thanks to the previous counselor Doctor Ricardo Carvalhido for his time and availability regarding meetings about the topic decision.

Finally, I also want to thank my family and friends. They constitute the most essential part of my life and, due to the circumstances caused by the pandemic, that role cannot be understated. A special mention to my mother, father, sister for keeping up with me throughout the long development time.

ABSTRACT

The project aims to respond to the management of processes in the public sector, focusing on optimization and sustainability. This discipline has evolved in the last decades, but the municipalities have not adapted to the needs of the current times. Although investments in technology and information management systems have been made, there is still a lack of documentation and task structuring.

The Viana do Castelo City Council, located in the north of Portugal, has been investing in different scientific areas. The use of BPM (Business Process Management) can bring several managerial improvements, through optimized implementations of models to manage the propagation of information.

To understand the area under study, it is essential to analyze the governmental structure, which is based on hierarchies and legislation, and to conduct interviews with the associated entities. A review of research associated with different topics such as tools, good implementation practices, BPM in general, and its application in local governments, smart cities, and sustainability, is essential to further explore the discipline.

For the implementation of BPM, it is necessary to identify the processes associated with different tasks. It is expected to obtain a positive validation of results, both quantitative and qualitative, about the models created so that they are suitable for the respective application.

KEYWORDS

BPM; Process Modeling; Municipal Management; Sustainability

INDEX

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

ABC – Activity-Based Costing

AI – Artificial Intelligence

BPMN – Business Process Management Notation

BPM – Business Process Management

BPMN – Business Process Management Notation

BPR – Business Process Reengineering

CPI – Continuous Process Improvement

CPS – Cyber-Physical Systems

CMVC – *Câmara Municipal de Viana do Castelo* (Viana do Castelo City Hall)

DAS – *Divisão de Ambiente e Sustentabilidade* (Environment and Sustainability Division)

DSRP – Design Science Research Process

GTF – Gabinete Técnico Florestal (Forestry Technical Office)

IDEF3 – Process Description Capture Method

IoT – Internet of Things

IPA – Intelligent Process Automation

IS – Information System

IT – Information Technology

OMG – Object Management Group

PMDFCI – *Plano Municipal de Defesa da Floresta Contra Incêndios* (Municipal Fire Defense Plan)

RPA – Robotic Process Automation

TQM – Total Quality Management

UML – Unified Modelling Language

VLT – *Vistoria de Limpeza de Terreno* (Land Cleaning Inspection)

1. INTRODUCTION

1.1. CONTEXT

Nowadays, process management is becoming increasingly important, both in the business environment and in public and private institutions. Not only does it constitute a general and detailed design of the processes involved, but it also helps in optimizing and performing these processes. This area needs further study due to the current need for digitization and reduction of response times. It is necessary to represent the processes clearly and objectively so that they are understood by all the entities involved. As its objective is to implement improvements and changes, this management must be well designed.

BPM (Business Process Management), according to Jeston and Nelis (2014), is a management discipline that uses business processes to achieve an organization's objectives through the improvement, ongoing performance management, and governance of key business processes. These improvements can be represented in time, quality, quantity, costs, and even sustainability. The scientific community assigns different definitions to these processes, but they are usually identified as the way to do the job. These always have inputs and outputs and are carried out when events occur. Despite its name, BPM can be used in any environment, be it corporate or not.

The Viana do Castelo City Council is an example of forest management for the country as it has been promoting and exploring technological alternatives in this sector. It has offices specialized in the environment and biodiversity that provide services related to conservation, spatial planning, incidences, maintenance, education, and management of water, waste, air, noise, and municipal equipment. Its relationship with the environment is essential to develop business opportunities such as tourism, wood production, and sporting events. Due to competition for several projects, there are many decentralized systems, databases, and processes, and therefore, they have not adapted to the latest information processing practices.

1.2. MOTIVATION

With the development of research in Smart Cities, Green Tech, and Business Intelligence, there is great importance in combining technologies with optimized and sustainable processes, but these are finding more use in business environments.

This area of study is not yet understood by the public sector, because “Despite the importance of the phenomenon, literature does however not yet provide a comprehensive picture of BPM capabilities in governments.” (Ubaid & Dweiri, 2020).

“The public sector is often characterized by archaic and rigid processes, red-tape and bureaucracies, and is often beset with sudden changes of policies” (Hutton, 1996) due to constant changes in government. In this way, this research becomes very relevant because, despite the beginning efforts to hire specialized organizations to evolve in this aspect, there is still a need, from the entities involved, to learn these practices as they do not have previous knowledge or know-how.

A well-organized and structured modulation of management processes will be an asset as “Process management opens the door for creative and innovative approaches to enhancing organizational performance” (Gulledge & Sommer, 2002). The department is structured hierarchically and has several different systems to centralize data and documents, but still does not have the knowledge of new business practices. Through BPM, the entities involved may have an opportunity to rethink tasks and, in the future, combine Business Intelligence with their analysis.

1.3. OBJECTIVES

This project aims to improve the processes in local governments, using BPM to model management processes of DAS (Environment and Sustainability Division), GTF (Technical Forestry Office) and requests made to the Municipality of Viana do Castelo, having as focus, the administrative and sustainable management.

The characteristics and individual experiences of each entity will contribute to the modulation and optimization of these processes, while also allowing rethinking of tasks, technologies, and management practices involved.

Research in this area has been increasing due, to the appearance of e-Government platforms, and the constant need to keep in touch with citizens, but even so, there is still no extensive analysis, with structured models for the application.

The project's result intends to expand the study of the use of BPM in municipalities through the creation of process models for optimized management. These possible optimizations can be qualitative and quantitative and should constitute a base for good institutional administration. This result becomes even more relevant for the people involved as it will introduce a catalog of how activities are performed and a tool for use in future projects.

To achieve this intention, the following objectives are:

1. Review of the literature on BPM and municipal management concepts.
2. Identification and analysis of the main processes to model.
3. Analysis and design of models (BPMN).
4. Obtaining results and discussion with the entities involved.
5. Review of limitations and recommendations for future work.

2. WORK PLAN

The project will be based on the Business Process Management Lifecycle by Dumas et al. (Chapter 2.1.2), centered on the development and analysis of models (modeled processes) to improve their functional performance in the associated organization. These models will contribute not only to documentation and structuring of current tasks but also for future use in work implementations, as they "can extend the knowledge base or apply existing knowledge in new and innovative ways" (Hevner et al.., 2004, p. 87).

Some aspects of Design Science Research will also be utilized to create a concise and comprehensible structure for the project. This type of methodology provides an opportunity to explore different styles and types of modulation and notation while being able to provide the qualitative and quantitative data collection necessary to assess the performance and value of the models.

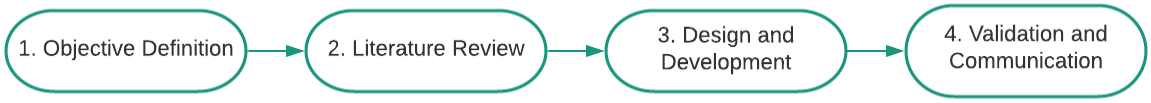


Figure 1.1 – Proposed Methodology

2.1. PHASES

Following the work plan, the different phases are defined.

Definition of objectives

In this first phase, meetings will be held with administrative elements of the Viana do Castelo City Council to explain what BPM and modulation are. These entities will give an overview of their structure and the activities they practice. The choice of the study area will be made, according to the interested departments.

Literature Review

This phase consists of researching the two most important points for the development of this work, namely, the study area and the tools to be used. It is, therefore, necessary to research and review:

- The existence of publications on the topics covered (Process Management, BPM, BPM in local governments, BPMN and Sustainable Management)
- How to apply this research in the development of the project
- Tools available to modulate BPM.
- The hierarchical and governmental structure of the department/city hall
- Decree-laws applied to the area of the processes under study.
- Possible problems that may arise and how to deal with them.

Design and Development

In this phase, the chosen value-adding key processes will be defined according to the meetings to be held, with administrative elements of the DAS (*Divisão de Ambiente e Sustentabilidade*), the GTF (*Gabinete Técnico Florestal*), and the Department of Information Systems of the Viana do Castelo City Hall.

Interviews with the entities involved will support the modeling of the chosen processes, according to the BPMN 2.0 notation and sustainable administrative management.

Validation and Communication

Finally, it is intended to hold meetings with the associated entities to evaluate the processes according to reality, their sustainability, and whether they can be applied in real scenarios. Re-drawings, according to the instructions given, to support this validation may be made. A critical analysis will compare what is currently implemented with the models proposed by this project.

The final report will be produced with the associated research and results.

2.2. TOOLS

A definition of the tools is necessary for the understanding of this project.

2.2.1. Bizagi Modeler

With the rise of BPM usage, a market for supporting this type of management has several software options. This work is supported by the usage of the Bizagi Modeler software.

The Bizagi Modeler application enables organizations to create and document business processes in a central cloud repository to gain a better understanding of each step and identify process improvement opportunities to increase organizational efficiency (Bizagi 2021).

The Forrester Wave™: Software For Digital Process Automation For Deep Deployments (2019), identifies Bizagi as a market leader. States that Bizagi “has always focused on low-code development for nonprofessional developers and has always thrived in environments that require a long tail of process-driven applications”. Moreover, “It offers the extremely popular Bizagi Modeler for process modelling and documentation at no charge” making it easily accessible. Due to the nature of this project work and the knowledge of the writer with the software, as a nonprofessional, Bizagi was chosen.

2.3. SCHEDULE

Was prepared a schedule to organize the project to achieve the proposed objectives. Included are the steps associated with the methodology, with reviews by the advisor, and a plan, starting in December 2020 and ending in November 2021.

ID	Task Name	Início	Conclusão
1	**Project**	**14/12/20**	**04/11/21**
2	**1. Objective Definition**	**14/12/20**	**31/01/21**
3	Definition of the research question	14/12/20	04/01/21
4	Meetings with entities	04/01/21	28/01/21
5	Proposal Writing	25/01/21	29/01/21
6	Advisor's Review	30/01/21	30/01/21
7	**2. Literature review**	**19/02/21**	**01/05/21**
8	Literature review of associated concept	19/02/21	19/03/21
9	Hierarchical and governmental structure	19/03/21	26/03/21
10	Research Alignment	22/03/21	03/04/21
11	Possible Problems	26/03/21	16/04/21
12	Advisor's Review	29/03/21	30/04/21
13	**3. Design and Development**	**19/05/21**	**22/07/21**
14	Interviews with entities	19/05/21	08/06/21
15	Process Selection	19/05/21	08/06/21
16	Model Design	20/05/21	06/07/21
17	Advisor's Review	21/06/21	16/07/21
18	**4. Evaluation**	**16/06/21**	**07/08/21**
19	Model Structuring	16/06/21	23/06/21
20	Meetings with entities	22/06/21	28/06/21
21	Data Collection	22/06/21	28/06/21
22	Qualitative and Quantitative Analysis	23/06/21	16/07/21
23	Results analysis	04/07/21	23/07/21
24	**5. Communication and Validation**	**06/09/21**	**04/11/21**
25	Validation of results	06/09/21	15/09/21
26	Advisor Review	27/10/21	31/10/21
27	Final Advisor Contact	01/11/21	01/11/21
28	**Report Writing**	19/02/21	02/11/21
29	**Report Delivery**	01/09/21	04/11/21

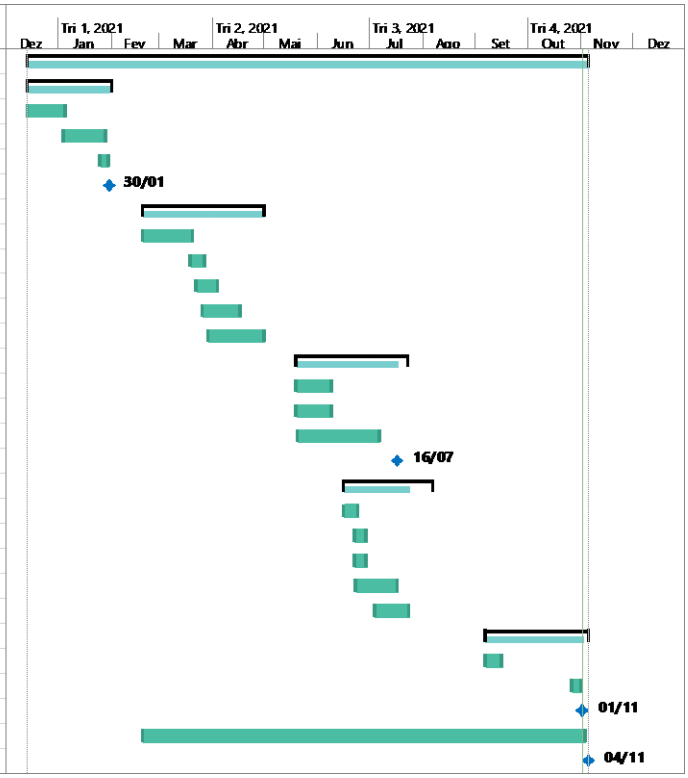


Figure 1.2 – Proposed Schedule

3. LITERATURE REVIEW

3.1. BUSINESS PROCESS MANAGEMENT

This chapter presents the concepts on which the development of the work project is based. Firstly, it introduces a look into BPM standards and related fields, such as BPM life cycle and BPMN as well as a brief description of a standard local government institution. Furthermore, recent developments and future trends in this managing field are elaborated.

3.1.1. Concepts

Each organization—be it a governmental agency, a non-profit organization, or an enterprise—has to manage a number of processes (Dumas et al., 2018). To comprehend BPM, one must understand a variety of concepts. With the evolution of how work is performed, in the 19th century, the functional organization was born. It was classified as a hierarchical structure wherein people work by their area of specialization while being supervised by a functional manager with expertise in the same field. In the 1980s, technology started to be introduced to perform tasks and this managerial view started to become inefficient. It is at this time, that concepts that later formed BPM started to be explored. "Process Thinking", according to Jeston & Nelis (2014), had its origins in the early last century as a tool for work management but gained support in the 1990s by works of "Business Process Reengineering (BPR)" (Davenport & Short, 1990), and Hammer and Champy (1990) "Reengineering Work: Don't Automate, Obliterate". BPR created a recursive relationship between Information Technology (IT) and business processes which aligned business strategies with changing technological trends. At the same time, there was a considerable focus on quality thinking for improvements, establishing concepts like Total Quality Management (TQM), "Lean Thinking", Six Sigma, ISO, and Kaizen (Blitz). All notions started to be applied in real cases and, soon after, the different concept promoters, riding the hype of "the next big thing" started giving it all the same name, BPM. This created a label, with many different definitions that lasted until today.

BPM can be regarded as a management approach for achieving both revolutionary and evolutionary improvements in business processes (Niehaves, Plattfaut, & Becker, 2013). Is the art and science of overseeing how work is performed in an organization to ensure consistent outcomes and to take advantage of improvement opportunities (Dumas et al., 2018). Although this is true, the term "improvement" can take different meanings in each organizational context. It considers the strategic objectives and people involved with the associated tasks. For some, this might mean a reduction of costs, while for others, an increase in time performance. Its value is only as good as the buy-in you get from the organization and senior management and then how it is implemented (Jeston & Nelis 2014) because this is a multifaceted activity, with execution and communication as critical factors for its success. People and their engagement in the implementation are critical, and a holistic approach in meeting the people and cultural aspects of managing an organization are crucial (Jeston & Nelis 2014).

The transition from BPR to BPM is usually a topic of confusion. One might think that the first is a direct update to the second, but they constitute different ideas. Whereas the former refers to a drastic reconstruction of existing business processes, the latter is more evolutionary, incremental, and practical. It is remarked that BPM allies some of the aspects of BPR with Continuous Process

Improvement (CPI) / Kaizen because while it does not put into question the current structure, it seeks to identify issues and resolve them incrementally, one step at a time to fine-tune the global business process. It is flexible, at lower implementation times and associated risks.

Davenport & Short (1990), describe business processes as a set of logically related tasks performed to achieve a defined business outcome. Dumas et al, (2012) further explored the concept, with a modern approach, adding that processes are a collection of inter-related activities, events and decision points which include several actors and objects, and lead to an outcome with value at least for one customer. The usual triggers are called events and occur automatically. On the other hand, activities do not automatically occur but consist of various steps that take time to perform. Moreover, they are interconnected with decision points that affect the execution and its different outcomes, being value-adding or not. Actors that take part, range from different entities and all work together to achieve a shared goal.

3.1.2. BPM Life Cycle

As previously stated, BPM has an incremental approach to the lifecycle of business processes, hence, this lifecycle consists of different phases which are defined by their own methods, techniques, and tools. The cycle's order is not mandatory, but it provides a structured approach to BPM development. Although there are different approaches, the Business Process Management Lifecycle by Dumas et al., (2018) (see fig. 2.1) is the most established. Each phase is properly explained, along with its outputs which comprise insights and models.

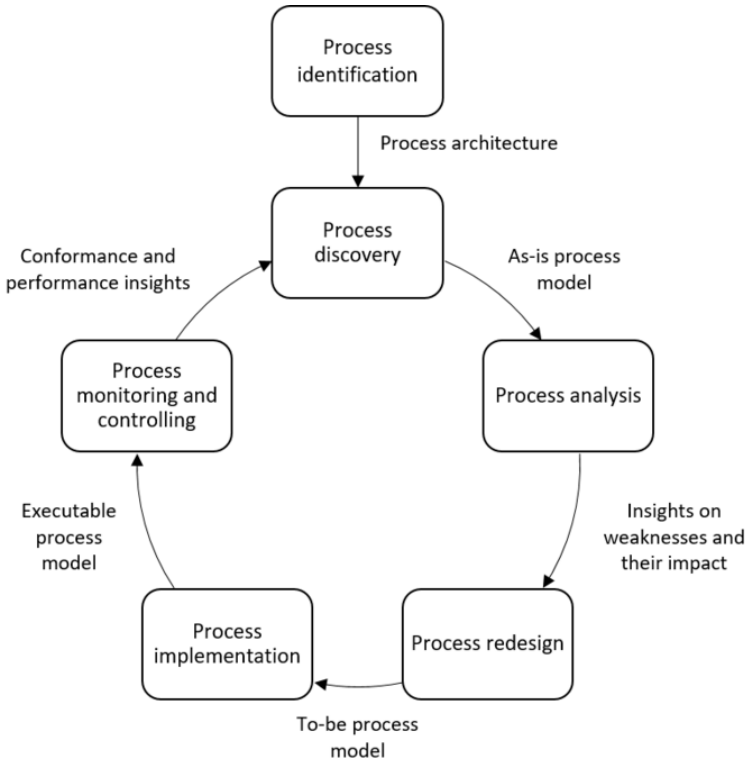


Figure 2.1 –The Business Process Management Lifecycle (Dumas et al., 2018, p. 23)

Process Identification

The first phase of the BPM lifecycle, where the business problem and its relevant key processes, are identified. The assessment should delimit their scope and recognize their associated relationships by creating a new and updated process architecture. The result serves to describe a comprehensive view of the organization's processes and their inter-relations. A performance measure identification can also be implemented to assess each process individually.

Process Discovery

In the second phase, through the previous identification and measurement, it is created one or multiple “AS-IS” process models. These models should reflect the understanding that people in the organization have about how work is done (Dumas et.al., 2018). They should be easy for stakeholders to understand, and because of this, they can be a great tool to facilitate communication.

Process Analysis

The third phase consists of an “AS-IS” model analysis through the definition and quantification of the performance measures. It should assess the process's performance, creating qualitative and quantitative insights, and spaces for improvement while taking the appropriate action to solve potential issues.

- Modeling of the AS-IS process – The AS-IS process models should reflect the understanding that people in the organization have about how work is performed. These are meant to facilitate communication between stakeholders involved in a BPM initiative and are only as good as the information provided.
- Modeling of the TO-BE process - An analysis of gaps and value can be performed through the previous AS-IS models, giving origin to the TO-BE process models. These should illustrate the changes in the current implementation and provide an asset for discussion with the associated entities, to verify the process outcomes and the necessary implementation work.

Process Redesign

In the fourth phase, it is performed an identification and analysis of solutions to produce an executable, redesigned version of improved processes, the “TO-BE” process model. It is important to note that both, the cost of the changes and the expected benefits, should be considered to achieve the organizational objectives.

Process Implementation

Following the fourth phase output (“TO-BE” process model), the necessary changes are implemented through change management and process automation. The organizational change requires a set of activities to alter the way of working of all participants involved in the process, and through process automation, it is executed a configuration or implementation of IT systems to support the new “TO-BE” process.

Process Monitoring and Controlling

After the implementation of the "TO-BE" process, monitoring and control are mandatory. Through data collection and analysis, leading to conformance and performance insights, the needed adjustments are identified, and the process execution can be controlled. With time, many adjustments need to be implemented, meaning that a lack of continuous monitoring and improvement of a process leads to degradation. The necessary corrections should be applied, and the cycle initiates once again to deal with new issues.

3.1.3. Process Performance Measures

To practice process management, a definition of essential measures was identified to analyze the overall performance of the associated activities. It is important to understand if the process is effective and is delivering what is desired.

The process performance measures are identified as quantities that can be determined for a given business process. The definition of measures may vary from case to case and various authors present different measurement criteria. According to Dumas et al., (2018) and ABPMP (2013), three fundamental measures are identified:

- Time – Associated with process duration and cycle times. Measures the time taken from the start of a process until its completion, considering the output.
- Cost – Associated with the financial value of a process. Typically, there are different perspectives of cost. It is possible to distinguish fixed, variable, and operational costs. Fixed costs are overhead costs that are usually not affected by the intensity of processing. On the other hand, variable costs are correlated with some varying quantities present in an organization. Operational costs, which are directly related to the process output, are driven by the costs related to human resources in the execution of the process.
- Quality – Identified by two different angles. External quality is related to the client's satisfaction with the final product or the process. Internal quality is associated with the view of the process participants.

ABMPP (2013) identifies a fourth measure that should be considered:

- Capacity – Related to the amount or volume of a realistic output related to a process.

Dumas et al., (2018) identify a different fourth measure that is currently increasing in importance:

- Flexibility - Defined in general terms as the ability to react to changes.

Both can be utilized following the case but usually, capacity relates to activities with a product as output, while Flexibility is associated with culture in a service environment. This difference in criteria presents an existing difficulty in selecting the "right" measures to evaluate a business process.

3.1.4. Process Improvement

Through the constant iterations of BPM, we can identify core management methodologies that can be applied.

Lean

Lean thinking or management is one of the most widely used business strategies in the last three decades (Sony, 2018). It was created by the Toyota Motor Corporation during the 1980s and focused on reducing waste, or Japanese equivalent 'MUDA', and creation of value in an organization. Womack & Jones (1996) define waste as any human activity which absorbs resources and creates no value. Lean identifies the following as wastes: transportation, inventory, motion, waiting, over-processing, over-production, and defects. Through the identification and elimination of wastes, activities are adjusted to create value, which is the primary goal of Lean. Value is classified as a capability provided to a customer at the right time at an appropriate price, as defined in each case by the customer (Womack & Jones, 1996).

The key Lean Management principles (Womack & Jones, 1996) are as follows:

- Value: Specify the value desired by the customer.
- Value Stream: Identify the value stream for each product/service providing the value customer. All the waste in the value stream can be challenged.
- Flow: Make the value-creating steps flow continuously. Eliminate wastes.
- Pull: Products and services are requested by the final consumer and not pushed from the production end.
- Pursue Perfection: There is no end to the process of reducing time, space, cost, and mistakes.

Aligning Lean and Kaizen, reflects a continuous improvement in the process flow, with constant non-value adding activities being removed and adjusted to maximize value and deliver to the customers exactly what they want at the lowest response times and costs.

To summarize, Lean is about doing more with less. Use the least amount of effort, energy, equipment, time, facility space, materials, and capital – while giving customers exactly what they want (Womack & Jones, 1996).

Six Sigma

Six Sigma was developed by William Smith at Motorola in 1996 (Taghizadegan, 2006) as a specific measure of quality, used to improve quality and to reduce costs (Hammer, 2002). Underpinned by statistical techniques, it presents a structured and systematic approach to process improvement, aiming for a reduced defect rate of 3.4 defects for every million opportunities, or Six Sigma (Brady & Allen, 2006). Simply put, reducing variability minimizes the number of defects, shortens process cycle times, and decreases direct costs (Harry et.al., 2011).

Six Sigma places a strong emphasis on measuring the output of processes or activities, especially in terms of quality, and encourages managers to systematically compare the effects of improvement initiatives on the outputs (Dumas et.al., 2018). This process's sole focus is to achieve business leadership and world-class performance by achieving a standard of near perfection (Truscott, 2012).

In Qualitative Process Analysis, some aspects of Six Sigma will be utilized.

Total Quality Management (TQM)

Total Quality Management is considered one of the approaches that inspired BPM. Also had its origins in Japan in 1949 (Powell, 1995), and produced such managerial innovations as quality circles, equity circles, supplier partnerships, cellular manufacturing, just-in-time production, and hoshin planning. (Ishikawa,1985; Akao, 1991). This leads to improved understanding of customer satisfaction and needs, better problem-solving and internal communication with greater employee commitment and motivation, stronger relationships with suppliers, and reduction in errors and waste.

While it has the same objectives and focuses on continuous improvement like BPM, the fundamental is different. In TQM the emphasis is on improving the tangible products and services themselves, while BPM aims to improve the processes that create these products and services (Dumas et.al., 2018).

In the later years, critics have started to suggest that TQM entails significant costs and implementation, associated with unrealistic assumptions about organizational culture and capacities (Powell, 1995).

Activity-Based Costing (ABC)

Developed in the 1980s to overcome some of the limitations of traditional cost accounting and to enhance its usefulness to strategic decision-making (Gupta & Galloway, 2003). It is usually considered an accounting practice, as it deals with cost measurement but, in a process context, it is mainly related to the problem of assigning indirect costs to cases (Dumas et.al., 2018). In this context, human resources, systems, and machinery are often shared by different products and services, and they serve different customers. According to ABPMP (2013), while ABC does not eliminate or change costs, it provides data about how costs are consumed in a process. Resources are assigned to and consumed by activities which in retrospect are consumed by cost objects (outputs of an activity). This consumption drives cost and either efficiency or inefficiency. Due to the constant variation in activity costs, continuous management is necessary to improve the value offered to the customer and overall profit.

In summary, Dumas et.al. (2018) states that:

BPM inherits from the continuous improvement philosophy of TQM, embraces the principles and techniques of Lean and Six Sigma, and combines them with the capabilities offered by modern information technology, in order to optimally align business processes with the performance objectives of an organization.

3.1.5. Process Automation

As previously stated, a process can be translated as the way we do things. They are defined by the tasks, roles, rules, and procedures necessary to create workflows in an organizational environment. In the beginning, with the appearance of the functional organization, they were carried out entirely by humans who used the physical objects necessary to carry out an activity. Over the years, with the introduction of information technology and the need for digitalization, they started to become partially or entirely automated by information systems, performing the tasks, and enforcing rules which were previously implemented by humans.

The process implementation may require process automation, which involves the configuration or implementation of an IT system (or the re-configuration of an existing IT system) to support the "to-be" process (Dumas et.al., 2018).

When we talk about the processes and their implementation with the new disruptive technologies, different methods and concepts start to emerge. Workflow automation, RPA, IPA, and Process Mining are riding the current and future trends to enforce the application of technology in process development and analysis. Technologies such as the Internet of Things (IoT), Big Data, AI, and Industry 4.0 create opportunities to meet the needs of customers and also contribute to the development of logistics and supply chains management (Witkowski, 2017).

As these technologies are new and still pose many research questions, we must start utilizing them in different environments to develop frameworks and methodologies adapted to each type of organization. Nevertheless, it is safe to assume that process automation is intrinsic to the future of process management.

Workflow Automation

Georgakopoulos, Hornick, & Sheth, (1995), describe a workflow as a concept closely supporting the reengineering of business and information processes. It may: describe business process tasks at a conceptual level necessary for understanding, evaluating, and redesigning the business process and capture information process tasks at a level that describes the process requirements for information system functionality and human skills. Modeling a workflow is far from trivial: It requires deep knowledge of the workflow language and lengthy discussions with the workers and management involved (Van Der Aalst, Weijters, & Maruster, 2019). It can be human-oriented, where the humans coordinate and perform the tasks while ensuring the consistency of results, or system-oriented, using computer systems to perform computation-intensive operations and specialized software tasks. In the latter, automation is crucial as this type of implementation deals with the issues associated with realizing a workflow using computers, software, information systems, and/or Workflow Management Systems (WFMSs) (Georgakopoulos, et al., 1995).

Modern process-driven applications cover advanced workflow process automation, systems integration in hybrid and heterogeneous information technology (IT) environments, and improved process-guided support of human tasks and automated documentation (Holzmüller-Laue, Göde, Fleischer, & Thurow, 2014). Workflow automation deals with scheduling and controlling workflow execution (Georgakopoulos, et al., 1995) to improve efficiency, productivity, accuracy, audibility, accountability, and job satisfaction.

Robotic Process Automation (RPA)

Robotic Process Automation is a preconfigured software instance that uses business rules and predefined activity choreography to complete the autonomous execution of a combination of processes, activities, transactions, and tasks in one or more unrelated software systems to deliver a result or service with human exception management (IEEE Corporate Advisory Group 2017). It operates on the user interface of software tools and automates mouse and keyboard interactions to remove repetitive, labor-intensive tasks. This minimizes human error due to mental lapses resulting from boredom or exhaustion (Chakraborti, et al., 2020). The preconfigured software instances reproduce the work that humans do, and they are called robots, or software robots (Moffitt, Rozario, & Vasarhelyi, 2018). Robots are becoming more autonomous, flexible, and cooperative day by day and at certain they will interact with one another and work safely side by side with humans and learn from them (Vaidya, Ambad, & Bhosle, 2018). In the case of software, they operate as "macros" and can perform tasks like logins, emails, analyses, report building, or data entry. With some configuration, they can be trained to read emails, open PDFs, identify salient information, enter data into ERP systems, and send an email to specific supervisors when ambiguity or errors are encountered (Moffitt, et al., 2018).

Intelligent Process Automation (IPA)

While on one hand, RPA allows the integration of systems in repetitive tasks, IPA builds on the traditional RPA technologies, while going a step further to automate complex tasks which require decision making, insights, and analysis or the composition, coordination, and collaboration of multiple IPA solutions (Chakraborti, et al., 2020). Beyond automating simple repetitive tasks, IPA achieves more complex automation by using AI to minimize human-dependent training and automating complex tasks that entail decision-making. This poses some problems in terms of costs and maintenance, as the systems need time to learn and identify how the decision-making process should be addressed. Furthermore, finding opportunities to automate tasks that are more complex than routine repeatable tasks require the use of structured and unstructured data from process logs (Chakraborti, et al., 2020) which is still not leveraged in public organizations.

Process Mining

Process mining has become a "hot topic" in business process management (BPM) research, and industry has expressed considerable interest in employing it as well (Van Der Aalst & Dustdar, 2012).

It appeared as an association between BPM and Data Mining. It turns a specific data model into an aggregated reconstruction of process flows. The data model encompasses an Event Log and a Case Table, obtained by looking into each activity's system log. The resulting data-based insights can be a great asset in the design of a model, allowing you to, firstly, discover your as-is-process, to compare its conformance with a to-be model, and to ultimately find bottlenecks, patterns, and areas of improvement to enhance the process (van der Aalst, 2016).
According to Van Der Aalst & Dustdar (2012), there are three types of Process Mining:

- Discovery - used as a starting point for analysis. It takes an event log and produces a model without using any other a priori information.

- Conformance –Compares an already existing process model with the same process's event log. This comparison shows where the real process deviates from the modeled one. This can quantify the level of conformance and detect differences. With conformance, we can determine if reality, as recorded in the log, conforms to the model and vice versa. This type of functionality also supports compliance checking, auditing, Six Sigma, and so on.

- Enhancement - aligns an event log and process model to extend or improve the modulation. This can identify problems like bottlenecks, service levels, throughput times, and frequencies. The goal is not to check conformance, but rather to improve the performance of the existing model following certain process performance measures.

Process mining has become a "hot topic" in business process management (BPM) research, and industry has expressed considerable interest in employing it as well (Van Der Aalst & Dustdar, 2012).

Industry 4.0

The term Industry 4.0 stands for the fourth industrial revolution which is defined as a new level of organization and control over the entire value chain of the lifecycle of products (Vaidya, et al., (2018). This is commencing with the introduction of technologies like CPS, IoT, and Cloud computing (Sony, 2018) in the working environments. Although this is meant for manufacturing activities, we can still leverage some of its aspects into the service procedures. It will use digital product models, which will be formed to a large degree in compliance with the requirements of customers (Witkowski, 2017).

According to Vaidya et al. (2018), the central objective of Industry 4.0 is fulfilling individual customer needs which affect areas like order management, research, and development, manufacturing commissioning, delivery up to the utilization and recycling of products.

3.1.6. Process Architecture and EPM

3.1.6.1. Process Architecture

The questions imposed by the identification are "what processes are executed in the organization" (designation) and "which ones should the organization focus on" (evaluation).

The designation of key processes is influenced by the association between the Porter's Value Chain Model and the designation of the organization's activities, characterizing them into three levels: Management, Core, and Support Processes.

Not all processes are equally important and not all processes can receive the same amount of attention (Dumas et.al., 2018). Various criteria have been proposed to evaluate which ones should be addressed first. The most common is based on Importance, Dysfunction, and Feasibility.

- **Importance -** Related to the strategic relevance that a process plays in an organization's pursue of objectives. Associated with profitability, business continuity, contribution to a public cause, and many others.

- **Dysfunction** - Aims to evaluate the health of each process, making it possible to identify which are the ones are causing the most problems. These may benefit the most from BPM initiatives.
- **Feasibility** - Determined by how each process is prone to management changes. Most notably, culture and politics involved in a particular process may be obstacles to achieve results from such initiatives (Dumas et.al., 2018), demanding, in this case, special attention must be given to identify realistic benefits.

Further assessments can be performed to determine the level of implemented process thinking practices.

3.1.6.2. Enterprise Process Management (EPM)

According to ABPMP (2013), Enterprise Process Management (EPM) is the application of BPM principles, methods, and processes to an individual enterprise. It assures the alignment of the portfolio and architecture of end-to-end processes with the organization's strategy and resources and provides a governance model for the management and evaluation of BPM initiatives. This perspective is critical in controlling the impact and thus the benefit of changes in the business operation.

Changes to rules, operations, policies, and procedures are made every day and over time they creep up causing disruption, decreasing effectiveness and can triggering infringements to regulations. Through an analysis of workflows, tasks, and activities both upstream and downstream, a view can be obtained of the entire organizational processes, or at least the ones in areas that reproduce changes.

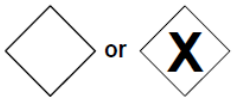
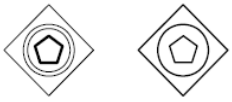
3.1.7. Business Process Management Notation

The main objective of the implementation of BPM in an organization is the modeling of associated key processes. There are many languages for modeling business processes diagrammatically (Dumas et.al., 2018). Flowcharts were among the most utilized, but due to a rise in cross-functional organizations, UML Activities Diagrams have started being employed with more frequency. Several iterations of data-flow diagrams, Event-driven Process Chains (EPCs), and Process Description Capture Method (IDEF3) also gained some weight. Nowadays, Business Process Model and Notation (BPMN), by the Object Management Group (OMG), has become the standard, with its latest version BPMN 2.0, being widely accepted.

According to OMG (2014), the main driver of BPMN is to create a simple and understandable mechanism for creating Business Process models, while at the same time being able to handle the complexity inherent to Business Processes. This can be done by organizing the graphical aspects of the notation into five specific categories:

1. Flow Objects
2. Data
3. Connecting Objects
4. Swim lanes
5. Artifacts

The following list provides an overview of the graphical elements utilized by this notation, according to the OMG group.

Category	Element	Description	Type	Notation
Flow Objects	Event	Something that "happens" during a process. These affect the flow of the model and usually have a trigger or a result. Different types affect the flow in different ways.	Start	
			Intermediate	
			End	
	Activity	Generic term for performed work. It can be classified as Sub-processes or Tasks.		
	Gateway	Used to control the divergence and convergence of Sequence Flows. Internal markers define its type of behavior and control of the incoming and outgoing flow.	Exclusive	
			Event-Based	
			Inclusive	
			Parallel	
Data	Data Object	Can embody what an activity requires and/or what it produces. The representation can be attributed to a single object or a collection of objects.		
	Message	Used to illustrate the contents of a communication between two process participants.		

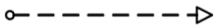
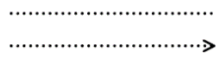
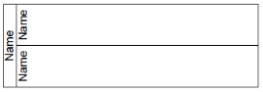
Connecting Objects	Sequence Flow	Used to show the order that the Activities are performed.		
	Message Flow	Indicates the flow of Messages between two process participants, one sender, and one receiver.		
	Association	Links' information and artifacts with graphical elements. Usually, used to describe or to add to the model's understanding.		
Swim lanes	Pool	Represents a participant in the process. As a container, it structures the model, attributing the designed process to the right entities. If represented as a "black box" it has no internal details associated.		
	Lane	Used to organize and categorize Activities. Can be used in conjunction with pools, to structure the model's design.		

Table 3.1.1 - Basic BPMN Graphical Elements

Although many more elements exist, a model can be created using the basic components. The following figure provides an example of a BPMN model.

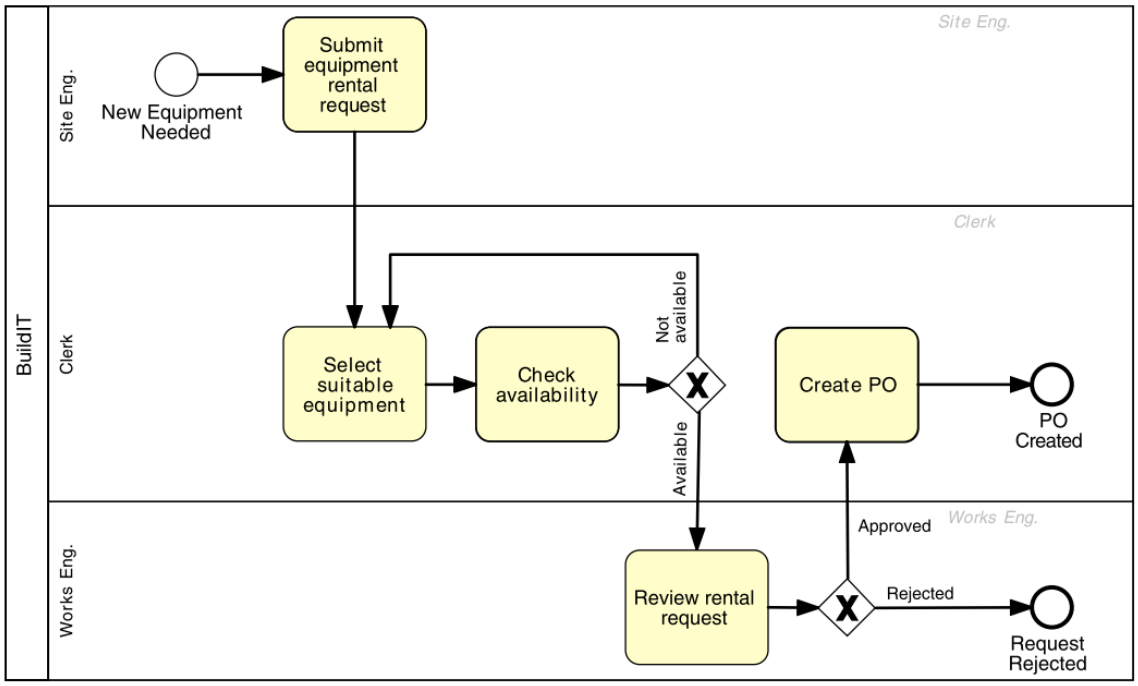


Figure 2.2 – Modulation Example of a Request Process (Dumas et al., 2018, p. 23)

4. THE PUBLIC SECTOR AND LOCAL GOVERNMENTS

4.1. LOCAL PUBLIC SECTOR CHARACTERIZATION

The Municipality of Viana do Castelo proposes a structure of departments to provide services to carry out the duties that it legally fits. The different departments and specifications are presented below:

- **Department of General Administration** – Coordinates the execution tasks that fall within the administration domains of human, patrimonial, and financial resources, as well as, coordinating the elaboration of budgets, management accounts, activity plans while monitoring their execution. Also elaborates and submits superior approval to instructions, circulars, regulations, and norms deemed necessary while ensuring management, safety, and conservation of facilities and equipment attached to the Department.

- **Department of Municipal Works and Services** – Manages the design and construction of equipment and urban spaces for collective use and territorial and urban infrastructures. It ensures the conservation of municipal buildings, equipment, and infrastructures, namely roads and urban furniture. Monitors the execution of works integrated into the Municipal heritage which are carried out by private individuals. Proposes actions in the scope of energy efficiency.

- **Department of Culture, Education, and Sport** – Promotes actions, in collaboration with the Ministry of Education, aimed at the development of the educational system as an essential factor for the socio-economic progress of the municipality. Directs cultural actions through partnerships for the defense of the cultural heritage. Stimulates policies to boost sports practices, to enhance the profitability of existing municipal sports equipment. Coordinates management and ensures the safety and conservation of cultural, educational, sporting, and social buildings and equipment.

- **Department of Territorial Management, Cohesion, and Sustainability** – Safeguards the urban quality and sustainable spatial planning. It achieves this through the elaboration and monitoring of territorial management instruments and the appreciation and supervision of actions related to the process of occupation, use, land transformation, and mobility. Supports the sustainability of gardens and green spaces, valuing and protecting the forest heritage, the conservation, and enhancement of the coast and watersheds, and the promotion of projects, activities, and resources for environmental education. Practices, the characterization of the model, systems, structures, and urban dynamics, guiding the city to the best practices and solutions regarding innovation, entrepreneurship, and digital intelligence. Fosters the strategic planning for social intervention, health promotion, and well-being of the population. It achieves this by proposing the development of Action programs that privilege healthy living habits and the social integration of disadvantaged groups. Ensures management and guarantees the safety and conservation of buildings and equipment assigned to the Department.

  The following figure presents the structure of this department:

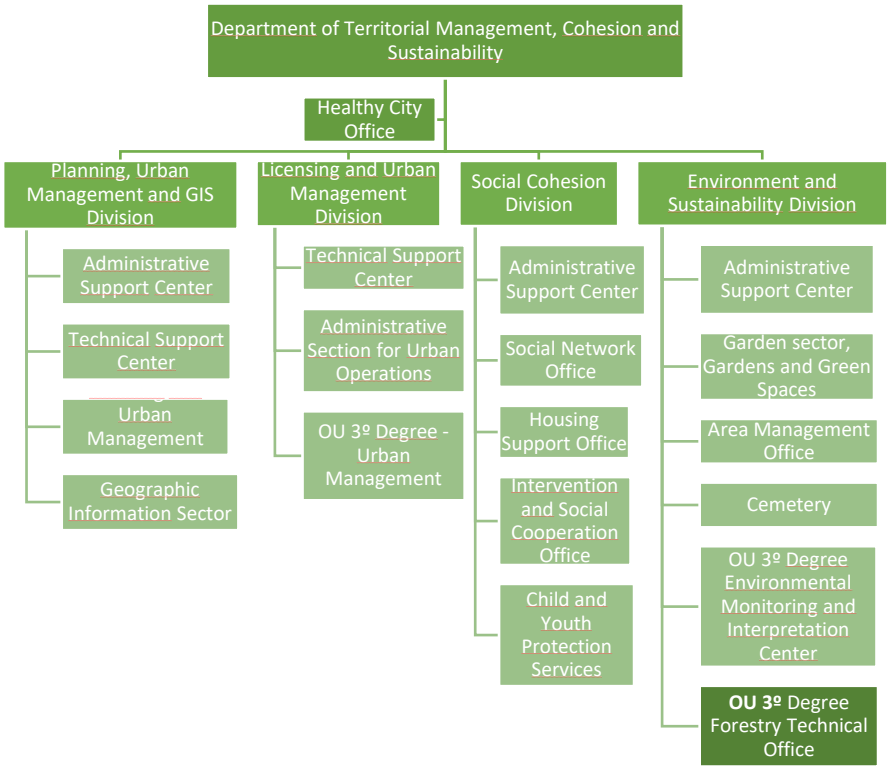


Figure 3.1 – Organizational Structure of the Department of Territorial Management, Cohesion and Sustainability

Within this Department is the Forestry Technical Office, where this project was developed. These office functions are related to the rural spaces of the municipality, essentially natural spaces, and forest spaces. Its main tasks include actions at the level of forest defense, forest ordering and planning, forest management, and, finally, recreation and leisure in rural areas. It is within the scope of the defense of the forest against fire that most of the work is carried out, because of the legal imposition and the powers attributed to the municipalities. The Decree Law No. 124/2006, of June 26, in its new wording, deals with the defense of people and property through rural fires, obliging municipalities to have a defense strategy through the Municipal Plan for the Defense of Forest Against Fires (PMDFCI). This plan starts by defining fuel management perimeters, which are areas where the vegetation has height, density, and maintenance criteria. It is up to the municipality to register the implementation and maintenance of these lanes and ensure that their managing entities comply with the PMDFCI plan and the legislation itself. The overall treatment of requests, and necessary contacts to keep the above-mentioned maintenance, are the focal point of the project.

The office presents a small staff of six, comprising of forestry engineers, social assistants, and administrative personnel, each assigned with hierarchical roles. The communication within the office is determined by voice, as many of the staff work in the same space, e-mail, phone calls, and within the supported Medidata information system. Interaction with other offices and entities is performed through emails and phone calls and the response times can range from minutes to a few days.

4.2. BPM IN THE PUBLIC SECTOR

The common position is that the original application area of the BPM models is the private sector or a very limited area of public sector (Niehaves, Plattfaut, & Becker, 2013). Rosemann et al. (2006) explicitly claim the validity of their model for the private sector only. Nevertheless, in the last decade, due to the rise of E-government initiatives, public sector organizations are getting pushed in the direction of private sector process management. Gulledge & Sommer, (2002) explain BPM's primary benefit as the "increased effectiveness and efficiency achieved from restructuring the organization along cross-functional processes." While this view works as a concept, it is difficult to apply in current local governments, due to the hierarchical nature of the command-and-control management structure. Niehaves, Plattfaut, & Becker, (2013) tried to assess its use and capabilities. The study identified that there is a place for BPM in this sector, but the results show that on average, the methods are being poorly developed. A lack of strategic alignment and process improvement plans can be considered as a cause, but they do not show the full picture. At the core of BPM are the individuals who are related to the processes at hand. Although some are starting to see this as a key component for improvements, these people are still not trained in BPM and there is not an established BPM culture in place.

Previous works (McAdam & Donaghy, 1999) and (Syed, et al., 2018) focus on identifying and exploring the critical factors associated with a BPM implementation in the public sector. The latter identified the most prevalent literature topics as top management support and BPM understanding, communication, and preparedness for organizational change. Therefore, good stakeholder engagement and communication with associated individuals will be necessary to achieve this project's objectives.

5. PROJECT WORK

5.1. DEVELOPMENT METHODOLOGY

This section will present the methodologies for the development of the work project. Using the Business Process Management Lifecycle by Dumas et al., as a foundation, the following considered steps are centered around the specification and design of models and their respective validation:

1. Understanding BPM and the CMVC Environment.
2. Process Identification.
3. Actors and Systems Specification.
4. AS-IS Process Modulation.
5. Critical Analysis of the AS-IS model.
6. Improvement proposal through the design of the TO-BE process model.
7. Validation.

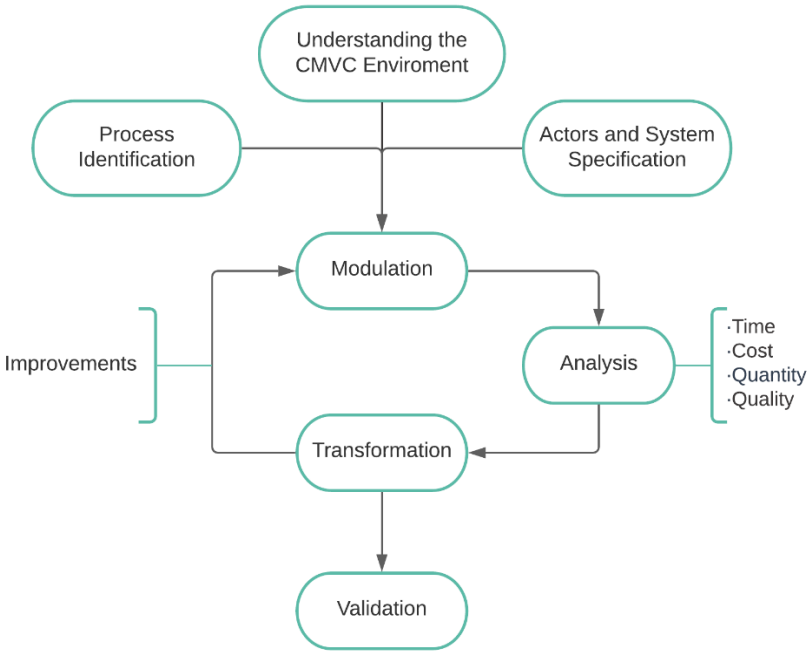


Figure 4.1 – Development Methodology

The previous literature review (chapter 3) acquired information on BPM aspects and its current position in the public sector. This investigation was accomplished by researching relevant topics through online platforms such as Google Scholar, Mendeley, Scopus, and Elsevier. The understanding of the CMVC Environment is essential to present a case study for this project. Furthermore, interviews with the City Counsellor for Innovation and Culture, the head of the Technical Forestry Office, and other associated entities were performed to identify the necessary processes for modeling (chapter 3.1) and the systems and actors involved (chapter 3.2). This data provided information to create the AS-IS diagrams. Further meetings were conducted to analyze the AS-IS diagrams and identify potential improvements to the processes through the fundamental measures (chapter 2.1.3) and the use of improvement methodologies. This result sufficed in the creation of TO-BE diagrams for each chosen process which required validation from the same associated entities.

5.2. AS-IS PROCESSES

5.2.1. Identification of processes

In this step, a meeting with the City Counsellor for Innovation and Culture and the head of the Technical Forestry Office was conducted to select and fully understand the processes and sub-processes for modeling.

The processes were partially modeled in an archaic way and needed revision and changes to fully update them to the current environment. It was necessary to review the documented diagrams, word files, and undocumented aspects to revise the processes in a modern, comprehensible language using BPMN 2.0.

Table 4.1 presents an explanation of the major processes identified in the department.

Number	Name	Type	Description
1	Handling Request	Process	An external entity submits an inspection request form. The document is processed by the SAM and delivered to the DAS department.
2	Land Cleaning Inspection - VLT	Process	If receiving a VLT request. Information is gathered, when needed, inspections are performed to evaluate if cleaning is necessary and notifications to the right entities are provided.
3	Land Cleaning Inspection - ANCO	Process	When an ANCO is issued by the authorities. Information is gathered and an inspection is performed to conduct a coercive cleaning.
4	Land Cleaning Inspection - Regulation	Process	If the request is related to gardens and urban areas. Information is gathered when needed and an inspection is performed to evaluate if cleaning is necessary, producing notifications to the involved entities.
5	Request Information	Sub-Process	Necessary procedure whenever additional information is required. The plaintiff and the associated parish council are contacted.
6	Notification - Plaintiff	Sub-Process	Notification to the associated plaintiff is sent.

7	Notification - Landlord	Sub-Process	Notification to the landlord is sent.
8	Validate Report	Sub-Process	After an inspection, a report is created and needs validation by the different hierarchical entities.
9	Request Coercive Cleaning	Sub-Process	Only occurs when Coercive cleaning is necessary. The landlord is notified and a member of the GTF accompanies the procedure.

Table 5.2.1 – Identified Processes

5.2.2. Entities Specification

A business process in an organization has associated actors and systems that interact with each other during its execution. To analyze and understand a process, it is important to specify these entities.

Actors are presented as the people that perform tasks in the process. The systems are the software or cluster of applications that participate in the process through an actor's use, aiding in the execution of activities or helping with communication through the various stakeholders. The inputs and outputs of the execution are represented in documents.

5.2.2.1. Actors

The representation of the actors in table 4.3 serves as a description of their roles and the processes where they are involved.

Actor	Description	Process Number
Plaintiff	External entity. Requests land clearing.	1, 4, 5
Landlord	External entity. Owns the land associated with the cleaning inspection.	6,8
SAM – Municipal Assistance Service	Support service to the Municipality. Provides form or information to the plaintiff. Receives and sends requests to the appropriate office.	1

SG – Gardening Sector	Part of DAS. Deals with gardens and urban land cleaning requests.	1, 3
GTF – Technical Forestry Office	Part of DAS. Manages the forestry and rural lands. Assists SG on information gathering. Most of the cleaning requests involve this office.	1, 2, 3
Administrative	Part of the GTF office. Evaluate requests and direct them to the appropriate actor.	1,2,3 4,5, 6, 8
Forestry Technician	Surveys the land, validates inspection, and creates a technical report.	2, 3, 7, 8
Social Technician	Receives requests, researches missing landlord information, and notifies the plaintiff.	2, 3, 4
Chief of GTF (Forestry Technical Office)	Validates the inspection technical report.	7
Chief of DAS (Environment and Sustainability Division)	Validates the inspection technical report.	7
Mayor	Signs requests and notifications.	5, 6, 8
Parish Council	External entity. Provides information when necessary.	4
Authority	Investigates and fines landlords in the case of an offense. Filles requests for an ANCO inspection.	1

Table 5.2.2 – Identified Actors

5.2.2.2. Systems

The representation of the systems in Table 4.4 serves as a description of their roles and the processes where they are involved.

System	Description	Process Number
Medidata	Information System for inspection and documentation handling. It creates pathways for internal process handling while linking the entries with the associated documents in a PDF format.	2, 3, 4, 7
ArcGIS	Geographical Information System used to identify land and help to acquire necessary information.	2, 3
Microsoft Outlook	The mailing system is used for internal communication and to request information from the parish councils.	
Microsoft Word	Word processor for document production.	2, 3, 5, 6, 7

Table 5.2.3 – Identified Systems

5.2.2.3. Documentation

Table 4.5 presents the documentation used in the associated processes.

Document	Description	Process Number
Application for Land Cleaning Inspection	The document that initiates the process. Possesses the plaintiff's identification, the claim with the location of the land/object of complaint. The plaintiff should fill the landlord's identification, but it is not required.	1, 2, 3, 4

Technical Report	A report produced by the Forestry Technician, as an object of evaluation of the land situation. Assesses if there is a need for immediate cleaning while presenting information about the terrain, photo evidence, and recommendations for the cleanup procedures. Needs to be validated by the Chief of GTF and Chief of DAS.	2, 3, 4, 7
Notification - Plaintiff	A letter, signed by the mayor, to notify the plaintiff about the current claim situation.	5
Notification - Landlord	A letter, signed by the mayor, to notify the landlord about the current claim situation.	6

Table 5.2.4 – Identified Documents

5.2.3. Processes modulation

The following diagrams present the current AS-IS models of the previously identified processes.

5.2.3.1. Handling Request

The plaintiff or authority submits a request for a land inspection. A member of The GTF administrative team evaluates the request and assigns the appropriate process following the situation.

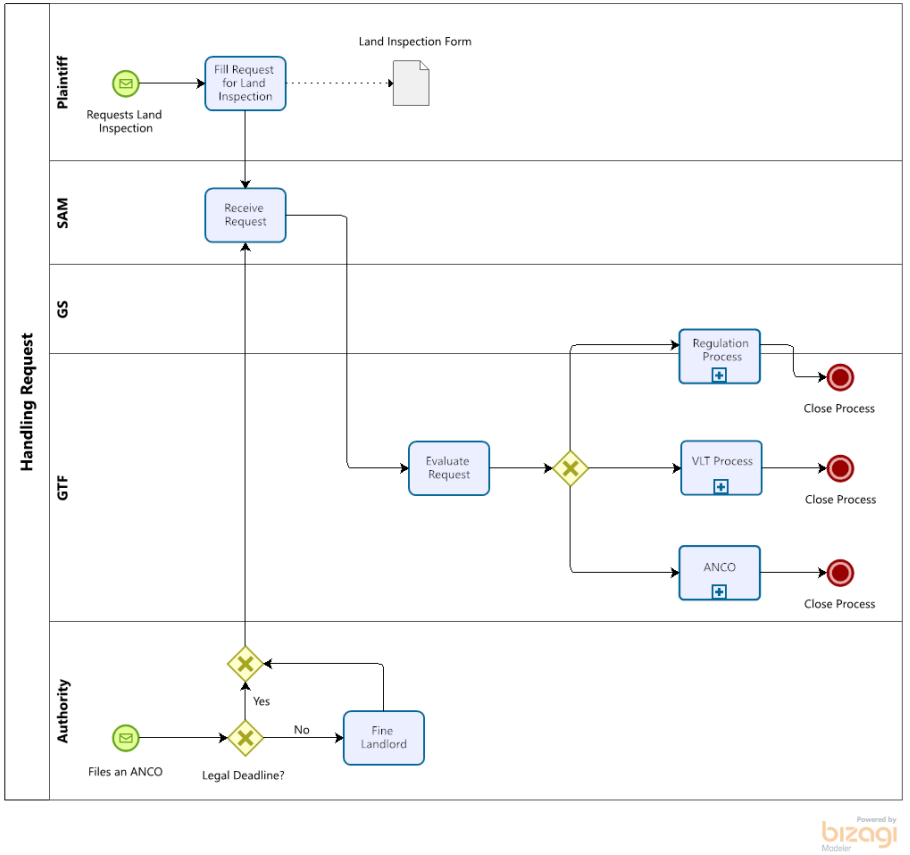


Figure 4.2 – AS-IS: Handling Request Process

5.2.3.2. Land Inspection – VLT Process

If the evaluation of the land inspection request results in a VLT process, the GTF administrative creates a new process entry on the system. Sometimes, the form is submitted with fields in blank, meaning additional information might be required to identify the owner and land. After assessing the request, multiple land inspections are performed, resulting in inspection reports. Notifications to the plaintiff and landlord are required along the process execution to keep them updated and request any necessary information. After the third inspection, the forestry technician assesses priority to identify if a coercive cleaning is in order, files an offense, and the administrative closes the process entry, terminating the execution.

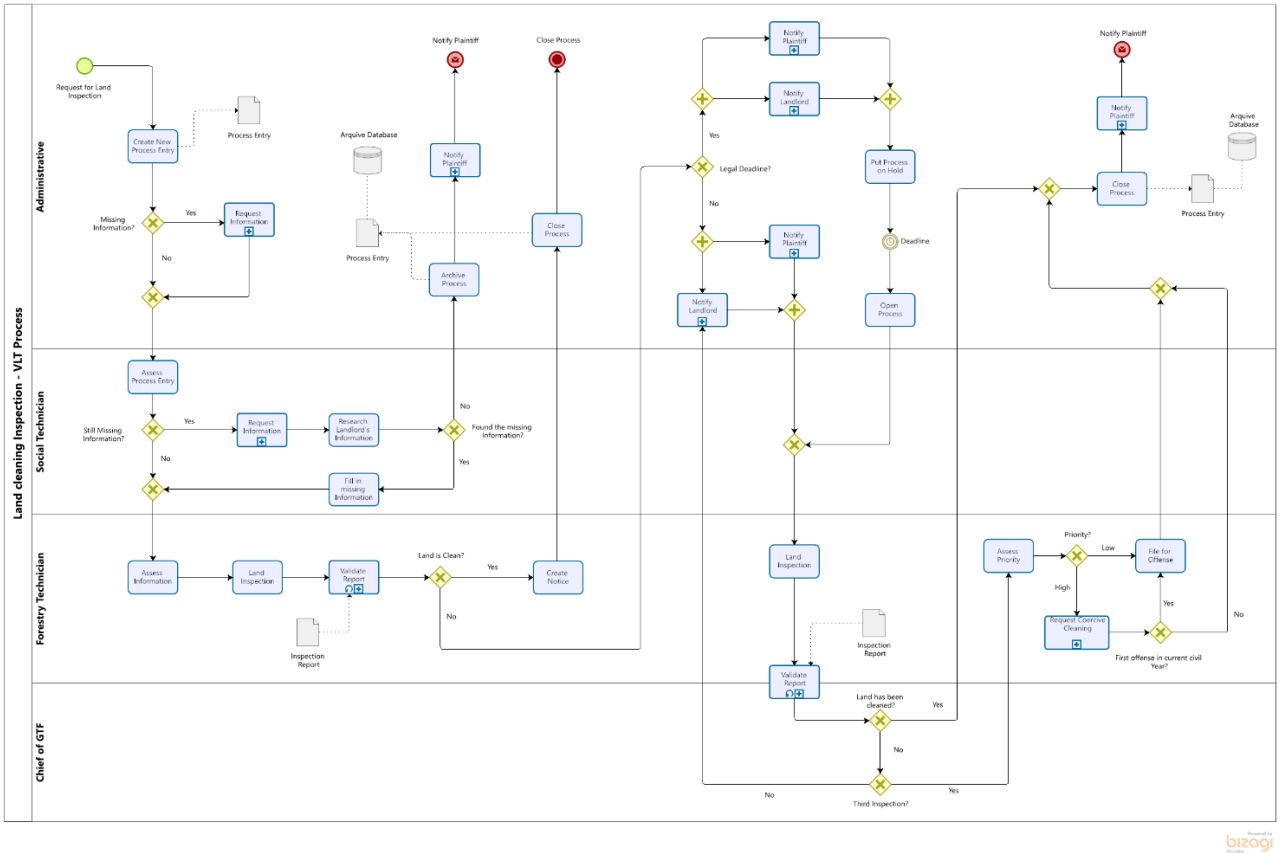


Figure 4.3 – AS-IS: VLT Process

5.2.3.3. Land Inspection – ANCO Process

If the request comes from the authorities, the GTF administrative creates a new process entry on the system as an ANCO. Additional information might be required to identify the land and owner. After assessing the available information, a land inspection is performed, resulting in a report. If the land is not cleaned, coercive cleaning is requested. The administrative close the process, terminating its execution.

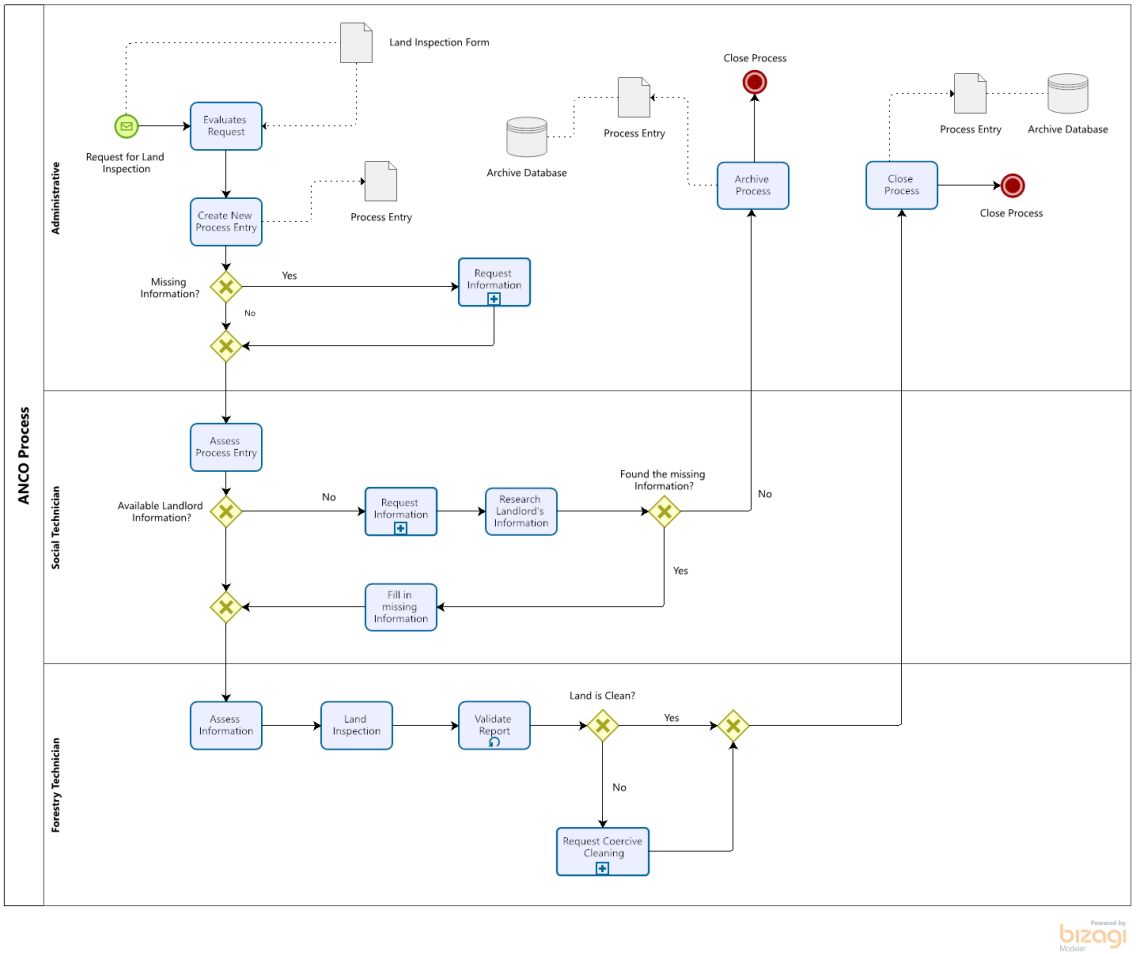


Figure 4.4 – AS-IS: ANCO Process

5.2.3.1. Land Inspection – Regulation Process

When the request concerns gardens or urban areas, the SG administrative creates a new process entry on the system that follows the Regulation. Additional information might be required to identify the land and owner. After reviewing the information, a single land inspection is performed by the gardening technician, resulting in a report. If the land is not cleaned, coercive cleaning is requested. The administrative close the process, terminating its execution.

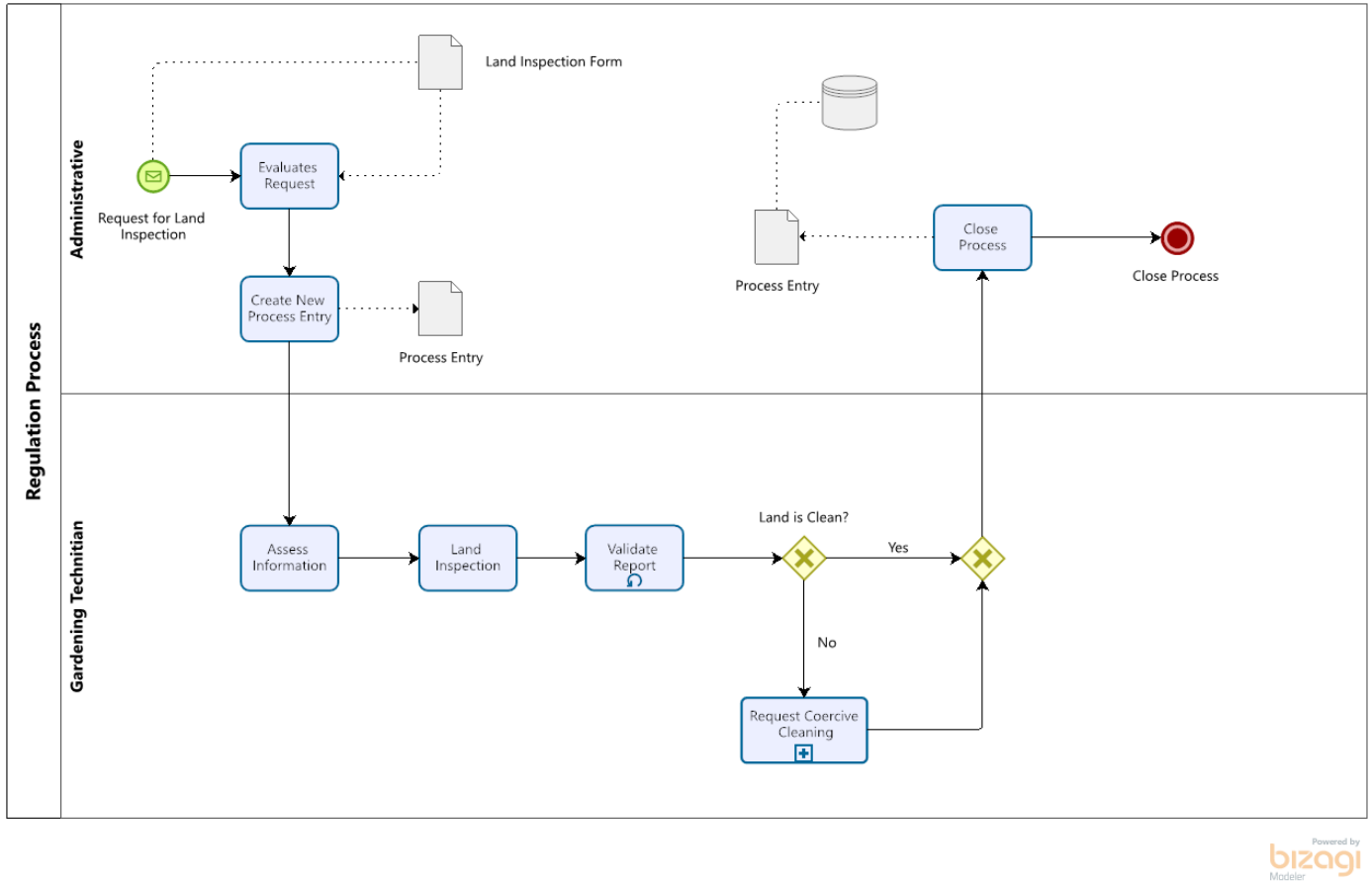


Figure 4.5 – AS-IS: Regulation Process

5.2.3.2. Subprocess – Request Information

When additional information is required, the plaintiff and the associated parish council, are contacted, usually by phone or email. If the requested information is received, the additional data is filled and the subprocess finishes. After ten days, if no information is provided, the subprocess is terminated.

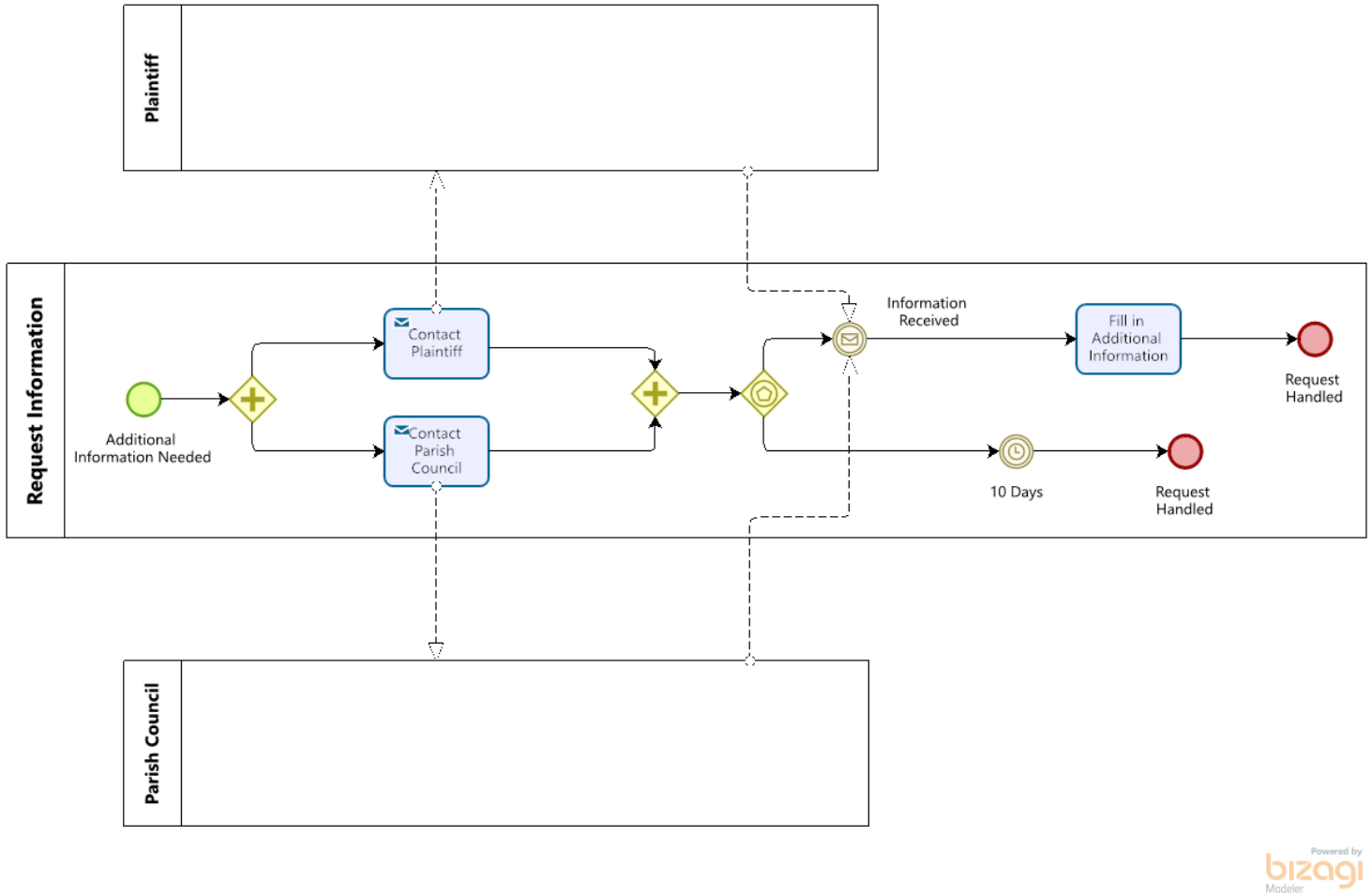


Figure 4.6 – AS-IS: Request Information

5.2.3.1. Subprocess – Notify Plaintiff

When a notification to the plaintiff is requested, the GTF administrative creates it. The notification is sent to the mayor for signing before is sent to the according recipient.

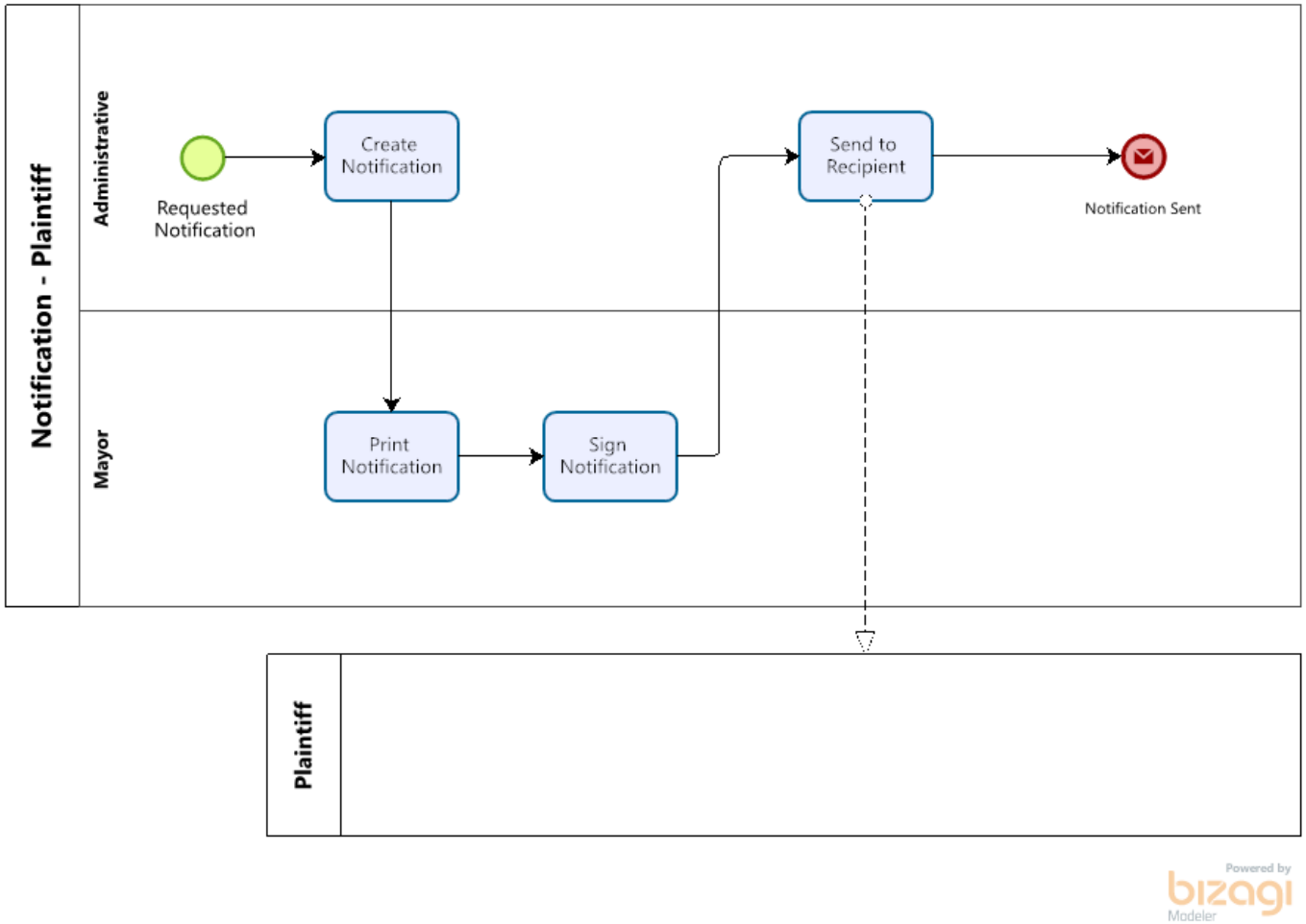


Figure 4.7 – AS-IS: Notify Plaintiff

5.2.3.1. Subprocess – Notify Landlord

When a notification to the landlord is requested, the GTF administrative creates it. The notification is sent to the mayor for signing before is sent to the according recipient.

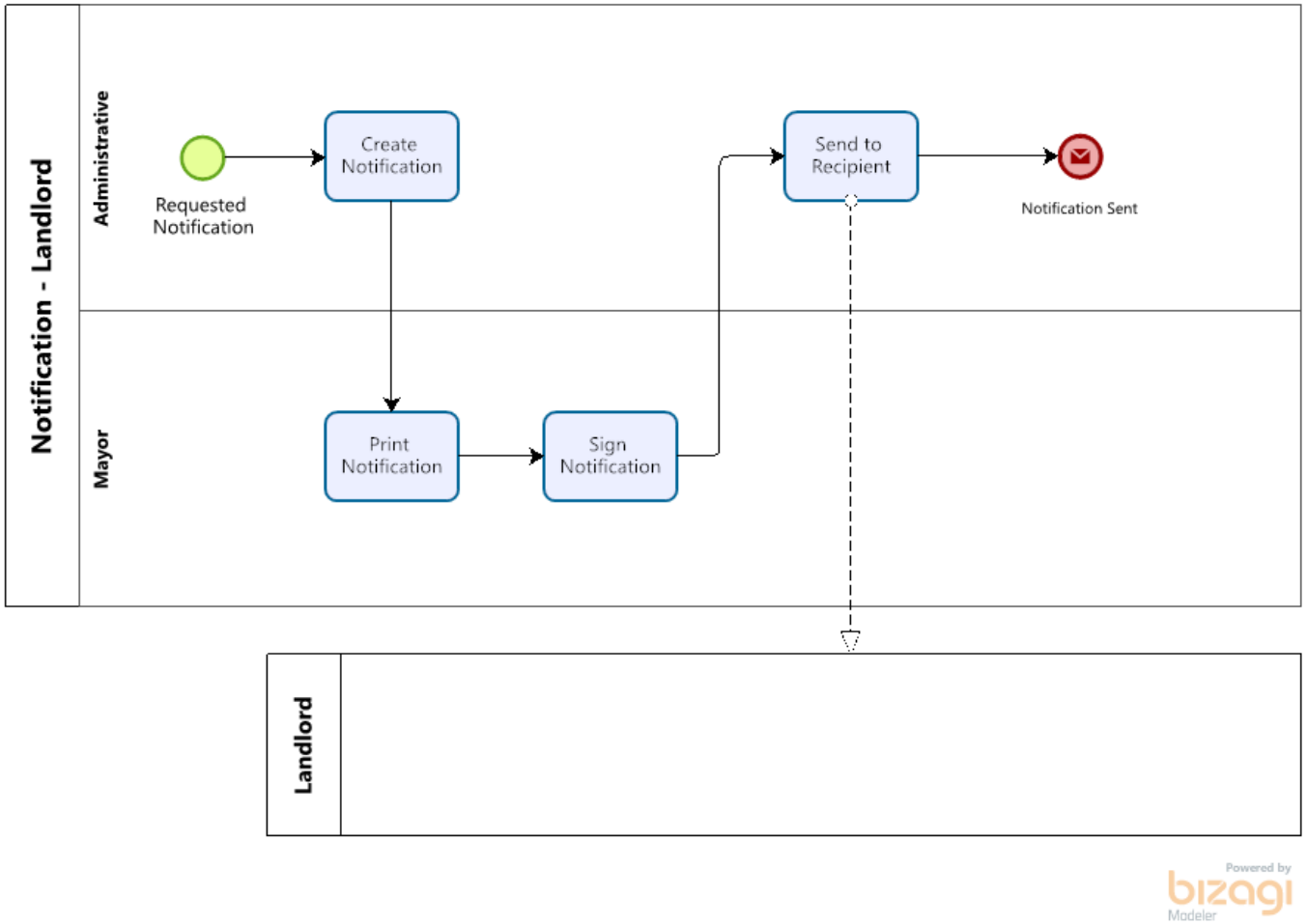


Figure 4.8 – AS-IS: Notify Landlord

5.2.3.1. Subprocess – Validate Report

After performing an inspection, the forestry technician creates a report with photographic evidence. This report must pass validation by the chief of the GTF office every time it is submitted. In some cases, the report must be validated by the DAS department chief as well, it can indicate governmental or judicial action. In extreme cases, it is necessary for a final validation by the Mayor. The file is flagged as validated, and the subprocess ends.

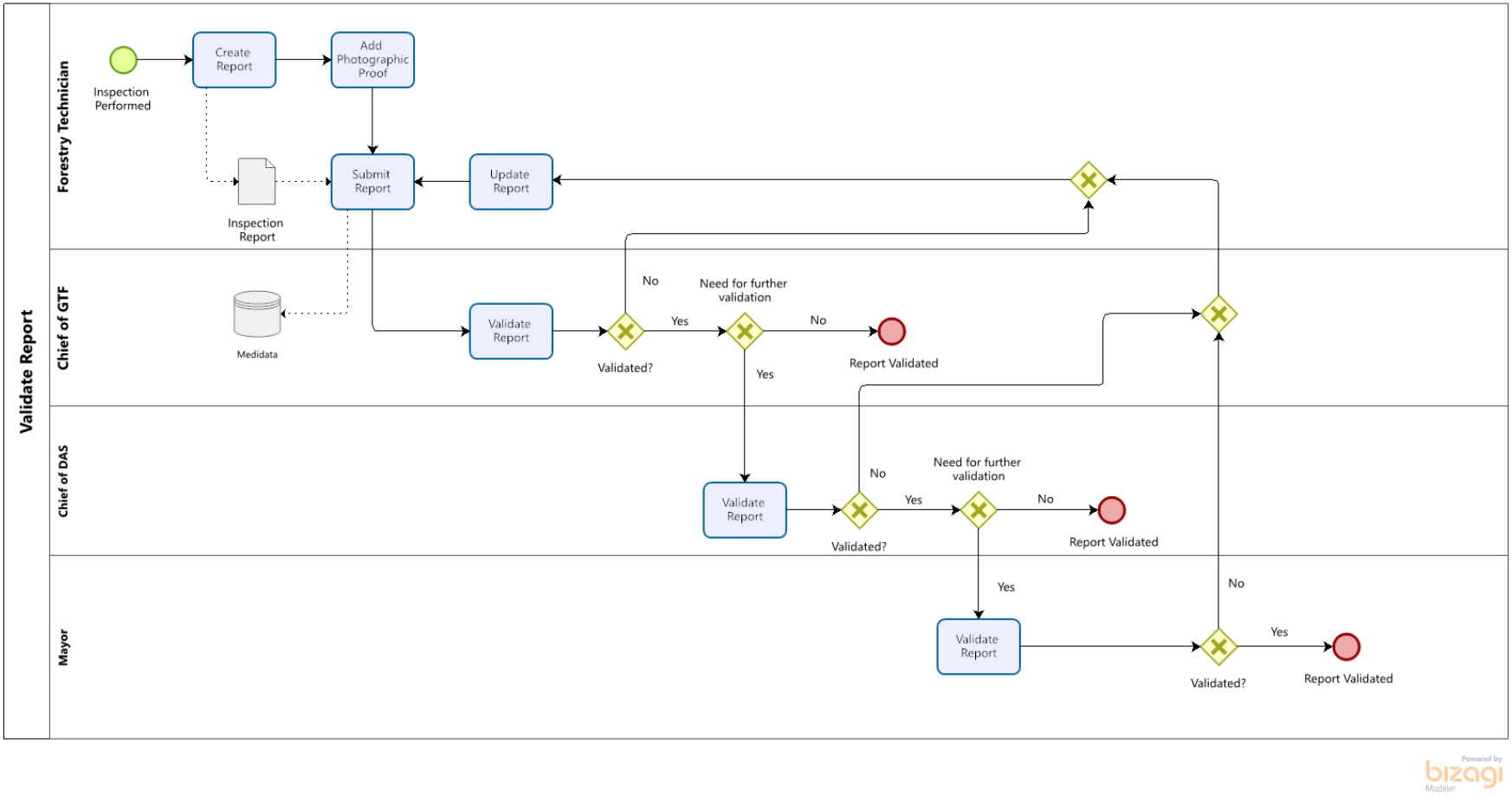


Figure 4.9 – AS-IS: Validate Report

5.2.3.1. Subprocess – Request Coercive Cleaning

If coercive cleaning is necessary, the forest technician adds cleaning recommendations to the report. The administrative must inform the mayor and create a notification for the landlord. The mayor must sign both the notification and a dispatch. After ten days, the technician posts a notice on land and schedules the coercive cleaning. In the meantime, if the landlord contacts the office indicating that they have cleaned the land, a verification and an inspection are performed. After verifying the cleaning, the subprocess ends.

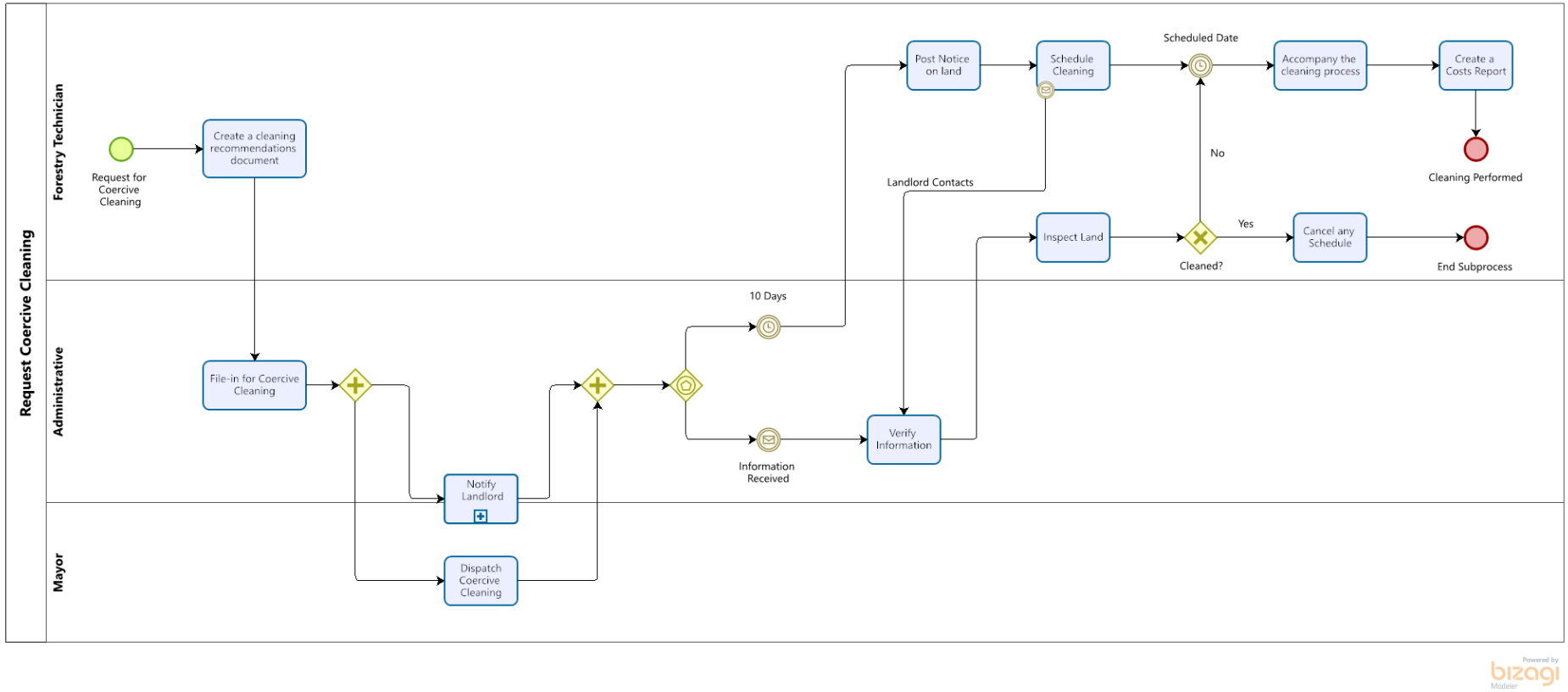


Figure 4.10 – AS-IS: Request Coercive Cleaning

5.3. CRITICAL ANALYSIS

After the initial modulation of the current AS-IS processes, an analysis is essential to evaluate and identify optimization opportunities in the process execution.

A presentation of the AS-IS diagrams was held with the author and co-supervisors, resulting in a session to identify the problems and propose improvements as solutions.

Process Number	Name	Analysis	Improvement Proposals
1	**Evaluation of request for right process execution**	Due to the different sources and types of processes that a request infers, an evaluation is necessary to address the type of procedure in question. This can lead to mislabeling due to human error, and in some cases, the information is not correctly provided.	A digital submission platform would agile the process and make each new process entry instantly available to the administrative. This, paired with an active database (i.e., BUPi Information System) with already established land and owner information, would create a process entry with the already available information. The current manual procedure would still be necessary due to a great number of identified plaintiffs not possessing digital literacy. If there are difficulties in identifying the correct procedure to follow, a system connected to ArcGIS and integrated with machine learning could provide a way to filter the land options to execute the correct process.
2, 3, 4	**The initial request for missing information**	Missing Information occurs many times. It creates anonymous requests, which most of the time cannot be resolved or are not under the law. This creates defects, due to	By creating a digital submission platform with required fields, the first information request can be removed, and the

		the missing information, leading to overprocessing, for the need for extensive lookup of missing information without really knowing if it even exists, and increased waiting times following the plaintiff's response.	anonymous requests would be singled out to just the physical forms. This results in a reduction of defects, overproduction, and related waiting times.
2	**Need for various inspections**	Due to the current code of law, the staff is obligated to perform various inspections, resulting in many associated costs. Anonymous requests usually lead to defects and most of them are still processed, leading to inspections that should not be performed. Some requests do not abide by the directives in place leading to wasted processing time and resources. Overall, continuous inspections lead to various costs, and it is not sustainable for the environment.	Include the BUPi Information System for additional terrain and owner information. Not processing anonymous requests should be in order as the majority do not follow the directives. If the request is not following the current code of law, the plaintiff should pay the costs of the motion. It would mean that the cleaning is immediately performed after the first inspection. The recurrence cleaning would lead to a sustainable improvement of the terrain itself and the reduction of motion also impacts this aspect. As the process becomes agile it would mean that the landlords have less room for delays. This is important as it would instill the ideals of cleanliness and sustainability in the landowners and, thus reducing the number of cleaning requests that the city hall will receive in the future.

5, 6	**Notification printing.**	Physically signing a notification is redundant in some cases. An email can be provided by the plaintiff and the landlord's contact would be present in the BUPi platform. Although some emails are already sent, the document is still printed, signed, and scanned. This happens due to resistance to change by the mayor's office and a need for an update to the current administrative code. It implies performance issues related to transportation, inventory, and waiting times.	Removing the necessity for printed and signed notifications if an email address is provided. In these cases, notifications should be digitally signed and sent, reducing both print and delivery costs, while optimizing waiting times and sustainability throughout the entire process. In cases where this method of contact is not available, the message should be sent by physical mail, but include an encouragement to provide a digital contact for further interaction.

Table 5.3.1 – Critical Analysis

The intrinsic need to follow the current law acts as a limitation in many aspects. Because it is a public entity, it poses administrative rules that sometimes impede the celerity of the processes. For example, deliberations for signings concerning notifications and obligatory waiting times for responses (10-15 to wait for an answer) are all according to the Administrative Process Code.

5.4. PROCESSES REDESIGN

Following the AS-IS models design and the critical analysis, a redesign is imperative. Using transformation techniques, previously explored in the Process Improvement chapter, and implementing new systems, the TO-BE models can be created to propose new process management.

5.4.1. Transformation technique - Lean

For this project purpose, the optimization will be focused on the removal of wastes akin to the various processes' executions. To that end, the Lean methodology is key in the findings and analysis of waste, while adjusting activities to obtain the maximum value.

The key principles of Lean were already identified in a previous chapter (Ch. 2.1.4), and the seven associated wastes can be derived from the identified performance measures leading to the Lean Value Stream Mapping of ABPMP (2013).

1. **Transportation**: Wasted time and effort to move things within a process or between processes.
2. **Defects**: Something unacceptable by the client, rework, or repair. In this case, associated with incomplete information and incorrect labeling of processes.
3. **Waiting**: Non-work time, queue time, or waiting for approvals, to start the next activity.
4. **Motion**: Unnecessary movement of staff, often due to poor planning and organizational layout.
5. **Overproduction**: Producing more than is needed, before it is needed, resulting in non-value work.
6. **Inventory**: Typified by stock or materials that are not being used in the process or current activities.
7. **Over-processing**: Doing more work than is necessary to add value to the customer. These redundancies can be caused by an unclear definition of what needs to be done and by whom.

Because we are dealing with a service, other changes can generate additional value while not impacting the process in any way. These could be translated to client experience, meaning that, a better engagement, brings more value to the customer. While this is often important, it is not strictly necessary in this case.

5.4.2. New System Integration - BUPi

The necessity for optimization calls for use of new technology. Databases associated with territorial registration and oversight are starting to be used in Portugal thanks to the creation of the BUPi (*Balcão Único do Prédio*) project.

BUPi is a new platform created by the Portuguese government to govern the Portuguese territory in the digital age. As a collaboration, between the justice and government areas of the environment, agriculture, and finance, this tool was designed to manage the territory by identifying landlords, valuing resources, and aiding in fire prevention. This acquired knowledge can help the municipalities' territorial planning and governance within its boundaries, thus ensuring their sustainable development, while offering a better quality of life to its residents. The collaboration between the Public Administration entities allows for more efficient use and sharing of information about the territory, in different domains, and the "Only Once" principle, exempting the Citizen from presenting information that the Public Administration already has (). This can also reduce data duplication due to the use of a centralized database that can be accessed by the different stakeholders. The final objective is to cross this information and data through artificial intelligence systems to extract knowledge about the territory and generate new economic opportunities and employment.

To use the platform a landlord must register its land on the BUPi website or visit a registration desk. This is achieved by drawing a georeferenced graphical representation with the associated land coordinates, and presenting both, the citizen card or digital mobile key, and the building's book. The

information is then stored for when the landlord wants to buy, sell, or restructure its land or to be used by the municipalities and government. In the future, the project will expand this information access to learning institutions, enterprises, and citizens.

Although the BUPi platform is still not present in many municipalities, as is the case of Viana do Castelo, this project has earned the 2019 Portugal Digital Award for Best Digital Transformation Project, which distinguishes the digital transformation project with the greatest impact on that year. This achievement, and the associated government investment, secure it as a great choice for future integration and process re-engineering.

5.4.3. Processes modulation

The following diagrams present the proposed TO-BE models. Under the previously identified problems, some processes were added to accommodate the proposed changes.

5.4.3.1. Handling Digital Request

This new process was added to create a digital channel for the submission of land inspection requests. Using a digital form, the plaintiff fills the request, and a submission system saves and filters to the correct department. A member of The GTF administrative team evaluates the request and assigns the appropriate process following the situation.

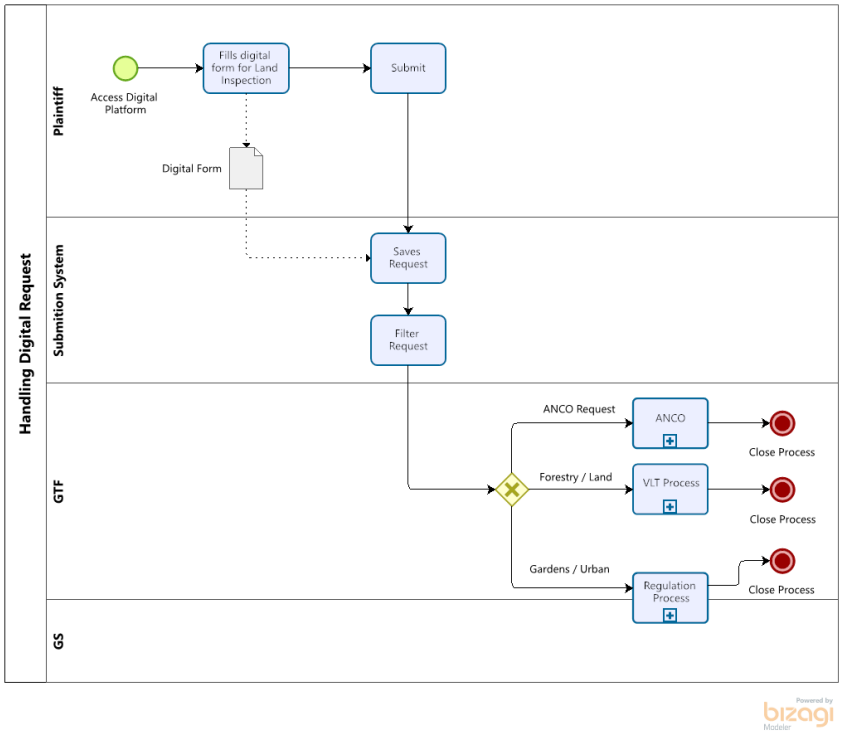


Figure 4.11 – TO-BE: Handling Digital Request

5.4.3.2. TO-BE Process - VLT

The initial information request is removed due to the introduction of the BUPi IS. If the associated land data is present, the necessary information is instantly provided by the system. In cases where the landlord hasn't yet registered the land on the BUPi platform, the Social Technician needs research for information. Another change is associated with the multiple inspections. In this new model, fewer inspections are performed. The costs related to the first inspection are charged to the plaintiff in the case of an invalid request. Other changes were performed for a better understanding of the overall model.

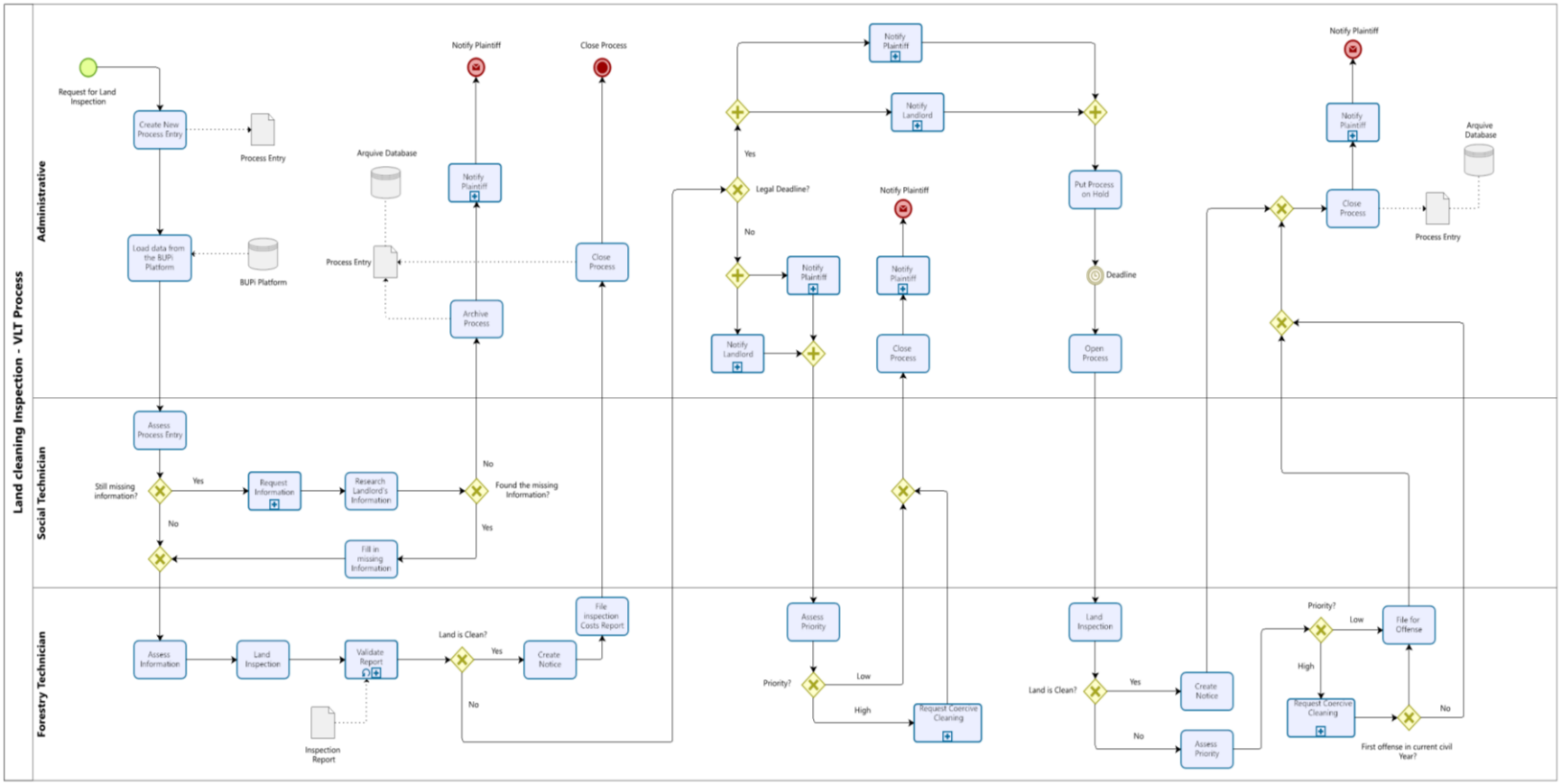


Figure 4.12 – TO-BE: VLT Process

5.4.3.3. TO - BE Subprocess - Notify Plaintiff

Changes were made to the previous model to create digital channel communication and encourage its use.

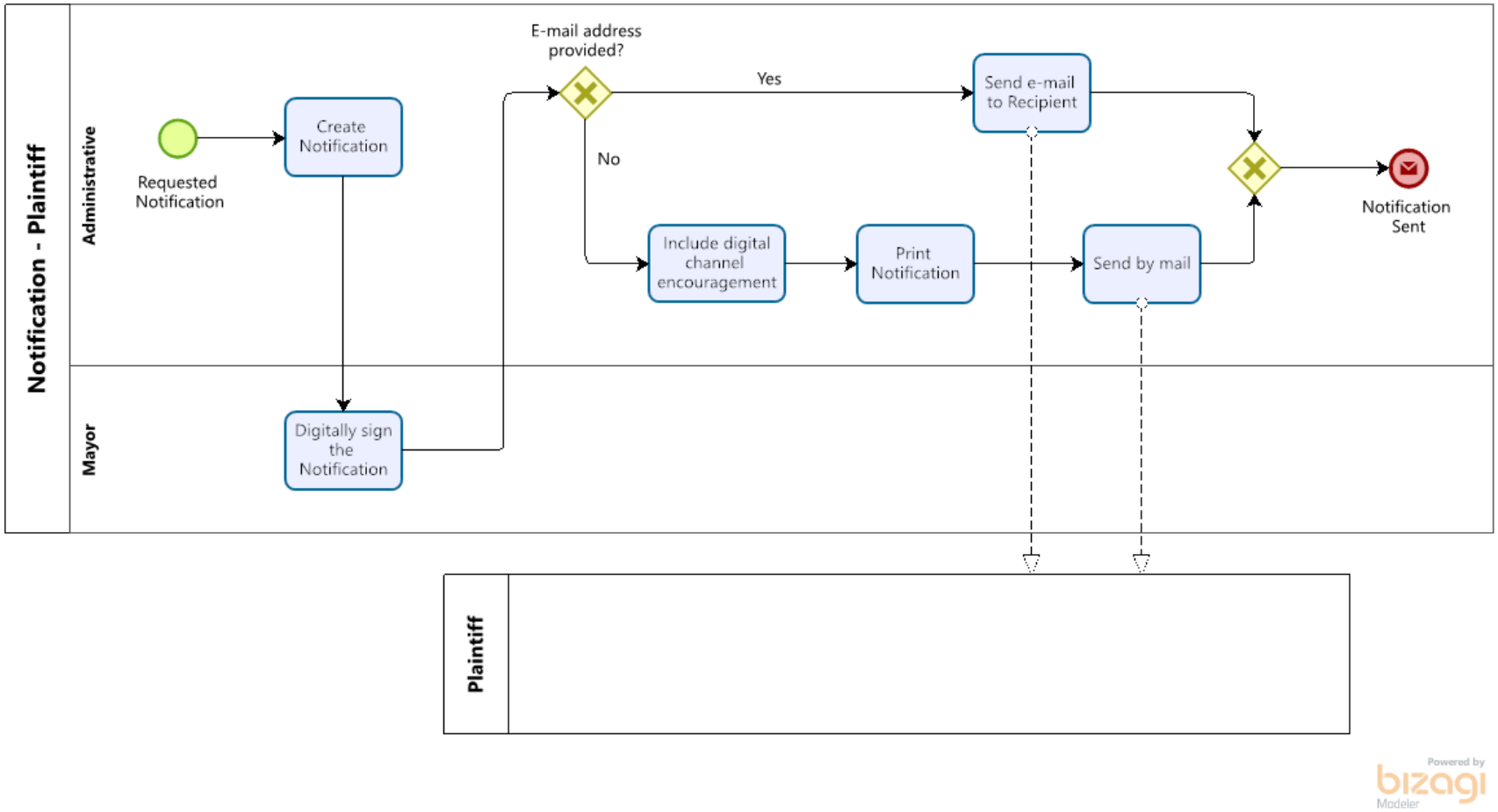


Figure 4.13 – TO-BE: Notification - Plaintiff

5.4.3.4. TO - BE Subprocess – Notify Landlord

Changes were made to the previous model to create digital channel communication and encourage its use through the registration on the BUPi platform.

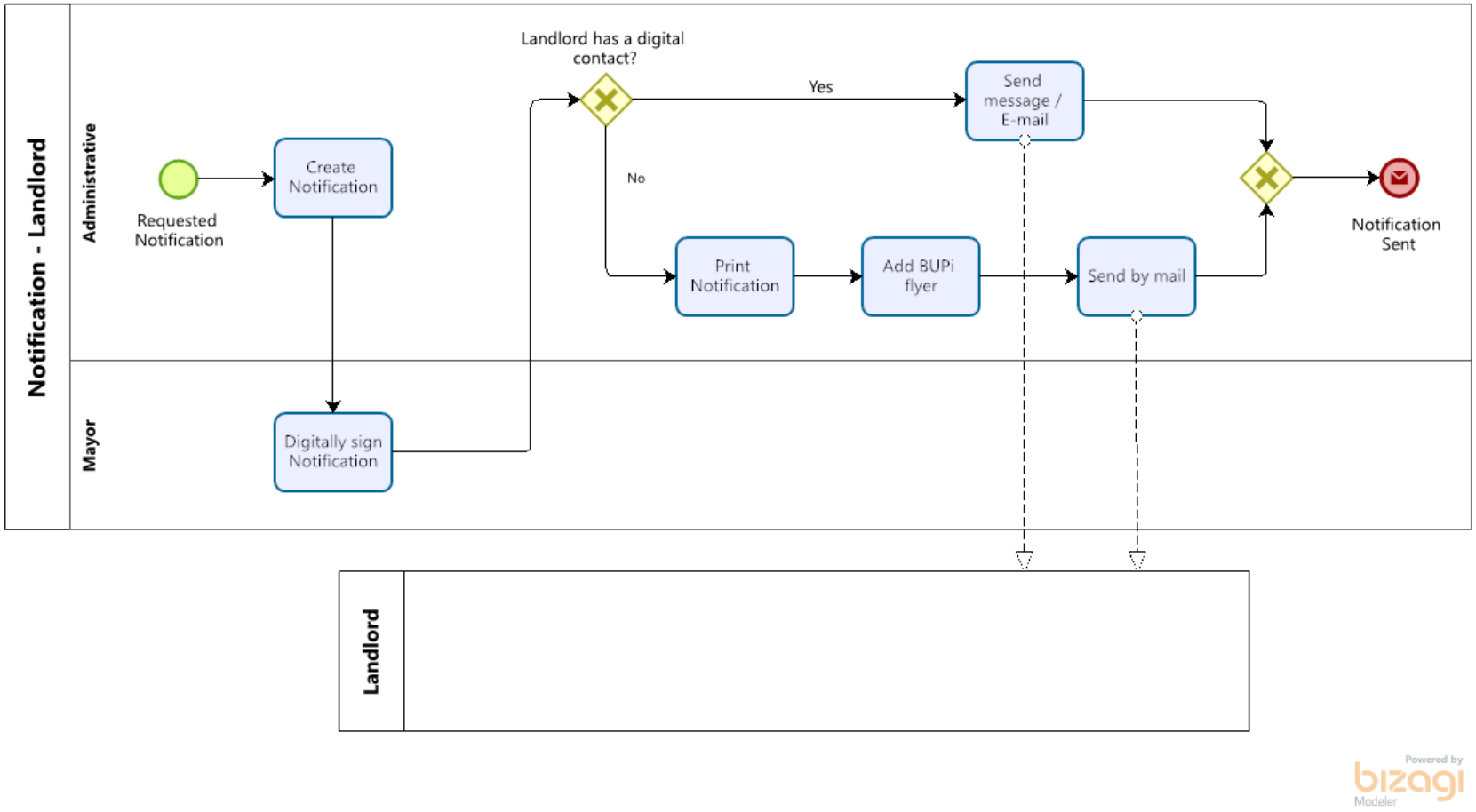


Figure 4.14 – TO-BE: Notification - Landlord

5.5. VALIDATION

This process is continuous, making validation an integral part of all steps. In this case, a result needs to be achieved, due to the constraints of time and work associated with this project. A proposal for improvements and a discussion of results are imperative for the conclusion of this project.

5.5.1. Interviews as a method for qualitative validation

As the models are based on qualitative data, it is necessary to conduct interviews to obtain the validation of the associated entities.

Qualitative research presents an opportunity to develop an initial understanding of the processes. A direct approach with depth interviews offers a one-on-one opportunity to comprehend the respondent's experience and perspectives on a particular idea, program, or situation (Boyce and Neale, 2006). Moreover, this method provides detailed information, usually not available through other data collection techniques, such as surveys and questionnaires. It offers a relaxed conversation, with open-ended inquiries, characterized by "why" or "how" which gives respondents the freedom to answer the questions using their own words (Guion, 2006). This type of approach is better suited for this work project because process modeling and validation require detailed information according to the point of view of the respondent.

The interviews were conducted in a semi-structured format offering pre-planned key questions but allowing conversation. The first meeting had the goals to understand the role of the respondents, interpret the associated process execution, and opinions on the matter. As expected, it was necessary to explain the objective of the project and the concepts of BPM. Because of directives, certain aspects were not fully divulged, and the meetings were not recorded. The following questions were asked to 3 members of the staff, including the office's chief, and a member of the IT team:

- **Q1.1** - What is your understanding of process management and BPM?
- **Q1.2** - Have you ever utilized process management practices in your work environment?
- **Q1.3** – Do you think this type of approach can be utilized in a City Hall setting?
- **Q1.4** – What role do you play in the associated process execution?
- **Q1.5** – Can you explain your view of the associated process?

During the first AS-IS designs, very few documents were available, and validation from the actors was required to confirm the truthfulness of the designs. The discussion also revolved around opinions and ideas for improvement, some of which supported the TO-BE diagrams design. After presenting and explaining the AS-IS models and the related notation, the following questions were raised:

- **Q2.1** – Did you understand the presented diagrams?
- **Q2.2** – Are the diagram's designs in accordance with the actual procedure?
- **Q2.3** – In your view, which optimizations do you propose?

To finalize the project, a discussion of results and their validation was required. The new TO-BE models were presented to the stakeholders and, after explaining the design, some questions were asked:

- **Q3.1** – Did you understand the presented diagrams and the used notation?
- **Q3.2** – What is your opinion of these TO-BE models?
- **Q3.3** – In your view, do you think is possible to apply these models to the office workflow?

- **Q3.4** – How was your experience participating in this project work?

The overall outcome of the final interview was to validate the diagrams, verify if a potential implementation could, to some degree, be applied in the near future, and identify how was the experience of working with a process analyst type professional and the implied management practices in this type of environment.

5.6. DISCUSSION AND RESULTS

At different stages of this project, several sessions with key elements were performed. The results of these conferences provided support towards the project work completion and shined a light on different issues.

The first meeting held a presentation of the concepts to the four respondents, followed by an explanation of the AS-IS process execution by each view.

Regarding the **Q1.1**, **Q1.2**, and **Q1.3**:

Respondent A: Knew basic diagrams (organograms and DFDs) but lacked understanding of current BPM and process management practices. After an explanation, the respondent expressed a view that methods like BPM played an essential role in the future management of the city hall and its digitalization. The current AS-IS workflow is not even documented, and the existing reports are very dated and difficult to present to any person. The lack of use of newer management practices can be explained by the low number of workshops and programs offered to the staff. The respondent added that the departments feel especially separated and are not connected, meaning that cross-functional activities are lengthy and arduous to manage.

Respondent B: Had worked on another department that used simple process illustrations and adopted that knowledge to create workflow diagrams when they moved to the current office to understand the different tasks at hand. This respondent considered process management practices and logical-based thinking to be very important to the working environment. Stated that there is an imperative need for future application.

Respondent C: Knew basic diagrams (organograms and DFDs) but lacked understanding of current BPM and process management practices. After an explanation, the respondent considered that BPM documentation could help in the integration of new staff.

Respondent D: The respondent didn't know BPM and considered it a new approach to process management. They acknowledged that the bigger projects, outsourced to private companies, might use it, but its current city hall application is non-existent. They considered the existing workflows dated and due for revision, stating that the current IT team did not possess enough time or resources to revise them.

Concerning **Q1.4** and **Q1.5**, the details were identified and utilized in the project work execution.

The next stage held the design and validation of the AS-IS models. Two meetings were adhered to validate the different models. The previous staff members were again interviewed at the end of this step.

Regarding **Q2.1**, **Q2.2**, and **Q2.3**:

Respondent A: Understood the models and validated their veracity. They stated that those designs were easy to follow and constituted a clearer view of the current processes. For them, BPM seems to provide a great tool for administrative work as it accommodates straightforward findings of process errors and improvement opportunities. After analyzing the model, the respondent stated that there were too many inspections being performed and there was a need for landlord self-policing. They acknowledged that although the main objective is to create awareness of the participating external actors, some requests lead to errors and others take too long to resolve. They proposed the creation of a fee that a plaintiff should pay in the case of an invalid request and the reduction of bureaucracies posed by the many obligatory validations.

Respondent B: Understood the models, confirming that they provide much more information than the previously used ones. They affirmed that the created AS-IS designs followed their view of the processes and requested another explanation of its notation for future use. They also proposed a fee related to the invalid requests and removal of the anonym ones because they create several assessment difficulties and slow the process execution.

Respondent C: Understood the models and affirmed that the created AS-IS designs followed their view of the processes. They stated that it should prove very helpful in the role changes that will take place later in the year. They affirmed that the number of inspections related to a single request was high but did not know if reducing them would be a solution. Because the office is dealing with people, most of them elderly, the respondent feels that some landlords enjoy the company that the staff provides in the checkups, even though this is not their job, and boosts the public appeal of the current government.

Respondent D: At first it found the models simple, like a variation of a DFD, but after further inspection it recognized their complexity, stating that they are easier to understand than the ones they are using. Although the current workflow system has a circuit-based view in its platform, for non-IT staff, the BPM approach poses a clearer as it focuses on the procedures instead of how the system operates. The difference in updated documentation should help in future improvement efforts. They were still hesitant to start implementing BPM on other projects due to the lack of present-day process management knowledge by the whole IT team.

In the last stage of the project, interviews, followed by a discussion, were held to ascertain the overall results of the project.

Regarding **Q3.1**, **Q3.2**, **Q3.3, Q3.4**:

Respondent A: Understood the presented TO-BE models and the associated notation. They identified these models as a new approach to the current process execution, fitting the current needs. According to the respondent, the suggested changes are certainly positive and state ideas in previously not explored areas, like the digital submission platform. Although the models can be applied, they still need time to adjust to the new tools that encompass the application. They believe the current laws do

not present enough room to change procedures for improvements, but in the future, it will be possible to implement similar models due to new government digitalization programs. Regarding the office, funds are available, and the staff is ready for change, but the overall institution is still lacking resources and is showing great resistance. The respondent wants more interaction with the IT team, dynamic approaches, and yearns for better cross-department communication pipelines. The respondent found the overall experience to be very positive, stating that they have acquired crucial knowledge for future managerial work. Having someone with an outsider's perspective brings new ideas that were not previously thought on. Process analysis was never considered and the dynamics it brings are very necessary for future work. Digitalization accommodates the workflow environment which is the most important aspect of an office and the current professionals do not possess the necessary understanding to realize the annexation of the available technological tools.

Respondent B: Understood the models and the notation. The respondent believed they could be implemented due to the introduction of some of the stated tools in the coming months. The current implementation seems flawed in some respects, and the new staff should benefit from having AS-IS and TO-BE process documentation. They found the information gathering optimization to be very convenient and wish the BUPi platform integration as soon as possible. The overall experience was positive and productive as it improved the process management knowledge of the respondent. Workflow diagrams are limited and don't show the full picture. As new roles and technology are added to the work environment, so to the documentation needs to be updated to accommodate the execution. The respondent ended the interview by stating that it will look for further process management information to extend its knowledge on the subject.

Respondent C: Understood the models and the notation. They think that the TO-BE application suited the workflow in the exact needs. Although the current process encompasses more costs and waiting times, the respondent believes it is difficult to apply some of the TO-BE aspects in the real world due to the necessary extensive interaction with the associated external entities. The proposed models comprise a pragmatic approach to these processes, but the respondent feels that the customer's age group still constitutes a barrier for its complete application. Regarding the office procedure, the changes are positive and would create a better working environment, but for this to happen, necessary changes to the administrative code need to be approved. The experience of working with process management was positive as it shined a light on the many present errors.

After the interviews a final discussion raised some current issues:

- There is a constant need for validations from executives and office leaders.
- Every dispatch and notification to necessary customers' needs to be signed by the mayor and sent as physical mail.
- There is a lack of process management knowledge and expertise.
- The current staff still poses a high resistance to change, although this is changing.
- The current laws do not abide by cross-functional, enterprise-like management.
- The systems in place need to be improved with the integration of e-government practices.
- The many on-site inspections that need to be performed impose sustainability, work, and cost-related issues.

The new implementation can resolve many of the issues but, due to role changes arising from municipal elections, it is still difficult to ascertain their full implementation. Nevertheless, the current post-election environment presents a good opportunity for change and the introduction of this project's process management might be facilitated.

The presentation of the TO-BE models and the associated process management was well received by the participating actors. A copy of the documentation was requested for study and use in future applications. The stakeholders declared this type of management essential, not only to the optimization of tasks and measure of ongoing performance but that it also plays a significant role in the work environment and the learning curve for new staff members. The discipline of process management was new to them, and this project showed the potential to rethink tasks and procedures. Because they now possess basic knowledge of these practices, there exists an intent to start employing them to some degree in the office. A significant change in logical thinking is prompting the staff to use the technology to its full potential, and the before mentioned BUPi system is now scheduled for introduction in the following months. Although some expressed an initial resistance to change, most of the staff is now certain that this system will decrease workload and facilitate the execution of the previously useless and cumbersome tasks. While the actors expressed a wanting for these changes, they stated that the current laws are limiting their use. The experience of working with a process analyst was well received with the hopefulness that, in the future, this type of specialized work integrates the city hall IT team. The present IT engineers have been under a substantial workload due to the COVID-19 pandemic, and there are no available resources to assist the management and optimization projects. A major identified critique was that the current technology implementation does not entirely suit the office's needs, and the constant necessity for IT support calls is slowing the overall performance. Furthermore, the staff wishes for a more dynamic and enterprise-like thinking IT department to create an engaging multi-platform environment and change the mindset of other office workers. The lean approach can be adapted to the public sector and brings a new managerial perspective to the administrative staff. The removal of waste is inconsequential when performing optimization efforts and, although that was always the objective, with lean, this can be achieved in a more rapid and structured way. Although insights and performance measures are gaining force in this sector, they are still far behind in use in comparison to private enterprise-like firms. The discussion ended with a general belief that, in the future, it will be possible to manage processes using these tools and approaches due to the push of the "*Portugal Digital*" program, which entails the digital transformation of the country.

6. CONCLUSIONS

6.1. LIMITATIONS

The suggested changes are limited to their application due to the current administrative code of law. The previous research on this sector already pointed this out, but it can be verified with small changes, both, in mindset and the administrative code, optimizations like these can be implemented. A revision of the code of law is necessary to fully expand the use of new management practices and integrate already available technology to its maximum potential. Though the government has started implementing databases and information systems, due to the rise of e-government necessity, it fails to develop the process execution and technology integration. The knowledge of process management constitutes a lack in the executive and staff's skills, and it posed a challenge to this work project. Nevertheless, the Viana do Castelo City Hall has already implemented optimizations to its processes throughout the last decade, but there is still room for improvements. It is something that very few public institutions do. The constant change in administration poses a challenge, but in some divisions, the staff remains roughly the same, meaning that the power of process management can be applied to some degree, with the only main problem being that some of the workforces have a high resistance to change.

Because this project work was conducted in an election year, some of the associated staff were difficult to contact, and a change in the City hall's positions has happened. Some of the people involved with this project (e.g., the Chief of the GTF) have changed roles and new members of the staff have been appointed. This change happened after the conclusion of the project work.

The interviews were well received by the respondents, but some did not allow recording. This proved difficult in the understanding of the process execution during the design phase.

Qualitative data validation was not explored, due to time constraints, lack of provided information, bureaucracies, and associated non-disclosure directives. The performance measures are difficult to ascertain as there exists considerable leeway in the deadlines and number of inspections performed. The current objective is to inform and cultivate a habit of land cleaning on the owners and not file for offenses. This is because of the high average age of the involved landlords and the background politics that entail a state organization. The main objective does not seem the overall optimization of the process but rather customer satisfaction, leaving the feeling that political satisfaction is more important than the management and performance aspects. The values and available information of the measures were not available to use.

6.2. RECOMMENDATIONS FOR FUTURE WORK

As previously mentioned, further research on this field is required. This project identified that the organizational structure of the public sector is still not prepared for cross-functional activities, but changes are being studied to revise this aspect. It is not a priority for most city halls, as budget and staff are very limited, but the larger should start to employ process managers and create a different environment in which everyone is familiar with these practices. Although silently existing, the political

aspect poses many difficulties in the application of process management in this sector, and it needs further exploration. Transparency is key to aid the reduction of this issue.

The state could be doing more regarding this topic. A process management training program for the executives and the information system division staff could be a great start to impose change. Although it encompasses costs, a simple course could encourage changes of perspective and inspire the introduction of the new process practices. Following the role changes due to the municipal election, it is necessary to update the current process management to accommodate role shifts. The previous staff learned to understand a BPMN model during the project's elaboration. After the changes, the newer staff should accommodate some process management knowledge to easily identify and understand the presented models.

The use of process management documentation is not used at all. It could help the new employees and executive board in the process of understanding the overall operations. It can also pose as a great asset for future optimizations, even in the eventual administration change. This project served to explore the introduction of BPM on these institutions, create a baseline of documentation in this aspect, and show how difficult it is to apply all its concepts even on simpler processes.

If the laws do not change, it will be difficult to optimize the processes. An examination of how to align the code of laws with the new technology and practices can lead to the creation of a framework following the best performance measures. The current landscape for enterprise process managing does provide context for a governmental application but some of its aspects are just not applicable or non-value adding in the public sector environment. A future study should focus on the evolution of an already existing framework so it can be applied in these cases, regardless of size and available budget. It is imperative as it could lead to reductions of costs to the state, improve customer experience to the citizens, increase sustainability, and create a better working environment for the staff so it can focus on what matters.

For practical application, it should be noted that the BUPi platform is being slowly rolled out to include the many different counties and, at the time of this project’s development, has still to cover the Viana do Castelo District. Because the first four years after the district inclusion on the program serve as an incentive for registration, further process management will need to be applied after that period to update the current iteration following the landlord's overall reception and the many updates to the platform.

7. BIBLIOGRAPHY

Aagesen, G., & Krogstie, J. (2015). Bpmn 2.0 for modeling business processes. In *Handbook on Business Process Management 1: Introduction, Methods, and Information Systems* (pp. 219–250). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-45100-3_10

ABPMP (2013). BPM CBOK Version 3.0: Guide to the Business Process Management - Common Body of Knowledge. (1st ed.). Association of Business Process Management Professionals - ABPMP.

Boyce, C. and Neale, P. (2006) Conducting In-Depth Interview: A Guide for Designing and Conducting In-Depth Interviews for Evaluation Input. Pathfinder International Tool Series, Monitoring and Evaluation-2.

Brady, J. E., & Allen, T. T. (2006). Six Sigma literature: A review and agenda for future research. *Quality and Reliability Engineering International*, *22*(3), 335–367. https://doi.org/10.1002/qre.769

Brocke, J. vom, & Rosemann, M. (2010). Handbook on Business Process Management 1: Introduction, Methods, and Information Systems. https://doi.org/10.1007/978-3-642-00416-2

Chakraborti, T., Isahagian, V., Khalaf, R., Khazaeni, Y., Muthusamy, V., Rizk, Y., & Unuvar, M. (2020). From robotic process automation to intelligent process automation: Emerging trends. In *arXiv*. Springer International Publishing. https://doi.org/10.1007/978-3-030-58779-6

Davenport, T., & Short, J. (1990). The New Industrial Engineering: Information Technology And Business Process R ... *Management*, *31*(4), 11–27. http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:The+New+Industrial+Engineering:+Information+Technology+and+Business+Process+Redesign#7

Decreto Lei nº 124/2006 de 28 de junho do Ministério da Agricultura, do Desenvolvimento Rural e das Pescas. Diário da República: I-A série, No 124 (2006). Accessed at 20 Oct 2021. Available at www.dre.pt.

Dumas, M., La Rosa, M., Mendling, J., & Reijers, H. A. (2018). Fundamentals of business process management: Second Edition. In *Fundamentals of Business Process Management: Second Edition*. Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-662-56509-4

Fischer, L., Shapiro, R., & Silver, B. (2012). *BPMN 2.0 handbook second edition: Methods, concepts, case studies and standards in business process management notation* (Second ed.). Lighthouse Point, FL: Future Strategies.

Gabryelczyk, R., & Roztocki, N. (2017). Effects of BPM on ERP adoption in the public sector. *AMCIS 2017 - America's Conference on Information Systems: A Tradition of Innovation*, *2017-August*.

Georgakopoulos, D., Hornick, M., & Sheth, A. (1995). An Overview of Workflow Management: From Process Modeling to Workflow Automation Infrastructure. 153, 119–152.

Gulledge, T. R., & Sommer, R. A. (2002). Business process management: Public sector implications. *Business Process Management Journal*, *8*(4), 364–376. https://doi.org/10.1108/14637150210435017

Gupta, M., & Galloway, K. (2003). Activity-based costing/management and its implications for operations management. *Technovation*, *23*(2), 131–138. https://doi.org/10.1016/S0166-4972(01)00093-1

Hammer, M. (1990). Reengineering Work: don't automate, obliterate. *Harvard Business Review*, *68*(4), 104–112.

Hammer, M. (2002). Process management and the Future of Six Sigma. *MIT Sloan Management Review*, *43*(2), 26–32.

Harry, M. J., Mann, P. S., De Hodgins, O. C., Hulbert, R. L., & Lacke, C. J. (2011). *Practitioner's Guide to Statistics and Lean Six Sigma for Process Improvements*. Wiley. https://books.google.pt/books?id=wQsA2dKzvQkC

Hevner, A. R., March, S. T., Park, J., & Ram, S. (2004). Design science in information systems research. *MIS Quarterly: Management Information Systems*, *28*(1), 75–105. https://doi.org/10.2307/25148625

Holzmüller-Laue, S., Göde, B., Fleischer, H., & Thurow, K. (2014). Improved Compliance by BPM-Driven Workflow Automation. *Journal of Laboratory Automation*, *19*(6), 528–545. https://doi.org/10.1177/2211068214549626

Jeston, J., & Nelis, J. (2014). Business process management: Practical guidelines to successful implementations. London: Routledge, Taylor & Francis Group.

Ko, R. K. L., Lee, S. S. G., & Wah Lee, E. (2009). Business process management (BPM) standards: a survey. *Business Process Management Journal*, *15*(5), 744–791. https://doi.org/10.1108/14637150910987937

Koplowitz, R., Mines, C., Sjoblom, S., & Reese, A. (2019, June 19). *The Forrester Wave™: Software For Digital Process Automation For Deep Deployments, Q2 2019* (Rep.). Retrieved April 29, 2021, from Forrester website: https://reprints.forrester.com/#/assets/2/159/RES144414/reports

McAdam, R., & Donaghy, J. (1999). Business process re-engineering in the public sector: A study of staff perceptions and critical success factors. Business Process Management Journal, 5(1), 33-52. https://doi.org/10.1108/14637159910249135

Michael Glykas (Ed.) (2013). Business Process Management: Theory and Applications. Springer Berlin Heidelberg.

Moffitt, K. C., Rozario, A. M., & Vasarhelyi, M. A. (2018). Robotic process automation for auditing. *Journal of Emerging Technologies in Accounting*, *15*(1), 1–10. https://doi.org/10.2308/jeta-10589

Niehaves, B., Plattfaut, R., & Becker, J. (2013). Business process management capabilities in local governments: A multi-method study. *Government Information Quarterly*, *30*(3). https://doi.org/10.1016/j.giq.2013.03.002

Peffers, K., Tuunanen, T., Gengler, C. E., Rossi, M., Hui, W., Virtanen, V., & Bragge, J. (2020). The design science research process: A model for producing and presenting information systems research. *ArXiv*, *May 2014*.

Pereira, V. R., Maximiano, A. C. A., & Bido, D. de S. (2019). Resistance to change in BPM implementation. *Business Process Management Journal*, *25*(7). https://doi.org/10.1108/BPMJ-07-2018-0184

Powell, T. C. (1995). Total Quality Management as competitive advantage: A review and Empirical study. In *Long Range Planning* (Vol. 28, Issue 3, p. 120). https://doi.org/10.1016/0024-6301(95)91626-1

Syed, R., Bandara, W., French, E., & Stewart, G. (2018). Getting it right! Critical success factors of BPM in the public sector: A systematic literature review. *Australasian Journal of Information Systems*, *22*. https://doi.org/10.3127/ajis.v22i0.1265

Sony, M. (2018). Industry 4.0 and lean management: a proposed integration model and research propositions. *Production and Manufacturing Research*, *6*(1), 416–432. https://doi.org/10.1080/21693277.2018.1540949

Taghizadegan, S. (2006). Essentials of Lean Six Sigma. In *Essentials of Lean Six Sigma*. https://doi.org/10.1016/B978-0-12-370502-0.X5000-0

Truscott, W. T. (2011). *Six Sigma: Continual improvement for businesses*. Abingdon, Oxon: Routledge.

Ubaid, A. M., & Dweiri, F. T. (2020). Business process management (BPM): terminologies and methodologies unified. *International Journal of Systems Assurance Engineering and Management*, *11*(6). https://doi.org/10.1007/s13198-020-00959-y

Vaidya, S., Ambad, P., & Bhosle, S. (2018). Industry 4.0 - A Glimpse. *Procedia Manufacturing*, *20*, 233–238. https://doi.org/10.1016/j.promfg.2018.02.034

Van der Aalst, W. M. P. (2016) Data Science in Action. In: Process Mining. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-662-49851-4_1

Van Der Aalst, W. M. P., & Dustdar, S. (2012). Process mining put into context. *IEEE Internet Computing*, *16*(1), 82–86. https://doi.org/10.1109/MIC.2012.12

Van Der Aalst, W. M. P., Weijters, A. J. M. M., & Maruster, L. (2019). Workflow Mining. *Encyclopedia of Big Data Technologies*, 1811–1811. https://doi.org/10.1007/978-3-319-77525-8_100371

Weske, M. (2012). Business process management: Concepts, languages, architectures, second edition. Business Process Management: Concepts, Languages, Architectures, Second Edition (pp. 1–403). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-28616-2

White, S. A., & Miers, D. (2008). BPMN modeling and reference guide: Understanding and using BPMN. Lighthouse Point, FL: Future Strategies.

Witkowski, K. (2017). Internet of Things, Big Data, Industry 4.0 - Innovative Solutions in Logistics and Supply Chains Management. *Procedia Engineering*, *182*, 763–769. https://doi.org/10.1016/j.proeng.2017.03.197

Womack, J. P., & Jones, D. T. (1997). Lean Thinking—Banish Waste and Create Wealth in your Corporation. *Journal of the Operational Research Society*, *48*(11), 1148–1148. https://doi.org/10.1038/sj.jors.2600967

Zwicker, J., Fettke, P., & Loos, P. (2010). Business Process Maturity in Public Administrations. In J. vom Brocke & M. Rosemann (Eds.), *Handbook on Business Process Management 2: Strategic Alignment, Governance, People and Culture* (pp. 369–396). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-01982-1_18