UHASSELT

KNOWLEDGE IN ACTION

Faculty of Business Economics

Master of Management

Master's thesis

Process Modeling as a tool for process improvement: an application at a research institute.

Armine Alaverdyan

Thesis presented in fulfillment of the requirements for the degree of Master of Management, specialization Business Process Management

SUPERVISOR :

Prof. dr. Mieke JANS

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2019

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Preface

This research is written as a final assignment to complete my master's degree in Business Process Management at Hasselt University. Writing a dissertation was not an easy task and I could not have completed it without a strong support group.

Firstly, I would like to express my gratitude to Prof. dr. Mieke Jans who was supervising my research and who has provided valuable comments and advice to complete the thesis. Besides her academic assistance, I would like to thank her for the personal support and patience throughout the whole process of writing the thesis. I also appreciate the willingness of PhD students and Faculty Administration members for their participation in our interviews and discussions.

Secondly, I am very thankful to my parents, my sister and my brother for their motivational, emotional and financial support throughout my life.

Lastly, I want to thank my beloved husband for his loving support and my son Marcus, whose smile helped me out from any difficulties during the writing of this master thesis.

I sincerely hope, that this research will be interesting for the reader and other researchers.

Armine Alaverdyan

Hasselt, August 2019

Summary

Whether or not the execution or strategy is appropriate, the majority of the businesses have the intention of doing things the right way. They want to be successful, they want to make money, and they want to provide a service that can compete with the best of what the market has to offer. Whether they implement the right approach, is another story; one that is open for debate and may not have a definite answer since it would be a subjective statement.

The term Business Process Modeling (BPM) was a household name in the software engineering system back in the nineties, which helped the international reputation of latter. BPM became the base of modern methodologies. For instance, those that supported data collection, data flow analysis, process flow diagrams and reporting facilities. Around the mid-nineties, the first visually oriented tools for business process modeling and implementation were introduced. By then, the theory had already cemented its place as one of the best approaches for documenting business processes. There are plenty of reasons why organizations use BPM these days. Generally, it is a popular solution to align operations in such a way that they all have a common objective and the resources to pull off its missions. It is also used to create visual models of processes, to have a better internal communication, to enhance efficiency, and to gain a competitive advantage.

Having business process modeling solutions available in any organization means one can focus on knowing where the organization currently stands and how it could reach its objectives in the foreseeable future. BPM needs to be implemented carefully to ensure that the targets can be achieved in the organization. It is a comprehensive approach which guides companies towards optimization of their resources.

Our research is focused on Business Process Modeling, its drivers, goals and its application at Hasselt University (UHasselt). The literature review has shown that BPM can be a good tool to assess how well the objectives are being achieved and it also points out the improvements that the process needs. In the scope of this thesis, we investigated the process of PhD Doctoral File submission at UHasselt. To find out the current situation that we have at the university, we decided to collect the necessary data through meetings and interviews with current PhD students, professors and administrative staff.

This research is organized in 5 chapters. The first Chapter is the introduction, which will introduce the problem statement of this research along with presentation of objectives and methodologies used. Problem statement of the thesis is divided in 3 sub-questions, and the next chapters will respectively give answers to those sub-questions. Chapter 2 will describe what Business Process Modeling is, starting from the definition of a "process". Chapter 3 will represent Hasselt University, general information about PhD at UHasselt and the processes of Doctoral Files submission. Chapter 4 will describe the results of interviews and meetings and provide possible recommendations for further researches. Final conclusions on the research topic will be represented in Chapter 5.

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Chapter 1: Introduction

In our current corporate, business, and social reality, we have to make sure that, if we are going to have an organization, we implement the right tools and push the right buttons to give ourselves an opportunity to have success. It doesn't matter if the organization is of the profit or non-profit variety: the key resides in giving yourself a chance to thrive (Buh, Kovačič, & Indihar Štemberger, 2015).

The implementation of Business Process Modeling, often shortened to its initials BPM, is a first step in achieving the general objective of any company, which is to be successful. BPM can help you have a better and clearer picture (literally and figuratively, since it can involve diagrams and maps and other graphic resources) about where your organization is at the moment and where you want to take it (Conger, 2015).

Additionally, it provides the tools to make a clear assessment about which objectives are being met and which ones need refinement, more investment or more attention. It is a comprehensive approach for improvement processes along the production chain. It allows those who apply it to optimize resources, achieving things in less time and with less money without sacrificing quality of service (Zairi, 1997).

1.1. Background of the research

People in managing positions have been looking for techniques to model business processes for decades now. Actually, some of these methods have existed since the early 1900s, and a few examples are the flow chart, functional flow block diagram, control flow diagram, Gantt chart, PERT diagram, IDEF, etc. (Harmon & Wolf, 2016).

Sometimes subconsciously, people have been looking for models to optimize resources, economize expenses and deliver better results in less time since the beginning of times. In the business world, achieving those things represents a huge plus since it will almost assuredly increase profitability. Actually, it was the Gantt chart the that first arrived at our business landscape, back in 1899. The flow charts followed in the 1920s, the Functional Flow Block Diagram and PERT were born in the 1950s, and

the Data Flow Diagrams and IDEF in the seventies. A brief description of some techniques will be done in this paper.

The business process modeling was born in the mechanical industry, as a result of different new processes and division of labor. According to (Brandall, 2016), it was in the winter of 1921, that Frank Gilbreth presented a paper to the American Society of Mechanical Engineers entitled "Process Charts: First Steps in Finding the One Best Way to Do Work." That piece proved to be a pioneer that convinced numerous businesses to the idea of modeling their processes, so they could optimize them (Brandall & Henshall, 2017).

Gilbreth, as it turns out, was a very versatile individual: he was an industrial engineer and, later, a management consultant who wrote a novel in the fifties, called "Cheaper by the Dozen", with time and motion study as the main themes. He was eccentric, but as (Brandall, 2016) points out, he was a brilliant mind when it comes to processes and what they serve for: finding the right solutions at the right time or finding the best one to achieve a specific objective.

It is believed that the phrase Business Process Modeling was coined in the sixties, by S. Williams (Baudoin, 2010). He wrote an article in 1967 called "Business Process Modeling Improves Administrative Control," explaining his thoughts about how to grasp a better, smoother understanding of how physical control systems could be implemented in the systems engineering field to improve business processes. However, more than two decades passes before the term got any real traction.

Sciences, methods and methodologies had one of their best decades in the 1990's. By then, people started to use and understand the term "process" as what it was: a productivity paradigm. Brands and firms around the world started to realize that it was better to use processes instead of functions and procedures, since the processes intend to include all phases of the development and production, even the chain of events to acquire supplies, order retrievals, sales, and more. A process is about what is done which can be described in a flow chart, while the procedure is about how something is done generally having a written text form. While old, outdate methodologies focus on illustrating time and cost, these modern tools and measures have a more all-inclusive approach on cross-functional activities that have grown in number and importance (Hammer, 1990).

Some of these new approaches include business process management, business process redesigning, business process innovation, integrated business planning, etc. They all want to improve the quality of the processes that the company owns, enhance the process outputs, and to minimize the process variability (Peng, Quan, Zhang, & Dubinsky, 2016).

1.2. Problem statement

"The problems that afflict modern organizations are not task problems. They are process problems… Our problems lie not in performance of individual tasks and activities, the units of work, but in the processes, how the units fit together in the whole" (Hammer, 1996).

Processes exist everywhere. Anything that is done in an organization is a part of a process, therefore, if it is necessary to improve what the organization does, then one should focus on improving their processes. It is important to concentrate on the processes while thinking about any possible improvement in order to avoid the typical mistakes that many organizations make. For example, sometimes the leaders think about saving some money, and they begin to push the employees to do more work with less salary or they are even trimming payrolls. But this kind of approaches, as a result, can have a negative influence in the long run and can even lead to increasing costs, reducing the quality of the products and services, and thus reducing the image of the organization (UCISA-PCMG, 2016).

The rise of business process modeling tools has allowed people not only to model their business processes in a way that lets them understand which areas need more attention and which ones are functioning properly, but also, they let the users implement and execute those models, and refine the models based on as-executed data (Poonia & Virender, 2010). Because they let their users get to know all processes and aspects of an enterprise, these tools provide transparency into business processes, as well as the centralization of corporate business process models and execution metrics.

If the business process modeling can optimize organizations and businesses all over the world, no matter location, traditions, climate or human capital; then why not to apply this technique on the public sector level? Despite of being non-commercial, institutions dedicated to teaching and distributing knowledge are also in need of optimization and improvements. It is a complicated sector and sometimes may seem that it is a very unusual place to implement methodologies from the private sector. Nevertheless, it is believed that transferring the expertise and knowledge from other fields can be a successful and cheap way of positive changes. The desire of an increased effectiveness and efficiency, as well as the quickly changing environment pushes the universities to adapt process improvement approaches more frequently (UCISA-PCMG, 2016).

Universities involve many stakeholders which makes its processes very complex: starting from student admission, staff member recruitments, organizing the educational procedures and ending by cooperating with other educational institutions. One of those stakeholders are the research institutes, which in turn have their own processes. As known, the main tasks of the research institutes are conducting new researches and providing valuable knowledge to the students. But besides the academic work, researchers are often required to complete some administrative tasks. In order to understand to what

extent it is possible to reduce the administrative burden from the researchers and to give them more time for their main job, we decided to investigate one of administrative processes that they are involved in.

As mentioned above, process modeling helps to improve processes in private sector. In this master thesis we will find out whether it is applicable for public institutions. Therefore, the research question of this master thesis will be formulated as follows:

CAN PROCESS MODELING BE APPLIED FOR PROCESS IMPROVEMENT IN THE CONTEXT OF A PUBLIC INSTITUTE?

We will investigate the above-mentioned research question with a case study, which relates to the process of Doctoral Files submission at Hasselt University. Considering the complexness of this research question, it will be further elaborated by splitting the main topic into a few sub-questions.

Sub question 1

First of all, we have to understand the term BPM itself, why do companies choose to invest in it and what are the needs and requirements of BPM. So, the first sub-question can be formalized as the following:

What is Business Process Modeling, and which are its drivers and goals?

Sub question 2

Secondly, as we are going to use BPM at UHasselt, we will give a description of the university and describe the process of doctoral file's submission. Further we will visualize the current situation using a BPMN software. So, the next sub-question can be formulated as:

Can the process of doctoral file submission at Hasselt University be modeled in an unambiguous way?

Sub question 3

Finally, as we will already have an idea of the current situation, we will try to find out the weak points, which could be avoided and will offer recommendations for further improvements. The last sub-question will be:

Is it possible to identify improvements in the doctoral file submission process at Hasselt University, based on the modeled as-is process?

By answering the mentioned sub-questions, we will come to the answer of our main research question. First, we will model the as-is situation of Doctoral File submission at UHasselt with the help of BPMN software. Next, we will give possible recommendations for future improvements. Finally, based on our suggestions, we will map the to-be model.

1.3. Research Methodology

In this part we will present the methodology and techniques used to complete this master thesis.

1.3.1. Research methods

Research methodology is technique to solve the research problem. It can be formalized as a science of studying how the research is done scientifically.

During the research, it is very important to establish the right research methodology and to gather all the possible information that could help to gain a better understanding of the discussed problem, in our case the impact of BPM.

While conducting this research we used a case study combined with qualitative and descriptive methods. Our methodology will include study of different publications, interviews, as well as the assessment of historical facts about business process modeling. Google Scholar was the main search engine to find necessary literature for completing this thesis. Some examples of terms used in order to find relevant articles and information were: "Business Process Modeling", "Process Optimization", "Process Improvement", "BPMN", "BPM techniques", "Bizagi Modeler" … Interesting and useful papers were also found using references within the articles, which were obtained through the above-mentioned method.

1.3.2. Data collection

Data collection is a huge part of any research project. There are two types of data: primary and secondary. Primary data collection is gathered for the specific research problem at hand, using procedures that fit the research problem best, for example through online surveys, personal interviews and communications via emails. They represent one of the best ways to conduct statistical analysis about a subject or hypotheses. On every occasion that primary data are collected, new data are added to the existing store of social knowledge. On the other hand, the secondary data is the one that has already been collected or produced by other authors or individuals. They involve publications, websites, books, journal articles, internal records, and other sources (Hox, Moerbeek, & Schoot, 2010).

Another difference between primary and secondary data collection methods is that the former is factual and original, and the latter is the analysis and interpretation of primary data that someone else collected. With primary data, researchers can aim for getting solution to the problem at hand, whereas the secondary data is collected for other purposes and the group of investigators take advantage of it and uses it as adaptation for a solution (Flick, 2014).

The primary data is collected in real-time, whereas the secondary data is information of the past. It is cheaper and faster to use secondary data, but the results aren't likely to be the same. This type is better to be used as supporting material.

Taking into consideration above-mentioned and other existing differences and usefulness of both, we have decided to combine the two methods of data collection. Interviews with PhD students, professors, administration staff were used as primary data source, and as a secondary source we used scientific and journal articles, publications, books, websites, etc. The primary data has been applied to the case study and helped to draw process models and suggest future improvements in this master thesis. The secondary data was used to describe and explain different scientific and professional terms used in the research as well as to provide some historical evolution of various frameworks.

Chapter 2: Business Process Modeling: Drivers and Goals

Business Process Modeling is a part of Business Process Management, that is why we start with a brief explanation of the latter and then go deep into the description of the first one.

Business Process Management is the art of managing how work is performed in an organization to ensure consistent outcomes and to take advantage of improvement opportunities, be it reducing costs, execution times, error rates, optimizing resources and many more (Dumas, Rosa, Mendling, & Reijers, 2013). Business Process Management not only improves organizational performance directly, but also assists with collaborative activities that in turn help to improve internal capabilities (Pawar, Rogers, Potter, & Naim, 2016). According to (Lindsay, Downs, & Lunn, 2003) Business Process Management strives to better understand the key mechanisms of a business to improve and in some cases to radically change the business performance by identifying opportunities for new business, outsourcing, improving business efficiency and using technology within different areas of the business to support business processes. Business Process Management is a structured approach to analyze and continually improve fundamental activities such as manufacturing, marketing, communications and other major elements of a company's operation. It is a systematic approach to making an organization's workflow more effective, more efficient and more capable of adapting to an ever-changing environment (Gazova, Papulova, & Papula, 2016). The advantages of Business Process Management are the effectiveness, visibility, control, flexibility, and the speed. According to many researchers it helps to reduce costs, flow time and to improve quality, productivity and efficiency of processes in organization, but on the other hand there are some barriers and risks while implementing Business Process Management. According to (Škrinjar & Trkman, 2013), the main challenge remains how to implement process principles into the organization's operation, which is mostly discouraging managers from Business Process Management implementation.

Now when we have an idea about Business Process Management, we can start explaining the Business Process Modeling. In order to understand its phenomena, the best place to start is to understand what exactly the *process* is. It is defined as "a collection of interrelated work tasks initiated in response to an event that achieves a specific result" (Nelson, 2018). And why they are called processes, but not just jobs to be done, is because when formalizing a process, the workflow with productivity is always kept in mind. As for the term "*business process*", it was first founded by Adam Smith in 1776, describing the first business process at a theoretical pin factory (Brandall & Henshall, 2017). (Dumas et al., 2013) explains the term business process as "a collection of inter-related events, activities and decision points that involve a number of actors and objects, and that collectively lead to an outcome that is of value to at least one customer". To visualize their statement, they introduce the following diagram in their book "Introduction to Business Process Management":

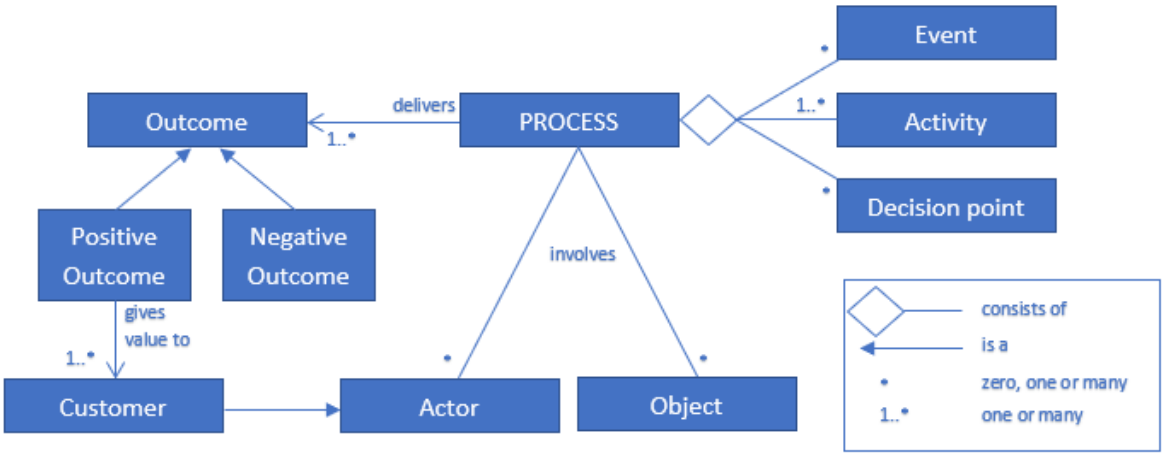

Figure 1: Description of business process (Dumas et al., 2013)

The existence of processes is very important, the absence of processes can even lead sometimes to disasters, and when there are no processes existing within the organization, it would always be difficult to find out where the mistakes come from.

When listing the business processes of any company, we will always get a list of several dozen lines in it. Therefore, the classification of the existing business processes enables the use of particular grouping and simplification of those business processes. There are three high-level classes of processes: Operating, Support and Management processes. According to (Lehmann, 2016) the Operating processes create, add, or deliver products or services for which customers are willing to pay. Normally they are designed to run the stated business strategy of an organization. Support processes do not directly create products or services but are assisting the execution of operating or management processes. And finally, the management processes provide the necessary means to ensure the best quality of the desired results. They are helpful when making decisions, controlling variance, and resolving problems. In other words we can say that there exist operational core processes, management processes focused to plan and project the future of the company, and the processes supporting the existence of the other two mentioned (von Rosing, August-Wilhelm, & von Scheel, 2015).

There is no process that is perfect, but the most important thing is to get to the perfection as closer as possible. To the question why it is important to model business processes, we can say that if processes are visualized, we will have a big picture, and will be able to understand the process flow better.

A *business process* is an activity or set of activities that will accomplish a specific organizational goal. In other words, business process is the combination of a set of activities within an enterprise with a

structure describing their logical order and dependence whose objective is to produce a desired result (Aguilar-Savén, 2004).

All the repetitious and interrelated functions, activities, operations and procedures that exist in any organization are called business processes. The potential client's order, the budgeting, the agreement of different documents and contracts, the opening of a new account, the implementation of production order, the calculation of vacation pay, and the product delivery can be considered as different examples of business processes. Within the universities business processes can be considered the admission of new students, the organizing of course schedules or exams, the approval of thesis topics, and many more.

The accurate and precise description and the usage of business processes within the organization's different departments allow to fully control the processes in any level of organization: in production, sales, service, marketing, finance or accounting, etc. The usage of the business processes also allows the company leaders to get rid of the daily complexes of the operational management, and to concentrate on strategic issues.

Business Process Modeling is the tool, that enables the understanding and the analysis of a business process. A process model can provide a comprehensive understanding of a process. An enterprise can be analyzed and evaluated through its business processes. Thus, the importance of correctly modelling its business processes is highly valued. Using the right model involves considering the purpose of the analysis and, knowledge of the available process modelling techniques and tools (Aguilar-Savén, 2004). The term Business Process Modelling has been used to incorporate all activities relating to the transformation of knowledge about business systems into models that describe the processes performed by organizations (Giaglis, 2001). According to (Lin, Yang, & Pai, 2002), business process modeling plays a crucial role on capturing existing processes and representing new processes adequately.

2.1. Why use BPM?

BPM helps the organizations to document, understand and improve their processes visually. BPM maps the as-is processes and helps to understand them in details, and at the same time gives the analysts the opportunity to propose a redesigned version of the process with any improvements assimilated, in other words the to-be processes (Dumas et al., 2013).

Though, reasons and the benefits of using BPM are dependent on the profile of an organization, the situation in it and the goals that a company aims to reach, we can still define some, that are most common. First, as we have already mentioned, the processes are being modelled in order to give the management visualized picture of the current situation in the company. Visualized processes make it

easier for the management team to make improved decisions and more accurate planning. Improved decisions, in turn, will lead a company to a competitive advantage in the market, and the accurate planning will ensure less costs in processes, production, IT etc. (Indulska, Recker, Rosemann, & Green, 2009).

Moreover, the right modeling of the business processes will also provide the management with some operational benefits. It can help to endorse optimization and improvement of the operational efficiency, which will in turn lead to reduced process execution time and increase process quality and productivity.

Another advantage of BPM that is worth to speak about, are the strategic benefits. BPM is a useful tool for strategic activities such as long-range planning, mergers and acquisitions, product planning or customer loyalty.

BPM present a perfect environment to promote and improve communications between the staff within different departments of an organization. It provides with a strong and positive ambiance, which will make the processes consistent and will eliminate any further guesses.

All healthy and perspective organizations are on a non-stop trip, where the focus is on improving how things are done to get more benefits. The longer an organization is traveling down this path, the better its business performance is. All the examples of successful companies have one thing in common – the importance of understanding the business processes of the firm in order to improve them. The Process Modeling plays a crucial role for the communication and driving works within the companies (White, 2008). Business Process Modeling helps to illustrate the flow of work any time when there is a need to address the new challenges or demands. When using the models inside the companies, the outcomes of BPM are more valuable for the big ones, where the employees do not share a common culture and a shared set of values. But if the models should also be used out of the firms, for example with the suppliers or customers, then the size of the organization does not really matter, and BPM is equally important.

2.2. Business process modeling techniques.

There exist different ways to model business processes, starting from pen and paper, to modern digital methods, such as BPMN (Business Process Modeling Notation), UPN (Universal Process Notation), Flowcharts, Gantt Charts, Petri Nets, etc (Hook, 2011).

Petri-Nets

According to (Peterson, 1977), a Petri net is an abstract, formal model of information flow. Moreover, (Tadao, 1989) explains it as a graphical and mathematical modelling tool applicable to many systems. The Petri-Nets technique made a successful, smooth transition from mathematics to the business process modeling world. They can classify or color-code complicated workflow steps, users, and routes in different colors. The Technische Fakultät, in Bielefeld (Germany) define Petri Nets as a collection of directed arcs connecting places and transitions.

The technique was developed by Carl Adam Petri and was the subject of his dissertation in 1962. Petri Nets, since then, have been used in office automation, work-flows, flexible manufacturing, programming languages, protocols and networks, hardware structures, real-time systems, performance evaluation, operations research, embedded systems, defense systems, telecommunications, Internet, e-commerce and trading, railway networks, and biological systems.

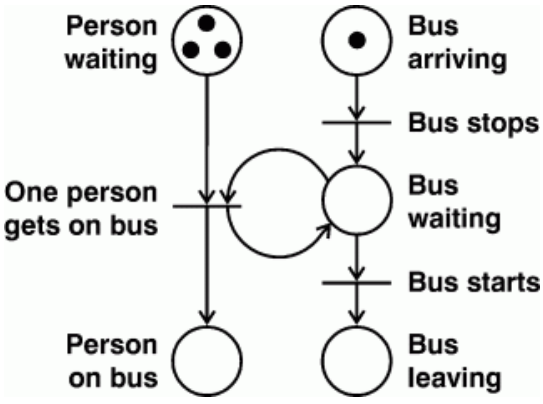

Figure 2: Example of Petri-Nets (Knüssel, 2013)

Gantt Charts

These charts originate with Henry L. Gantt's work during the First World War and were first established by the mid-1920s as a general production planning tool(Wilson, 2003). Instead of showing each step in a sequence like some of the other techniques, the Gantt Charts can showcase the whole process by implementing time taken as one of the primary measures. It is perfect for making sure processes and projects have a timeframe to be completed or accomplished.

The www.gantt.com identifies Gantt charts as commonly used elements and techniques in project management. They are useful ways of showing activities (tasks or events) displayed against time.

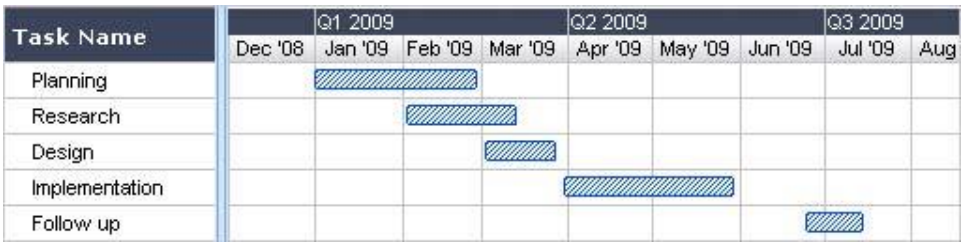

Figure 3: Example of Gantt Charts (Gantt.com)

Located on the left of the chart is a list of the activities and along the top is a suitable time frame for their completion. Each activity is represented by a bar; the position and length of the bar reflects the start date, duration and end date. To sum up, the Gantt chart can show the user what activities have be done and when they need to be completed or accomplished, or what is the same, the schedule.

Universal Process Notation

The Universal Process Notation (UPN) technique represents a more simplified approach. The UPN models a box for each task that need to be achieved, which is understandable for a layman. Each box showcases the person in charge of completing the task, what needs to be done and when it happens in the sequence. Information Technology applications find it very useful to analyze and design processes, while management implements it to comply with standards and norms within the industry.

The true power of the UPN model is its simplicity, because any user can understand it. It is lingua-franca for process. In addition, the diagrams that it uses are tighter so that they fit onto a single screen, which means they can be accessed at point of need. The elements and many of the process mapping tools, and also the diagramming tools like PowerPoint and Visio, can be used to develop UPN diagrams.

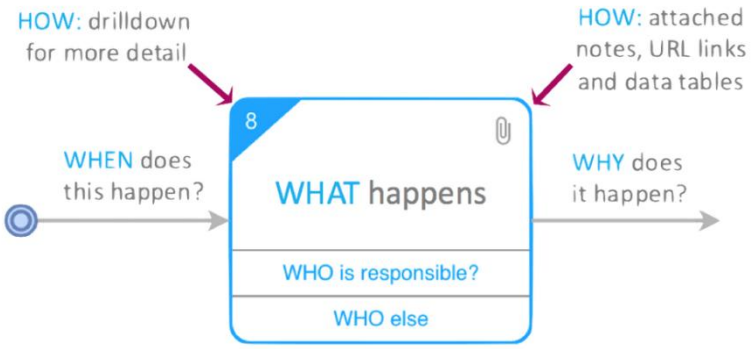

Figure 4: Example of Universal Process Notation (elements.cloud)

Flowchart Technique

The Flowchart technique is a resource that helps people explain the complex process flows that a project may have in an easy, but efficient manner. The flowcharts paint the picture of the process steps in order of sequence, from inputs to process to outputs. It can be defined as a picture of the separate steps of a process in sequential order of fulfillment. They are extremely helpful in complex processes as it helps to simplify things.

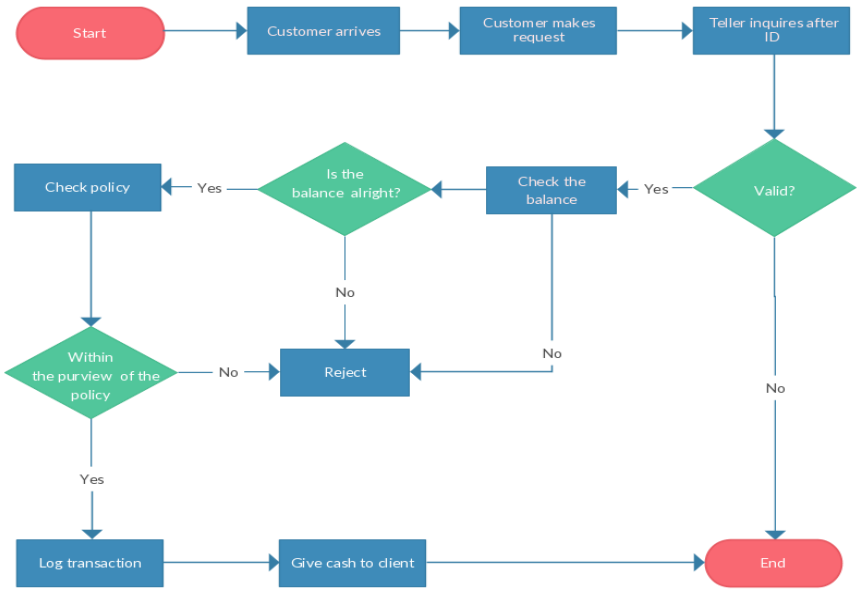

Figure 5: Example of Flow chart (creately.com)

It includes elements such as sequence of actions, materials or services entering or leaving the process (inputs and outputs), decisions to be made, people who become involved in the process, and time spent at each step and/or process measurements. Flowcharts can be used in manufacturing processes, an administrative or service processes, a project plan, and more applications. It is considered a generic tool that can be adapted for a wide variety of purposes.

Business Process Modeling Notation (BPMN)

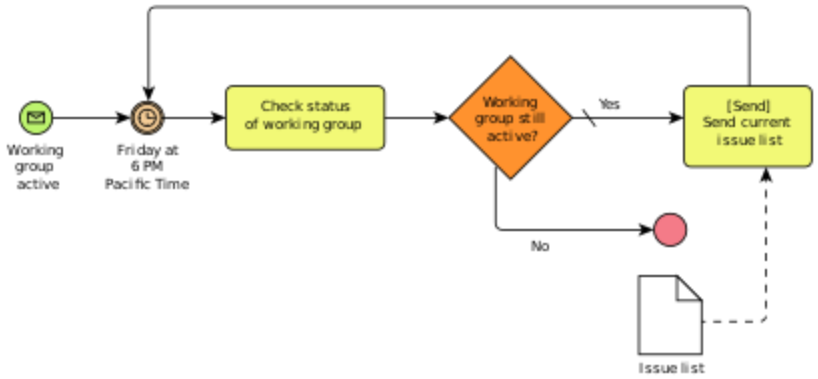

Figure 6: Example of BPMN (Wikipedia.org)

According to (zur Muehlen & Recker, 2008), the Business Process Modeling Notation (BPMN) is a standardized graphic notation that allows the modeling of business processes, in a workflow format. BPMN was initially developed by the Business Process Management Initiative (BPMI) and is currently maintained by the OMG (Object Management Group). The BPMN 1.0 specification was released to the public in May 2004 (White, 2004). Its current version, as of January 2014, is 2.0.2. According to White, the development of BPMN was an important step in reducing the fragmentation that exists with the process modeling tools and notations, and the consolidation of the best ideas into a standard notation. BPMN is designed to cover many types of modeling and allows the creation of end-to-end Business Processes. BPMN defines a Business Process Diagram (BPD), which is based on a flowcharting technique tailored for creating graphical models of business process operations (White, 2004).

BPMN is the gold standard that process analysts implement when it comes to creating business process modeling tools. Business Process Modeling Notation is defined as "simple usage" of arrows, lines, and geometric figures to highlight communication flows and the little details and connections of the whole process.

For example, (Silver, 2011), who is a process consultant and author of the book "BPMN Method and Style," belives that BPMN will become the most commonly used method for process modeling and execution when the majority of companies get their products shipping and crank up their marketing machines. This highlights the importance of BPMN as a process modeling tool as well as indicates that it has more potential in it (Dumas et al., 2013).

The BPMN is a "learned language," and because of that, it still represents a barrier to the average user, no matter how easy it is to understand. Consequently, it can be unsuitable for beginners and those who want to create their own applications but represent a top-notch resource for process consultants.

BPMN 2.0 diagram elements and symbols[1]

BPMN is a fairy complex language, with over 100 symbols. According to BPMN website the five basic categories of elements are provided below.

- **Flow Objects** (Events, Activities, Gateways)
- **Data** (Data Objects, Data Inputs, Data Outputs, Data Stores)
- **Connecting Objects** (Sequence Flows, Message Flows, Associations, Data Associations)
- **Swimlanes** (Pools, Lanes)
- **Artifacts** (Group, Text Annotation)

Flow objects:

Events: These are triggers that start, complete or modify a project. Its types are message, timer, error, compensation, signal, cancel, escalation, link and others. They are shown by circles containing other symbols based on event type. They can be "throwing" or "catching" events.

Activities: These are the tasks that a person performs within the system. It is highlighted within the BPNM technique with a rectangle with round corners, and they can become more detailed with sub-processes, compensations, loops, and multiple instances.

Gateways: It is a decision point that has the ability to adjust the path depending on conditions or events. They are highlighted as diamonds and can be inclusive or exclusive, parallel, complex, and based on events.

[1] More information on BPMN symbols can be found in the Appendix

Data:

Data objects: They show what data is needed for a determinate activity. They use a standard document shape. In business process modeling, our main focus is the business workflow. The use of various kinds of BPMN data objects is mainly for representing the input, output or the usage of different kind of data in accomplishing a business workflow.

Connecting objects:

Sequence flow: It is the element responsible for showing the order of activities to be performed in the diagram. It is as a straight line with an arrow, and it may show a conditional or default flow.

Message flow: It shows messages that flow across pools, or departments, and it is a dashed line with a circle at the beginning point and an arrow at the finish.

Associations: They are dotted lines that associate artifacts or text to a determinate gateway, activity or event.

Swimlanes:

Pool and swim lane: The pool is one the most important elements, while the swim lane inside a pool can show the activities and flows for a specific participant, assigning roles and tasks within the process.

Artifacts:

They are additional information added by developers with the intention of detailing the diagram. They can be:

Group: The logical grouping of activities. It does not modify the diagram's flow.

Annotation: They provide further explanation to a part of the diagram.

BIZAGI Modeler

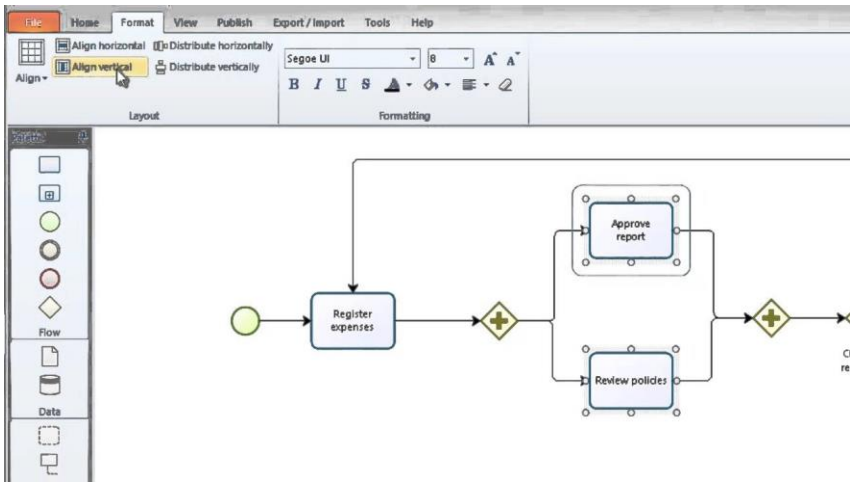

Figure 7: Example of Bizagi Modeler (Bizagi.com)

In the scope of this master thesis, we are going to model the process of Doctoral file submission with the help of BizAgi Modeler, which is a BPMN process modeling software that facilitates the creation and implementation of the workflows. BizAgi (www.bizagi.com) supports the entire business process life cycle via different components that allow— through its graphic and dynamic environment—the building of a process-based solution(Garcia, Vizcaino, & Ebert, 2011) It is one of the most popular BPM tools being used by more than one million people to model business processes. For personal usage it is exceptionally comprehensive, not to mention free of charges.

Chapter 3: Case Study at Hasselt University

3.1. History & Organizational Structure of UHasselt

Hasselt University (UHasselt) is an internationally oriented innovative university in Belgium, which has campuses in Hasselt and Diepenbeek. It was established in 1971, as the "Limburgs Universitair Centrum", but opened its doors for students in Diepenbeek since 1973. It changed its name to Hasselt University on June 15, 2005. It has about 6500 students and about 1400 academic, administrative and technical staff members. The objective of the university is to give its students and staff the chance to develop their potential in a dynamic environment. UHasselt has attractive undergraduate, graduate and PhD programs, which are supported by a range of effective teaching and learning methods.

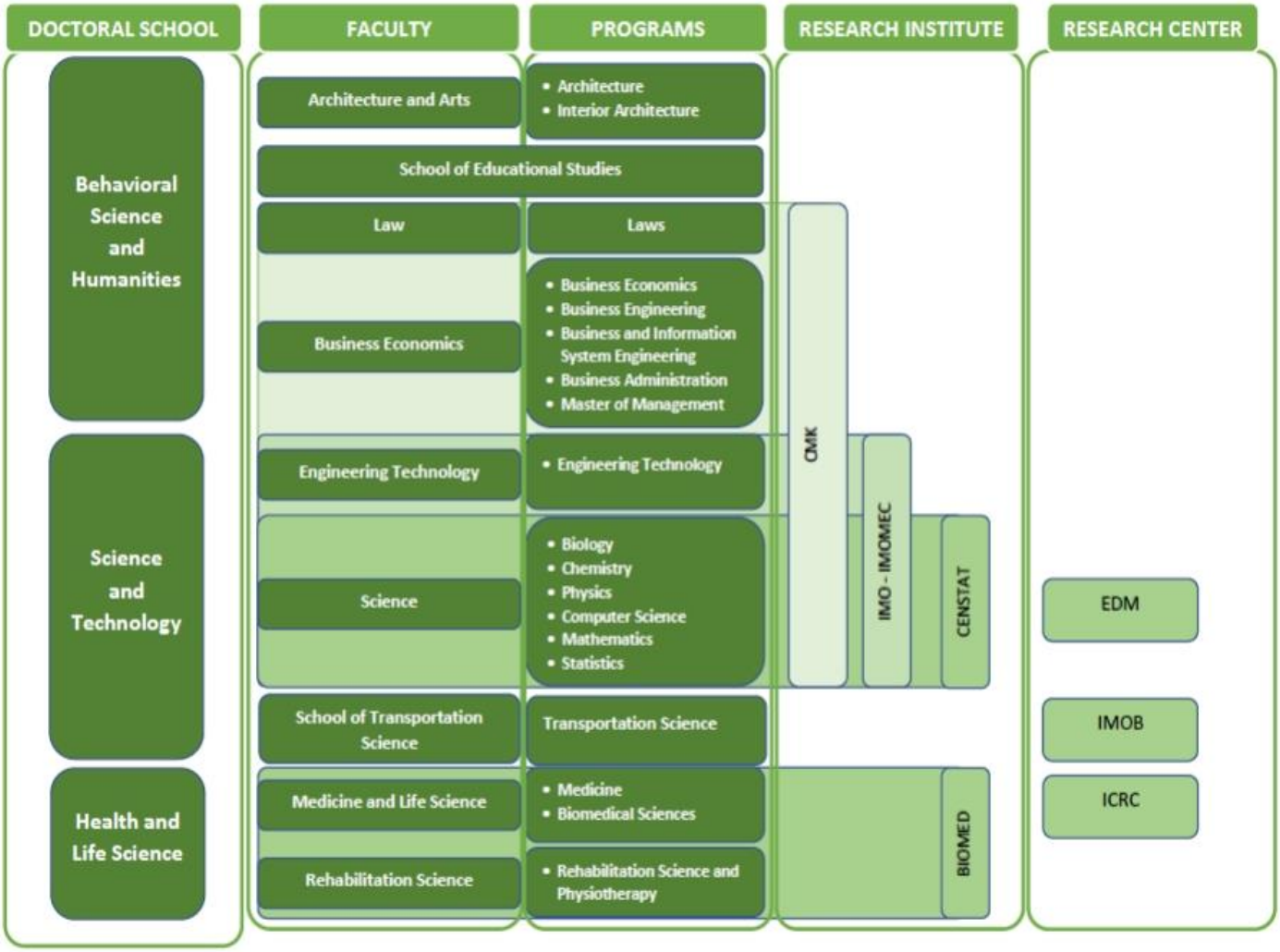

Figure 8: Organizational structure of UHasselt

The academic structure of UHasselt (Figure 8) resembles a *matrix organization*. According to (Horney & O'Shea, 2009) a matrix organizational structure is the one that shares power among two or more dimensions, which means that a subordinate may reports to more than one "boss". One of the advantages of this structure is that it can lead to an efficient exchange of information within the university, but at the same time it can also result in internal complexity. The matrix structures are usually used in those organizations, where activities need to be organized in two dimensions. In our example, the matrix organization helps UHasselt to drive education and research in an integrated manner.

At the top UHasselt is separated into *faculties and schools*. It has seven faculties (Medicine & Life Sciences, Rehabilitation Sciences, Sciences, Engineering Technology, Business Economics, Law and Architecture & Arts) and two schools (School for Transportation Sciences and School for Education studies). They drive the faculty wide policy with regards to academic education and research. Within the faculties, several *capacity/discipline groups* operate. They group all members of personnel who conduct research and education within the same discipline. Every capacity group consists of one or multiple *research groups*. They guarantee the organization of the specialized research. *Six research institutes* (Biomedical Research Institute, Centre for Environmental Sciences, Center for Statistics, Expertise Centre for Digital Media, Transportation Research Institute) are traversing the classical tree structure of the faculties, capacity groups and the research groups. They group researchers from different research groups who execute the entire array of research within a particular focal point domain. This ranges from fundamental and applied research to concrete valorization applications. The research institutes aim at achieving a critical mass and greater visibility, which in turn increases the efficiency of the research.

3.2. PhD at UHasselt

3.2.1. Doctoral Schools

At UHasselt the student can continue the academic study in PhD, concentrate from four to six years on it, and, if successfully defended, get the highest academic degree, the PhD Degree. The framework for PhD candidates is organized at Hasselt University in *three doctoral schools*.

- Doctoral School of Behavioral Sciences & Humanities
- Doctoral School for Health & Life Sciences
- Doctoral School of Sciences & Technology

There are one or more faculties within each Doctoral School, which are represented in the figure below.

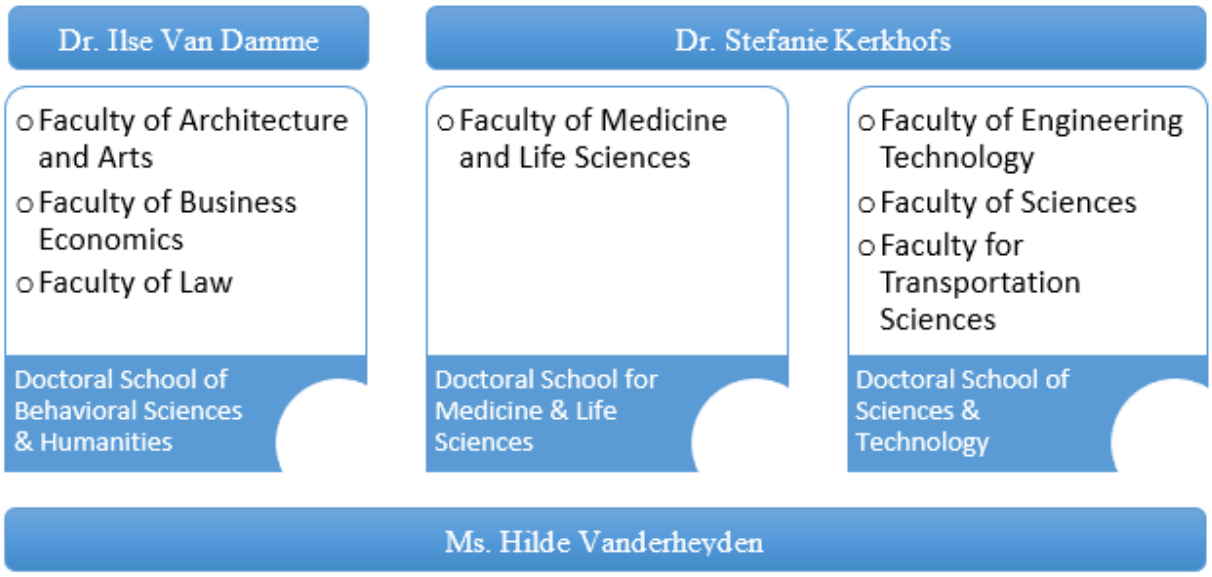

Figure 9: Structure of Research Institutes at UHasselt

The Doctoral Schools guarantee that within this framework different activities are organized for young researchers. These activities include trainings and workshops on discipline-specific and cross-cutting skills, career development etc. UHasselt strengthens the international orientation of PhD candidates or for postdocs to give them more professional opportunities. This framework is realized thanks to the Flemish government, who subsidizes the young researchers. For each of the doctoral schools there exist minimum requirements that need to be met before the PhD defense is authorized. Each Doctoral School has its coordinators. For example, Dr Ilse Van Damme is responsible for Doctoral School of Behavioral Sciences & Humanities. Dr Stefanie Kerkhofs is responsible for the other two, Doctoral School for Health & Life Sciences and Doctoral School of Sciences & Technology. The administrative assistant for the doctoral schools is Ms Hilde Vanderheyden.

3.2.2. The "necessary components" of PhD

The two important parts of each PhD student are the *Preparation* and *Defense* of the PhD thesis. During the preparation of the thesis the student has to do a literature study, collect data or samples and make analysis. The student will also study methodologies to analyze and interpret the results and, therefore, to conclude to relevant research results. At the end of the PhD the student has to write a PhD thesis about the research, and then defend it to an international scientific jury consisting of experts in that specific research field. It is also very important for the PhD student to go public during those four or six years of working on the PhD. Networking at congresses or workshops and publishing in scientific journals

are among the important steps while preparing the thesis. The PhD student has to be active in the scientific forums of the research field, thus having the chance to learn more, present his/her work, get feedback and build a network of contacts. Going public also means that the PhD student must have some good scientific publications in the journals of the research domain. These papers are necessary for defending the thesis. For each Doctoral School, there are minimum requirements, which should be met for obtaining a PhD.

3.2.3. Enrolment as a doctoral student

Anyone wishing to prepare their doctoral thesis at the Hasselt University must first of all *enroll as a doctoral student* at the start of the doctorate, and this enrolment must be renewed annually at the start of every academic year. The re-enrollments are free but compulsory. The terms and conditions are specified annually by the university board.

During the first year of the study at the university, the student has to choose a promoter and a subject, arrange the financing of the project, enroll as a doctoral student and submit the doctoral file. In consultation with his promoter, the doctoral candidate draws up a doctorate file that he submits to the faculty within 3 months of his first enrolment. Doctoral candidates with an assistant's mandate of 3 x 2 years are given 6 months to submit this file. The doctorate file is submitted to the faculty board for approval. After approval, the faculty sends the doctorate file to the student office. The faculty also sends the student office its advice on the doctorate file. The submission and approvals of the doctoral file are done online, and the student has to log in with his/her personal ID and password. At the end of the first year the student has to organize a meeting with the members of the doctoral committee in order to discuss the current situation.

As mentioned above, at the beginning of the second year the student has to be re-enrolled. Just a few steps are needed to be followed when the student receives an email from the student administration to re-enroll. A progress report and the meeting with the doctoral committee's members are still important.

The same steps are necessary for the third year: the re-enrollment as a PhD student and the organization of meeting at the end of the year.

Finally, the last year has to start again with the re-enrollment following the steps in the e-mail received by the student administration. The final payment of the registration should be done in the meanwhile. All the preparation works for defending the thesis have to start about 6 months before the planned date of defense.

From the administrative point of view the enrolment is a critical and repetitive step. An equally important step is the submission of the doctoral file, that is why we decided to address to it, visually represent the process with the help of BPMN software and to understand whether it can be modeled in an unambiguous way.

3.3. From procedures to processes

As mentioned before in the literature review, the procedure is about how something is done, which generally has a written text form. As for the process, it describes what is done with help of flow charts. In this part of the writing we are going to describe 3 procedures dedicated to the submission of Doctoral file. At first, we will address the main procedure of submission. After the file is approved by the faculty council, there are two possibilities of modification:

- Changes initiated by the promoter
- Changes initiated by the head of administration

So, the next two procedures will describe those modifications.

After the description of the above-mentioned procedures, we will transform them to processes and we will visualize them with the help of Bizagi process modeler. In order to have a better understanding about the process, the used components will also be analyzed.

3.3.1. Step by step description of procedures

During our research, we had several interviews with the coordinator of the Doctoral Schools and Professors, and thanks to those interviews we could have a clear idea and understanding about the submission of the Doctoral file and therefore, we were able to summarize everything in a written procedure. It can be described with the following steps.

1. PhD student has to start an application by creating a new doctoral file. The student has to fill in their doctoral file. In the file the following details should be stated:
    - the copy of master's degree,
    - the research group/research institute in which the doctorate will be prepared,
    - the subject,
    - the research plan,

- the discipline (possibly multi-disciplinary),
- the faculty,
- the doctoral school,
- the URL where the doctoral school regulations can be found,
- the name of promoter,
- at the suggestion of the promoter: the constitution of the doctoral committee and possible co-promoter(s) (maximum 2),
- in case of a Baekeland doctorate or a doctorate in cooperation with a company, the company that will be cooperated with in the doctoral framework and the industrial mentor (maximum 1) with the necessary skills to guide the doctorate from within the company or from an industrial perspective,
- the detailed results of the eligibility investigation so that they can be followed up further.

2. Once everything is filled in, the button "Submit" appears and the PhD student submits the file.

3. Each doctorate is supervised by a promoter and once the student submits the file, an e-mail is sent to the promoter with a request to check the content and to approve it. The promoter receives an e-mail with a link to "My doctoral file" of the student. Then the promoter needs to click on "Files awaiting your approval".

4. The promoter controls the content of the doctoral file and has two possibilities: either to accept it or not.

5. If the doctoral file is not accepted by the promoter, then the promoter has again two possibilities: edit the different parts and accept the file or send it back to the PhD student with the request to change some elements. After the necessary changes are done, the student has to submit the file again, and afterwards, the promoter has to accept the modified version.

6. If the doctoral file is accepted by the promoter, then he/she has to fill in the start date of the PhD student and an e-mail will be sent to the faculty administration asking to control the doctoral file and to approve it.

7. First the administrative director checks it and has 2 options (reject: send it back to the PhD student or send to faculty council: this doctoral file can be approved during the next meeting of the faculty council).

8. The faculty council can decide whether to reject or register the Doctoral file. If it is approved, then the faculty administration has to fill in the date of approval and clicks on the 'save' button.

An e-mail will be sent to the promoter and PhD student to mention that the doctoral file is approved. This will be the end of this procedure.

9. If the file is rejected by the faculty council, they can give comments and click on the 'save' button and e-mail will be send to the promoter and PhD student (also the comments will be sent in the e-mail) with request to adapt the doctoral file and submit it again). The PhD student must adapt the doctoral file, submit it and then the flow is repeated until the file is accepted by the faculty council.

If the doctoral file needs to be changed after the approval of the faculty council, there are two possibilities: changes can be initiated by the promoter or by the head of administration.

If the change is initiated by the promoter, then the change request can be described with the following steps:

1. The promoter has to go to the doctoral file of the PhD student which needs to be changed and click on 'start change request'.

2. The promoter can adapt the different elements of the doctoral file and then click on 'Confirm this change request'. An e-mail will be sent to the faculty administration asking to approve these changes. Parallelly an e-mail will be sent to the PhD student to inform him/her about the changes.

3. The faculty administration can then click on 'view change request' and then has two options: reject or approve the changes. If the file is rejected the promoter will receive an e-mail with the request to adapt the doctoral file. The same process will be followed as described before.

4. If the faculty council approves the file, the changes are registered, and the date of the faculty board needs to be filled in. The procedure is finished.

If the change request is initiated by the head of administration of the faculty, no e-mail will be sent. They just need to make the necessary changes, to save the file and to fill in the new date of the changes.

3.3.2. Modeled processes and their components

Before modeling the process, we will first analyze it and its components through the figure proposed by (Dumas et al., 2013), which was mentioned in our literature review. We have adapted their diagram to our case and created the following figure:

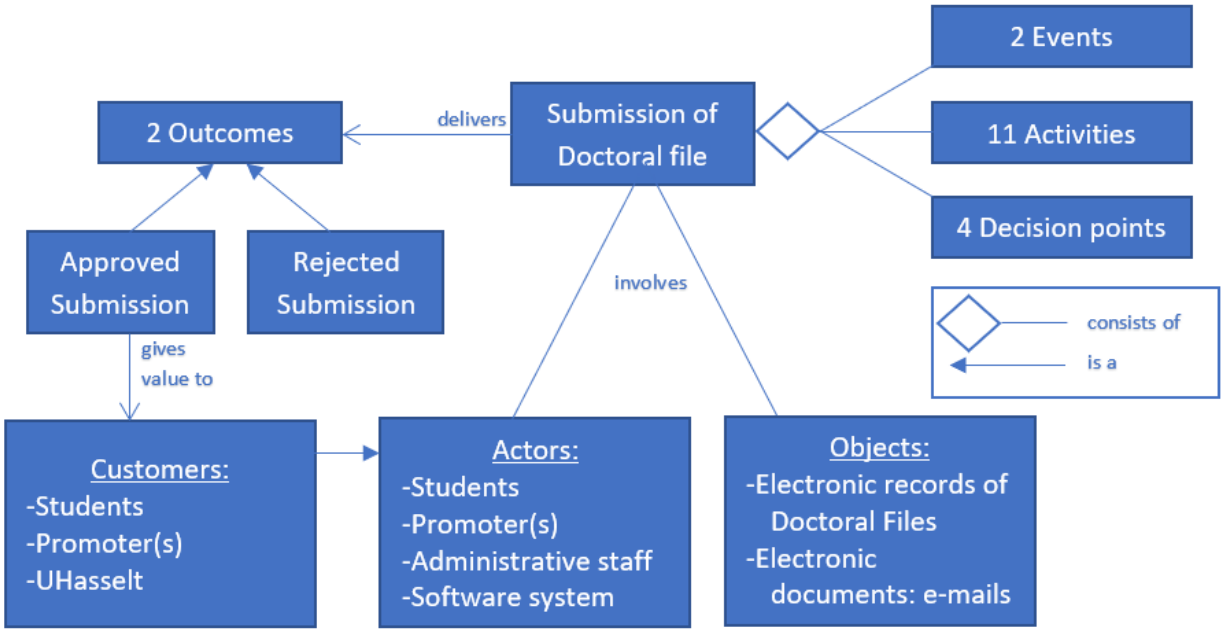

Figure 10: Description of The Doctoral File submission process

As all the processes, ours as well encompasses several *events* and *activities*. Events correspond to things that happen atomically, which means that they do not have any duration. In our case we have start and end events of the submission process. The events may trigger the execution of series of activities. If they are quite simple, we can call them just *tasks*. For example, in our process the creation of a new doctoral file is an activity, as the student should fill in a lot of details in the file. But the next step (submission of the file) we can name a task, as the student has only to push the "submit" button.

Besides the events and activities, the processes involve also *decision points (gateways)*. This is, for example, the case when the promoter must check the content of the doctoral file and decide if the file is accepted or not.

The processes also contain *actors*, *physical* (equipment, materials, products, paper documents) or *immaterial objects* (electronic documents and electronic records). There are three types of actors: humans, organizations and software systems. In our case students, promoters, administration staff are examples of human actors. UHasselt is an example of the second type of actors: an organization. As for

an example of a software system, the directory of the doctoral file can be considered. There are also physical and non-physical objects in our process, for instance paper or electronic documents which should be filled in during the processes.

The execution of a process leads to one or several *outcomes*, which normally should deliver either positive or negative values to the actors involved in the process. In our case, if the submission of the doctoral file is approved, it delivers positive value both to the PhD student and the promoter. In the opposite case, when the file is denied, no value is gained neither by the student, nor by the promoter or the University itself.

Among the actors involved in a process, there is usually one who consumes the output of the process and therefore plays a special role within the process. They are called *customers*. For example, in the above process, there are multiple customers, because the outcome of the process provides value both to the PhD student who gets the position, and the promoter who gets the student in their team.

Now, when we have an idea about the Doctoral file submission process, we can move to the main goal of this research. Having interviews with specialists in the field of Business Process Modeling and due to their willingness to support us with the research of this master thesis, we could model the processes of Doctoral file submission (Figure 11) in an unambiguous way.

Each process should have a container, a rectangular *pool*. Our process is contained in a pool called "Approval of the Doctoral file". It is subdivided in three *lanes*, which define the actors who carry out the activities of the process and may be responsible for many tasks. "PhD student", "Promoter" and "Faculty Administration" are the three lanes of our model, which are an aid for carrying out the graphic consultation involved in the process.

The *start event*, which is represented by a circle, triggers the process and initiates the first *activity*: creation of the new doctoral file. The activities, represented as rounded rectangles, characterize the work performed by the organization. There are two types of activities: *tasks and subprocesses*. In our example we have used only simple tasks. Most of the activities are *user tasks*, which means that it is an activity performed by a person or user with the help of a system or a software. For example, "Create a new doctoral file", "Submit the file", "Check the content of the file", "Make the changes" etc., are all user tasks. A small icon of a person can be noticed in the left upper corner of the activity, but which is not always necessary to put. We can also see a *script task*, which executes an expression, marked with a document in the left upper corner of the task. In our case the last activity is a script task, which is used to identify the sending of an e-mail.

Another symbol that we can see in our model, is the diamond shape, which represents *gateways*. We have used *data-based exclusive gateways*, which help to depict the actors' decision. This will be a

brunching point where one path is selected from the possible options. It is used to control the divergence and convergence of the flow (split and merge). Activities are created relating to each path. In our example 4 gateways are present. For example, with the first gateway the decision of the promoter is represented: to accept or reject the submitted Doctoral file.

End event, represented by a red circle, indicates the end of the path in the process.

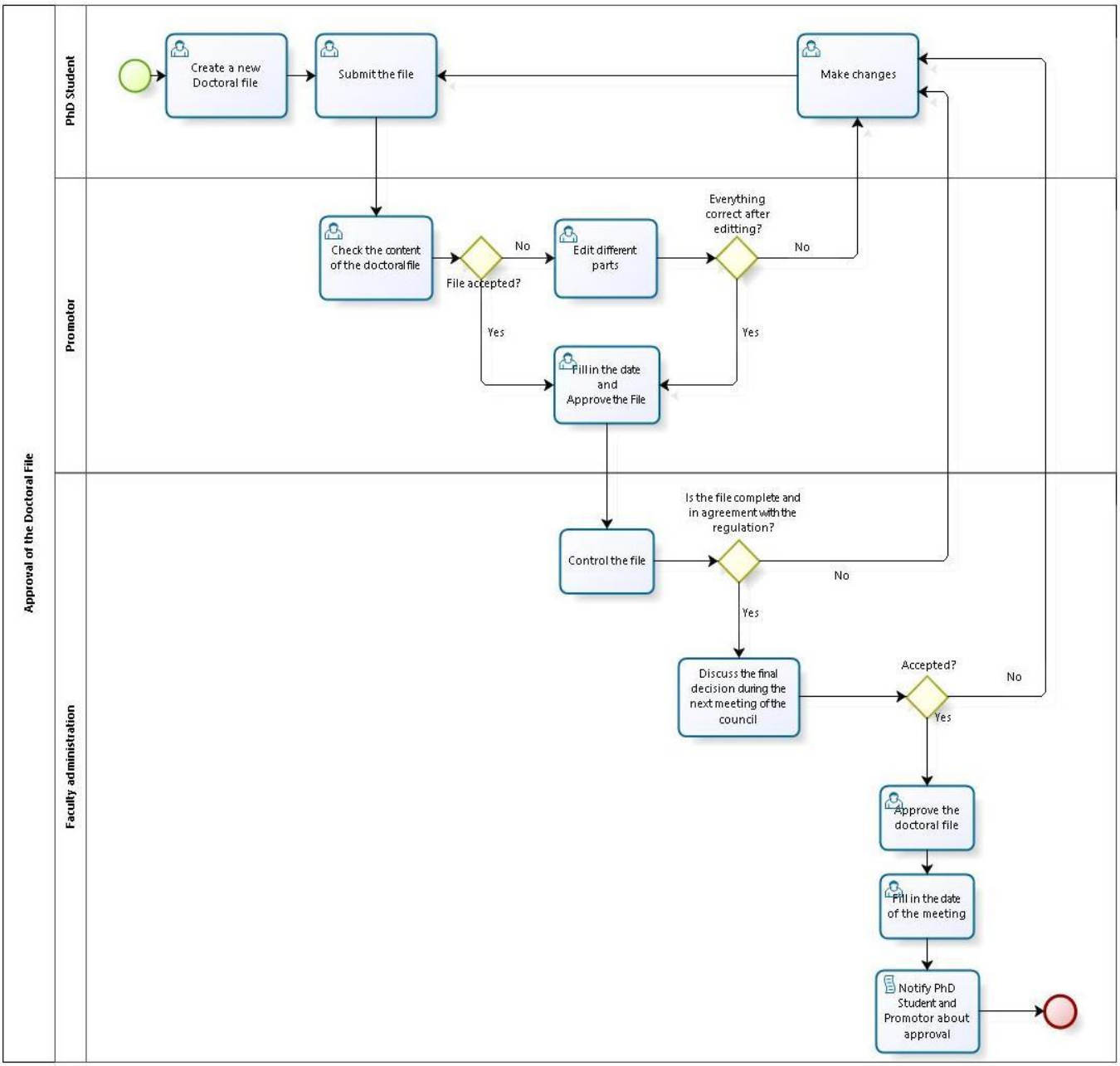

Figure 11: Approval of the Doctoral File

There are some cases when the Doctoral file needs to be changed after it has been approved by the faculty council. As already mentioned in the above-described procedures there are two possibilities of those modifications. Either promoters or the head of administration may initiate changes in the Doctoral file. The processes of these changes are normally a part of the initial process, but to have a clear view and simpler models, we came up to an idea to draw these processes apart. Separating these processes from each other does not affect the whole process at any sense.

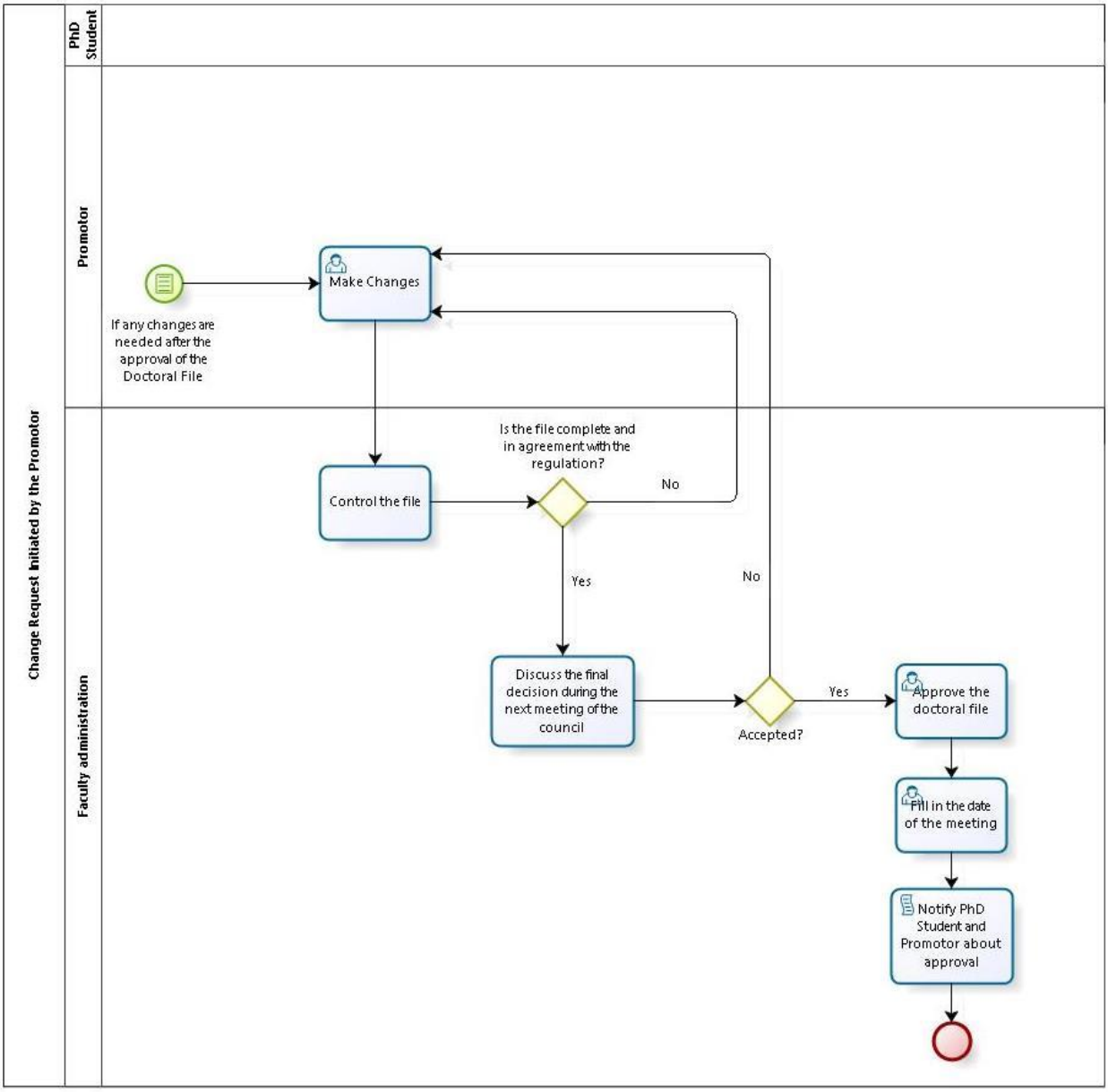

Figure 12: Changes initiated by the Promoter

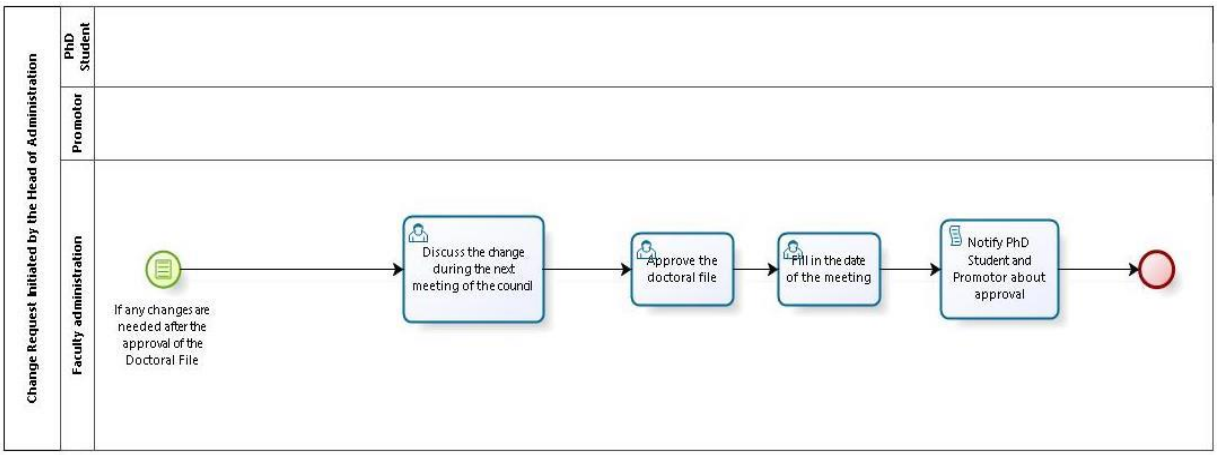

Figure 13: Changes initiated by the Head of Administration

The above-modeled two processes are encompassing almost the same symbols as our initial model of submission of the Doctoral file. The only difference is that they both start with *conditional start events*, represented by a green circle with a document in it.

Chapter 4: Process Improvements

According to our modeled processes, there were 3 lanes in the pool, which means 3 main consumers of the process: PhD Students, Promoters and Administration staff. Thus, we decided to categorize the possible improvements in 3 groups, referring the activities involved in each lane. However, the changes in each group are always interrelated.

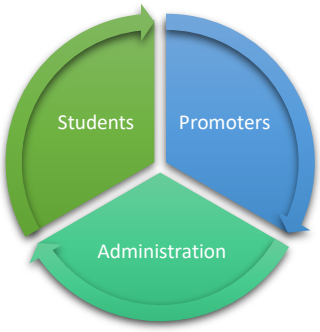

Figure 14: Consumers of the process

During the meetings and conducted interviews with several representatives of the above-mentioned groups, we came up with different recommendations and changes. These recommendations can serve as new investigation topics by other researchers. In this part of the thesis we will elaborate and illustrate the possible changes on the processes modeled in Bizagi software.

PhD Students

Depending on the type of contract (4-years or 6-years), PhD students need to submit the Doctoral File within 3 or 6 months. During our meetings, we came up with an idea that sometimes it is necessary to remind the PhD Students about completing the Doctoral File. We think it could be useful to send a reminding email to the students 2 weeks after the approval of their admission in order not to face unwanted delays in the whole process of submission. The change is illustrated in the figure below.

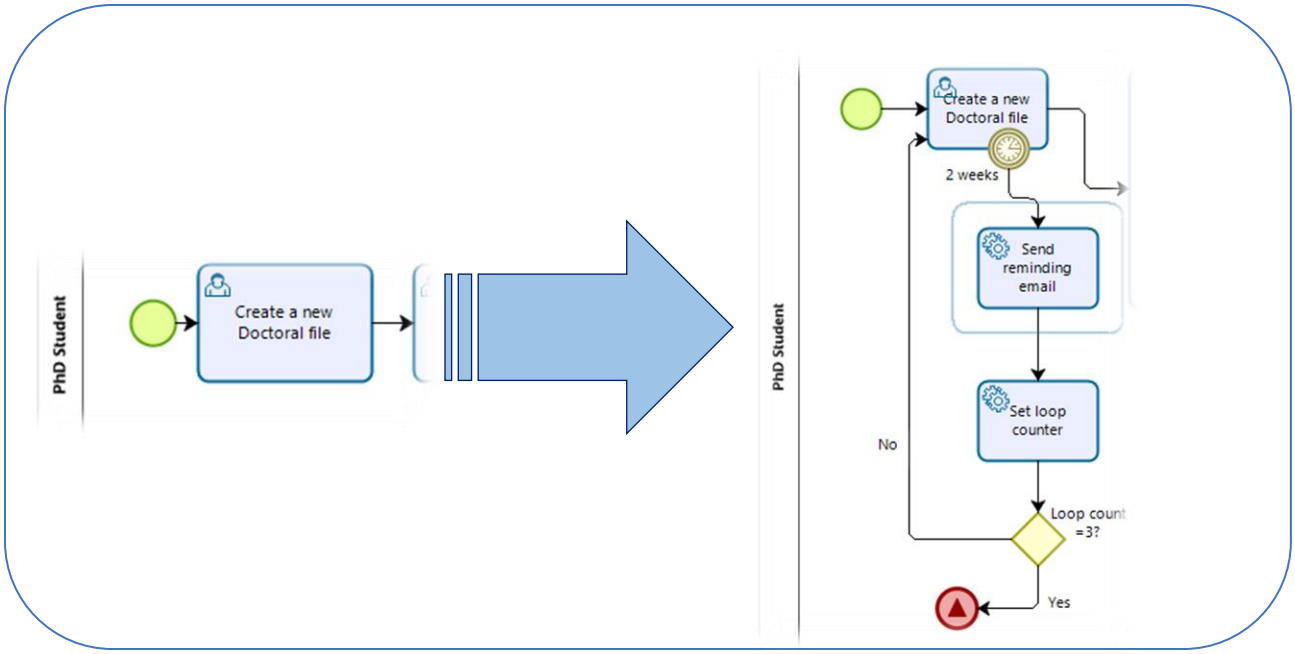

Figure 15: Possible improvement 1/part 1

As you can see in the figure above, the *Timer Intermediate Event* is introduced, which uses the clock marker within the Event shape. When attached to the boundary of an Activity, they are creating time-outs. In our case when the activity to "Create a Doctoral File" starts, so does the timer. If the activity finishes first, then it completes normally, and the process continues accordingly. If the defined time terminates before the activity is completed, the timer triggers additional activity without interrupting the initial task, and the process continues down the sequence flow from the timer intermediate event. In our example, an email is triggered to the PhD student to expedite the situation. "Send reminding email" is a *Service Task*, which means that it is an automated task that the system executes without any intervention of the end user. In the process we also propose to add a *Loop counter*, in order to avoid the infinite cycle of sending the reminder emails every 2 weeks. The latter means that if a reminder is sent already 3rd time, and the Doctoral File is not complete yet, then it would be better if an administration employee contacts the PhD student personally to find out the reasons of the delay. After the student is contacted personally, we assume that he/she will proceed the task immediately. The following mini-process will occur in our model:

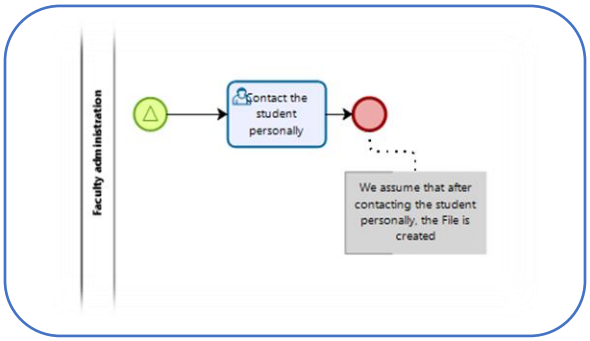

Figure 16: Possible improvement 1/part 2

Based on the discussions with the faculty administration members, most of PhD students are facing a problem with the submission of the File. Sometimes after the completion of all the details the students forget to push the "submit" button, which again causes delays. Thus, our next recommendation for an improvement will be adding another *Timer intermediate Event* as a reminder email to send to the PhD students who have not submitted their Files by that time. Since the file is already completed and only the "Submit" button has to be pushed there is no difference to distinguish between the two types of contracts. We recommend that the reminder is sent after a week following the completion of the file. In order not to complicate our model and to keep it visually simple we will use another feature of BPMN to model a reminder as a *sub-process*. The sub-process is an activity that contains other activities.

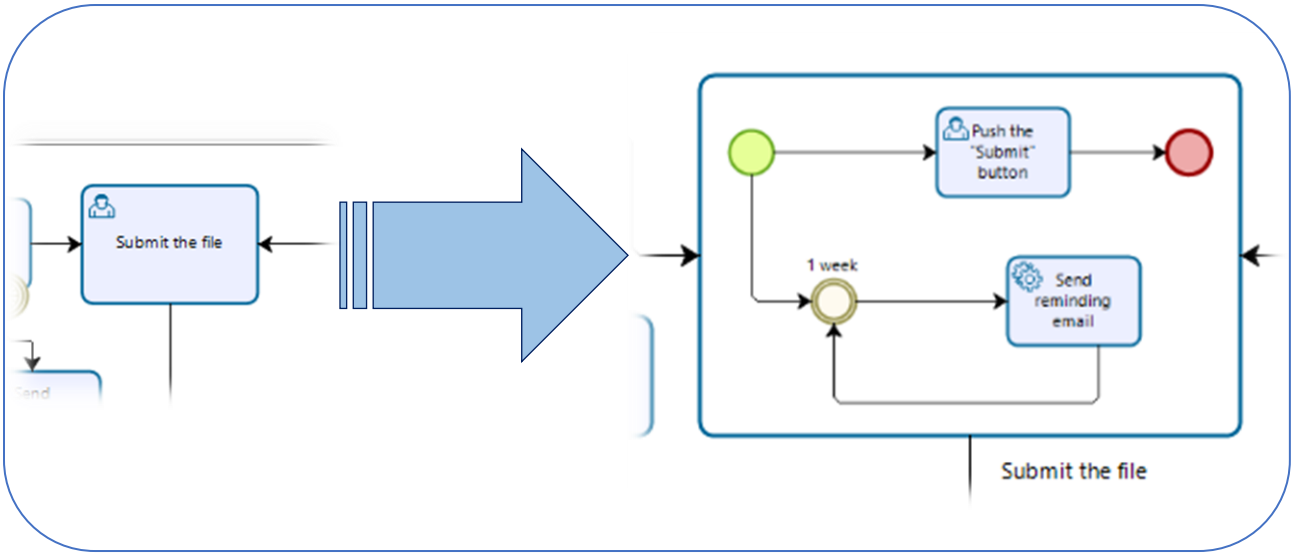

Figure 17: Possible improvement 2

Promoters

As described above, when the Doctoral File arrives to the promoter, and there appear changes to be made, the promoter has two options: either to send the File back to the student, or to make the changes and to approve it. We recommend that an email containing the details about modifications is sent to the PhD Student. This will assure the balance between all parties and will avoid any miscommunication among the users of the process. The possible modification in the model will have the following view:

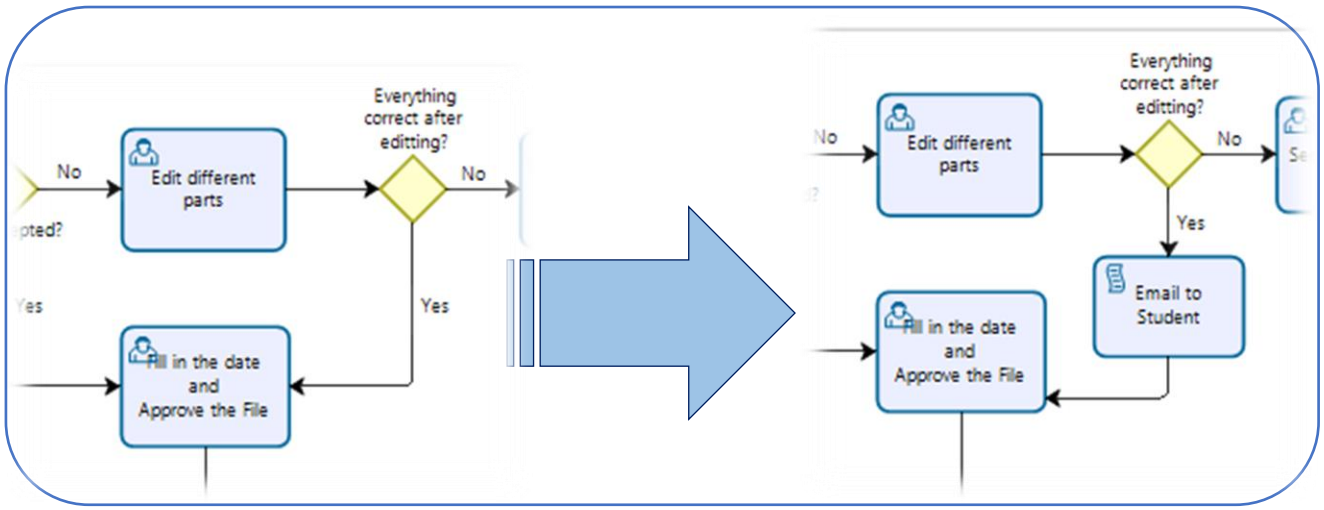

Figure 18: Possible improvement 3

Administration

The next suggestion that we have refers to the Faculty Administration part of the process, particularly the step where the final decision about the Doctoral File approval is discussed. In our as-is process after the File is approved by the Head of Administration, it has to be discussed during the next meeting of the faculty council. As it was described and graphically presented in the previous chapter, within the faculties of the Hasselt University several *capacity/discipline groups* operate. They group all members of personnel who conduct research and education within the same discipline. Every capacity group consists of one or multiple *research groups*.

During the meeting of the faculty council, when the decision of a Doctoral File should be made, all the members of the capacity groups, which are involved in a specific faculty, are participating. For example, the Faculty of Business Economics has 5 Capacity groups:

- Accounting, Finance & Governance
- Behavior, Communication & Linguistics
- Economics
- Marketing & Strategy
- Quantitative Methods

Let us take the capacity group of Quantitative Methods. There are two research groups in it: Business Informatics (BINF) and Logistics (LOG). If, for instance, the decision concerns the PhD student who is in BINF research group, then not only the members of Quantitative Methods capacity group are participating, but also all the members of remaining 4 capacity groups who are involved in the Business Economics Faculty.

Having in mind the workload of academic researchers at the university, we think that the presence of other capacity groups' members during the decisions made for the students of a specific group is not necessary and does not add any value to the process. This change of course will not affect any tasks in our modeled process, but this will play a significant role on whole research process being done at the university.

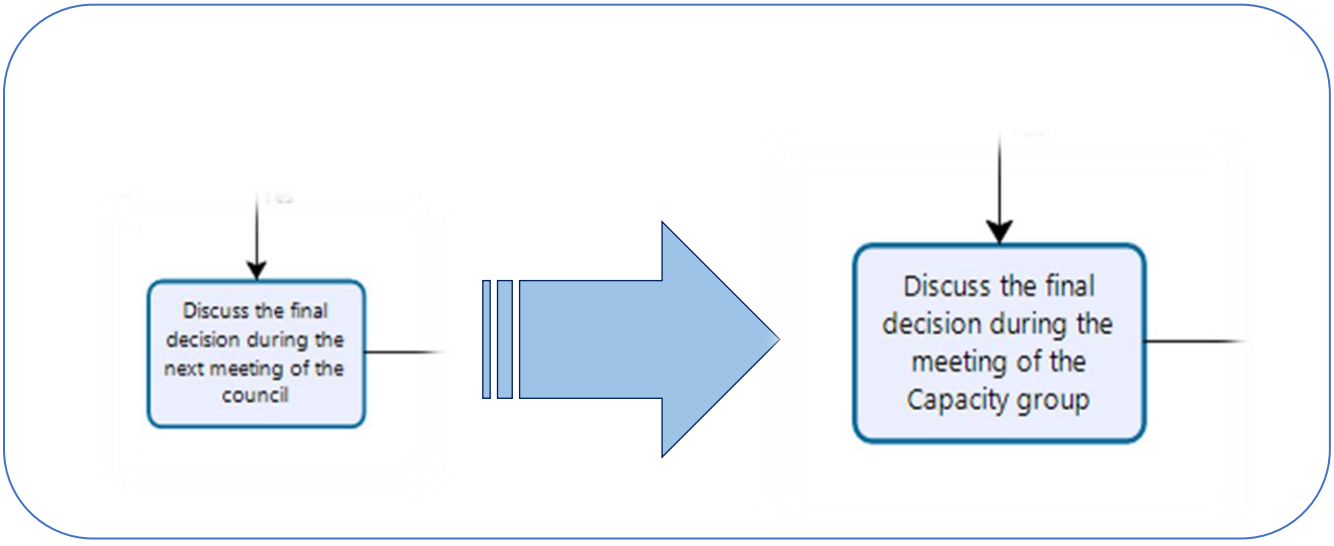

Figure 19: Possible improvement 4

Finalizing this chapter and combining all the above described modifications and improvements, our final to-be process of the Doctoral File submission at Hasselt University can be modeled. This improved model fills in the gaps of the current as-is process and gives a chance to UHasselt to have a balanced process with efficiently used resources and good time management.

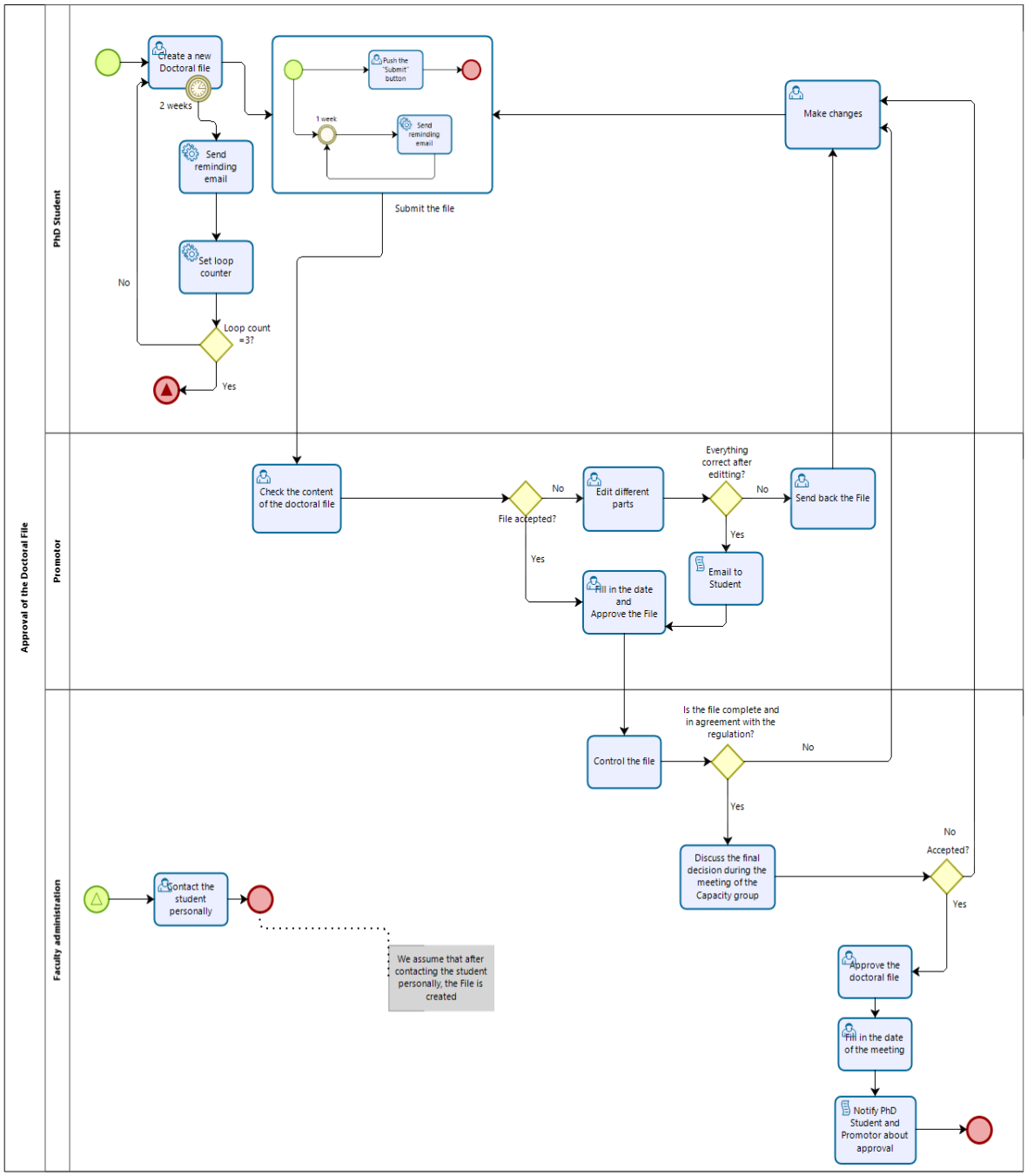

Figure 20: To-be process

Chapter 5: Conclusion

This final chapter of the dissertation will summarize the usefulness of BPM as a process improvement tool, used in the public sector. This study was aimed to describe the usage of BPMN in the University of Hasselt by mapping the process of Doctoral File Submission. The data collected during different interviews and discussions was used to model the current process, to define some weak points in that process, to provide improvements for them and to create a new model.

While conducting this research we came across with several limitations that could reflect on the results of the writing. One of the limitations that we met was the process of the necessary data collection. The sample size of interviewees in relation to the number of all process-related people was not objective. Another difficulty was raised by the dissimilar needs of different stakeholders of the discussed process. Some needs of respondents were very technical such as a function in the system that checks the format of the uploaded documents, or increasing the size of different buttons etc., which were out the scope of this thesis. Moreover, the time available stipulated by the university and personal issues made it more difficult to conclude the research.

Having met the mentioned limitations we state that the suggested improvements in this thesis are based on the limited data gathered during this particular research. The successful implementations of the provided improvements still should be validated and are subject to another research. Hence, they are left out from the scope of this thesis.

5.1 Concluding Remarks and Recommendations

No matter if the organization operates in private or public sector, it will have to deal with many procedures and processes. Nowadays, one of the main issues for all kind of organizations remain the correct usage of their processes. If the processes are organized correctly, the company will increase the productivity, its customer satisfaction rate, optimize the resources and gain competitive advantages in the market.

In order to understand if the correct processes are in place and if they are organized efficiently it is better to visualize them. To do this there are many tools and methods in the market. One of these tools is the Business Process Modeling (BPM). It is a comprehensive approach that guides companies towards the successful management of their current processes. BPM is a useful tool to assess how the objectives

are being achieved. It also makes it easy to define the weak points in the current processes and to help the users to find solutions to them.

One of the digital methods of mapping business processes that we have used to complete this master thesis is the BPMN. It is a standardized and straight-forward graphic notation which is very easy both for the modelers and the users of those models.

In the scope of this thesis we have modeled the process of Doctoral File submission at Hasselt University. For doing this we used the BPMN software "Bizagi Modeler". With the use of this software and the data collected during the interviews with professors and faculty administration we were able to model the current situation (Figures 11, 12, 13) at UHasselt. Further, based on the gathered information we found out the weak points on the modeled process and provided improvements to them.

From the as-is model, it appears that there are missing a few reminders that would stimulate the submission of the doctoral file on time. Their absence causes unwanted delays in the entire process.

After the student submits the file, the promoter should either approve it and send to the administration or reject it and initiate the necessary changes (either by the promoter or by the student). In case the promoter makes the changes, based on the information provided us by the administration, there is no notifying e-mail going to the student. In order to keep the balance in the process, we suggest that this e-mail is implemented in the process.

Besides the academic researches and teaching, professors are supposed to take part in many administrative tasks. In order to reduce the extra burden from them and to give more time for academic activities we propose to include in the final meeting of council only those promoters who are engaged in the capacity group where the PhD student is involved in.

After having conducted all the interviews and meeting with all three consumers (PhD students, promoters, administrative members) of the discussed process, having made all the proposed changes based on the collected data and summarizing them in the to-be process model, we are able to claim that the process modeling can be successfully applied for the process improvement in the context of a public institution.

5.2. Guidelines for Future Research

Having conducted several meetings both with academic and administrative staff, we had an impression that the meeting of the faculty council or the capacity group has only administrative role. It seems that it adds no value to the process of the Doctoral File Submission. In place, we suggest that after the promoter checks the PhD student file, he/she informs the members of the capacity group and they undersign the checked file. Next, the file goes to the faculty administration, where it is being finalized and a notification about the decision is being sent both to the student and the promoter.

For the further researches, we suggest this opinion to be investigated in detail. If proved successful, this will eliminate unnecessary tasks and will ease the job both for the faculty administration and professors.

The proposed improvements are based only on the limited information and data gathered during this master thesis. In case of new arguments coming out, the statements and proposals made as a result of this research are subject to a new investigation.

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bizagi

Activities [Rounded rectangles]

Activities represent the work performed by an organization; it is a step within the process.Activities can be atomic or compound.

Task

A task is a simple activity which is used when the work performed within the process is not defined at a more detailed level. BPMN defines different types of tasks:

Sub-process

Is a compound activity whose detail is defined as a flow of other activities.

Embedded sub-process
Depends completely on the parent process.
It cannot contain pools or lanes

Reusable sub-process
Is a defined process like another business process diagram, that does not depend on the parent process.

Gateways [diamonds]

Gateways are elements used to control divergence and convergence of the flow. (Split and Merge)

Data-Based Exclusive Gateway
Divergence: the Exclusive Decision has two or more outgoing Sequence Flows, but only one of them can be taken and the decision will be taken after evaluating a business condition.
Convergence: is used to merge alternative paths.

Event-Based Exclusive Gateway
Is used as a Divergence element, This gateway represents a point in the process where only one of many paths of the process can be selected but based on an event, not a data expression condition.

Parallel Gateway
Divergence: is used to create parallel flow.
Convergence: is used to synchronize multiple parallel paths into one. The flow continuous when all the incoming sequence flows have reached the gateway.

Inclusive Gateway
Divergence: indicates that one or more routes can be activated from many available, and the decision is based on process data.
Convergence: indicates that many outgoing routes of an Inclusive gateway, used as an element of divergence, can be synchronized into just one.

Complex Gateway
Divergence: is used to control complex decision points that are not easy to manage with other types of gateways.
Convergence: When the Gateway is used as a Merge then there will be an expression that will determine which of the incoming Sequence Flow will be required for the Process to continue.

Events [circles]

Events represent something that happens or may happen during the course of a process.
These Events affect the flow of the Process and usually have a cause or an impact and there are 3 types of events based on how the process flow is affected.

Start Events

- Indicate the instance or initiation of a process
- These do not have any incoming Sequence Flow

None Start Event
Does not specify any particular behavior. It is also used for a Sub-Process.

Message Start Event
A process starts when a message is received from another participant.

Timer Start Event
Indicates that a process starts at certain time or on a specified date

Conditional Start Event
A process starts when a business condition becomes true.

Signal Start Event
A process starts when a signal coming from another process is captured. Note that the signal is not a message; messages have clearly defined who sent them and who receives them.

Multiple Start Event
Indicates that there are many ways to start the process. Only one of them will be required to start the process.

Intermediate Events

- Intermediate Events indicate something that occurs or may occur during the course of the process, between Start and End.
- These can be used within the sequence flow or attached to the boundary of an activity. Intermediate Events can be used to catch or to throw the event trigger.
- When the event is used to catch the Event marker will be unfilled, and when the event is
- used to throw the Event marker will be filled.

None Intermediate Event
Indicates that something that occurs or can occur within the process. It can only be used within the sequential flow of the process.

Message Intermediate Event
Indicates that a message can be sent or received. If the event is of reception, it indicates that the process has to wait until the message has been received. This type of event can be used within the sequential flow or attached to boundary of an activity to indicate an exception flow.

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.

Conditional Intermediate Event
Is used when the flow needs to wait for a business condition to be fulfilled. It can be used within the sequential flow indicating that it should wait until a business condition has been fulfilled or attached to boundary of an activity indicating an exception flow that is activated when the condition is met.

Signal Intermediate Event
Is used to send or receive signals. If it is diagrammed within the sequential flow of a process it can send or receive signals. If it is diagrammed attached to boundary of an activity, it can only receive signals and indicating an exception flow that is activated when the signal is captured.

Multiple Intermediate Event
This means that there are multiple triggers assigned to the Event.

Cancel Intermediate Event
Is only used in Transaction Sub-Process. This event is always diagrammed attached to boundary of the transactional sub-process and indicates an alternative flow that can be made when the transaction sub-process is cancelled.

Error Intermediate Event
Is used to capture errors and to handle them. This event can only be attached to the boundary of an activity.

Compensation Intermediate Event
The Compensation Intermediate Event enables you to handle compensations. When used within the sequential flow of a process they indicate that a compensation is necessary (throwing). When used on the borders of an activity it indicates that this activity will be compensated when the event is triggered (catching).

Link Intermediate Event
Is used to connect two sections of the process.

End Events

- End Event indicates where a process will end.
- A process can have more than one end. It does not have outgoing sequence flows.

None End Event
Indicates that a route of the process has reached its end. A process can only finish when all the routes of the flow arrive at an end

Message End Event
Indicates that a message is sent to another process when the process arrives at the end.

Signal End Event
Indicates that a signal is generated when the process ends.

Multiple End Event
Indicates that many results can be given at the end of the process. All the results should occur.

Cancel End Event
Is only used in Transaction Sub-Process and indicates that the Transaction should be cancelled.

Error End Event
Indicates that a named Error is generated when the process ends.

Compensation End Event
Indicates that the process has finished and that a compensation is necessary.

Terminate End Event
This event ends the process immediately. When one of the routes of the flow arrives at its end, indicating that the process has completely finished.

Swimlanes

Pool

- A pool is a container of a single process.
- The name of the pool can be considered as the name of the process.
- There is always at least one Pool.

Lane

- A lane is a subdivision of a pool
- Represents a role or an organizational area.

Connecting Objects

Sequence Flow

- Is used to show the order that activities will be performed in a Process.
- It is used to represent the sequence of the flow objects, where we find activities, gateways and events.

Conditional Sequence Flow
Default Sequence Flow

Message Flow

- A Message Flow is used to show the flow of messages between two entities or processes.
- Message flows represent messages, not flow controls.
- Not all message flows are fulfilled for each instance of the process nor is there a specific order for the messages.

Association

- An Association is used to associate information and
- Artifacts with Flow Objects.

Artifacts

Allow or provide additional information about a process.

Annotation

- Provides additional information about the process for the reader.

Group

- Is a visual mechanism that allows the grouping of activities for the purpose of documentation or analysis.

Data Object

- Provides information about the entrance and exit of an activity.