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The use of BPMN to characterize processes

Importance of Business Process Modeling in the health area

Dissertation to obtain the master's degree in business management

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Dedication

To my parents.
For the support. For the opportunity to continue my academic path.

Acknowledgment

After completing my degree in Biomedical and Laboratory Sciences, and quickly concluding that this was not the way to feel professionally fulfilled, I realized that I would have to bet on another aspect that would feed my hunger for knowledge. The area of Management was my choice, which led me to decide on this master's in business management.

The time has come to thank, not only to those who helped me in this change in my academic path, but also those who helped and encouraged me to complete this master's thesis.

Conducted under the guidance of Professor Luís Manuel do Carmo Farinha, from the Escola Superior de Gestão de Idanha-a-Nova, an exemplary, demanding professor who aroused my interest in the area of Business Process Management - a professor with whom I had the privilege to be a student, during the master's degree. I would like to thank you for agreeing to be the supervisor of this master's thesis.

To Professor Ana Maria Gonçalves Lourenço Roque Santos Pinto, who is also a professor at the Escola Superior de Gestão de Idanha-a-Nova, whom I have as a model, and which I greatly appreciate. My gratitude for accepting to be a supervisor of this academic work.

Abstract

Currently, a healthcare institution, of whatever type, needs a detailed management of all the processes involved, so that these organizations and their professionals can provide their services more efficiently, and archive the goals of the institution.

In health institutions, the processes aren't identified, procedure's manuals are difficult to interpret and often, the professionals don't have time to consult them. Business Process Management can be a possible solution, used for managing the processes in this type of institution, decreasing human and technical errors.

This thesis aims to study the importance and the need to implement the Business Process Modelling and Notation (BPMN) in healthcare institutions, through the analysis of interviews to different professionals who work with this notation in different areas, and compare these results, with previous studies also in the healthcare area.

We conclude that the implementation of BPMN can indeed be used in the healthcare institutions, and with the necessary training and engagement from all the professionals, can be a benefit, in order to improve the institutions services.

Keywords

Business Process Management; BPMN; Health Institution; Processes.

Resumo

Atualmente, uma instituição de saúde, de qualquer tipo necessita de uma gestão detalhada de todos os processos envolvidos, para que estas organizações e os seus profissionais possam prestar um serviço com mais eficiência, e alcançar os objetivos da instituição.

Nas instituições de saúde, os processos não estão devidamente identificados, os manuais de procedimentos são de difícil interpretação e, muitas vezes, os profissionais não têm tempo para os consultar. A Gestão de Processos de Negócio pode ser uma possível solução, usada para gerir os processos neste tipo de instituições, diminuindo os erros técnicos e humanos.

Esta tese tem como objetivo estudar a importância e a necessidade da implementação do Business Process Modeling and Notation (BPMN) em instituições de saúde, através de entrevistas a diferentes profissionais que trabalham com esta notação em diversas áreas, e comparar estes resultados com estudos anteriores, na área da saúde.

Concluimos que a implementação do BPMN pode sim ser utilizada em instituições de saúde, e com a devida formação e envolvimento de todos os profissionais, pode ser um benefício, por forma a melhorar os serviços destas instituições.

Palavras-chave

Gestão de Processos de Negócio; BPMN; Instituições de saúde; Processos.

Abstracto

Actualmente, una institución de salud, del tipo que sea, necesita una gestión detallada de todos los procesos involucrados, para que estas organizaciones y sus profesionales puedan brindar sus servicios de manera más eficiente y lograr los objetivos de la institución.

En las instituciones de salud, los procesos no están identificados, los manuales de procedimientos son difíciles de interpretar y, muchas veces, los profesionales no tienen tiempo para consultarlos. Business Process Management puede ser una posible solución, utilizada para administrar los procesos en este tipo de instituciones, disminuyendo los errores humanos y técnicos.

Esta tesis tiene como objetivo estudiar la importancia y la necesidad de implementar el Modelado y Notación de Procesos de Negocios (BPMN) en las instituciones de salud, a través del análisis de entrevistas a diferentes profesionales que trabajan con esta notación en diferentes áreas, y comparar estos resultados, con estudios previos también en el área de la salud.

Concluimos que la implementación de la BPMN sí puede ser utilizada en las instituciones de salud, y con la adecuada capacitación e involucramiento de todos los profesionales, puede ser un beneficio, con el fin de mejorar los servicios de estas instituciones

Palabras-chave

Gestión de Procesos de Negocio; BPMN; Institución de salud; Procesos.

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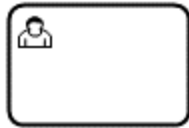
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User's activity

A user's task is a typical task from a workflow where a human executes the task with the help of a software.



Manual Task

It is a task that is expected to be performed without the aid of any business process execution or any application.



Link Intermediate Event

It is used to connect two sections of the process.



Timer intermediate event

Indicates a waiting time within the process. This type of event can be used within the sequential flow indicating a waiting time between the activities or attached to boundary of an activity to indicate an exception flow when a time-out occurs.



Data Storage

A data storage offers the activities a mechanism to update the information stored that will stay during the process.

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List of abbreviations and acronyms

AP- Appointment Process

BP- Business Process

BPD- Business Process Diagram

BPM- Business Process Management

BPMI- Business Process Management Initiative

BPML- Business Process Modeling Language

BPMN- Business Process Model and Notation

BPMS- Business Process Model Systems

BPQL- Business Process Query Language

DDL- Data Definition Language

DDL- Data Definition Language

ESGIN- Escola Superior de Gestão de Idanha-a-Nova

HGCR- General Hospital de Ciudad Real

INE- Incorporation of a New Employee

IT- Information Technologies

ISO- International Organization for Standardization

KPI's- Key Performance Indicators

QMS- Quality Management Systems

SME's- Small and Medium Enterprises

SPS- Surgical Patient Scheduling

SOA- Service-oriented Architecture

SPSS- Statistical Package for Social Sciences.

UCLM- University of Castilla-La Mancha

UML- Unified Modeling Language

Introduction

In the context of globalization and transformations, the management of the organization's knowledge and potential is an effective tool for increasing the effectiveness of organizations.

The society transformation is changing the user's information and knowledge needs. The organizations, seeking to effectively meet the client's needs, are no longer equipped with knowledge, abilities, and skills to manage traditional resources; there is also a need for an effective management of the organization's knowledge and potential (Raudeliuniene, Davidavicienė, & Jakubavicius, 2018). How to efficiently manage them, in a dynamic and uncertain environment in the present of limited organization resources, is a problem, investigated in the knowledge management discipline and realized through a process knowledge management cycle that created preconditions for creating mutual value for both users and members of the organization.

At present, quality improvement and processes optimization are two important concepts for big companies, strongly established in the industrial and business area. There are work philosophies based on the concept "everything can be improved". In this regard, Lean Manufacturing and Six Sigma are two of the most used nowadays. Lean Manufacturing is a management methodology focused on the design of the processes. It seeks to eliminate or reduce those activities without added value, better known as wastes. On the other hand, Six Sigma is based on reducing the processes variability (Kosky, Balmer, Keat, & Wise, 2021), this methodology aims to obtain a competitive advantage by reducing both defects in the manufacture of a product and in any service provided to the customer. Lean and Six Sigma are complementary, being Lean Six Sigma the result of combining both philosophies. However, in recent years, a novel methodology called Business Process Management (BPM) is having a great impact. BPM emerges to integrate different disciplines of management directly with the operation of processes.

1.1 Background and motivation

As a previous biomedical student and professional, the author clearly understood that the processes that are executed in a healthcare unit or department are not clearly identified, neither we, healthcare professionals, have a solid base where we can support ourselves when some doubt appears. It's common to find a procedure's manual in some departments/ services, but we found it difficult to quickly read it and find the answer to our questions; apart from that, is very common that professionals in

the same institution don't have a general knowledge about the procedures or processes done by their colleagues in another departments.

Although BPM is still used in the majority by business or IT companies, some studies, such as Rolón, Chavira, Orozco, & Soto, (2015), Silva & Soares, (2016) and Fernández, Fernández, Jorquera, & Iglesias, (2020) have demonstrated that we can implement this type of methodology in the healthcare system.

As a way to resolve or at least diminish this gap, healthcare units could use Business Process Model and Notation (BPMN) to clearly identify its processes- and since it is a very easy notation to understand, we can make it easier for every type of professional, no matter his age, status, or education, to have a better understanding of the processes executed in this type of institutions.

A previous study was made, where healthcare professionals answered to a survey related to the importance of the processes in this type of institutions. Now, we will interview professionals who used and implements BPMN in different businesses and understand if BPMN is really a benefit to the healthcare institutions.

1.2. Study object and investigation questions

The fact that health organizations do not have processes clear and formalized, leads to inefficiencies across the entire organization. Thus, it becomes important to know all the processes in this type of institutions and transforming knowledge into turning them accessible to any professional, so that they are prepared to provide their service, and so that in in case of doubt, they can access relevant, clear, and objective information about these same processes.

As mentioned earlier, the dissertation will be directed to the study of the use of BPMN to characterize processes in institutions, more specifically in health institutions, to solve the central research problem:

Can BPMN be used in healthcare institutions, and will it be a benefit for the professionals in order to improve the institution's services?

A previous study was conducted by Luciano, Pinto, & Nunes, (2020), where different health professionals where asked several questions about the processes in their institutions and the importance of these same processes. With this study, and following the same line of thoughts, we came up with several research questions that we want to see answered/resolved, through the elaboration of this study:

- Will the processes in this type of organizations really be important?
- Do the professionals of these institutions have knowledge of all processes performed in their department/service? Do all the staff have access to procedure manuals?

- Will it be possible to solve the central problem of the investigation, applying the organizational practice of management oriented to processes?
- Do BPMN professionals think this is a good tool to improve the processes? Why? Which are the benefits in using it?
- Did these professionals implement this type of management in any health institution?

With previous studies, we have the answers related to what healthcare professionals think of the processes.

With the interviews done to the BPMN professionals we have the answers related to the benefits and improvement that this type of management can bring to the healthcare institution and its professionals.

The possible resolution of the investigation problem, with the implementation of a process-oriented management with resorting to the use of BPMN, would reduce errors and failures, both technic and human, with the ultimate goal of achieving the objectives of the organization, and provide a quality service to the client/patient.

1.3. Results and goals

For the development of this thesis, the main goal is to perceive the importance that BPMN can have in institutions, more specifically healthcare institutions, according to the health professionals, and professionals who implement BPMN in different companies. With this, we also present other goals, such as:

- Understand what a business process is and BPM.
- Identify the main elements from the BPMN 2.0.
- Understand the importance of quality and process management in health institutions.
- Identify the difficulties that companies have before they have BPMN, as well as the obstacles that can appear during the implementation.
- To know the different software's available in the market.
- To identify the main advantages in the implementation on BPMN in institutions.

1.4 Methodologic approach

The methodological approach used in this thesis was the Qualitative Research, a technique used in projects that address research questions, data collection and

analysis. The main goal of this research is to obtain an answer to the question is being studied.

For the state of the art and support our thesis with previous studies, articles, thesis, and organizational websites were consulted from the 1st of January 2021 to the 25th of March 2022. Different search engines (such as RCAAP, Research Gate and Scopus) were used. Regarding the articles, the main keywords used were BPMN, process management, BPMN in healthcare and business process.

For the authors study, a qualitative method was used: though the social network LinkedIn, a first search was made under the word BPMN. The professionals chosen to do the interview should have professional experience in the BPMN field. 7 professionals were chosen from Portugal, and we proceed to send an invitation to participate in the study (attached), where the same study was fully explained. Only 4 professionals responded positively to the invitation, to whom we sent the script for the interview. Later on, only 3 professionals showed up to the previous scheduled interview. We opted to carry a semi-structured interview, which is more deeply explained in the fifth chapter of the current work.

1.5 Thesis's structure

This thesis starts off with the background and motivation to its development, followed by the study object, goals and main results, and the methodological approach that was used.

The second chapter is dedicated to the state of the art, to what concerns the Business Process and its importance. We started by doing a bibliometric analysis, followed by the meaning of the business processes, the different types, and the business process life cycle. Also in this chapter, we investigate the business process modeling, the Business Process and Notation (it's history, business process diagram and notation elements), and some of the most featured business process systems.

In the same chapter we look at BPMN as a quality tool, and we connect BPMN with the quality management and healthcare. The management in the healthcare units is also investigated: we analyse more deeply the management and the processes in the healthcare units, with reference to the problems in these institutions, and the importance of Process Management in solving or decrease these problems. To support the importance of the BPMN in health, we analyse three different studies that shows us the importance of BPMN to the health professionals and institutions, and some case studies, where the implementation of this notation brought improvement in the processes executed in these types of units.

The third chapter is dedicated to the methodology used for this investigation. The following chapter is where we analyse and discuss the results from our qualitative research and understand the importance of BPMN according to professionals who implement it, so we can understand if this type of management is indeed important and crucial to minimize different problems identified in the health field.

Finally, in the conclusion, we answer our research problem as well as the research question, that were announced in the beginning of this work. We also include the limitations that we identified when working on developing this thesis, and what we consider that should be the future work.

2. State of Art

2.1. Business Process and its importance

We live in a world that changes faster all the time. What worked only yesterday may no longer work today and much of what works today, may not work tomorrow. Smart managers know that organizations that succeed do so because they adjust to keep up with the changes that are taking place (Harmon, 2019)

Business process management (BPM) is concerned with the design, execution, monitoring, and improvement of business processes. Systems that support the execution of processes have been used extensively by companies to streamline and automate intraorganizational processes. Yet, for interorganizational processes, challenges of joint design and a lack of mutual trust have hampered a broader uptake (Mendling & Weber, Blockchains for Business Process Management - Challenges, 2018).

For Thom & Avila (2021), BPM is a subject related to multiple areas, such as computer sciences, administration, production engineering and information systems. BPM has been adopted gradually by different types of organizations, whose main goal is to document and improve their business processes, and their automation. Through BPM application, the processes are more effective, efficient and adaptive, which improves productivity and reduces costs.

To Mendling, et al. (2018), BPM is a group of methods, techniques, and tools to discover, analyse, redesign, execute and monitor business processes. These are the work an organization does when it produces its products or offers its services.

According to Harmon, (2019) Business processes continue to be one of the most important assets of an organization. Like blood vessels, they fill it with life and determine its way and speed of value creation as well as the cost to serve its customer base. Thus, processes reflect not only organizational productivity, effectiveness, and efficiency, but also its reliability, complexity and ultimately its culture. Internally, processes orchestrate the internal system of value creation and, externally, they are an important source of competitive advantage. A well-designed process is the runway for new products and services, but equally process innovation can be a source of new revenue potential when products and services have plateaued.

Processes put work, man, and machine into context. Traditionally, this meant that roles and resources are guided to ultimately arrive at a valuable contribution as the overall process outcome. As such, processes are the recipe for converting organizational resources into guided action. Ensuring compliant process executions is essential to organizations, and the lack thereof has had dramatic consequences for a number of corporations over recent years (Harmon, 2019).

Every company wants to improve the way it does business, produce things more efficiently, and make greater profits. Non-profit organizations are also concerned with efficiency, productivity, and with archiving the goals they set for themselves. Every manager understands that archiving these goals is a part of his or her job.

Considering the management of the automotive industry, we can see how well it has developed along the years: Since the first internal combustion automobiles were produced in Germany in 1885, some entrepreneurs in Europe and north America set up companies to build cars. Henry Ford was one of those. When he started the third company, Henry tried a new approach to automobile manufacturing: first, he designed a car with high quality, not too expensive, and easy to manufacture. Next, he organized a moving production line. Basically, the working man in the factory, started assembling a new automobile at one end of the building, and completed the assembly as it reached the far end of the plant. Workers, at each point of the production line had a specific task to do. At the end, Henry Ford conceptualized the development of an automobile as a single process and designed and sequenced each activity in the process to assure that the entire process ran smoothly and efficiently. By organizing the process this way, Henry Ford was able to significantly reduce the price of the building automobiles. As a result, he was able to sell cars for such a modest price that he made it possible for every middle-class American to own a car. Within a few years, Ford's new approach had revolutionized the auto industry, and it soon led to changes in almost every other manufacturing process as well.

Ford's success is just an example of the power of innovation and process improvement to revolutionize the economics of an industry. **The bottom line is that the analysis of business processes and their improvement to increase the efficiency and productivity of companies is a perennial management responsibility.** Obviously, managers have many other responsibilities, but one of the most important ones, is the ability to examine the processes by which their companies produce products or services and upgrade them to assure that they remain as efficient and effective as possible.

2.1.1. Bibliometric Analysis

The subject of bibliometrics, or scientometrics, is related to the quantitative evaluation of scientific papers and other published work, including the article's authors, the journals where this works were published, and the number of times they were cited. Like Lord Kelvin said, "(...) when you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in number, your knowledge is of a meagre and unsatisfactory kind, (...)". A.W. Jones, from a Lecture to Institution of Civil Engineers (1883).

Data Source and research process

The Science direct database in the Scopus was retrieved online as the source for the bibliometric analysis. The data was retrieved on the 3rd of April 2021. The retrieval keywords were "BPMN in healthcare". No language restrictions were used. The retrieved results were saved as "export citation to RIS".

There were 314 results, Figure 1, published between 1996 and 2022. The articles type varies, as represented in the **Figure 3**, as the different subject areas where the studies were made, **Figure 2**.

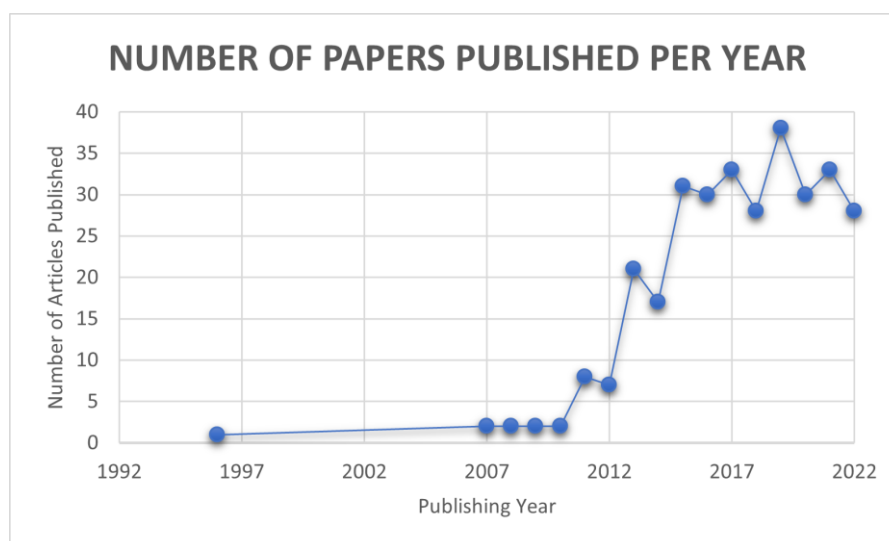


Figure 1. Number of papers published per year in the database Scopus, when searching for publications under the keywords "BPMN in healthcare". Self-elaboration

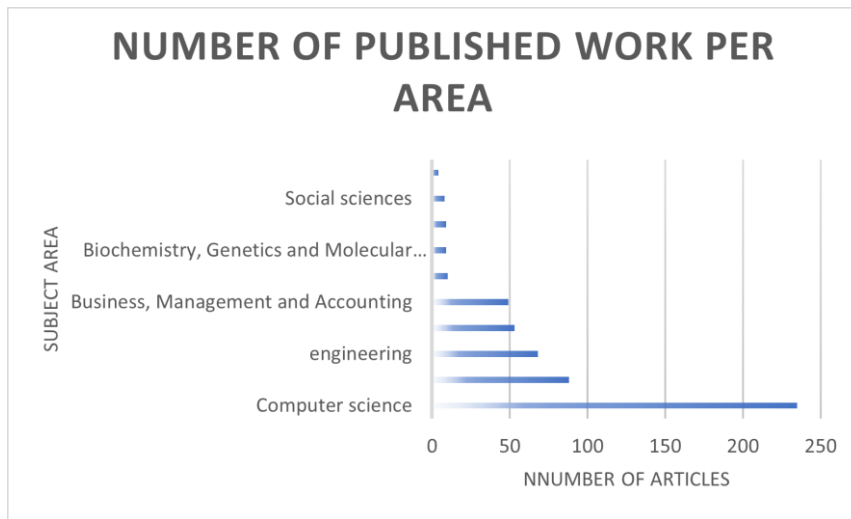


Figure 2. Number of published works per area, when searching for publications under the keywords "BPMN in healthcare" in the database SCOPUS. Self-elaboration.

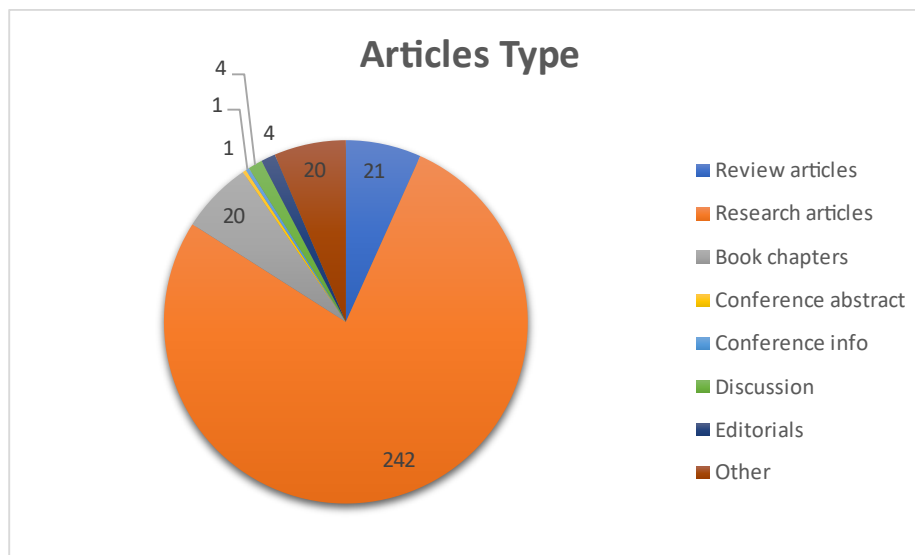


Figure 3. Type of work published in the database Scopus, when searching for publications under the keywords "BPMN in healthcare". Self-elaboration.

Analytical tool and method

A visualization software can generate node-link maps which can be used to visually observe the research distribution, hotspots, and direction of research development. In this bibliometric analysis, the data was imported into VOS viewer, **Figure 4**, version 1.6.18, release on January 24, 2022, and analysed systematically. The networks presented by the software may for instance include journals, researchers, or individual publications, and they can be constructed based on citation, bibliographic coupling, co-citation, or co-authorship relations (VOSviewer, 2022).

Table 1. Co-occurrence analysis of keywords. Self-elaboration.

Cluster 1 (red)	Cluster 2 (dark green)	Cluster 3 (dark blue)	Cluster 4 (light green)	Cluster 5 (purple)	Cluster 6 (light blue)	Cluster 7 (orange)	Cluster 8 (yellow)
Business Process. Cloud Computing. Modeling. Monitoring. Optimization. Process-aware information Systematic literature review workflow	BPMN Business Process Model Case study Model-driven development Ontology Web services	Big Data. Business Process Management Conceptual Modeling. Data mining. Machine learning. Virtualization	Automated process discovery. Conformance checking Healthcare processes Process discovery Process mining	BPMN. Business Process Model. Industry 4. Knowledge management	Framework. Interoperability. Simulation. Standards	Fog computing. Internet of things;	Healthcare. Process Modeling

2.1.2 Business Process and clinical process

A process is a series of activities performed within a company or organization. A process model defines the behaviour of a process and consists of a clear start, a number of tasks that need to be carried out, sequences and condition that determine the process flow, and a clear end. The scope of a complete process can involve one or more organization units (Deloitte, 2005).

A business process is a collection of inter-related events, activities, and decisions points that involve actors and resources and that collectively leads to an outcome that is of value for an organization or a customer (Domingos & Martins, 2017)

To Siegel (2008), a business process is a set of one or more linked procedures or activities executed following a predefined order which collectively realize a business objective or policy goal, normally within the context of an organizational structure defining functional roles or relationships. A process can be entirely contained within a single organizational unit as well as it can span several different organizations.

Business Process collaboration across enterprise boundaries is a complex task due to the lack of a unique semantics for the terminology or their BP models and to the use of various standards in BP modeling and executions.

Business Process Management (BPM) provides governance of a business's process environment to improve agility and operational performance. It is a systematic approach to improve any organization's business processes. BPM is not a technology, and it is not related to diagram creation or systems architecture.

Types of Business Processes

Business processes can be categorized (Bizagi, 2021) into different types, with the most common three as follows:

- Operational processes- also called primary processes. They relate directly to the core business- the mission of the organization: they create the products or services that generate the organization's income. Examples of this include
 - Taking customers' orders.
 - Processing products payments.
 - Managing bank accounts.
- Supporting processes- also known as secondary processes. These involve back-office processes within the business functions that keep the organization running. These processes do not provide direct value to customers. Some examples may be:
 - Accounting.
 - HR Management.

- Workplace safety.
- Management processes- These types of processes measure, monitor and control the activities related to business procedures and systems. These do not provide value directly to the customer. Some examples are:
 - Internal communications.
 - Governance.
 - Strategic planning.
 - Budgeting.
 - Infrastructure or capacity management.

All three kinds of models are closely linked, and the classification, in **Figure 6**, is important to keep in mind when designing a model.

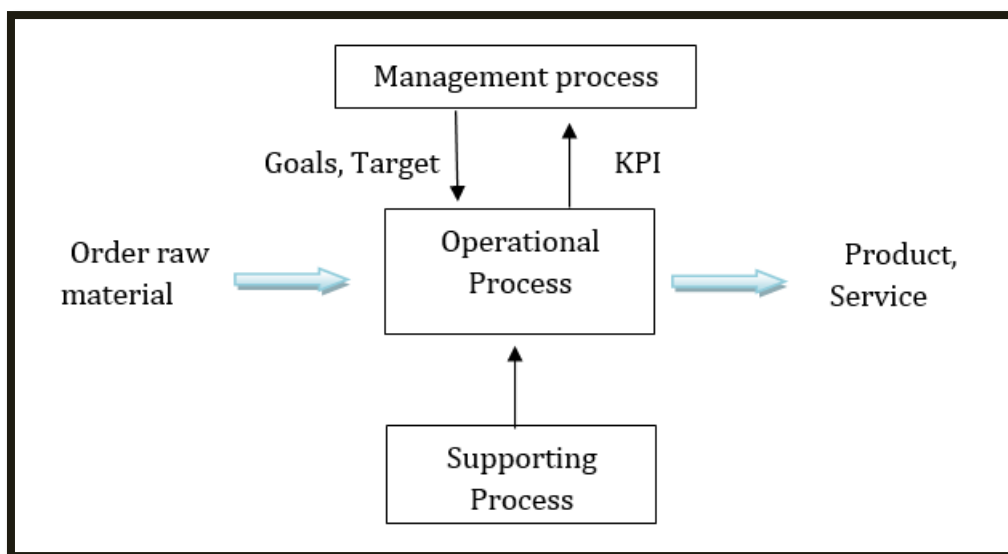


Figure 6. Types of Business Processes. Self. Elaboration.

Clinical and business processes share some shortcomings such as duplicity of tasks, bottlenecks, lack of communication between the involved actors, long waiting times, and so on, as described by Fernández, Fernández, & García (2019). These weaknesses make clinical processes inefficient, increasing the cost borne by health systems. In the last years, BPM has begun to be applied in the health field. The BPM strategy in the healthcare sector was mainly applied to optimize administrative processes. Administrative processes are those done by administrative staff, and which involve the performing of the necessary tasks for proper operation of the hospital such as patient's registration, stock control, or managing an order to a supplier.

Clinical processes are those performed by clinical staff and directly related to the patient's health such as blood draw, assessments of tests by a specialist, or surgical procedures. However, in the last years, novel studies have employed this methodology to different clinical processes.

Later in this work, we will talk more deeply about the processes and the management in the clinical field.

2.1.3. Business Process Life Cycle

In Smith and Fingar, (2003) BPM was defined for the first time as a process management strategy centred on the continuous improvement of business processes using Information Technologies (IT) as one of the fundamental principles for the accomplishment of processes. To do this, BPM philosophy defines a life cycle, **Figure 7**, composed of the following steps: design, modeling, execution, monitoring, and optimization.

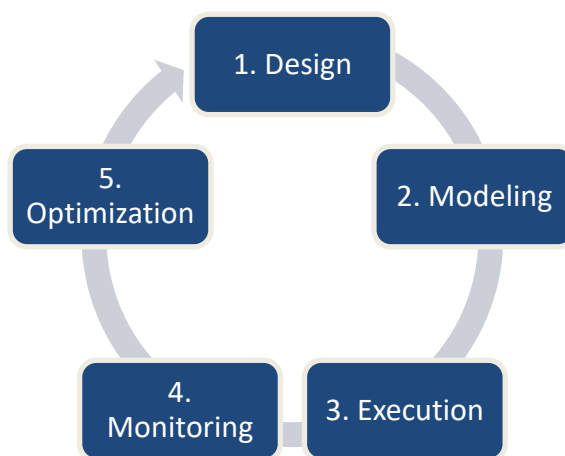


Figure 7. Business Process Life Cycle. Self-elaboration.

The design stage aims to understand and analyse the functioning of processes within the organization, mainly, what tasks are performed, who is responsible, and what roles are involved in them, that is the AS-IS model. This stage involves a substage of discovery that allows identifying any weakness or deficiency that may exist, eliminate, or restructure tasks and suggest improvement measures. In the second stage, if improvements in the AS-IS model are identified, the redesign process and the interactions between the different actors of the process are described graphically through a formal process notation called Business Process Management Notation (BPMN), that is the TO-BE model.

In the execution stage, the implementation of the modeling is carried out, and the described tasks are automated. The monitoring phase controls the fulfilment of the present objectives and identifies any possible errors, anomaly, or deviation from the defined objective. This is achieved through the definition and analysis of the key performance indicators (KPI's) used to quantify the impact of an implemented measure. Finally, with these results, in the optimization phase, it is intended to implement the new measures that help to optimize the process.

In Aziz, Loya, and Chatwin, (2014) a review based on studies of patient safety, clinical processes, and clinical handoffs concluded that the combination of the BPM approach together with the accounting control theory is a novel technique useful for describing, improving, and monitoring handoff processes in the context of a clinical

process. On the other hand, the review evidenced the great potential that has the use of a service-oriented architecture (SOA) approach applied to BPM to improve health care by implementing reliable clinical decision support systems.

2.1.2 Business Process Modelling

Business Process Modeling is defined as the time period when manual and/or automated (workflow) descriptions of a process are defined and/or modified electronically.

Business Process Modelling is the activity of representing processes of an enterprise, so that the current process may be analysed and improved in the future. Business Process Modeling is typically performed by business analysts and managers who are trying to improve process efficiency and quality. The term “Business Process Modeling” was coined in the 1960’s in the fields of systems engineering. In the 1990’s companies started to substitute terms like “procedures” or “functions” with the terms “processes” and “workflows” (Chinosi & Trombetta, 2001).

2.1.3 Business Process Model and Notation (BPMN)

BPMN stands for Business Process Modeling Notation. It is a standard for modeling business processes and web service process, as put forth by the Business Process Management Initiative (BPMI). BPMN is a core enabler of a new initiative in the Enterprise Architecture world called Business Process Management (BPM). Business Process Management is concerned with managing change to improve business processes (Martin & Jog, 2003).

To Chinosi and Trombetta, (2001) the primary goal of BPMN is to provide a notation that is readily understandable by business users, ranging from the business analyst who sketch the initial drafts of the processes to the technical developers responsible for actually implementing them, and then finally to the business staff deploying and monitoring such processes. BPMN was originally published in 2004 by the Business Process Modeling Initiative as a graphical notation (partially inspired by UML Activity Diagrams) to represent the graphical layout of business processes. The ever-increasing number of adoptions from companies and the growing interest upon this notation caused the adoption of BPMN as OMG standard in 2006.

BPMN consists of one diagram- named the Business Process Diagram (BPM). This diagram has been designed to be easy to use and understand, but also provides the ability to model complex business processes. It has also been designated specifically with web services in mind. BPMN is only one of three specifications that the BPMI has developed- the other two are a Business Process Modeling Language (BPML) and a Business Process Query Language (BPQL). All have been developed using a solid

mathematical foundation, which enables a BPMN Business Process Diagram to map directly to BPML, in the same way that a physical data model maps directly to Data Definition Language (DDL).

BPMN provides a number of advantages to modelling business processes over the unified modeling language (UML). First it offers a process flow modeling technique mathematical foundation is expressly designed to map to business execution languages, whereas UML is not (Martin & Jog, 2003).

The Business Process Modeling Notation (BPMN) is the new standard to model business process flows and web services. Created by the Business Process Management Initiative (BPMI), the first goal of BPMN is to provide a notation that is readily understandable by all business users. This includes the business analysts that create the initial drafts of the process to the technical developers responsible for implementing the technology that will perform those processes (Martin & Jog, 2003).

A second, equally important goal is to ensure that XML languages designed for the execution of business processes, such as BPEL4WS (Business Process Execution Language for Web Services) and BPML (Business Process Modelling Language), can be visually expressed with a common notation.

History of BPMN

BPMN is one standard to describe business processes. It was created due to a need in the marketplace to invent a common language to describe the processes and map them to execution logic. BPMN was originally developed by the Business Process Management Initiative (BPMI). They released a version 1.0 to the public in May 2004. In June 2005, BPMNI merged with OMG, the Object Management Group. A BPMN Specification document was released by OMG in February 2006 (GitBook, 2021).

Version 2.0 of BPMN was developed in 2010, and the actual version of the specification was released in December 2013. The latest version (2.0.2) has been formally published by ISO as the 2013 edition standard: ISO/IEC 19510. Image 4 shows the history and progression of BPMN along the years.

Over the last few years, BPMN rapidly became the de facto standard for process modeling. Part of its success is due to the fact that BPMN offers a familiar look and feel to business analysts, while providing powerful business process model expressiveness.

BPMN 2.0 models can be used to communicate, and interchange the business requirements of a business process, as well as providing the underpinning of the actual process implementation- BPMN 2.0 is a fundamental evolution of the original standard. The development of BPMN through the years is indicated in **Figure 8**:

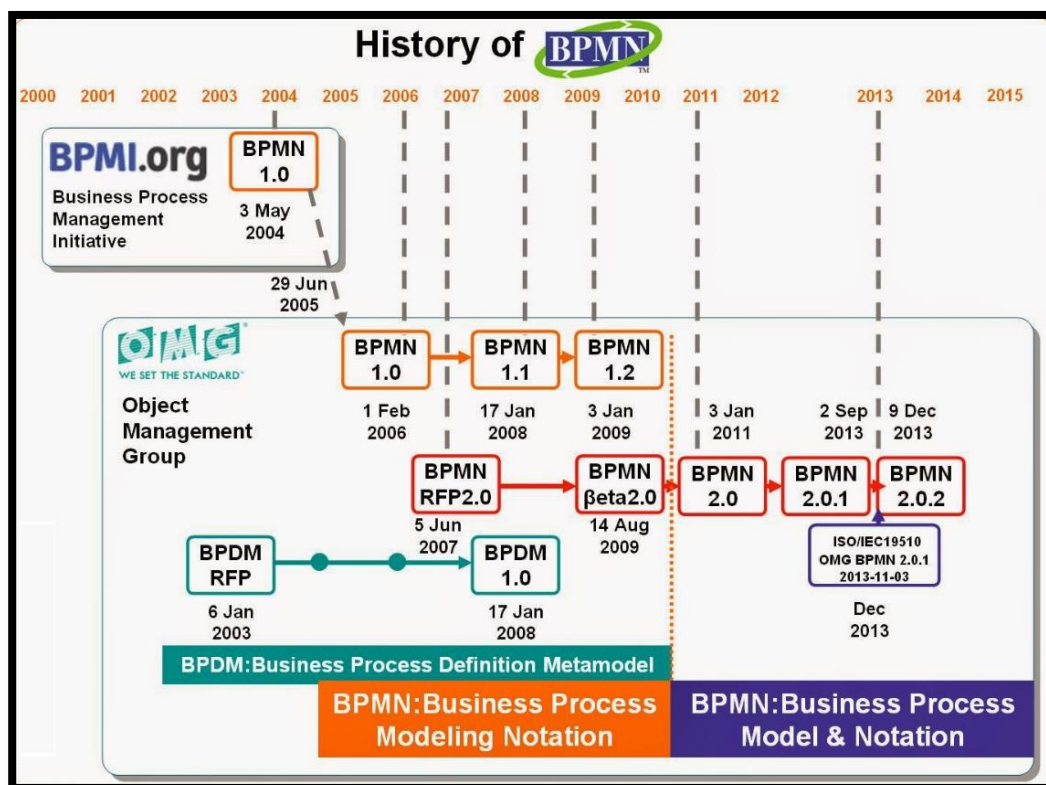


Figure 8. History and evolution of BPMN. (GitBook, 2021)

Business Process Diagram

A Business Process diagram is a visual representation of one of your core business processes, that depicts a directed flow of activities that are specified by using a subset of Business Process Modeling Notation.

A simple process, **Figure 9**, represents the internal processes that occur within one organizational unit or business entity (workflows). It shows on a screen what happens as data passes from one task to the next until is completed (IBM, 2016).

Creating a business process diagram can be easy or challenging depending on the tool that is being used. If use BPMN 2.0, users need to learn all the symbols and sign used to show how the data should flow from task to task. These symbols are presented and enlightened in the next sub-chapter.

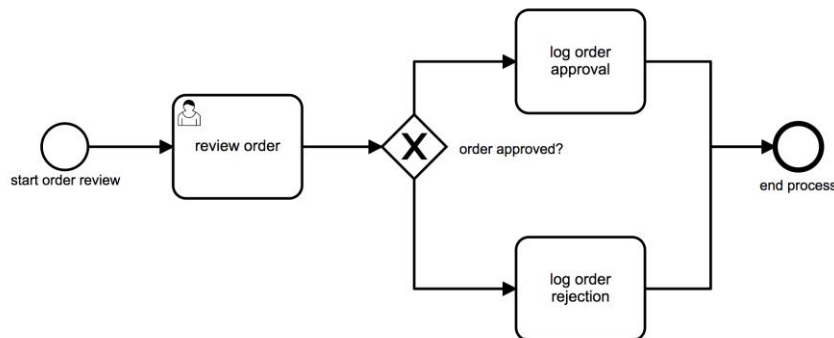


Figure 9. Example of a simple process using BPMN notation (Dawson, 2018)..

These diagrams are basically a roadmap for implementation- it outlines the expected outcome and provides something concrete to build from. Diagramming a business Process:

- Makes it possible to look at the picture and consider all types of potential scenarios.
- Helps the user to research and understand you process thoroughly so that you can see how it can be changed or improved when automated.
- Produces a visual aid that everyone can agree on- ensuring that everyone is on the same page.
- Helps the user to reduce upfront errors and prevent unnecessary changes down the road.

Notation elements from BPMN 2.0

The main goal of BPMN 2.0, is to promote an easier notation to be understood by all users, including the analysts that create the first sketches of the processes, the main tech developers that are responsible to implement the technology that will execute these processes, and also, all the people that will administrate and monitor the processes.

There are five basic categories, **Figure 10**, for the BPMN 2.0 elements: Flow objects; Connecting Objects; Swimlanes and Artefacts.

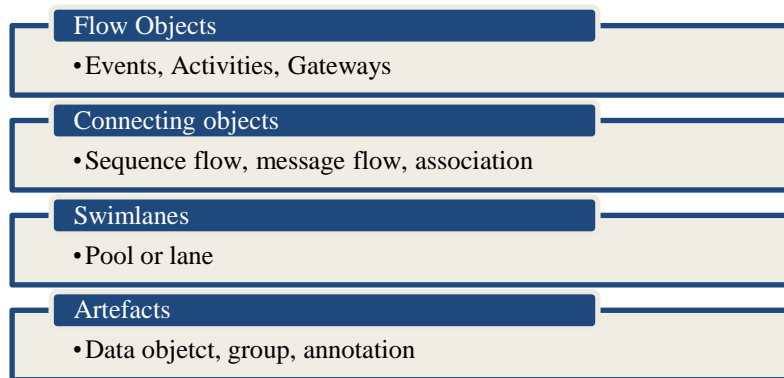


Figure 10. Categories for the BPMN 2.0 elements. Self-elaboration.

Flow Objects- Are the main elements from BPMN 2.0. They define the behaviour of the process through three basic types:

- Event- is represented by a circle. Represents something that happens during the business process, and it always has a trigger and a result in the process flux. There are three kinds of events, **Figure 11**, according to the position in which they occur during the process: initial, intermediate, and final.



Figure 11. Types of events in BPMN. Self-elaboration.

- Activity- An activity is represented by a rectangle with rounded edges. It represents a generic task that the organization does. There are two types of activities, **Figure 12**, them being the task or the subprocess. The last one, has a plus sign on the inferior part of the rectangle.



Figure 12. Representation of activity (task and subprocess) in the BPMN language.

- Gateway: Is used to control the divergences and convergences of the flow process, **Figure 13**. It also determines the decision point, bifurcation, and fusion of the process. It is represented by a rhombus shape.



Figure 13. Representation of gateway in the BPMN language. Self-elaboration.

Connecting Objects- They bond the flow objects, swimlanes and artefacts. There are three ways to connect the elements:

- Sequence flow- Throw a sequence flow (that connects the flow objects, defining the order in which these are executed). It is represented by a solid line with an arrow at the end, **Figure 14**.

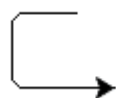


Figure 14. Representation of sequence flow by BPMN. Self-Elaboration.

- Message flow- Represents the message changing between two entities in the process. We use a dashed line with an unfulfilled arrow at the end **Figure 15**.

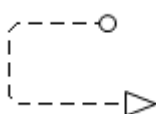


Figure 15. Representation of message flow by BPMN. Self. Elaboration.

- Association- Represented by a dotted line. It is used to associate data, text, or other artifacts with flow objects. They are also used to show the inputs and outputs of the activities, **Figure 16**.

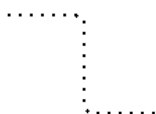


Figure 16. Representation of association by BPMN. Self. Elaboration.

Swimlanes- Diverse methodologies use the concept of swimlanes, as a way to organize the activities and separate them into categories, in a way to illustrate the different functions and responsibilities. Swimlanes are divided in two categories, **Figure 17**:

- Pool- Represents an entity in a process. It also performs as a container for separate activities from other pools.
- Lane- It is a portion inside the pool, and they are used to organize and categorize activities.

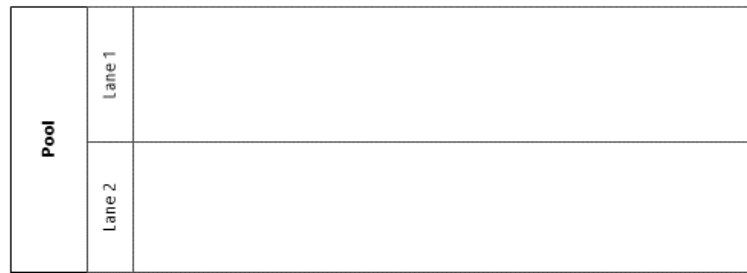


Figure 17. Representation of pool and lane by BPMN. Self-elaboration.

Artefacts- These are used to give additional information about the process. We can add as many artefacts as we want to a diagram, as long as they are appropriated to the business process that is being modelled. BPMN defines three different artefacts, which are:

- Data objects- It is a mechanism that shows how some data is required or produced in the activities. These are connected to activities by associations **Figure 18.**



Figure 18. Representation of data object by BPMN.

- Groups- Represented by a rectangle with a dashed line with rounded edges. It is used for documentation or analysis, and do not affect the process sequence **Figure 19.**



Figure 19. Representation of groups by BPMN.

- Text annotations- It is a mechanism for the modelers to add more information, to help other readers to understand the process and the BPMN diagram **Figure 20.**



Figure 20. Representation of text annotations by BPMN.


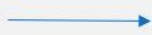









Flow Objects	Connecting Objects	Swimlanes	Artefacts
 <p>Events</p>	 <p>Sequence Flow</p>	 <p>Pool</p>	 <p>Data Objects</p>
 <p>Activities</p>	 <p>Message Flow</p>	 <p>Lanes</p>	 <p>Groups</p>
 <p>Gateways</p>	 <p>Association</p>		 <p>Text Annotation</p>

Figure 21. Summary of the main notation elements for BPMN 2.0.

2.2. Business Processes Management Systems

The BPMS are software tools that result in other's technologies evolution, such as Workflow, EAI (Enterprise Application Integration) and WebServices, among others, that gives users the capability to model, implement, execute, monitor, and administrate business processes, allowing the interaction between people, areas, and systems in the organization. The attribution of tasks to the right people in the right time, using the most adequate information, is one of the goals of one of the BPMS (Freitas, 2015).

BPMS comes like an integration environment, that supports BPM in different phases, and improves the processes from its management. For this to happen, these tools use technologies to control and manage the business processes, allowing the users to be involved, and the improvement of the process's life cycle.

For every type of process automation, there are different BPMS platforms in the market, with different offers when it comes to functionalities. In this section, we present four different BPMS platforms and compared them when it comes to the licence, the data base, the server application, if it has free modelling and free automation.

The relation between the functionalities given by BPMS to BPM are represented in **Figure 22**. Normally, these tools help organizations through the life cycle of BPM projects, and they have the capability to document the existing processes, as well as define goals and metrics in the evaluation of the results.

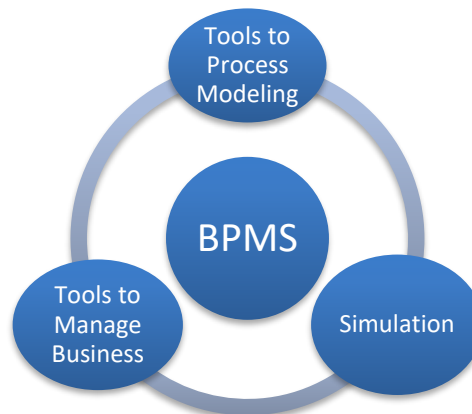


Figure 22. Functionalities given by BPMS to BPM.

When relating BPMS to the healthcare field, we can expect an improvement of the business and patient outcomes through automation. We can connect every professional and systems if we agile the process applications to improve the patient experience while reducing costs and protecting regulatory compliance. Popular healthcare automation examples are, **Figure 23**:

- Patient Records**
 - Store patient records securely and manage access to provide clinicians with the information they need to provide the best treatment.
- Patient Care**
 - Reduce time spent on data entry and spend more time diagnosing and treating patients.
- Emergency Room**
 - Get data to the right people more efficiently to reduce patient wait times.
- Patient Onboarding**
 - Speed up registration and reduce errors to start treating patients quicker and increase staff productivity.
- Patient Billing**
 - Develop compliant workflows to manage billing more efficiently and receive payments faster.

Figure 23. Healthcare automation processes examples (Bizagi, 2021).

We can find different Business Process Management Systems online, such as **Figure 24:**



Figure 24. Different BPMS we can currently find online.

KissFlow

KissFlow Workflow is a tool for business processes that allows the creation of a limited number of applications to automatize different entrepreneur activities.

With KissFlow, **Figure 25**, is possible to create workflows in an easy and quick way. Is also a solution that is deeply integrated into Google's applications. This way, users have a unified experience with the other office tools that they already use on a daily basis. In addition to the advantage of a familiar user interface, companies have the ability to use the features present in G-mail, Google Calendar, Google Docs, and create complete automation solutions. Furthermore, KissFlow Workflow runs on the Google Cloud infrastructure and therefore offers the same security and reliability as other tools (Kissflow, 2021).



Figure 25. KissFlow Logo (KissFlow, 2021).

This is the considerate as the best-in-class BPM software that enable organizations to reinvent existing business processes for digital optimization. It's a no-code development nature, that allows business users to automate process flows, enforce business rules, and make ad-hoc process changes without any coding.

Some of this software characteristics, **Figure 26**, are (Kissflow, 2021):

KissFlow	Fluid forms- Design completely custom forms with 20 field types, flexible layouts, calculations, and advanced lookups;
	Visual Workflows- Visually create the path items flow through, complete with conditions and advanced assignments;
	Access control- Define responsibilities and visibility according to the user's role, level, and the nature of form data;
	Reports and analytics- Get key insights into processes with customizable dashboards and reports with the information you need.
	No coding necessary- The workflow manager that lets users manage workflows without code;
	Easy-to-use interface- In the sea of workflow tools, users value our uncomplicated, simple design;
	Integration-friendly. Link your workflow system instantly with APIs and handy tools like Zapier;
	Built for scalability- Handle increased usage, data volume, and complexity easily with automation.
	Real-time analytics- Custom metrics keep you aware of the state of each workflow process.

Figure 26. KissFlow characteristics (Kissflow, 2021).

Process Maker

Process Maker, **Figure 27**, is an award winning low-code BPM and digital process automation platform. The modeler empowers business users to design business processes days. User can drag and drop tasks and decision points on to the modeling canvas, and the add in their forms, users, data connectors and more. The Process Maker modeler is a BPMN 2.0 compliant, as well as intuitive, and powerful (ProcessMaker, 2021).



Figure 27. Process Maker Logo (Process Maker, 2021)

Business users can easily design elegant forms and display screens that are used in the workflows with no-code. Forms are used to capture data, display data from other systems, and design approval screens for managers to make decisions. This is used by corporations, governments, and education organizations.

Some of this software characteristics, **Figure 28**, are (ProcessMaker, 2021):

ProcessMaker	Low-code digital process orchestration- Empower business users to design and deploy sophisticated business processes using a powerful and intuitive low code platform.
	Automate Workflows- Automate processes across multiple departments and systems to eliminate manual tasks, data silos, and bottlenecks. Improve visibility and tracking for processes across your entire organization and drive the highest levels of operational excellence with ProcessMaker.
	Drag and drop tasks and decision points- Leverage our low code, powerful, BPMN 2.0 compliant process modeler to drag and drop tasks and decision points, and then add in your forms, users, data connectors and more.
	Accelerate Digital Transformation- Connect processes across legacy software and point solutions to accelerate your digital transformation and connect all of your systems, people, and work on one platform.
	Streamline Compliance- Improve workflow agility for compliance control, policy, amanagement effectiveness, and risk management transparency. From new regulatoty filing to incident response, leverage flexible workflows so you can adapt quickly to new regulations.

Figure 28. Process Maker characteristics (ProcessMaker, 2021)

Zoho Creator

Zoho Creator, **Figure 29**, is a low-code automation platform that allows the customer to rapidly create, integrate and extend business apps. It allows users to connect data from a wide range of apps to set up tight integrations, derive insights, automate processes, among other functions (Zoho, 2021).



Figure 29. Zoho Creator Logo (Zoho, 2021)

Some of the top brand companies that use Zoho Creator are Samsonite, Whirlpool, Audible and Saint-Gobain. The platform also counts with over seven million users, allowing them to transform their business with customized solutions.

Some of this software characteristics, **Figure 30**, are (Zoho, 2021):

Zoho Creator

Create applications- With Zoho Creator, users can build multiplatform applications that integrate with your existing processes.

Automate workflows with ease- Workflows configuration to automate user's business applications with minimal steps and iterations. Any user with business logic knowledge can build an application in no time.

Connect and extend applications- filling the gaps in the existing system or extend its functionality.

Figure 30. Zoho Creator Characteristics (Zoho, 2021)

Nintex

Nintex, **Figure 31**, is the global leader in workflow and content automation. The easy to use, point-and-click functionality of their workflow automation software has given every organization from Small and Medium Enterprises (SME's) to massive enterprise organizations the ability to take everything from basic business functions to company-wide processes with a few clicks to the next level (Nintex, 2021).



Figure 31. Nintex Logo (Nintex, 2021).

Nintex workflows allows you to easily automate simple business processes and critical business wide systems without the need of code. The workflow tool can transform long winded manual processes into an efficient automated process that permits employees to spend more time doing what they are actually employed to do.

This software is used among some of the biggest companies in the world, including Amazon, AstraZeneca, Coca-Cola, Microsoft, Siemens, LinkedIn and Johnson and Johnson.

Some of this software characteristics, **Figure 32**, are (Nintex, 2021):

Nintex

Manage- Visually pain, map, and manage your business processes with tools process owners and participants can use;

Automate- Identify the processes best suited for or in need of automation and get started with clicks, not code.

Optimize- Optimize your business processes leveraging the data created through your automated processes.

Figure 32. Nintex Characteristics (Nintex, 2021)

Bizagi

Bizagi, **Figure 33**, is a leader in intelligent process automation. They help companies to digitally transform since before the term was invented, transforming, and automating the company's processes.



Figure 33. Bizagi Logo (Bizagi, 2021).

Their vision surrounds the age of intelligent automation, being able to be the process automation platform of choice, enabling the agility organizations need to compete. Their mission is to help their costumers to transform faster into intelligent digital businesses.

This software is also used among some of the biggest companies in the world, including Adidas, Audi, ManpowerGroup, BNP Paribas and Citizens Bank.

“Bizagi possesses the native capabilities and partnerships needed to support business process automation across the enterprise- including business decision management and robotic process automation.” Forrester Research

Bizagi offers its enterprise-grade automation solution through not one, but three separated products: Bizagi Modeler, Bizagi Studio, and Bizagi Engine. The first two have free access and offer the necessary functions to create process models and their automation in test environment. Meanwhile, to use these models in work context, we need the third product, Bizagi Engine, which has a cost associated.

Some of this software characteristics, **Figure 34**, are (Bizagi, 2021):

Bizagi

Business Model- Bizagi's performace based pricing model means that users only pay for what they use.

Bizagi's Team- They have a dedicated local support team. that will guide the users though their intelligent automation journey.

Bizagi's platform- A flexible, business-friendly platform that allows users to model, simulate and automate any process.

Figure 34. Bizagi characteristics (Bizagi, 2021)

2.1.5 Comparison between BPMS

Table 2. Comparison between BPMS- Kiss flow, Process Maker, Zoho Creator, Nintex and Bizagi.

	KissFlow	Process Maker	Zoho Creator	Nintex	Bizagi
Code	No code necessary	Low code platform	Low code platform	Low code platform	Low code platform
Deployment	Cloud- based & Open API	software hosted in the Amazon Web Services (AWS) Cloud	Cloud- based & Open API	Cloud- based & on site (registration request)	Cloud- based Open API
Platform	Windows; Mac; Android & IOS	Windows; Android & IOS	Windows; Mac; Android & IOS	Windows; Mac; Android & IOS	Windows; Mac; Linux; IOS; Android and Windows phones.
Price	Between 10\$ and 19\$/ per user per month	Prices depend on the number of users, and start on the 1495\$ billed annually	Prices depend on the number of users, and start on the 100€/250 users per month, to 10000€/ 100.000 users per month	910\$ per month for 10 users; For enterprises starts on the 1400\$/ month for 10 users.	Free for personal use (Bizagi Modeler); Every product has a different price.
Free Trial	Available	Available	15-day free trial	Available	Available

2.3 BPMN as a Quality Tool

High levels of quality are essential to achieve Company business objectives. Quality, a source of competitive advantage, should remain a hallmark of Company products and services. High quality is not an added value; it is an essential basic requirement. It does not only relate solely to the end products and services a Company provides, but also relates to the way the Company employees do their job and the work processes they follow to produce products or services.

The work processes should be as efficient as possible and continually improving- and this is where the quality comes into the business management. The company employees are one of the most important resources for improving quality, since they are responsible for ensuring their work processes, efficiently and continually improving.

2.3.1 Quality Management Systems: what is it?

A quality management system (QMS) is defined as an organizational structure, that documents processes, procedures, and responsibilities for achieving quality policies and objectives. A QMS helps coordinate and direct an organization's activities to meet customer and regulatory requirements and improve its effectiveness and efficiency on a continuous basis (American Society for Quality, 2021).

ISO 9001 is defined as the international standard that specifies requirements for a quality management system (QMS). Organizations use the standard to demonstrate the ability to consistently provide products and services that meet customer and regulatory requirements. It is the most popular standard in the ISO 9000 series, and the only standard in the series to which organizations can certify.

ISO 9001:2015 applies to any organization, regardless of size or industry. More than one million organizations from more than 160 countries have applied the ISO 9001 standard requirements to their quality management systems (American Society for Quality, 2021).

Organizations who use ISO 9001, have the ability to, **Figure 35**:

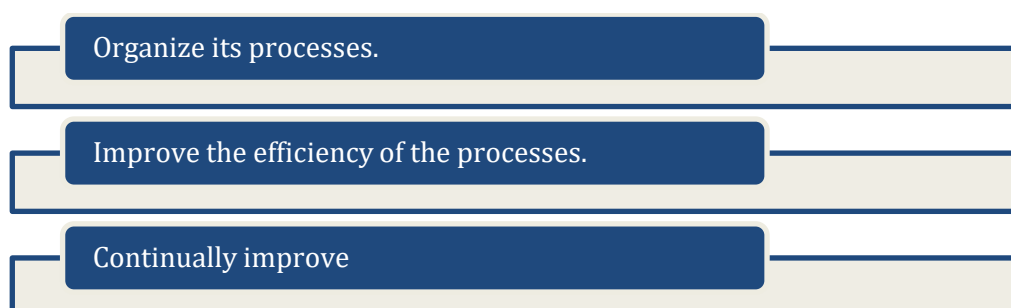


Figure 35. Abilities organizations who use ISO 9001 have.

Implementing a quality management system affects every aspect of an organization performance. Benefits of a documented quality management system include:

- Meeting the customer's requirements, which helps to instil confidence in the organization, in turn leading to more customers, more sales, and more repeat business.
- Meeting the organization's requirements, which ensures compliance with regulations and provision of products and services in the most cost-efficient manner, creating room for expansion, growth, and profit.

These benefits offer additional advantages, such as, **Figure 36**:

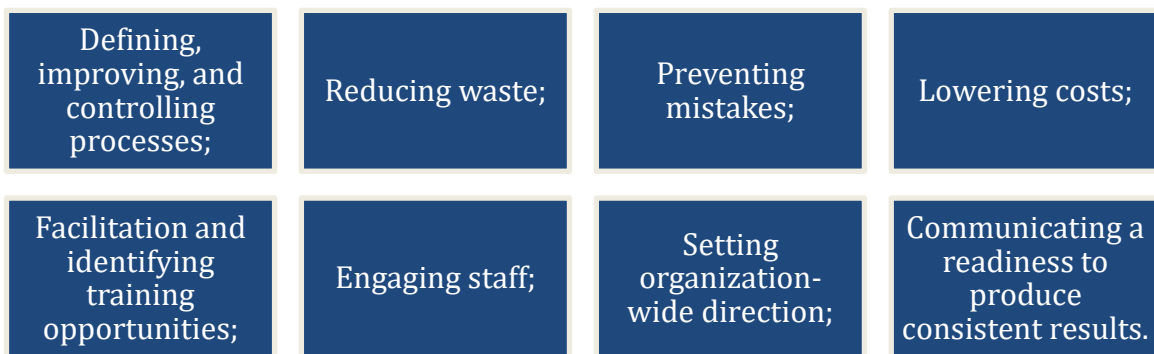


Figure 36. Advantages in the implementation of a quality management system.

2.3.2 ISO 9001:2015- a process-oriented approach

ISO 9001 is based on the plan-do-check-act methodology and **provides a process-oriented approach** to documenting and reviewing the structure, responsibilities, and procedures required to achieve effective quality management in an organization. Specific sections of the standard contain information on many topics, such as (American Society for Quality, 2021):

- Requirements for QMS, including documented information, planning, and determining process interactions.
- Responsibilities of management.
- Management of resources, including human resources and organizations work environment.
- Product realization, including the steps from design to delivery.
- Measurement, analysis, and improvement of the QMS through activities like internal audits and corrective and preventive actions.

Quality management also has a series of principles, **Figure 37**, such as:



Figure 37. Quality Management Principles

2.3.3 Quality Management Systems in the healthcare

The 13th principle in the International Conference on Harmonization Good Clinical Practice (ICH GCP) guideline, clearly states that systems and procedures that assure the quality of every aspect of the (clinical) trial should be implemented.

Hospital management has always been a challenging topic for managers, due to the concentration of different areas, processes, and different professionals in a single environment. The quality in health units, on the other hand, has been assumed, in recent years, as a strategic axis in this sector.

The growing concern with health-related aspects has been accompanied by profound changes in the sector, which has driven the quality of health units to become a strategic axis, accompanied by the rapid development of methodologies related to improving the quality of care rendered (Gomes S. M., 2011) (Ovretveit, 1999).

This change resulted from the combination of a set of factors. The practice of medicine has been increasingly complex and multidisciplinary; healthcare consumers and families are informed and have higher and higher expectations; the rapid production of knowledge in the areas of quality, management and clinical practice itself; the rapid technological advances and the wide range of experiences in this area, with satisfactory results in the health units, materialized in an additional sensitivity to issues related to the quality of the health services provided. (Campos e Vaz, 2010; Øvretveit, 1999).

This need generated a movement governed by the appearance of several quality programs, which aim to materialize quality in health units.

Hospital quality should encompass medical care, appointments, admissions, complementary exams, food, internal and external logistics, among others. From the moment that hospitals, clinics, or laboratories focus on quality, this type of management manages to standardize processes and verify/identify where faults, opportunities and improvements are found.

2.3.4. Relating BPMN and ISO 9001 in quality

Standardization is defined as an activity that gives rise to solutions for repetitive application to problems in various disciplines including science and it is aimed at achieving the optimum degree of order in a given context. Generally, the activity consists of the process of establishing (determining, formulating, and issuing) and implementing standards. Therefore, standards are the ultimate result of a standardization activity and within the context of quality systems consist of quality documents or documents related to the quality systems (Manghani, 2011). **The identification of processes in a Service or in a company, is a key part in any form**

of model implementation process of ISO 9001 (Montini, Matuck, da Cunha, Dias, & Isaac, 2014).

According to Schonreiter, (2018), the term quality management is like a synonym for the term process management, arguing that processes themselves are the subject of quality management. A process-oriented quality management system encompasses, manages, and directs all the activities in the organization. Process management is an integral part of a model quality system (Idan, 2012). Different sectors apply quality management to manage processes and ensure the quality of products and services.

ISO 9001 is applicable to hospital management, clinics, medical equipment companies and all other organizations involved in the healthcare field. The application of this standard to quality in the area of healthcare provision is due to the fact that the standard is, as mentioned above, designed to adapt to any context and has requirements of any type of organization. Medical procedures or complementary diagnostic techniques can be submitted to ISO processes, which involve the implementation and monitoring of indicators of continuous improvement and verification of non-conformities.

Although there are other certifications used in the hospital environment (ONA, Accreditation Canada, NIAHO, HIMSS, Joint Commission International), ISO 9001 is the standard most applied in order to raise the quality of processes.

2.4. Management in Healthcare units

Everyone is confronted with the healthcare delivery system in a certain way. Government interventions in the provision of healthcare can occur through the economy, healthcare providers, doctors, and medical staff, and so on. The provision of healthcare is represented by a set consisting of services and products, as well as the institutions and regulation of stakeholders (Briestensky & Kljucnikov, 2019).

The success of a hospital cannot be measured as easily as that of ordinary business entities. They need to be evaluated by some factors such as the financing and quality of the healthcare. Evaluation is a complex process consisting of many parts. There might be some key performance factors of healthcare organizations that include the following: a financial analysis indicator, budgeting process indicators, costing system, but also customer satisfaction, the quality of services, number of errors, the process efficiency, process utilization rate, the personnel satisfaction, and staff training and education.

2.4.1. Processes in the Healthcare units

The Healthcare processes are highly complex and variable, due to the daily work that requires frequent reactions to the intermediated results from the diagnostic process, as the unexpected medical instructions.

Beyond being complex, these structures have an enormous interdependency: Their services are not independent, but are interconnected, and make the organization function as a hole. If there is a problem or something is not working correctly in a service, this will interfere with all the services, and consequently, the final result. (Gomes, 2018; Luciano, Pinto, & Nunes, 2020).

Thus, it is extremely important that the health sector maintains its current processes defined, not only to achieve continuous improvement in the services offered, but also as an essential part of the quality programs in which it is integrated (Rolón et al., 2015)

In a competitive healthcare market, it is imperative that hospitals reorganize their structure and operations in order to make customer service more efficient. Labour, capital, and information are critical resources: availability, correctness, and facilities to process information are crucial for efficient patient care (Rolón, et al. 2015).

Healthcare organizations face several difficulties and problems in the management of their numerous processes, which can be divided into strategic problems, tactical problems, and operational problems. From a Business Process Management perspective, we can define a relationship with these difficulties (**Figure 38**), which are (Bandara, Indulska, Chong, & Sadiq, 2007):

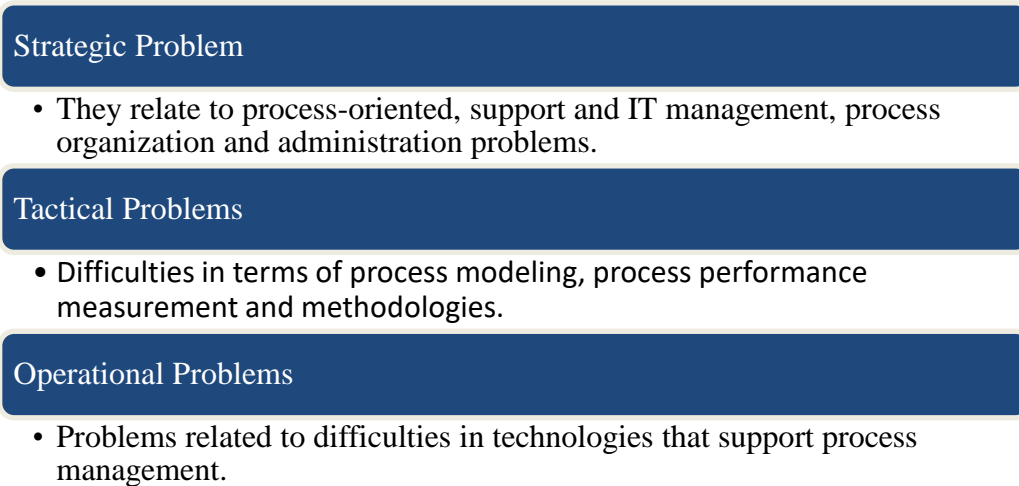


Figure 38. Healthcare organization's difficulties (Bandara et al. 2007).

In these types of organizations, it is common to find a manual of processes / procedures in the various services (Management, Administration, Nursing, Pathology, among others), which professionals can consult when doubts arise about a certain procedure or technique. These manuals are documents that aim to establish and standardize the main technical and organizational practices and procedures of the service. In addition to being quite extensive, these documents are not practical in an emergency situation, and are not interpretable by any type of professional.

Thus, BPM is a reliable approach to standardize processes, and it is one of the process managements practices most used by organizations, and can be applied in different contexts, while BPMN provides, through simple language, pertinent information about the process/ procedure to any type of professional.

2.4.2. Studies on process management in healthcare

In this section of the thesis, we decided to demonstrate the importance of the implementation of BPM in the Healthcare systems by show some of the work done in different healthcare units around the globe.

(Luciano, Pinto, & Nunes, 2020), Portugal

Among them, is Luciano, et. al, (2020), a study conducted by the author of the current thesis, in Portugal, that relies in the analysis of statistical data from the application of an inquiry to professionals who exercise in these types of organizations. The query has three sections of questions, each one dedicated to one goal: the first one, to perceive how the professionals saw their own service and department, and if they were satisfied with the manual, they had available to consult the processes they had in the service; the second one, had questions directed to the BPMN itself; and the third section, had the social demographic questions.

With the answer from 131 professionals from very different positions (including doctors, department directors, managers, executive elements, engineers, pharmacists, superior technicians, and other technicians) and study levels (with professionals that had the secondary school, to professionals with Masters, MBA's or

In the first section of the query, the study concluded that on average, professionals attribute higher levels of agreement to the statements "I would like to better understand the processes carried out in the institution where I work" and "I think it is important that all elements of the institution where I work, have a general knowledge of the processes carried out there", with the latter reaching the highest mean, and a lower standard deviation, indicating a high degree of agreement on the professionals responses.

Also in this section, in the statements directed to the procedures manual (that we can find in the health services), in the statement "There is a procedures manual related to all the procedures/ processes that occur in my department/service", we can conclude that we have the highest standard deviation value of all the statements, meaning that the professionals were not unanimous in their answers, that is, there are departments/ services with and without a manual of procedures. The lowest average is associated with the statement "I find it easy and quick to consult the procedures manual of my service/ department".

In the second section the authors had questions related to the BPMN itself; one of them was "Do you think it is advantageous to implement a method/notation (BPMN), that defines and characterizes the processes carried out in the health unit where you work?". In the following **Figure 39**, the professional's answers are exposed, with 72.52% of positive answers and only 3.05% of negative.

Do you think it is advantageous to implement a method/notation (BPMN), that defines and characterizes the processes carried out in the health unit where you work?

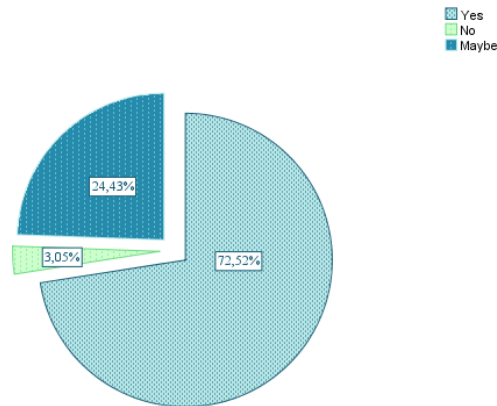


Figure 39. Answers to the question "Do you think it is advantageous to implement a method/notation (BPMN), that defines and characterizes the processes carried out in the health unit where you work?"

In order to investigate the percentage of professionals who had knowledge of BPMN and the level of this knowledge, the question "Do you have knowledge of BPMN" was applied, **Figure 40**:

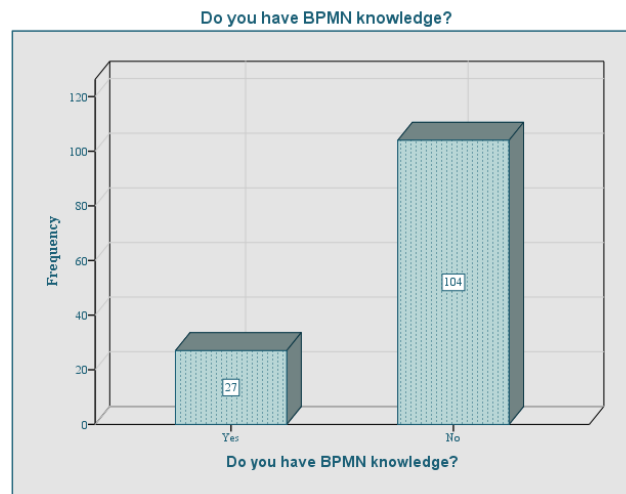


Figure 40. BPMN knowledge.

Authors obtained 27 positive responses (20.6%) and 104 negative ones (70.4%), revealing that the vast majority of professionals do not have any knowledge of BPMN.

Basically, the authors found that professionals, in general, give a high degree of importance to the processes and procedures carried out in the institution and in the service where they work, but they do not feel confident with the procedures manual they have. They also consider that the implementation of the BPMN would be an asset to define and characterize the processes in the institution.

(Silva & Soares, 2016), Brazil

The research that led to the study from (Silva & Soares, 2016) is related to a case study of analysis and design of an Electronic Patient Record, in a public hospital. For this article specifically, the specification of business processes was carried out in order to serve as a guide for the other stages of the application development. In this study, BPM was performed using the BPMN language in order to map all the processes and data flows.

One of the processes mapped in this work was the implementation of bariatric surgical care lines, focused on the patients, since it is a process processed in various services/sectors, and several health professionals in a healthcare unit.

The following processes were mapped in this study, **Figure 41**:

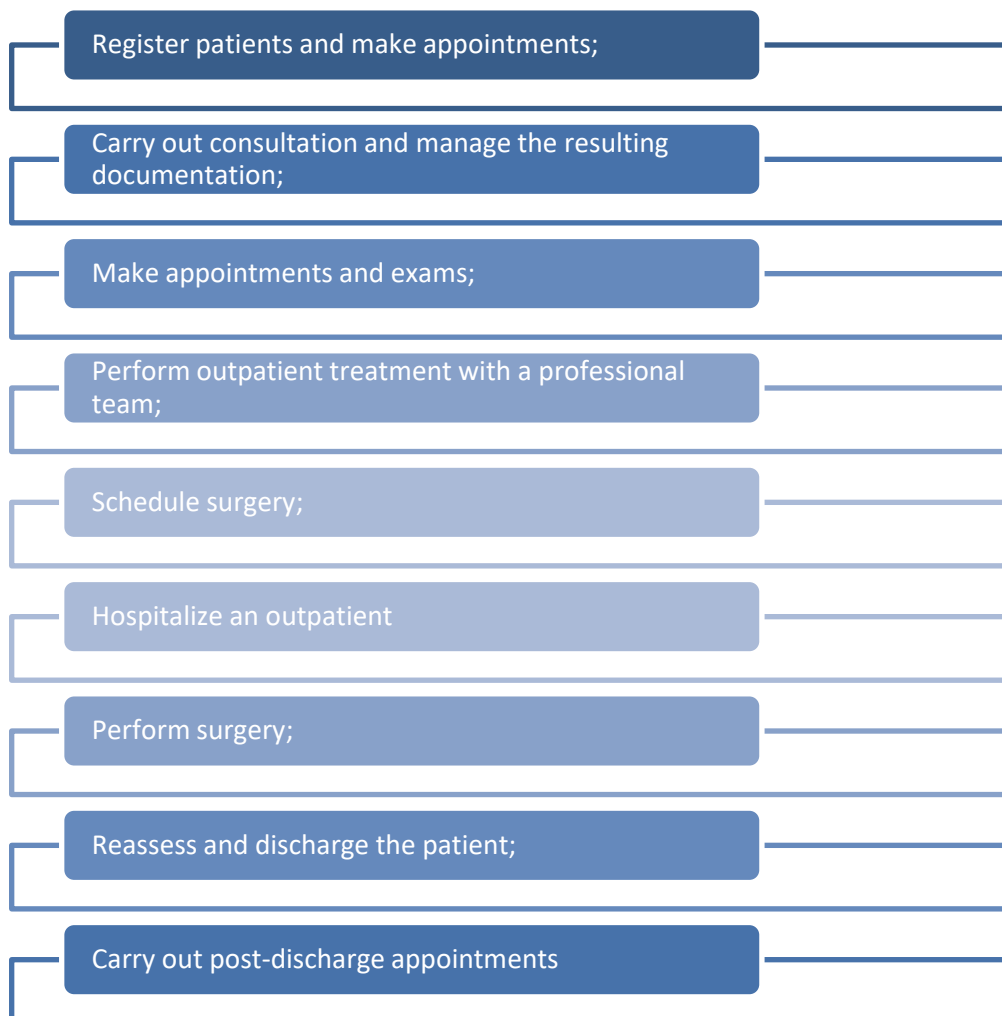


Figure 41. Processes mapped in the Study. Adapted from (Silva & Soares, 2016)

With the mapping realized in the study, the authors were able to develop a notebook with the healthcare unit processes and workflows. Among the mapped processes, “Carry out consultation and manage the resulting documentation” was one of the most important ones, **Figure 42**.

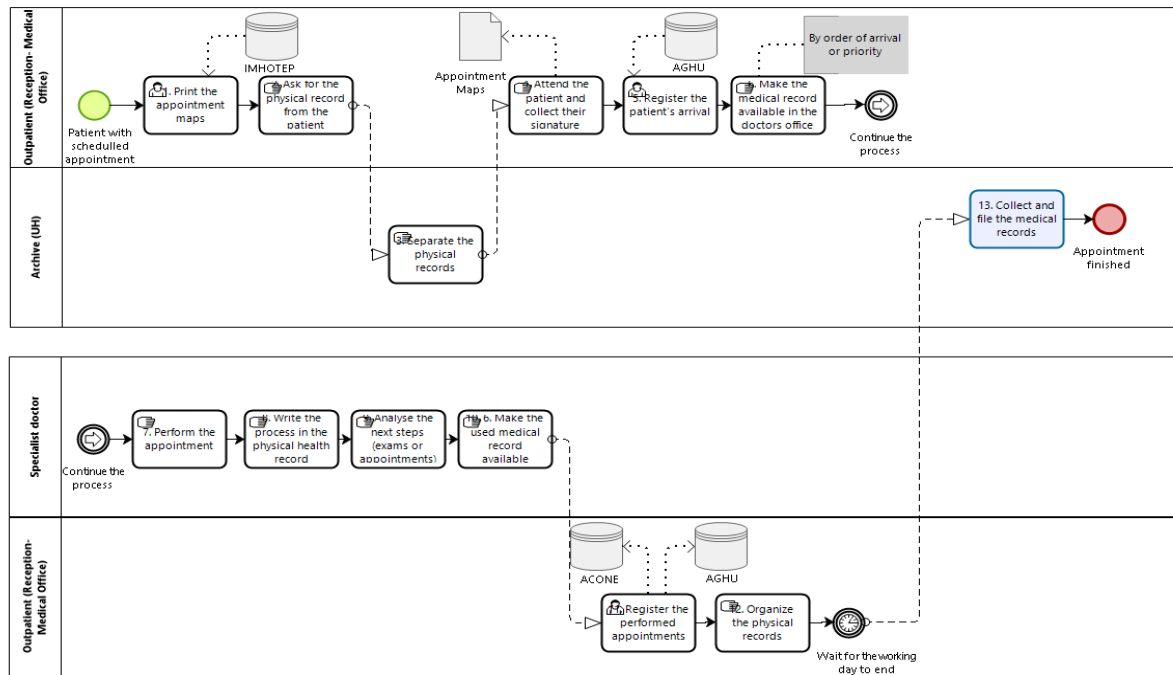


Figure 42. “Carry out consultation and manage the resulting documentation” process. Adapted from (Silva & Soares, 2016)

This University Hospital has different information systems, such as Med lynx (a management system), IMHOTEP (a management software developed by the TI team from the hospital), and the AGHU (a project from the Education Ministry that aims to standardize the care and administrative practices in all 46 university hospitals in the country, to improve the care processes, as well as the availability of indicators standardized among all members of the network. The three systems were the main data sources for the development of the electronic patient record.

To model the “Carry out consultation and manage the resulting documentation” process, interviews were done to the sectors involved, with the supervision of the coordinator nurse- that way, the authors were able to check all the tasks and systems used in the process. The validation of the modelled process was done by the manager nurse for the care and outpatients division.

The mapping of the nine identified processes is a portrait of the real activities performed by the hospital health professionals- they were able to develop a notebook with the processes and workflows found in the hospital and published it in EBSERH. **From the modeling of the referred processes, it was possible to, Figure43:**

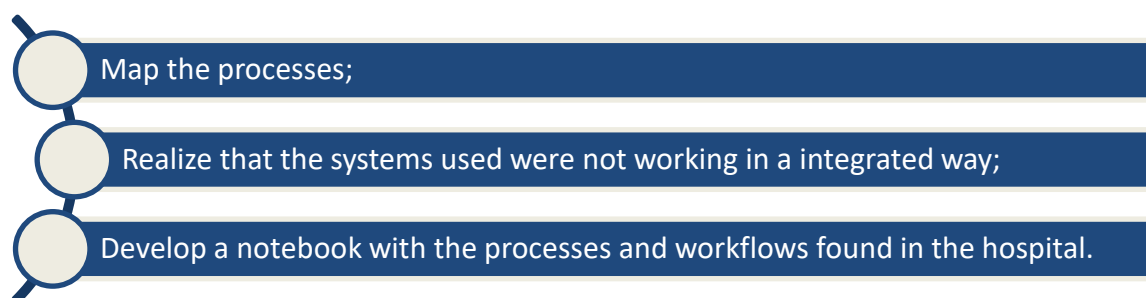


Figure 43. Conclusions and the benefits of using BPMN in Health Institutions according to (Silva & Soares, 2016)

(Rolón, Chavira, Orozco, & Soto, 2015), Spain

In 2015, Spain (Rolón, et. al, 2015), a study was developed in order to show the experience obtained in the creation of the conceptual models of certain hospital processes which can be used as a basis for others in collaboration with hospitals in order to model their processes using BPMN.

The main objectives in the case study were, **Figure 44**:

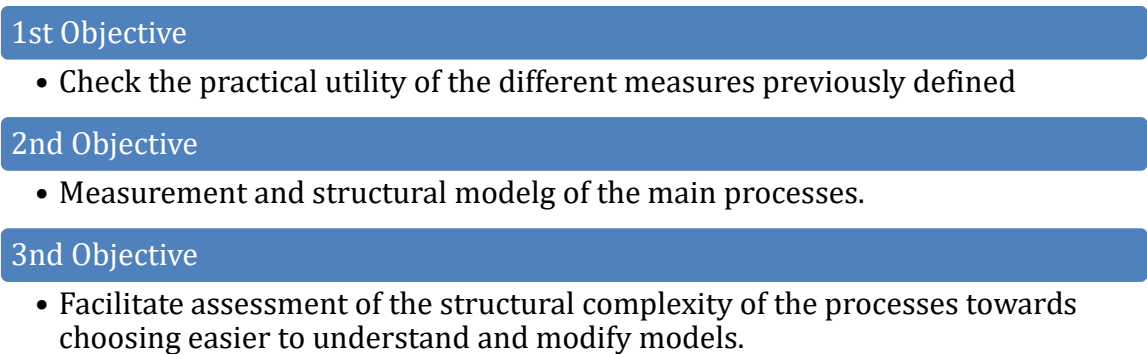


Figure 44. Main objectives of the study

When planning the case study and the methods, a collaboration was done between two work groups of different profiles (businesses and systems), and then a multidisciplinary work group was created. This group included software engineers from UCLM and health professionals and administrative staff from the HGCR. The work was carried out in six phases, **Figure 45**:

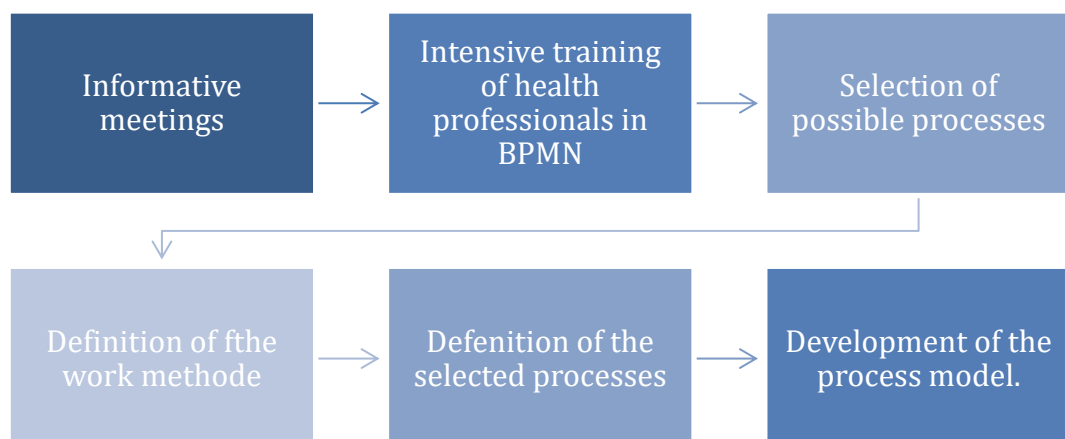


Figure 45. Collaborative work

The hospital experts in the processes developed a record that included: mission of the process, limits, clients, responsible persons, participants and its duties, glossary of

terms, suppliers for the process, description of activities and documents and register. The group of experts in the systems made de modelling of the processes and its sub processes thought a reiterative and incremental method: they added progressively more details, until reaching the level requested by the hospital. The approval of the results was given thought joint revisions of each interaction until the final version was obtained.

As a result of this joint work, three different processes were chosen to be developed (Surgical Patient Scheduling (SPS), Incorporation of a New Employee (INE) and Appointment Process (AP)), and a total of thirty-one sub processes from the three central ones.

In the article developed by these authors, the process chose to be presented was the SPS, **Figure 46**- This process includes the activities since the moment a patient/client is admitted in the hospital for the surgery, until he is discharged.

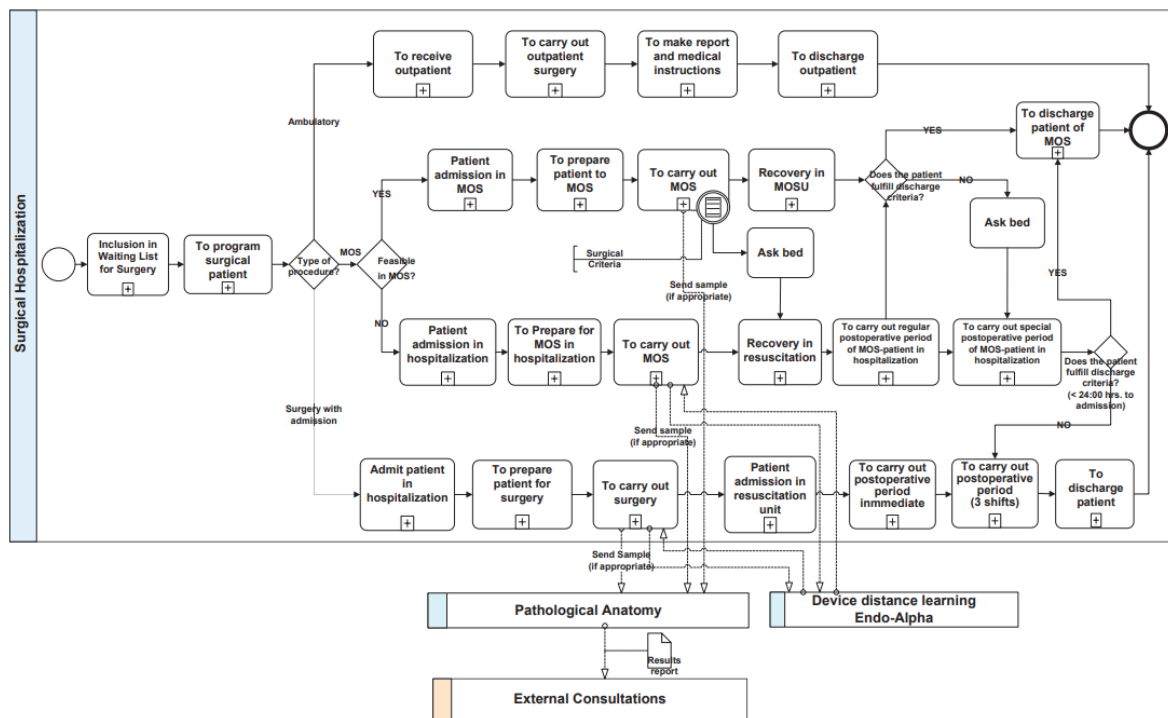


Figure 46. Surgical Patient Scheduling process model. (Rolón, et. al, 2015)

With the development of these models and their sub processes, it was possible to the authors to obtain the “As-is” models of the most representative processes in the health services provided by this institution. This work will be a reference/basis for the construction of future models.

According to the authors, the application of the BPMN notation was very useful since “Due to its characteristics, and the construction of the process models presented could be facilitated to both participant groups (business and systems)” (Rolón et al., 2015, p. 5607). Another important contribution was the

actual knowledge of all the complexity around each process- at the beginning of the study, the authors did not anticipate that these were such complex processes.

3. Methodology

3.1. The importance of BPMN (in general) according to professionals who implement it

This chapter describes all data collection activities arising from the implementation of the qualitative research methodology. Therefore, the foundations for the construction of the interview guides are presented.

The semi-structured interview is characterized by a compromise between the previously established scripted questions, and some spontaneity and improvisation on the part of the interviewees.

For research purposes, the semi-structured interview is a dialogue - whose conditions are a priori explicit and accepted (Delhomme & Meyer, 2002).

As we announced in the beginning of the current work, the investigation questions to which we want to search for an answer are:

- Will the processes in the health organizations really be important?
- Do the professionals of these institutions have knowledge of all processes performed in their department/service? Do all the staff have access to procedure manuals?
- Will it be possible to solve the central problem of the investigation, applying the organizational practice of management oriented to processes?
- Do BPMN professionals think this is a good tool to improve the processes? Why? Which are the benefits in using it?
- Did these professionals implement this type of management in any health institutions?

3.2. Qualitative research

Through qualitative research it is intended to understand a social situation, an event, a role, a group, or a specific interaction.

According to Bogdan, Biklen, Miles and Huberman (1994), qualitative research advocates obtaining descriptive data, focusing on ascertaining the perspective of those involved.

According to Silverman, (2000) qualitative research is subjective and personal, subjectivity is seen by several authors as an essential element to understand human activity.

As defined in the research methodology, the qualitative research was carried out through semi-structured interviews, followed by a guide of questions from the theoretical framework and more specific matters related to the object of study that are intended to be deepened.

More specifically, the objectives of the interviews with professionals who implement or have implemented the BPMN notation in different institutions where: the study of the existing opportunities for implementing this type of notation; obstacles before and during implementation; the training given to employees; the objectives of the companies and the benefits of this implementation.

3.3. Interview guide

An interview guide was prepared in order to explore the knowledge, experiences, and opinions of each of the interviewees.

The interview guide, designed for professionals who implement or have implemented the BPMN in different institutions (Annex 1), consists of 14 questions, focused on the implementation of the BPMN. The questions came from scientific literature related to BPMN and specific questions related to the research topic. Therefore, it was intended to obtain information about the interviewee (to the extent of their academic qualifications and acquisition of knowledge about BPMN), the existing opportunities and the type of companies that seek this type of solutions, the obstacles and difficulties that companies have before and during the implementation of the BPMN, the training given to the employees of the companies where this type of notation is being implemented, the objectives of the companies, types of software used, and the advantages of implementing this notation.

Several topics were discussed, and the interviews topics were structured in the following way, **Figure 47**:

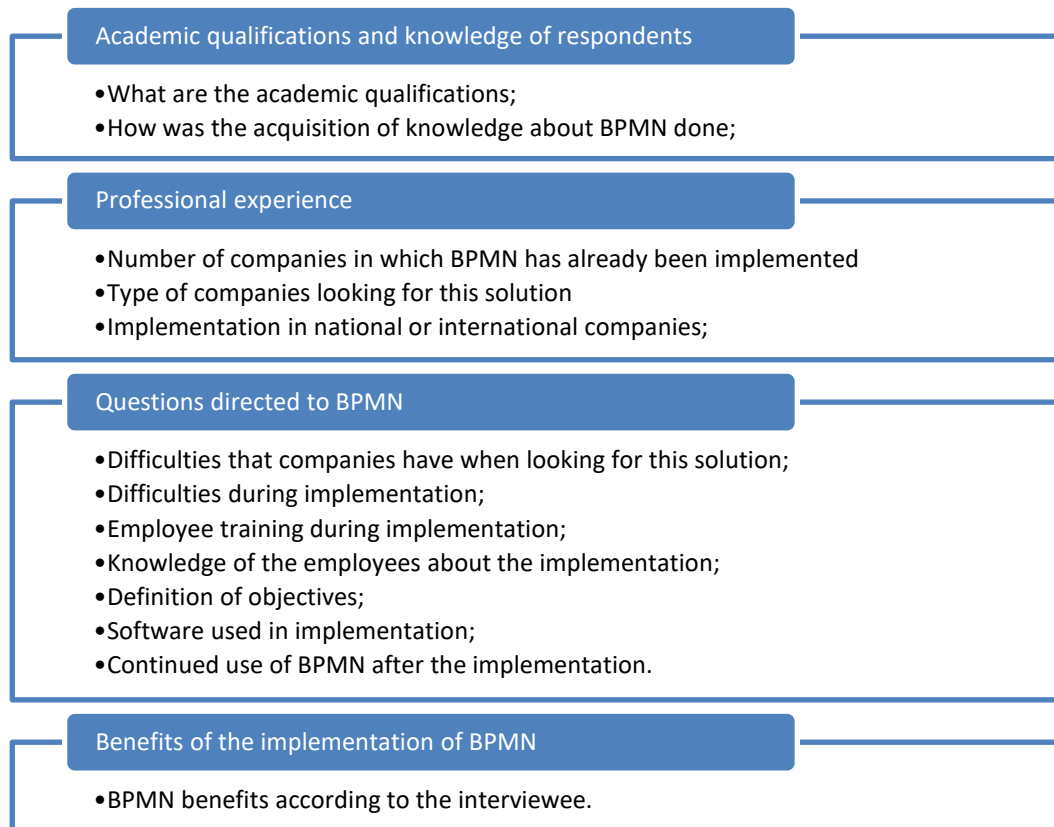


Figure 47. Topics and subtopics addressed in the interviews

3.4. Interviews

As we said previously, though the social network LinkedIn, a first search was made under the word BPMN. The professionals chosen to do the interview should have professional experience in the BPMN field. 7 professionals were chosen from Portugal, and we proceed to send an invitation to participate in the study (attached), where the same study was fully explained, as well as its contextualization. The interviews requests were sent via email (annex II), and a new contact was made to schedule the date and place of the interview. Only 4 professionals responded positively to the invitation, to whom we sent the script for the interview. Later on, only 3 professionals showed up to the previous scheduled interview. We opted to carry a semi-structured interview, which is more deeply explained in the fourth chapter of the current work.

The interviews were conducted during the month of November 2021 - two of the interviews were carried out via Zoom (interview A lasting 55 minutes; interview B lasting 40 minutes), and a third was answered by the interviewee and sent by email later due to the non-compatibility at a professional level of arranging a face-to-face or online interview.

All interviews were recorded in audio and video format, with the express authorization of the respondents before the beginning of the questions - information

that could identify the interviewees was hidden, such as the name of the companies and projects where they have already worked, safeguarding their non-recognition .

Afterwards, the interviews were transcribed. There are several transcription methods, according to (Azevedo, et al., 2017): transcription to a word processor (e.g., Microsoft Word) of the interviews, or using specific software, which provide a set of tools that facilitate and speed up task, such as NCH Express Scribe.

There are also two types of transcription according to Bucholtz, (2000), namely naturalistic versus non-naturalistic. Naturalistic transcription corresponds to the detailed transcription of what is said and exactly how it is said and advocates the preservation of different elements of the interview in addition to the verbal content, such as non-verbal language, contextual aspects and interaction between the interviewer and the interviewee (Oliver, Serovich, & Mason, 2005). On the other hand, non-naturalistic transcription privileges verbal speech, and focuses on the omission of idiosyncratic elements of speech, such as stuttering, ticks, involuntary vocalizations, and non-verbal language, presenting a more polite and selective transition.

The transcription of the conversations, of vital importance for the future analysis of the data, turned out to be quite arduous due to the time consumed. The transcription of each interview took approximately two hours. In the transition from interviews to writing, we tried to respect, as far as possible, the characteristics of the oral record. However, certain aspects of orality were corrected, namely word repetitions, eventual inaccuracies in terms of agreement processes, as well as redundant repetitions of words were omitted. The formal treatment of conversations was also standardized to avoid discrepancies at this level. This initial work resulted in 3 interviews - interview A and B with about 4 pages each, after 4 hours of transcription, and interview C with two pages.

The summary of the main topics of the answers was compiled in the Matrix of the interviews. Transcripts of interviews with professionals can be found in the appendix (D).

4. Analysis and discussion of results

4.1. Sample characterization

All the interviewees were male professionals, who worked in companies in the IT sector, in the metropolitan area of Lisbon, Portugal.

The interviews started with the question about academic qualifications; The first and second interviewees had bachelor's and master's degrees in computer engineering and management. The third interviewee had a degree in computer engineering. This information matches what we analysed during our bibliometric analysis, where majority of the papers published are related to the computer sciences area.

Regarding the answers obtained to the question about the acquisition of knowledge in the area of BPMN, these were transversal to all the interviewees - they all acquired knowledge about this notation during their academic paths, with the presence of curricular units on business processes. The third interviewee also considered that the knowledge he acquired during his professional experience, was important.

When asked about their professional experience, all interviewees shared a little about the companies and projects in which they worked; The first interviewee implemented BPMN in five projects, in four different companies, inside and outside the country (Portugal): "I have had the opportunity to implement BPMN in 5 projects, in 4 different companies: two projects were implemented in the same company"; The second interviewee, in addition to an internship, participated in several projects, national and internationally, in the company he currently works; the third interviewee had the opportunity to implement BPMN in two different companies - "(I) implemented in 2 companies, 1 in Portugal and 1 in Brazil". When asked about the type of companies or sectors that are most looking for this type of process management, we got very different answers, **Figure 48**:

1st interviewed	2nd interviewed	3rd interviewed
<ul style="list-style-type: none">• There is no rule;• Banking• Finance	<ul style="list-style-type: none">• No specific sector• Projects that have a business process as fundament;• E-commerce, Health, Industry, Public sector	<ul style="list-style-type: none">• Real State

Figure 48. Type of companies/ sectors, that look for this type of solutions.

When asked if they have already had the opportunity to implement BPMN in a healthcare company, the first and second interviewees responded positively (European Medicine Agency, and SICAD, respectively), while the third interviewee responded negatively. We were not expecting to have many positive answers, taking in consideration that BPMN in the healthcare field, is a relatively new topic.

4.2. BPMN and it's difficulties, training, objectives, software, and benefits

In this section, several issues that were more focused on BPM/ BPMN and its implementation were addressed. Regarding the difficulties that companies have when looking for this type of solution, interviewee A states that “most companies either have no idea of the business processes that exist, or they have identified the problems that a product or service they sell has (by complaints from customers, or stakeholders), and part of someone looking for a solution, and evaluating what exists (processes) and is not documented or does not exist at all”. Companies often have, according to the same interviewee, “(...) an internal communication problem”, and there may or may not be documentation about the processes.

Interviewee B, on the other hand, clearly says that one of the great difficulties is “(...) the lack of know-how”. Interviewee C refers to the difficulty that the company has in recognizing its own processes, and “(...) knowing how to structure them, because they were able to create the models correctly”.

With this question, we quickly realised that many of the difficulties or obstacles referred by the interviewees, are the ones we stated during the state of the art, when discussing the clinical processes: the lack of documentation and an internal communication problem, as the healthcare professionals do not have the knowledge about what other services do.

During the actual implementation, the responses varied. Interviewee A focused on the lack of communication between the various employees of the company: “(...) the bigger the company, the greater the probability of this happening (...)”, but that “fortunately”, the most important people are involved.

Interviewee B goes further and addresses several obstacles, such as, **Figure 49**:

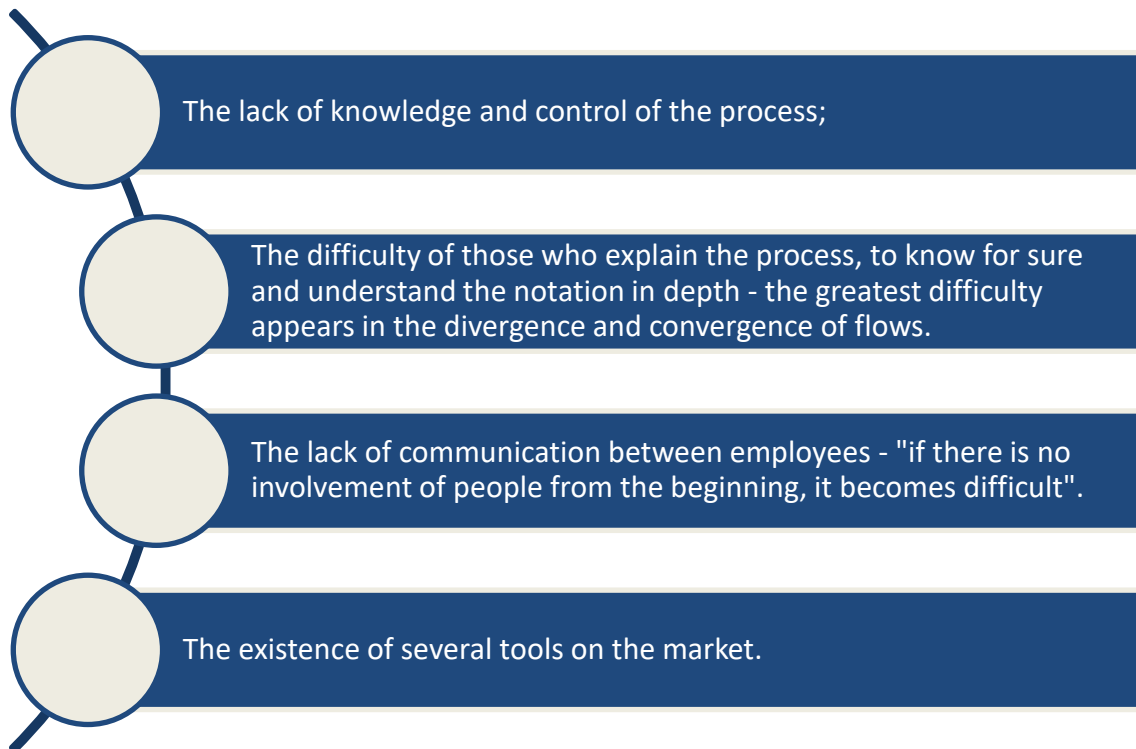


Figure 49. Obstacles to the implementation of BPMN, according to the second interviewee

Interviewee C mentions the frequent changes to the processes in which “changes (...) can have consequences in the previous and following steps, leading to changes in the process”.

Interviewee A also explained that outside Portugal, professionals tend to be more dedicated to the planning, analysis, and conception in these projects, leading to a better and easier implementation.

4.2.1. Training

As mentioned earlier, not all professionals, in whatever area, are aware of BPMN. Therefore, training is important when implementing this type of notation, so that everyone fully understands the notation and the final graphics.

For the first interviewee, training is given to employees mainly on the type of visual elements that exist in the language that is being used, in order to understand the concepts. The second interviewee told us that “typically there are initiatives between client and supplier”, in which although there is no training itself, there is an involvement of employees in the initiative. In other initiatives related to enterprise architecture projects, the client is given the know-how about business process management and “(...) yes, there is specific training in BPMN”. The third interviewee only addressed the training that professionals have on-job.

Following this question, we asked professionals if the employees of the company where they implement BPMN, are aware that this implementation is being carried out. The first interviewee had previously mentioned that there is indeed an involvement of employees; the second interviewee follows the same line, “we always try to get everyone involved”, while the third interviewee says that “generally”, most employees are involved, as they are the ones who have a deeper knowledge of the reality and the limitations of the existing processes.

Interviewees were asked whether internal objectives were defined prior to the implementation of BPMN in companies. The first interviewee reported that if these objectives existed, he did not have access to them, but “(...) I can assume that [they] had them, through the final product. But there are always common goals, such as improving the relationship they have with customers or suppliers or improving competitiveness within the industry.”. Internally, the interviewee also mentioned that employees are up to date with new technologies and best practices in the market, but that the main objective is always “the improvement or creation of a product”.

The third interviewee makes it very clear that this process of making clear the definition of the scope and objectives, must be done before any implementation.

The second interviewee speaks of two scenarios: the first in a closed project and BPMN is an end, being “a common language to communicate the characterization of the process”. The second scenario encompasses a business initiative, where objectives are defined, such as the mapping or characterization of processes to implement an ISO9001 (as mentioned by Montini, Matuck, da Cunha, Dias, & Isaac, (2014) or defining processes in the company to define responsibilities or increase customer satisfaction.

When asked about the software they use, responses varied between the following programs, **Figure 50**:



Figure 50. Software used by the professionals who were interviewed

4.2.2. Benefits of implementing BPMN from the perspective of the professionals interviewed

We started this investigation after we perceived some major faults in health institutions, more specifically problems related to the processes that exist in this type of enterprises. The gap in the identification of the processes, the lack of a solid base where these professionals can support themselves, and the inexistence of a general knowledge about the procedures or processes carried out in other departments are some of the biggest faults identified.

As we discussed during the state of the art, BPM and BPMN implementations bring several benefits, such as the process improvement in efficiency and quality (Chinosi & Trombetta, 2001), the implementation of a notation that is understandable by all the users, a graphical layout of the processes, and the ability to model complex business processes (such as de clinical processes). These were some of the benefits exposed in the state of the art, and as a comparison, the interviewees were asked to give some personal input about what they consider to be the top benefits in the implementation of BPMN.

The answers are described in **Figure 51**, and as we can easily conclude, are aligned with the literature review, and are a solution to the weaknesses of the clinical processes stated by Fernández, et al., (2019).

This implementation is extremely important, as the health sector need to maintain its current processes defined, to improve the services and provide an efficient patient care, according to Rolón, et al., (2015).

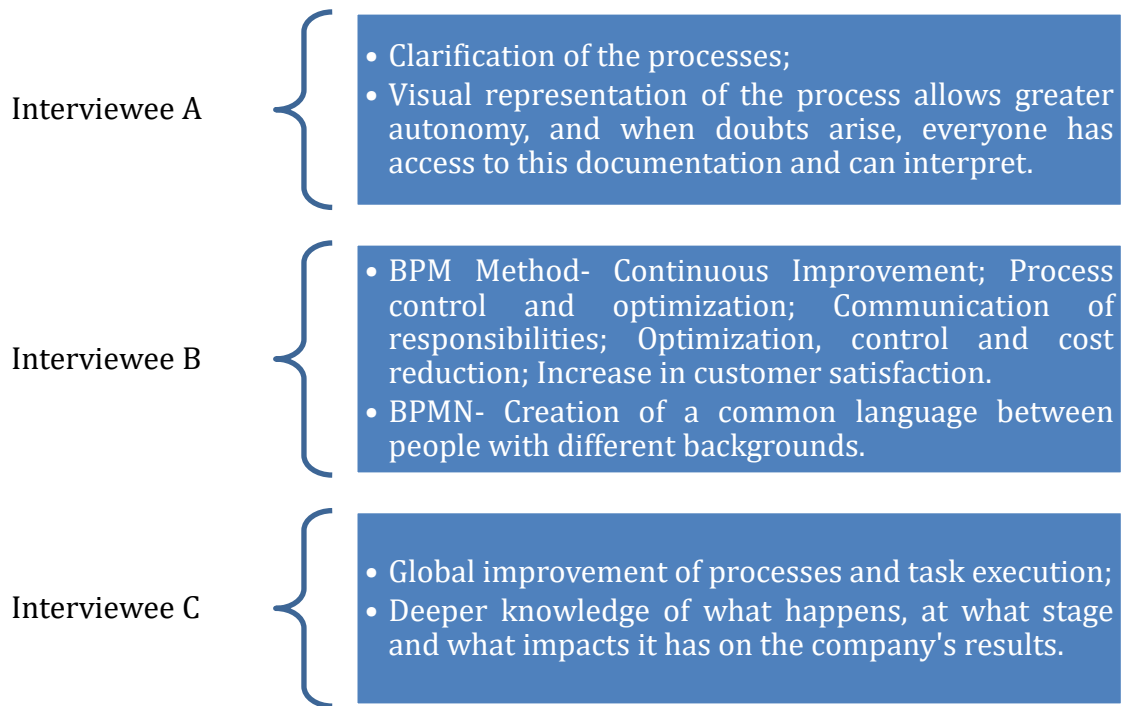


Figure 51. Benefits in the implementation of the BPMN, according to the professionals who were interviewed

With the combination of the state of the art and the answers given by the professionals, we can understand that BPMN could indeed be used to resolve our diminish the faults in the health institutions- processes would soon be clearly identified, a solid base would be created with graphics of the processes, with a very easy notation that can be understood by any professional, in any area/department.

Out of curiosity, we asked these professionals about the state of the implementations they have already carried out in companies.

The first interviewee is not aware of the state of implementations but expects that “the project will remain in the company, and it will serve until it becomes outdated (with a person responsible for updating it.” The second interviewee replied that companies continue to use the documentation “when there is a department, or someone allocated to these initiatives.” The third interviewee tells us that the implementations he made, continues to be used.

5. Conclusion

During this investigation, several discussions and some conclusions were made regarding the analysed topics. Thus, in this chapter, only some of the main conclusions obtained in this thesis will be grouped.

This was a qualitative and exploratory study, as there is not much investigation or bibliography about this topic: we observed this by the bibliometric analysis in chapter 2.1.1. Through the Science direct database, we were able to conclude that only after the year 2011, the number of published papers with the keywords “BPMN in healthcare”, started to grow with more evidence (In 1996, only one paper was published, in 2011, 8 papers, and until April 3rd, 2022, 28 documents were published).

We also perceived that BPMN is mostly used/ studied/ related to areas such as Business and Management, Engineering and above all Computer Science. Also, there are not many people working with this methodology who were willing to participate in this study, since only 3 professionals agreed with an interview- all these professionals had a higher education in Computer Science.

We recall the central research problem “**Can BPMN be used in healthcare institutions, and will it be a benefit for the professionals in order to improve the institution’s services?**”, and other research questions we wanted to be answered with this work, **Figure 52**:

Will the processes in this type of organizations really be important?

- As discussed in chapter 2.4.1, processes in the healthcare institutions are very complex; these structures have a high interdependency when it comes to the services, meaning that when there is a problem in a service, this will interfere with all the services and consequently in the final result. It is extremely important to define the processes to archive continuous improvement, make customer service efficient, among others.

Do the professionals of these institutions have knowledge of all processes performed in their department/service? Do all the staff have access to procedure manuals?

- According to the Luciano et. al (2020) study, we, very easily conclude, that the healthcare professionals would like to have more knowledge about the processes that occurs in their institution; Also, when questioned about the procedure manuals, there is a gap between the answers, meaning that there are departments with and without this manual. The main finding is when they were asked about the easiness in consulting these manuals, with a lower average.

Will it be possible to solve the central problem of the investigation, applying the organizational practice of management oriented to processes?

- Taking in consideration all the previous studies, where the authors were able to map the processes, and use BPMN to construct a process model that was understandable by all the participants, the central problem can, indeed be solved by the application of management oriented to processes.

Do BPMN professionals think this is a good tool to improve the processes? Why? Which are the benefits in using it?

- The author concludes, with the responses given by the professionals interviewed, that they fully support the use of BPM and BPMN to improve the processes- the main benefits stated by them were: the improvements of the processes and the task execution; the visual representation of the processes with the use of BPMN, which allows a better understanding and a easier access to the information; the continuous improvement, optimization of the processes, better communication, cost reduction and finally, the improvement of the client satisfaction.

Did these professionals implement this type of management in any health institution?

- Two of the professionals interviewed did implement this type of management in heath institutions.

Figure 52. Research questions. Self-elaboration.

In the beginning of this journey, we identified some of the faults in the healthcare area, when talking about the processes, as shown by Luciano, et al. (2020). Some of them were:

- The poor identification of the processes carried out in the institution or service.
- The lack of a document where the professionals can quickly consult when they have doubts.
- The lack of knowledge from the professionals about the processes in general in the institution where they work.

Several work, directed towards the implementation of the BPMN in institutions in the health area, were mentioned and analysed (a study from Brazil, (Silva & Soares, (2016), one from Spain, (Rolón, et al, (2015), and one from Portugal, (Luciano et al., (2020)).

Although there is not a vast bibliography, and this is a recent topic, as we observed in the analysis of the bibliography, we were able to identify some studies that we think are relevant to support our thesis, and to perceive the added value in the implementation of this notation in the management of the process of business.

When studying the perception that health professionals have regarding the importance of the processes carried out in the service/institution in which they work, we conclude, according to the study by Luciano, et al. (2020), that professionals think that generally, the processes and procedures carried out in the institution have a high degree of importance, and although they do not have the general knowledge about all the processes, they would like to have that perception. Apart from that, these same professionals, who work in healthcare institutions, do not have the confidence with the procedure's manuals they currently have in their services. Finally, they also consider that the implementation of a method that defines and characterizes the processes carried out in the institution.

When searching for previous papers where the authors tried to implement BPMN in a healthcare institution or service, we analysed two different studies. The one from Silva and Soares (2016), where the authors were able to map the processes, in order to design an electronic patient record. They were also able to develop a notebook with the processes and workflows found in the hospital. In the end, they concluded that the system they were using previously, was not actually working. In another study, developed by Rolón, et al. (2015), thought the collaboration between two work groups, and the creation of a multidisciplinary team, they were able to develop process models for 3 different processes (SPS, INE and AP), and a total of 31 subprocesses. According to the authors, the application of BPMN notation was very useful, since due to its characteristics, the construction of the process model was facilitated to both participant groups.

With the interviews we have done to different professionals, we were also able to understand whether BPMN is useful when implemented in different institutions, and if yes, how so.

According to these professionals, **there are plenty of benefits when BPMN is implemented**, some of them being; the clarification and improvement of the processes and the task executions; the visual representation of the process, that allows a better understanding and easier access to the information (plus, it is easy for any professional to interpret the data), also defended by Chinosi and Trombetta (2001); Continuous improvement, as said by Martin and Jog (2003), better control and optimization of the processes, better communication of the responsibilities; improvement of the optimization, control and cost reduction, improvement of the client satisfaction, among others. **Of course, there are downfalls** when not all the professionals participate in this type of initiatives, or do not have the appropriate formation for the notation used. Also, it is very important that there is a professional who is in charge and makes the necessary improvements through the years, and who will be responsible for the training and the update of the documentation wherever is necessary.

To manage business processes, it is fundamental to understand the importance and the concept of a process. Business processes are a core unit of BPM that is focused on identification, discovery, analysis, redesign, execution, and monitoring as a body of methods, techniques, and tools. In this way, the aim is to improve performance (Dumas et al. 2018).

Quality management has been based on this definition since the beginning of the 20th century: for several decades, business organizations have been identifying, describing and in some cases standardizing their business processes by introducing quality management systems. To think in the quality management in healthcare is a must, and allows a service focused on quality, standardization, and optimization of processes. Certifications such as ISO 9001 are pillars for organizations in the health area to standardize actions based on quality that promote continuous improvement and guarantee the satisfaction of customers and all interested parties. With that being said, it is essential to have a process oriented management, and use quality tools to solve the main issues related to the process management. As one of our interviewees mentioned, Interviewee II, BPMN can also be implemented in quality systems in different types of companies, and as we stated in the state of the art “.

This way, we conclude that BPMN can indeed be used in the healthcare institutions, and with the necessary training and engagement from all the professionals, can be a benefit, in order to improve the institutions services.

Although BPMN was not implemented in a healthcare institution in this study, the expected contribution of this work, based in the study carried out, is to incentive professionals and organizations to give the processes the importance they have, more concretely in the health area, and to provide them with the knowledge about BPMN, and the possible benefits and outcomes of its implementation. Also, we expect to have

contributed to the state of the art, creating a relation between healthcare and business processes, since this is not a topic frequently related to the Business Process Management.

5.1. Limitations

The main limitation of this work was the difficulty in being able to contact professionals who implemented the BPMN. As already mentioned, of the various professionals contacted, only 3 agreed to carry out interviews. All respondents had similar backgrounds - it would be interesting to interview professionals with different backgrounds, and of different genders.

In addition, the area of BPM is more discussed in the areas of management, information technology and engineering, as shown in the bibliometric analysis, in chapter 2. However, the merger between the areas of BPMN and health is something that is beginning to be discussed more and studied in recent years, in order to solve several problems, present in institutions in this area.

5.1. Future Work

After the conclusion of this dissertation work, it is noticeable that this study still presents some points to be explored. The next step would be to actually implement BPM in a healthcare institution, and then carry out a study on the improvements after the implementation. This way, the expected benefits could be analysed with the implementation, using BPMN, and later pass this knowledge on to other organizations, so that they can take the same benefit from the study.

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Appendix A

Email asking for an interview to professionals who implemented BPMN

Assunto: Estudo sobre a importância e necessidade de implementação da notação BPMN em instituições de saúde

Senhor(a),

Espero que se encontre bem.

Sou aluna da Escola Superior de Gestão de Idanha-a-Nova, onde estou a desenvolver a minha tese de mestrado em Gestão de Empresas.

O tema de estudo incide sobre a importância da implementação da notação BPMN em instituições da área da saúde, com o qual se pretende dar um contributo para um conhecimento mais profundo desta realidade, numa perspetiva académica, mas também de apoio às organizações que procurem este tipo de soluções. Em particular pretende-se estudar as oportunidades que existem para implementar o BPMN, os obstáculos antes e durante a implementação, a formação dada aos colaboradores, os objetivos das empresas e os benefícios desta implementação.

Gostaria de lhe perguntar se estaria disposto a agendar uma entrevista, cujo objetivo principal será o aprofundamento de algumas questões em relação à implementação do BPMN.

Desde já agradeço a sua atenção, e aguardo uma resposta tão breve quanto possível.

Bruna Luciano

Appendix B

Interview Guide

Guião de Entrevista

O tema de estudo incide sobre a importância da implementação da notação BPMN em instituições de diferentes áreas, com o qual se pretende dar um contributo para um conhecimento mais profundo desta realidade, numa perspetiva académica, mas também de apoio às organizações que procurem este tipo de soluções. Em particular pretende-se estudar as oportunidades que existem para implementar o BPMN, os obstáculos antes e durante a implementação, a formação dada aos colaboradores, os objetivos das empresas e os benefícios desta implementação.

QUESTÕES

1. Quais são as suas habilitações académicas?
2. Como adquiriu este conhecimento sobre Business Process Model and Notation e processos de Negócio?
3. Em quantas empresas já teve oportunidade de implementar o Business Process Model and Notation?
4. Qual o tipo de empresas/setor que procura mais este tipo de gestão de processos?
5. Alguma vez implementou o BPMN numa instituição na área da saúde? Se sim, qual?
6. Implementou o BPMN apenas em empresas nacionais ou internacionais?
7. Quais as dificuldades que as empresas têm quando procuram por este tipo de soluções?
8. E aquando da implementação, quais os obstáculos que costumam surgir?
9. Sabemos que o BPMN não é uma ferramenta que a maioria dos profissionais, seja em que área for, conheçam. Aquando da implementação desta notação nas empresas, existe algum tipo de formação dos colaboradores da mesma?
10. Os colaboradores têm noção de que está a ser feita esta implementação? Ou apenas os colaboradores de topo/staff/chefias?
11. São definidos objetivos internos, prévios a implementação do BPMN nas empresas?
12. Que tipo de software costuma usar na implementação?
13. Sabe se, após a implementação desta notação, as empresas continuam a trabalhar e a aplicar o BPMN?
14. No seu ponto de vista, quais são as mais valias, vantagens que esta notação pode trazer a uma empresa, no geral?

Appendix C

Interviews

Entrevista ao Profissional A

E: Quais são as suas habilitações académicas?

A: Tenho a licenciatura em engenharia informática e de computadores no técnico; Tenho o mestrado também em engenharia informática e de computadores no Instituto Superior Técnico, e um segundo mestrado em Gestão Internacional no Ashridge Executive Education, Hult International Business School, que se dividiu entre Londres e Nova York.

E: Portanto tem uma formação mais direcionada para a engenharia informática e a gestão.

A: Certo, obviamente estive mais anos a estudar na área da engenharia informática do que na gestão. Mas a razão por ter estudado o mestrado em gestão internacional, é porque havia uma especialização em gestão de projeto, e, portanto, tem muito a ver com a gestão dos processos de negócio. Em informática, a maior parte das cadeiras era muito técnica, muito orientada para a programação.

E: Como adquiriu este conhecimento sobre processos de negócio/ BPMN?

A: Em termos de processos de negócio, foi sobretudo numa cadeira de terceiro ano, chamada modulação de processos, na qual pela primeira vez utilizei o UML e BPMN, e utilizei um software chamado Sparx ea, uma versão mais académica do Microsoft BizI. No mestrado, primeiro ano, tive mais uma cadeira, na qual também trabalhei com BPMN, que abordava a organização e gestão dos sistemas de informação.

E: Em quantas empresas já teve oportunidade de implementar o BPMN?

A: Ora bem, já tive oportunidade de implementar o BPMN em 5 projetos, em 4 empresas diferentes: dois projetos foram implementados na mesma empresa.

E: Qual o tipo de empresas/ setor que procura este tipo de gestão de processos?

A: Varia imenso. Eu diria que depende muito. Não há uma regra, e dependo das necessidades dos projetos que as empresas implementam. Eu diria que a banca e a área farmacêutica, por uma questão de disponibilidade financeira, e por uma questão de existência de pressão para haver inovação e vantagem competitiva em relação aos outros concorrente, são os que acabam por ter mais necessidades destes perfis. Na área da informática, talvez 80% das vagas são para programadores, e os outros 20% para analisadores de perfis- esta a realidade em Portugal. Lá fora não temos esta realidade, felizmente, e penso que é devido a uma questão cultural. Lá fora, existe mais tempo dedicado ao planeamento, análise e conceção, enquanto em Portugal existem menos pessoas para realizarem o mesmo trabalho- por várias razões, mas principalmente por falta de budget.

Sobretudo ingleses, alemães, escandinavicos e bálticos, dedicam muito tempo às sessões de planeamento, brainstorming, reuniões com o gestor de projeto, com o scrum master, para identificação dos problemas, ouvir os experts e perceber o histórico de

projetos que já tiveram, para perceber quais os problemas, o que implementaram, qual foi a equipa. E, portanto, é destas sessões de brainstorming que resultam os chamados “road maps”, e percebemos quais as tarefas que vão ser feitas, a linha temporal.

E: Alguma vez implementou a gestão de processos, ou o BPMN numa instituição na área da saúde?

A: Sim, tive oportunidade de implementar na agência europeia do medicamento. Foi um grande desafio! Esta instituição da união europeia tem como objetivo regular o mercado farmacêutico, ou seja, o projeto era interno, tinha o propósito de acelerar a aprovação ou rejeição de qualquer medicamento/ vacina no espaço europeu, e tinha como stakeholders externos as empresas da área farmacêutica. O processo foi uma agilização do processo de regulação de um produto novo.

E: A seguinte questão seria se já tinha tido oportunidade de fazer este tipo de estudo/ implementação só em Portugal, ou também fora do país.

A: Sim, esta foi só uma das várias oportunidades que tive de implementar o BPMN numa instituição fora de Portugal. A nível nacional tive essa oportunidade da Vodafone. Lá fora também trabalhei na Ema e Accenture.

E: Quais as dificuldades que as empresas têm quando procuram por esta solução?

A: Eu acho que a maior parte das empresas, ou não tem noção dos processos de negócio que existem, ou então identificou os problemas que uma determinadas solução que vendem possui (por queixa dos clientes, ou stakeholders), e parte de alguém procurar uma solução, e de avaliar aquilo que existe (processos) e não está documentado, ou que não existe mesmo. Normalmente as empresas têm alguma problema interno de comunicação, ou porque tem uma pressão externa de querer aumentar número de clientes/ volume de negócios. Quando já têm a documentação criada, é mais fácil fazer os processos “to be”. Apenas analisamos e percebemos o que falta a nível de processos, de documentos, etc. Se os processos estiverem muito complicados, conseguimos simplificar. No caso da Vodafone, não existia esta documentação, e, portanto, tive que confiar muito nas sessões de brainstorming, reuniões e entrevistas, para depois desenhar os processos.

E: E, aquando da implementação, quais os obstáculos que costumam surgir? Os colaboradores têm noção de que está a ser feita esta implementação?

A: A falta de comunização é um clássico- quanto maior a empresa, maior a probabilidade de isso acontecer entre os colaboradores. Felizmente, na maior parte dos projetos, as pessoas mais importantes estão envolvidas- em grupos de trabalho, em pastas no Teams. O “Project Manager” tem esse trabalho de reunir as várias partes que devem estar alinhadas no que esta a ser feito no projeto.

E: Sabemos que o BPMN não é uma ferramenta que a maioria dos profissionais conheçam. Aquando da implementação desta notação nas empresas, existe algum tipo de formação dos colaboradores da mesma?

A: Tive um cliente da indústria de gás/ energia, e têm sobretudo como mercado o Reino Unido e Irlanda. O chefe da equipa era uma pessoa que já trabalhava á imenso tempo no BPMN e ao longo de todos os anos na empresa, nunca deu formação ou nunca partilhou com os restante colaboradores o seu conhecimento sobre o BPMN. Não sei porque, não lhe sei dizer. Mas foi uma dificuldade para mim, quando estava a fazer o workshop sobre o BPMN, havia grandes diferenças relativamente ao conhecimento que cada um dos colaboradores tinha. Esta pessoa não estava motivada porque já sabia muito mais que os restantes colaboradores. Alguns aprenderam com maior facilidade, outros com menos facilidade, mas aprenderam sobretudo o tipo de elementos visuais que existem nesta linguagem (BPMN ou UML), perceberam os conceitos e coloquei-os a fazer alguns exercícios (que na altura trabalhava na Orbus Software em Londres, que vendia um software).

E: São definidos objetivos prévios à implementação do BPMN nas empresas? Objetivos subjetivos?

A: Bom, eu diria que se as empresas tinham, eu não tive acesso a esses objetivos. Posso admitir ou assumir que eles tinham esses objetivos por aquilo que me iam perguntando ou então através do produto final. Mas diria que existem objetivos sempre comuns, como por melhorar a relação que têm com os clientes, ou fornecedores, ou melhorar a competitividade dentro da indústria. A nível interno, possivelmente, colocarem os colaboradores a par com as novas tecnologias, boas praticas no mercado. Mas o objetivo principal é sempre a melhoria de um determinado produto, ou a criação de um produto novo.

E: Que tipo de software costuma usar?

A: Tipicamente, 80% dos casos, é o Microsoft Visio. Também existem algumas empresas, para processos mais rápidos, costumam usar o *Draw io*, uma ferramenta online.

E: Sabe se, após a implementação desta notação, as empresas continuaram a trabalhar e a aplicar o BPMN?

A: Eu não tenho nenhuma prova de que continuem a usar ou deixem de usar, normalmente sou contratado para implementar o BPMN num determinado projeto, e posteriormente não sei o que a empresa faz. Obviamente eu quero pensar que, o projeto fica na empresa, e que serve até ficar desatualizado, e que há uma pessoa responsável por atualizar. Como isto também é algo relativamente recente, antes dos anos 2000 não se falava em processos de negócio. Esta pergunta vai ser muito boa de se fazer daqui a 10/15 anos. Até lá, o que acho que acontece, é, quando há dúvidas consulta-se a documentação dos processos de negócio, e posteriormente, se chegarem à conclusão que por uma evolução da estratégia é necessária mudar ou fazer uma

remodelação, chamam alguém para o fazer. Caso contrário, o Project manager é a pessoa que vai atualizando o projeto.

E: No seu ponto de vista, quais são as mais valias que esta notação pode trazer a uma empresa, no geral?

A: Ora bem, acho que uma das grandes mais valias é mesmo a clarificação dos processos, e de como as “coisas” funcionam. Acho que por mais que as pessoas estejam há 10, 15, 20 anos na mesma empresa, sempre a fazer a mesma coisa e inseridas na mesma equipa, é sempre bom ter uma representação visual, para ter a certeza de que toda a gente está a seguir e a fazer corretamente o trabalho. Para os colaboradores estarem o mais autónomos possíveis, e interromperem o trabalho de outros quando surgem dúvidas, convém que todas tenham acesso a esta documentação, consigam interpretá-la, e para no caso de alguém faltar, mudar de empresa, não haver um bloqueio. E mesmo recebendo colaboradores novos, é sempre importante ter a documentação organizada e atualizada.

Entrevista ao Profissional B

E: Quais são as suas habilitações académicas?

B: Sou licenciado em Sistemas de Informação e Engenharia de Computadores, e mestre na mesma área, no Instituto Superior Técnico.

E: Como adquiriu este conhecimento sobre Business Process Model and Notation e processos de Negócio?

B: No curso tive duas cadeiras: análise e modelação de sistemas e engenharia e tecnologia e processos de negócio. Na primeira cadeira houve uma introdução à modelação de processos de negócio, não só em BPMN, mas também noutras notações. Na segunda cadeira foi quando tive contacto com os processos de negócio, o ciclo BPM, preparação do processo para execução. Portanto todo o meu conhecimento foi baseado nestas duas cadeiras, e posteriormente também a minha tese de mestrado foi sobre este tema.

E: Em quantas empresas já teve oportunidade de implementar o Business Process Model and Notation?

B: Portanto, eu antes de entrar na Syone, fiz um estágio de verão, e este estágio foi precisamente sobre este tema, e, portanto, houve duas vertentes: uma vertente era modelar um processo que depois seria implementado tecnicamente por outra empresa (era uma espécie de uma análise de requisitos de um processo de aprovação de contratos)- esta foi a primeira utilização a nível mais profissional. A nível da Syone temos uma ferramenta de arquitetura empresarial, e a nível dessa ferramenta, temos uma camada de negócio modelada e arquitetura de processos, que depois são modelados em BPMN. Temos ainda ligado a isso, a ISO27001 e ISO9001, que também têm processos associados e fichas de processos associados e os processos são modelados de forma mais simples. Relativamente aos restantes processos da empresa, esses são modelados todos nessa ferramenta, em BPMN. Para além disso, no âmbito dos projetos em que já estive envolvido, em que há Workflow ou processos de negócio associados ao projeto, tipicamente utilizamos o BPMN também para os modelar, não só a nível nacional como a nível internacional- portanto temos um cliente internacional que também utiliza BPMN. Tento utilizar sempre o BPMN para fazer modelação de processos.

E: Qual o tipo de empresas/setor que procura mais este tipo de gestão de processos?

B: Um dos problemas que existe nas empresas, é a inexistência de pessoas com o Know how da notação e do método em si, e, portanto, quando falamos de setores, diria que não há um setor específico, mas tudo o que seja projetos ou soluções tecnológicas que tem por base um processo de negócio, seja ele no setor do e-commerce, saúde, indústria, retalho, setor público, etc, em todos esses, é transversal o fator que os leva a procurar este tipo de gestão de processos.

E: Alguma vez implementou o BPMN numa instituição na área da saúde? Se sim, qual?

B: Na ótica do BPM, da metodologia, não, mas numa ótica do levantamento de requisitos sim. Portanto um dos projetos para o estado, o SICAD, onde utilizamos BPMN para uniformizar os processos.

E: Implementou o BPMN apenas em empresas nacionais ou internacionais?

B: Tive oportunidade de implementar em ambas as opções, empresas nacionais e internacionais.

E: Quais as dificuldades que as empresas têm quando procuram por este tipo de soluções?

B: Tal como disse anteriormente, uma das grandes dificuldades que as empresas têm é o know how, ou a inexistência do mesmo.

E: E aquando da implementação, quais os obstáculos que costumam surgir?

B: Portanto, vou dividir o tipo de obstáculos existentes por fases: na fase da descoberta a primeira dificuldade é as pessoas terem noção do processo, não existe um Process owner. Existe um manager e as pessoas que executam os processos, e tipicamente as pessoas não têm consciência de que aquilo é um processo, e que existe um Process owner que controla o processo; Na fase da modulação, existe a dificuldade de quem está a explicar o processo, de saber ao certo e compreender a fundo a notação. Tipicamente, quem está a fazer um levantamento do processo está a fazer “sharescreen” com o BPMN, a pessoa vai falando, e nós vamos modelando. A maior dificuldade aparece na divergência e convergência dos fluxos. As pessoas baralhadas por existir um gateway para juntar os fluxos, e para dividir os fluxos;

Uma dificuldade transversal prende-se com as pessoas terem noção desta iniciativa com um todo, a nível de comunicação da empresa, de que estamos a fazer modelação de processos e a levantar processos. Portanto se não existe um envolvimento das pessoas desde o início, acaba por tornar-se difícil.

Na questão da otimização do processo e implementação, é não haver noção dos controlos dos processos, portanto as pessoas não sabem os KPI's, quais os outputs e inputs, o que compensa controlar. Outra dificuldade é o tipo de ferramentas existentes para modelar- existem várias no mercado, e cada pessoa usa uma determinada ferramenta.

E: Sabemos que o BPMN não é uma ferramenta que a maioria dos profissionais conheçam. Aquando da implementação desta notação nas empresas, existe algum tipo de formação dos colaboradores da mesma?

B: Tipicamente, existem iniciativas entre cliente e fornecedor. À medida que faço o levantamento de requisitos vou explicando o que cada símbolo significa, mas não há uma formação propriamente dita- existe sim um envolvimento dos colaboradores na iniciativa. Depois existem outras iniciativas de projetos de governação de arquitetura

empresarial, que é no fundo dotar o cliente de know how sobre gestão de processos de negócio- aí sim, há formação específica em BPMN.

E: Os colaboradores têm noção de que está a ser feita esta implementação? Ou apenas os colaboradores de topo/staff/chefias?

B: Portanto, nós tentamos sempre que toda a gente esteja envolvida. As chefias têm sempre alguém do seu departamento mais envolvidos que fazem chegar a informação aos colaboradores. Obviamente que não há um envolvimento a 100% por parte de todos os colaboradores.

E: São definidos objetivos internos, prévios a implementação do BPMN nas empresas?

B: Se estivermos a falar de um âmbito fechado, de projeto, de implementação ou desenvolvimento de software, tipicamente há um levantamento de requisitos, e o BPMN é um fim em si mesmo. O BPMN é usado para caracterizar o processo e comunicar a todos os stakeholders envolvidos no projeto, e é usado como “base”, uma linguagem comum para comunicar a caracterização do processo. Quando falamos em iniciativas empresariais, aí sim são definidos objetivos- vou mapear e caracterizar os processos para implementar uma ISO9001 por exemplo; ou vou definir processos na empresa para definir responsabilidades, ou controlar os outputs, ou aumentar a satisfação dos clientes, portanto aí sim, definem-se objetivos.

E: Que tipo de software costuma usar na implementação?

B: No nosso caso, se falamos de modelação, existem várias ferramentas para modelação de processos, como por exemplo o DrawIO, Signave, Bizagi ou SAPorDesigner. A nível de implementação/simulação (execução e simulação), na simulação uso o Bizagi, e na execução nunca utilizei, pois normalmente nunca chegamos a essa fase.

E: Sabe se, após a implementação desta notação, as empresas continuam a trabalhar e a aplicar o BPMN?

B: Sim, quando existe alguém responsável por isso- quando existem um departamento ou alguém alocado a estas iniciativas, estas iniciativas não “morrem” e existe um “*continuous improvement*”. Quando estas iniciativas são desenvolvidas por um prestador de serviços e posteriormente não existe ninguém na organização para dar continuidade, as empresas deixam de usar. Já tive um caso deste género.

E: No seu ponto de vista, quais são as mais valias, vantagens que esta notação pode trazer a uma empresa, no geral?

B: Vou dividir novamente, a nível que método BPM, traz muitas vantagens, nomeadamente a nível de melhoria continua, a nível de controlo e otimização dos processos (sem dúvida), e a nível de comunicação de responsabilidades, quando há interação entre dois departamentos no mesmo processo, o “*end over*” fica explícito, o que por si só já ajuda a controlar, otimizar e reduzir custos, e nalguns casos aumentar

a satisfação dos clientes, a nível interno e externo. Agora a nível de BPMN por si só, a mais valia é criar uma linguagem comum, entre pessoas, que têm backgrounds diferentes, ou seja, por negócio a falar com o IT, com o colaborado, com o CEO, e posso apresentar o mesmo diagrama BPMN com uma linguagem comum- isso é a grande vantagem. Mas lá está, é preciso as pessoas têm que ter uma formação, caso contrário haverá sempre dificuldades.

Entrevista ao Profissional C

E: Quais são as suas habilitações académicas?

C: Sou licenciado em Engenharia Informática pela Faculdade de Ciências da Universidade de Lisboa.

E: Como adquiriu este conhecimento sobre Business Process Model and Notation e processos de Negócio?

C: Durante o curso fomos sendo introduzidos a alguns aspetos desta notação, mas acima de tudo foi com experiência profissional em projetos que implementei quando estava a trabalhar na Accenture Portugal.

E: Em quantas empresas já teve oportunidade de implementar o Business Process Model and Notation?

C: Implementei em 2 empresas, 1 em Portugal e 1 no Brasil.

E: Qual o tipo de empresas/setor que procura mais este tipo de gestão de processos?

C: No caso das implementações em que estive envolvido, eram empresas da área do "Real Estate".

E: Alguma vez implementou o BPMN numa instituição na área da saúde? Se sim, qual?

C: Não

E: Implementou o BPMN apenas em empresas nacionais ou internacionais?

C: Nacionais e Internacionais

E: Quais as dificuldades que as empresas têm quando procuram por este tipo de soluções?

C: Conhecerem por vezes os próprios processos e saberem como estruturar os mesmos de forma a conseguir criar os modelos de forma correta.

E: E aquando da implementação, quais os obstáculos que costumam surgir?

C: Frequentes alterações aos processos em que a alteração de qualquer passo pode ter grandes consequências dos passos anteriores ou seguintes e que levam a alterações profundas no total do processo.

E: Sabemos que o BPMN não é uma ferramenta que a maioria dos profissionais conheçam. Aquando da implementação desta notação nas empresas, existe algum tipo de formação dos colaboradores da mesma?

C: No meu caso tive formação on-job com alguns dos colegas que já trabalhavam com a mesma. Existiam algumas formações sim, no entanto devido ao tempo disponível não tiramos partido.

E: Os colaboradores têm noção de que está a ser feita esta implementação? Ou apenas os colaborados de topo/staff/chefias?

C: Regra geral a maioria dos colaboradores (pelo menos os que irão estar envolvidos ou fazer utilização dos processos) estão envolvidos, isto porque em muitos dos aspetos são eles que têm um conhecimento mais profundo da realidade e das limitações dos processos existentes.

E: São definidos objetivos internos, prévios a implementação do BPMN nas empresas?

C: Todo esse processo deve ser definido antes da implementação dos processos, caso contrário será bastante difícil prosseguir com a implementação dos mesmos, definindo claramente um âmbito e requisitos.

E: Que tipo de software costuma usar na implementação?

C: Fiz uso sempre das ferramentas SAP para implementação, em especial o Netweaver Studio.

E: Sabe se, após a implementação desta notação, as empresas continuam a trabalhar e a aplicar o BPMN?

C: No caso das implementações que foram feitas e até ao momento, penso que as mesmas ainda são utilizadas.

E: No seu ponto de vista, quais são as mais valias, vantagens que esta notação pode trazer a uma empresa, no geral?

C: Melhoria global dos processos e da execução das tarefas, assim como um conhecimento mais profundo de o que acontece em que fase e quais os impactos no dia a dia e nos resultados das empresas.

Appendix D

Interviews Matrix

Interviews Matrix

QUESTIONS	1 ST INTERVIEWED	2 ND INTERVIEWED	3 RD INTERVIEWED
WHAT ARE YOUR ACADEMIC QUALIFICATIONS?	Bachelor and Masters	Bachelor and Masters	Bachelor
HOW DID YOU GET THIS KNOWLEDGE ABOUT BUSINESS PROCESS MODEL AND NOTATION AND BUSINESS PROCESSES?	Subjects in the bachelor and master's degree	Subjects in the bachelor and master's degree	Subjects in the bachelor's degree and professional experience in different projects
IN HOW MANY COMPANIES HAVE YOU HAD THE OPPORTUNITY TO IMPLEMENT BUSINESS PROCESS MODEL AND NOTATION?	5 projects in 4 different companies	Summer internship (modelling processes) + several projects in the current company	2 different companies
WHAT TYPE OF COMPANIES/SECTOR ARE MOST LOOKING FOR THIS TYPE OF PROCESS MANAGEMENT?	It depends, there is no rule, but mostly banking and finance.	No specific sector, but factor- everything about projects and technological solutions that have as fundament a business process	In my case, it was always companies in the real state.
HAVE YOU EVER IMPLEMENTED BPMN IN A HEALTHCARE INSTITUTION? IF YES, WHICH ONE?	Yes, in the European Medicine Agency.	Yes, SICAD for the Portuguese state.	No
DID YOU IMPLEMENT BPMN ONLY IN NATIONAL OR ALSO IN INTERNATIONAL COMPANIES?	Both national and international.	Both national and international.	Both national and international.
WHAT DIFFICULTIES DO COMPANIES HAVE WHEN LOOKING FOR THIS TYPE OF SOLUTION?	The lack of notion on business processes, lack of documentations, identification of problems and the searching for a solution.	The lack of know how	The lack of knowledge about their own processes.
AND DURING IMPLEMENTATION, WHAT OBSTACLES USUALLY ARISE?	The lack of communication	The lack of notion of the processes; The know-how of the notation; The lack of	Sometimes some processes need to be altered, and these alterations can affect steps before and after, which

		communication; People often don't know outputs, inputs and KPIs.	leads to profound alternation in all the process.
WE KNOW THAT BPMN IS NOT A TOLL THAT MOST PROFESSIONALS ARE FAMILIAR WITH. WHEN IMPLEMENTING THIS NOTATION IN COMPANIES, IS THERE ANY TYPE OF TRAINING FOR IT'S EMPLOYEES?	Yes	Yes, there are initiatives between the client and the provider.	Yes, but the time is very limited.
ARE EMPLOYEES AWARE THAT THIS IMPLEMENTATION IS BEING CARRIED OUT? OR JUST THE TOP COLLABORATORS/STAFF/BOSES?	In most of the projects, yes, the most important people are involved.	We always try to involve everyone- the top management always have someone more involved, but there is not an 100% involvement.	In majority of the cases, yes, mostly the ones that are more involved in the process and have a deeper knowledge of the reality and limitations of them.
ARE INTERNAL OBJECTIVES DEFINED PRIOR TO THE IMPLEMENTATION OF BPMN IN COMPANIES?	The professional did not have access to the objectives, but there where the "common" objectives such has the improvement of the relationship with the clients, suppliers, our improve competitiveness. The main goals were always the improve of a product or the development of a new one.	It depends. If we have a closed initiative, BPMN is a solution itself. But if we use BPMN in business initiatives, there are objectives.	Yes, and the scope and requirements must be defined before the implementation.
WHAT KIND OF SOFTWARE DO YOU USUALLY USE IN THE IMPLEMENTATION?	80% of the cases is Microsoft Visio. Others can be Draw IO.	There are different tools in the market- we tend to use DrawIO, Signave, Bizagi or SAPorDesigner.	I use SAP tools, specially the Netweaver Studio.
DO YOU KNOW IF, AFTER IMPLEMENTING THIS NOTATION, COMPANIES CONTINUE TO WORK AND APPLY THE BPMN?	No.	Yes, when there is someone or a department responsible for this type if initiatives.	In my case, all the implementations I made are still being used.
IN YOUR POINT OF VIEW, WHAT ARE THE ADVANTAGES THAT THIS	Process clarification; Visual Representation of the process;	Continuous improve, better control and optimization of processes, better communication and attribution of responsibilities, Reduction of the costs,	There is a global improvement of the processes and execution if task, as well as the knowledge of what

NOTATION CAN BRING TO A COMPANY, IN GENERAL?

Access to correct and updated documentation

higher satisfaction of clients. This notation is a common language for people with different backgrounds.

This happens in each phase and the impact in the company.