YRKESHÖGSKOLAN
NOVIA

Business Process Automation with iBPM

Case Company X

Sofia Nylund

Degree Thesis for Bachelor of Engineering

Industrial Management and Engineering

Vaasa 2023

DEGREE THESIS

Author: Sofia Nylund
Degree and location: Industrial Management and Engineering, Vaasa
Supervisor: Mikael Ehrs

Title: Business Process Automation with iBPM

Date: 31.5.2023 Number of pages: 92 Appendices: 2

Abstract

The purpose of this research was to find out how the case company can improve and automate business processes with the help of intelligent Business Process Management (iBPM) technology. In addition to this to find out the advantages and disadvantages of the automated case study to gain an understanding of why resources are needed for automation projects.

In order to evaluate the first automated business case with iBPM, qualitative research was conducted in the form of focus group interviews. These included members of the process owner core team, process automation lead and developer as well as key users of the case study to provide a more holistic view. During the focus groups, guidelines, best practices and challenges that resulted from the learnings from the case study were identified. Additionally, the advantages and disadvantages of iBPM automation were identified to gain a wide understanding of the added value automated business processes provide to the case company.

Next to that, the research found that processes that need technical implementation can use the practical framework by Freund and Rücker (2019) to align business and IT in a BPMN (Business Process Model and Notation) process model to prepare the implementation of the process flow in an execution engine. Furthermore, the five steps by Dumas et al. (2018) were taken into account to convert a conceptual process model into an executable one using the BPMN language.

The conclusion indicates that the Camunda BPM lifecycle can be utilized to recognize the stages needed for process automation and the findings from the research increased the value for the case company when compared with the development process of the case study.

Finally, six recommendations for the case company were given. These regards effective communication, increase understanding of iBPM automation, utilize the Camunda BPMN framework, complement modeling tool with a new feature, encourage learning of the BPMN standard and recognize demand for software developers.

Language: English
Key Words: Business Process Management, intelligent BPM, process automation

EXAMENSARBETE

Författare: Sofia Nylund
Utbildning och ort: Produktionsekonomi, Vasa
Handledare: Mikael Ehrs

Titel: Affärsprocessautomation med hjälp av iBPM

Datum: 31.5.2023 Sidantal: 92 Bilagor: 2

Abstrakt

Syftet med detta examensarbete var att undersöka hur fallföretaget kan förbättra och automatisera affärsprocesser med hjälp intelligent affärsprocesshanteringsteknologi (iBPM). Utöver detta undersöktes även fördelar och nackdelar med den automatiserade fallstudien för att få en förståelse till varför resurser behövs för automationsprojekt vid fallföretaget.

Tillvägagångsättet för metodiken var att använda kvalitativa undersökningsmetoder i form av fokusgruppsintervjuer för att utvärdera den första automatiserade affärsprocesser med iBPM i fallföretaget. Dessa inkluderade medlemmar i de ledande processägare, processautomationsansvarig och utvecklare samt huvudanvändare av fallstudien för att få en helhetsbild av utvecklingsprocessen.

Under fokusgrupperna identifierades riktlinjer, bästa praxis och utmaningar som härrör från lärdomarna från fallstudien. Dessutom hittades både fördelar och nackdelar med iBPM-automatisering för att få en bred förståelse för det mervärde automatiserade affärsprocesser ger fallföretaget.

Utöver det fann forskningen att processer som behöver teknisk implementering kan använda det praktiska ramverket av Freund och Rücker (2019) för att anpassa affärs- och IT-samarbetet i en BPMN (Business Process Model och Notation) processmodell. Detta för att förbereda implementeringen av processflödet i en automationsmotor. Vidare beaktades de fem stegen av Dumas et al. (2018) för att konvertera en konceptuell processmodell till en körbar modell med hjälp av BPMN standarden.

Slutsatsen tyder på att Camunda BPM-livscykeln kan användas för att identifiera de steg som behövs för processautomatisering och resultatet från forskningen ökar värdet för fallföretaget när det jämfördes med utvecklingsprocessen från fallstudien.

Slutligen gavs sex rekommendationer till fallföretaget. Dessa gäller effektiv kommunikation, ökad förståelse kring iBPM-automation, utnyttja Camunda BPMN-ramverket, komplettera modelleringsverktyget med en ny funktion, uppmuntra inlärning av BPMN-standarden och erkänna efterfrågan på mjukvaruutvecklare.

Språk: engelska
Nyckelord: affärsprocesshantering, intelligent BPM, affärsprocessautomation

Table of Contents

List of Figures

List of Tables

1. INTRODUCTION

In today's fast-changing environment, organizations are facing new challenges to adapt and compete in the increasingly competitive and digital world of business. Hence, companies need to master the ability to continuously improve and innovate their business processes considered that Harmon (2019) states that business processes are one of the most important assets of an organization. Furthermore, they act like the arterial system, playing a critical role in both internal organizational functioning and inter-organizational supply networks (Dumas, La Rosa, Mendlin & Reijers, 2018).

As cited in Darwin's Origin of Species, "*it is not the strongest of the species that survives, nor the most intelligent; it is the one most adaptable to change*" (Megginson, 1963). For an organization to adapt and survive, they must understand the importance to constantly improve its processes and one way to achieve this is through the implementation of Business Process Management (BPM) and Process Automation (Benedict et al., 2019).

BPM is based on the reflection that each outcome that a company provides is the result of a number of activities performed. Business processes function as the key instrument when organizing these activities and improving the understanding of their interrelationship. Consequently, effective collaboration can be facilitated by utilizing the concept of business processes (Weske, 2007).

The rapidly growing BPM discipline is changing how processes are managed within and across organizations, and automation is playing a crucial role in this transformation (Benedict et al., 2019). Furthermore, BPM helps deliver a new level of operational management support and performance monitoring capabilities as well as ensures compliant process execution which is critical for organizations (Harmon, 2019).

In the following sub-chapters, the background and problem description of the research will be provided as well as the objective including the research questions will be identified. Furthermore, the limitation and the scope of the research will be considered and finally, an outlook of the disposition of this research paper will be presented.

1.1. Background

This thesis is produced for a case company that wants to stay ahead of technological developments to continuously improve its business operations. The case company utilizes Robotic Process Automation (RPA) to automate rule-based tasks across different applications and systems and this has proven for the business to bring huge benefits including increased efficiency, productivity and quality while enabling people to focus more on value-adding work.

In addition to this, the case company has implemented a Business Process Management Solution (BPMS) that was internally developed on top of the BPMN 2.0 (Business Process Model and Notation) standard to replace Microsoft Vision used in the past. This enables process migration between different solutions and utilization of processes for multiple purposes. Therefore, the BPM solution serves as a foundation for continuous development in process automation. Along with the BPMS, it assists as a backbone in Intelligent Business Process Management (iBPM) as the process diagrams created in the BPMS application are compatible with the automation engine which allows businesses to automate a wide range of processes. A huge difference between RPA and iBPM automation is that the latter can include tasks performed by humans within the automation.

The case company consists of two functional units which operate in the Marine and Energy sector. The units are divided into different divisions that either are production and/or service-oriented for different production lines. Within the divisions, different business units focus on different stages of the business operations. One of the divisions in the case company has successfully automated the first business process with iBPM which is now in production use. In addition to this, another division is at the beginning of their iBPM journey towards their first automated business process. Worth mentioning is that even though they are in different divisions of the case company they are utilizing the same applications.

During the last months, a proof-of-concept demo case was developed in the second division to demonstrate its capabilities with some of its features for the division's management and business users. The outcome was positive, and thus, the development can continue to entail the whole process. The aim for the future is to develop the demo case into a full production version within the year 2023. Thereafter, to continue foster active participation by process owners and process experts within the second division to continuously initiate new ideas for automation projects.

In conclusion, it is important to clearly understand how the first automated business case was developed, and which benefits it brought to the case company and compare it with best practices in the literature review. This business case will be referred to as the case study. Therefore, focus groups consisting of the development core team, the process automation lead

and developer, and key users will be interviewed to understand the development path as well as the benefits and challenges of an iBPM automated process. As a result, the collected information will support the second division to start their own journey towards iBPM automation.

1.2. Problem description

Business processes today include many repetitive tasks, manual reminders and coordination of projects that are costing organizations both time and money. As modern technology has developed, automation can be a great initiative to reduce costs and time, increase productivity, reduce mistakes, and improve employee satisfaction (Winn, 2022).

In the case company as of today, RPA is the leading initiative when it comes to process automation. Even though, RPA enables automation across applications and systems, it does not allow for human interaction. This problem can be solved with iBPM automation since it can be seen as the skeleton via all tasks within a business process can reside, both system and human tasks. Furthermore, the BPMS can connect to APIs (Application Programming Interfaces), assign tasks to humans for them to make business decisions, and trigger RPAs to perform repeated work. Thus, iBPM can act as a one-stop shop for orchestration, execution, and real-time overview of how a business process executes.

Therefore, iBPM technology needs to be continuously presented within the case company with the purpose of internal stakeholders understanding how iBPM relates to RPA but at the same time hugely differs from it. A common understanding is necessary to recognize the benefits of utilizing iBPM automation in addition to RPA. However, a problem that could occur is resistance to understanding why yet another technology is needed.

The first automated iBPM business case is in production use since October 2022 and as of the time of writing this thesis, a second division started their journey towards developing an automated process in iBPM. For this reason, the subject for this thesis was carefully chosen in co-operation with the case company to acquire the needed knowledge of iBPM automation to support the team in the second division with their iBPM journey. Nevertheless, the gained insights can be beneficial throughout the whole case company.

1.3. Objectives

The objective of this study is to explore the concept of process automation using iBPM (intelligent Business Process Management) technology, provide a practical guide from mapping to automating a process and explore the benefits and the added value it brings to the case company. The targets of the research can be divided into two main research questions with additional sub-questions, which will be elaborated on below.

RQ1: How can the case company effectively improve and automate business processes with iBPM?

- What are the practical guidelines and best practices when developing process automation in iBPM?
- How to overcome pitfalls and what are associated risks with iBPM automation?

To attempt to answer the above-mentioned questions, focus group interviews will be conducted in a semi-structured way. By analyzing the theoretical review, it will gain valuable insights into the existing literature related to the BPM lifecycle and the framework of BPMN (Business Process Model and Notation) to help understand how process automation projects should be carried out. Furthermore, the theory will be used to address best practices related to the way of working and how to overcome pitfalls during the development.

The interviews will be conducted with the employees that are in touch with the first automated business case to discover lessons learned and tips on how they would improve the approach towards automating business processes with iBPM. Additionally, to find out in detail what went well and where they stumbled upon challenges throughout the whole development process. This is in order to prevent re-inventing the wheel as a successfully automated business case is already in production at the case company.

The findings will be presented in the results and discussion section of this thesis as well as presented for the case company in the form of a presentation. Moreover, the outcome will be in the form of concrete recommendations on how the case company can adapt their way of working when building executable business processes with iBPM.

RQ2: Why should the case company allocate resources for iBPM process automation?

- How does iBPM automation bring advantages and added value to the case company?
- What are disadvantages of automating business processes in iBPM?

The investment in process automation through intelligent Business Process Management (iBPM) can have significant benefits for the case company, including improved efficiency, cost savings, and better quality of service. Therefore, this research will investigate the advantages and added value iBPM automation brings to the case company as well as explore the disadvantages to have a wide understanding of the opinions of iBPM automation.

To gain findings for the second research question, an attempt will be to conduct semi-structured focus group interviews in order to gain explicit answers from both managers, developers as well as key users of the case study. This ensures that different views are collected in an effort to conclude which added value and disadvantages automated business processes bring to the case company. Another cornerstone in these questions is the theoretical review that will be used to support the gathered information from the interviews.

The outcome will be discussed in the results and discussion chapter and the findings will be essential for proofing the concept of iBPM automation to help bring automation projects forward in the case company depending on the achieved outcome.

1.4. Limitation

The delimitations for this research were set in agreement with the case company. The thesis will cover how the case company can effectively automate business process automation in iBPM and focus on gaining knowledge on the added value such automation projects contribute to the case company. However, the technical implementation of the processes in the execution engine will not be addressed due to the missing knowledge from the author's field of study.

Initially, the work in the thesis was thought to include firstly research about the past automated iBPM success case to find out the positive and negative things they stumbled upon on their way to implementation. Secondly, with the help of a developed proof-of-concept demo introduce process automation to more business units in order to find out how they interpret future process automation possibilities and also, investigate the maturity of their business processes. However, after discussing the limitation of this thesis with the case company, it was decided to leave the latter part outside the scope of this thesis. Therefore, the knowledge and findings from this thesis can be utilized later when introducing the iBPM technology to other business units.

1.5. Disposition

In the last sub-chapter, an outline of the report will be provided. The first chapter provided the introduction of the research including the background, purpose and research objectives. In the second chapter, the theoretical framework will be considered which is used as a basis for the research question's sub-questions. The third chapter focuses on the methodology of the research and in the fourth chapter, the results will be presented. The fifth chapter provides the conclusion and discussion on the research answering the research's questions, additionally the limitation and further research are considered. In the sixth and final chapter of this report, the recommendations will be given to the case company and by that, the research's questions will be answered.

2. THEORETICAL FRAMEWORK

This chapter is divided into seven sub-chapters. The first section will explore business processes and their importance, history and the drivers for change. The second section will delve into the definition, advantages and the future of BPM (Business Process Management) as well as look at two BPM lifecycles. An in-depth description of the Business Process Model and Notation 2.0 (BPMN) standard and process modeling will follow in the third section. After that, in the fourth section, process automation and the difference between RPA and BPM will be explained and additionally, the workflow engine is considered.

Thereafter, in the fifth section, the BPM suite (BPMS) and intelligent BPM (iBPM) will be discussed in addition to the advantages of introducing a BPMS. In the sixth section, a more practical framework will introduce how one can apply BPMN on projects that require technical implementation. In the seventh and final section, the pitfalls, challenges, and practical tips will be discussed related to the development path towards process automation.

2.1. Introduction to business processes

A business process consists of activities that are executed in coordination to accomplish business goals. These activities can take the form of system activities, user interactions, or manual activities (Weske, 2007). Processes can on one hand be very simple and on the other hand, extremely complex. Earlier when process work was done in manufacturing it was popular to say that a process took inputs and transformed them into outputs. However, Harmon (2019) mentions that many prefer today to avoid this language as it sounds too much similar to a manufacturing operation where physical objects were reshaped into a physical product. Nowadays, most service processes are more likely to take information and modify it by generating new data, recommendations, or printed documents (Harmon, 2019).

Processes are the arterial system within organizations and in inter-organizational supply networks. Historically, the importance of business processes had not been appreciated for a long time even though they are the lifeblood of an organization. This has changed due to the growing demands for globalization, integration, standardization, innovation, agility, and operational efficiency. In addition to the opportunities raised by digital technologies, it has finally increased in importance for reflecting on and ultimately improving and designing new business processes. As a result, BPM emerged to support all stages of the business process lifecycle (Dumas et al., 2018).

History of business process change?

The history of corporate business process change initiatives can be traced back to the Industrial Revolution of the late 18th century. This led factories and managers to put considerable energy into the organization of manufacturing processes. A number of entrepreneurs changed processes and revolutionized the industry. In 1903, Henry Ford changed the manufacturing process and transformed how automobiles were assembled (Harmon, 2019). Ford's assembly line reduced its production time from more than 12 hours to two and a half hours (Red Hat Inc., 2018).

Modern business process automation software and applications can streamline complex workflows and provide transparency and control over all aspects of the process. By collapsing development and deployment timelines from months to hours, business process automation simplifies and accelerates operations. This technology continues the legacy of previous automation efforts, enabling users to focus on critical tasks while freeing them from repetitive routines (Red Hat Inc., 2018).

What drives business process change?

To understand what drives the business interest in business processes before digging into more theoretical concepts. The returning answer to what drives business process change is that in economically bad times, companies seek to make their processes more efficient so save money. Contrary, in economically good times, companies want to increase their production and enter new markets. Therefore, they improve their processes to offer better products and services to reach new customers or improve their competitors' achievements (Harmon, 2019).

Another cause for constant innovation and increase in productivity is the constant change and competition from competitors which in turn leads to an even more intense focus on how the business processes are being handled. Focusing on how work gets done is to focus on business processes. Today's managers know that success is achieved by doing things better, faster, and cheaper than what is being done today, and this is precisely what the focus on processes is all about (Harmon, 2019).

2.2. Business Process Management (BPM)

The concept of Business Process Management needs to be considered as it provides an initial understanding of how business processes can be improved with the help of automation. Additionally, the BPM lifecycles can be used as a framework for the case company to effectively improve business processes. The theory also highlights the benefits of BPM automation which can provide a theoretical explanation as to why the case company should allocate resources for BPM automation.

2.2.1. Definition and general overview

Business Process Management (BPM) is considered to be both a management discipline and a set of technologies that treat business processes as assets. BPM assumes that an organization's objectives can be accomplished by defining, engineering, managing and committing to continuous improvement of its key cross-functional business processes. Recent studies confirm that BPM is rapidly growing as the dominant management model of the twenty-first century. More than 80 % of the world's leading organizations are actively engaged in BPM programs many of these on a global scale (Benedict et al., 2019). Furthermore, the BPM market was worth USD 10,64 billion in 2020 and the market is expected to grow with a compound annual grow rate of 12 % in the coming years, reaching USD 26,18 billion by 2028 (Fortune Business Insights, 2021).

Benedict et al. (2019, p. 18) define it as follows: *"Business Process Management (BPM) is a disciplined management approach to identify, design, execute, document, measure, monitor, and control both automated and non-automated business processes to achieve consistent, targeted results aligned with an organization's strategic goals. BPM involves the deliberate, collaborative and increasingly technology-aided definition, improvement, innovation, and management of end-to-end business processes that drive business results, create value for customers, and enable an organization to meet its business objectives with more agility".*

Along with this new management discipline, new organizational structures and roles are emerging as well as a new genre of professionals is emerging to support these practices. It brings tremendous advantages to those businesses that adopt the successful strategy of managing by process and adapting new information systems tools to support those activities (Benedict et al., 2019). However, this concept is not new as existing Six Sigma and Lean principles are other examples of BPM methodologies (IBM, n.d.-a).

2.2.2. Benefits and advantages

This section describes seven benefits and advantages of introducing Business Process Management (BPM) in an organization.

Increased efficiency and cost saving by optimizing existing processes and introducing more structure to the development of new ones (IBM, n.d.-a). Embedded analytics provides managers with greater visibility into process performance while enabling them to identify bottlenecks (Pratt & Lutkevich, 2022). Eliminating process redundancies and bottlenecks results in improved productivity and efficiency whereas resources can be allocated to other high-priority tasks (IBM, n.d.-a).

Enhanced employee and customer experience when BPMS tools help eliminate repetitive work and make information more accessible which allows employees to focus on their work and customers which in turn results in increased customer satisfaction. Additionally, clear workflows reduce the learning curve in the employee onboarding process, enhancing productivity and engagement (IBM, n.d.-a).

The *automation and optimization of business processes* can enhance the quality of performance in operation by ensuring smoother running processes. Automated processes can decrease the cycle times of individual process steps, reduce the need for insight and control and reduce human errors, thereby saving companies valuable money and time (Petersen, n.d.).

Transparent and consistently documented end-to-end business processes require that all processes are documented in centralized management software, allowing for clear visibility into how processes are running and who is currently responsible for which task. With this level of transparency, it becomes possible to identify areas for optimization and automation early on and implement them in a meaningful way (Petersen, n.d.).

Continuous monitoring and data-based analysis are crucial for optimizing workflows as the data provided is necessary to make informed decisions about optimization. This data can be used to perform target/actual comparisons, establish average values, and identify potential deviations (Petersen, n.d.).

Greater transparency as a result of reduced system and process complexity. If manual process steps are restructured and digitized using BPM, the number of people involved in the process is typically reduced, resulting in fewer interfaces. This reduction in complexity not only streamlines the process landscape but also enhances stability and transparency (Petersen, n.d.). Furthermore, process automation provides greater transparency by clearly defining task owners along the process, fostering accountability and improving communication among teams (IBM, n.d.-a).

Less dependency on development teams since a low-code BPM suite reduces dependency on development teams. Business users and non-IT experts can be learned these tools which enable greater process automation across the company (IBM, n.d.-a).

2.2.3. Future of BPM

The structured approach of BPM to improve business processes is an evolving discipline, driven by the dynamic nature of work and business in the 21st century. Factors such as the increasing adoption of digital technology, the need for businesses to operate in a digital marketplace, and the shift to remote work during the COVID-19 pandemic have pushed businesses to reassess their processes to fulfil their business goals.

For that reason, BPM and the technologies that support it have evolved to meet the new needs. BPM is changing from a discipline dominated by a highly paid consultant to a continuous improvement driven from the ground up in organizations. Some of these trends are:

- Citizen developer tools are enabling more users across the organization to identify, implement and measure new ways to improve processes.
- Intelligent business process automation is incorporating AI, machine learning and RPA in workflows.
- The extension of BPM functionality into business applications by major software vendors is extending the reach of BPM principles and technology.
- Process mining tools that automate the discovery of process models from event logs make it easier for organizations to construct an accurate picture of the process activities and how they can be optimized.
- Adaptive process management and the use of BPM to optimize front-end business processes will also become increasingly important in the future of BPM.

(Pratt & Lutkevich, 2022)

2.2.4. The BPM lifecycle

The BPM lifecycle is a cyclical and iterative framework that standardizes the implementation and management of business processes within an organization. It consists of five stages or phases, which are design, model, execute, monitor, and optimize as seen in Figure 1. These stages are carried out systematically, and each stage has specific activities to achieve efficiency in business operations (Malak, 2022).

While some BPM experts may include more steps or call the steps by different names, the five stages of the BPM lifecycle are commonly recognized. The lifecycle allows for the continuous improvement of company processes by repeating the cycle rather than stopping after the last step is completed. Overall, the BPM lifecycle is an essential component of the business process management discipline, providing a strategy for systematically improving company processes (Malak, 2022).

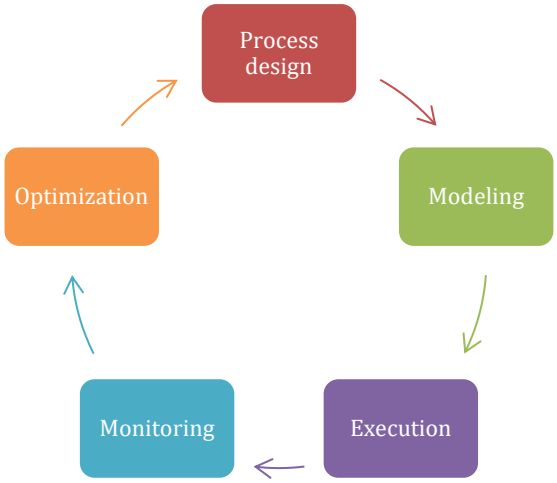


Figure 1. The BPM lifecycle

1. Design

The first step in the lifecycle is the designing stage, where the team should define the milestones of the process. Next, they should identify the individual tasks involved in the process and assign task owners for each step in the workflow. It is important to clearly define the steps so that the team can pinpoint areas that require process optimization and track metrics to measure the progress of such optimization (IBM, n.d.-a).

This may be done by reviewing current business rules, interviewing various stakeholders and discussing outcomes with the management (Devi, 2021). Additionally, certain goals are defined that are supposed to be achieved as a result of BPM (Petersen, n.d.).

2. Model

In the modeling stage, the team should develop a visual representation of the process model, including timelines, task descriptions, and data flow (IBM, n.d.-a). This in order for teams to visualize the workflow sequence and for the workflow engine to execute or automate it (Devi, 2021). Business process management software can be useful during this phase (IBM, n.d.-a).

To improve the efficiency of the process framework, it is important to have a clear understanding of the current state (as-is) and the desired future state (to-be) with changes. Once the revised design has been created, it should be shared with all relevant stakeholders for evaluation and approval. Obtaining stakeholder buy-in and soliciting feedback is critical at this stage to make any necessary changes or improvements (Malak, 2022). The goal is to create a clear and concise model that can be used to guide the development of automation (IBM, n.d.-a).

3. Execute

The third step is execution where the improvements are implemented. This is when the previous preparation stages are put into action and the goal is for the BPM system to run

smoothly and efficiently (Datarundown, 2022). The team can conduct a proof-of-concept by testing the new BPM system with a limited group and after integrating any feedback, the process can be rolled out for a broader audience (IBM, n.d.-a).

To successfully implement a process, a clear and concise plan should be developed that is easily executed by those responsible for the process. In addition, it is important to track and monitor the performance of the BPM system (Datarundown, 2022).

4. Monitor

In the fourth stage, the organization monitors the performance of the improved process and makes changes where necessary (Datarundown, 2022). Furthermore, business processes are executed and data collected to analyze how critical activities progress over time. This data collection enables the development of key performance indicators (KPIs) to assess the benefits of the newly implemented process and identify bottlenecks, delays, or potential errors (Malak, 2022).

5. Optimize

The optimization stage is the final step in the business process management lifecycle, which involves improving a designed and implemented process. Optimization can be achieved through various methods such as streamlining to simplify the process, automation to make it faster, or redesigning to enhance quality. The objective of the optimization is to continually enhance the process to become more efficient over time, resulting in time and cost savings and a better experience for both employees and customers (Datarundown, 2022).

2.2.5. Camunda BPM lifecycle

Freund and Rücker (2019) refined the simple BPM lifecycle model according to their expertise to make it more practical while keeping it lightweight without too many restrictions. The enhanced BPM lifecycle is called the Camunda lifecycle and can be viewed in Figure 2. This model is intended to describe one process at a time that can be run through the lifecycle independently of any other process, also the process can be at a different stage each time it repeats.

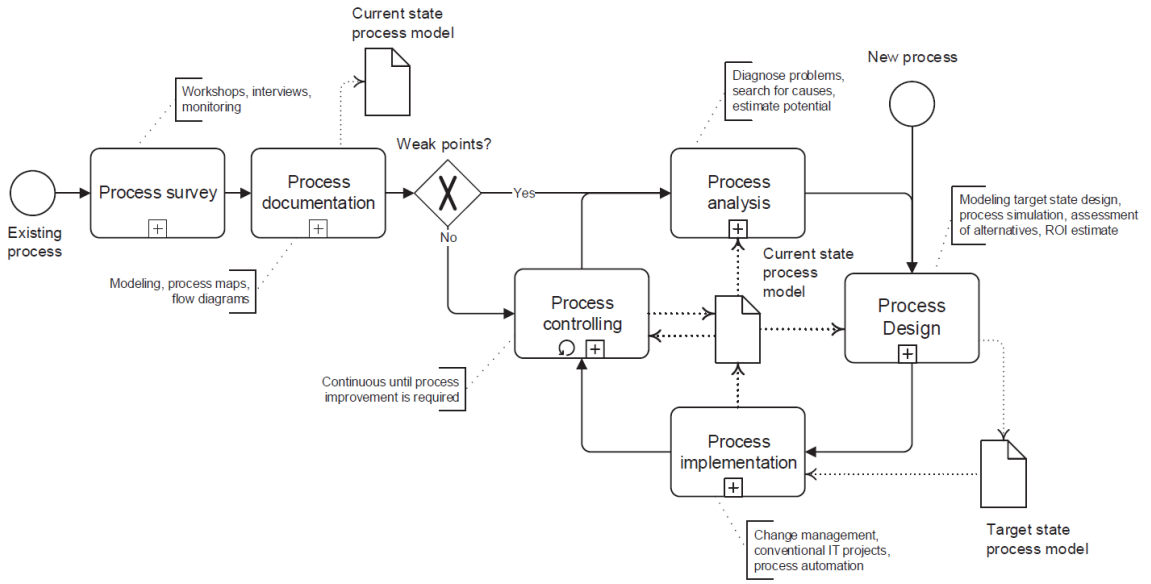


Figure 2. The Camunda BPM lifecycle (Freund & Rücker, 2019)

The cycle triggers when one of the following situations happens: An existing process is to be documented or improved, or a new process is to be introduced.

- An existing process is first examined by e.g., workshops or one-on-one interviews to identify what needs to be accomplished as well as who needs to be involved and which IT system.
- In the *process documentation* stage, the findings from the process discovery are documented in a current state process model. A systematic examination of the current process clearly identifies weak points and their causes.
- *Process analysis* is conducted either during first-time documentation or continuous process control when a weakness in the process has been identified that cannot be easily remedied.
- After identifying weak points through process analysis, they serve as the starting point for another *process design*. If required, various process designs can be evaluated through process simulation. Additionally, a process design is conducted when introducing a new process. In both cases, the outcome is a target state process model.
- The target state process model is usually implemented as a change in business or organizational procedures as well as an IT project. This can involve automating the process or for software to be developed, adapted, or procured. The *process implementation* results in a current state process that corresponds to the target state model, which has already been documented.
- The key tasks of *process control* include continuous monitoring of individual process instances and analyzing data to identify weak points quickly. Direct solutions are

required for problems with individual entities and the current state process model may need to be adjusted if necessary.

- If there is a need for an improvement project in cases the problems are unclear or complex, it starts over again with the systematic *process analysis* of the weak points. The decision to initiate such a project should involve the process owner and other stakeholders. While continuous process control is typically seen as following process implementation, it may be more beneficial to have it follow initial documentation, particularly if there is doubt about the necessity of improvement.

Process modeling is crucial in the BPM lifecycle, which highlights the importance of a modeling standard such as BPMN (Business Process Model and Notation). However, it should be noticed that process modeling is not a stage in the Camunda BPM lifecycle, since process modeling is a method that affects all stages in the lifecycle, especially process documentation and process design. BPMN was developed to improve process automation and even without IT expertise, understanding process automation can help grasp how BPMN establishes the connection between business and technology. Due to the significance, process modeling and the BPMN standard will be elaborated on in the following sub-chapter.

(Freund & Rücker, 2019)

2.2.6 Summary of Chapter 2.2

Business Process Management (BPM) is both a management discipline and a set of technologies that treats business processes as assets and involves defining, engineering, managing and continuously improving key cross-functional business processes. More than 80 % of the world's leading organizations are actively engaged in BPM programs many of these on a global scale.

BPM provides benefits such as increased efficiency, cost savings, enhanced employee and customer experience, optimized business processes, and greater transparency. Trends in BPM include citizen developer tools, intelligent business process automation, process mining tools, and adaptive process management, driven by factors such as the increasing adoption of digital technology and the shift to remote work during the COVID-19 pandemic.

The BPM lifecycle includes five stages: design, model, execute, monitor, and optimize, whereas the ultimate goal is to continuously improve business processes by repeating the cycle rather than ending it after the last step. Furthermore, the Camunda BPM lifecycle is an enhanced version of the simple BPM lifecycle model and involves stages such as process survey and documentation, analysis, design, implementation, control, and improvement projects. Process

modeling is crucial in the BPM lifecycle whereas BPMN is a modeling standard that affects all stages in the lifecycle, especially process documentation and design.

2.3. Business Process Modeling

The theory of process modeling and the BPMN standard is defined due to its importance in all the phases of BPM and process automation. Additionally, the naming conventions can help increase the mutual understanding when reading models and ensure that process models are more understandable. Lastly, they provide a practical guideline for the case company to follow when modeling process models that is the prerequisite for automating processes as both the modeling repository and automation engine works with BPMN 2.0 standard.

2.3.1 General overview

Business process modeling involves creating representations of existing or proposed business processes, which can provide an end-to-end perspective or focus on specific portions of an organization's processes. The purpose of process modeling serves several objectives, including managing organization processes, analyzing process performance, and defining changes. They are tools that can express a target business state or specify requirements for resources needed to enable effective business operations, such as people, information, facilities, automation, finance, and energy (Benedict et al., 2019).

The level of detail and type of model needed for a project depends on its requirements. Therefore, it is important to understand the reason behind why a process is being modeled before starting modeling. This as the models produced will look quite different depending on the purpose for which they are produced. Some reason for modeling a process is to understand the process and share the understanding of the process from the people daily involved with it. Furthermore, a model can help to better understand the process and to identify and prevent issues. Most importantly is that this step is the prerequisite to conducting process analysis, redesign, and automation (Dumas et al., 2018).

To facilitate business process change, Harmon (2019) recommends that companies create architectures and store process information in business process repositories. To achieve this, a standard notation should be adopted and used consistently throughout the organization. Companies typically use the notation provided by their business process modeling tool to manage their repository. These tools support various notations, including tailored variations to meet individual company needs or preferences. The choice of notation is less important than using it consistently (Harmon, 2019).

2.3.2 Business Process Modeling and Notation (BPMN)

A number of modeling and notational standards are in use today and they are an important component of business process modeling (Benedict et al., 2019). However, BPMN diagrams support a core set of diagramming elements which represent the emerging consensus and are rapidly becoming the standard notation supported by business process tools and by business process authors. As of today, BPMN 2.0 has the most support (Harmon, 2019).

Business Process Model and Notation 2.0 is the global standard for modeling and automating business processes and these diagrams allow stakeholders to visualize and represent the sequence of business activities and information flows required to accomplish a specific process. By using the BPMN everyone from business analysts, developers and business managers "speaks the same language" which enables adaptability with total confidence (IBM, 2022). In Figure 3, an example can be seen of a simple process flow drawn in BPMN 2.0 standard.

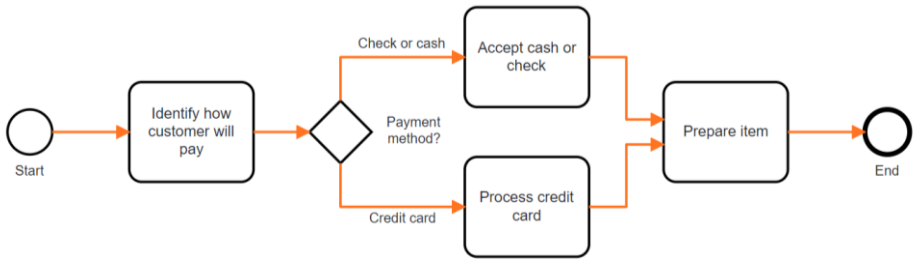


Figure 3. Process flow modeled in BPMN 2.0

The goal of BPMN is laid out in the standards document, which states that *"the primary goal of BPMN is to provide a notation that is readily understandable by all business users, from the business analyst that creates the initial drafts of the processes, to the technical developers responsible for implementing the technology that will perform those processes, and finally, to the business people who will manage and monitor those processes"* (Weske, 2007, p. 206).

In terms of a material sense, BPMN is a specification that exists in the form of a PDF document that can be downloaded free from OMG's website (Object Management Group®, n.d.). Furthermore, the 500-page long document defines all the BPMN symbols, their meanings and the rules for combining them (Freund & Rücker, 2019).

History of BPMN

BPMN was created by the Business Process Management Initiative (BPMI) and has undergone multiple updates since then (Lucidchart, n.d.). From the beginning, the goal was to establish a standardized graphical process notation that also could serve as a basis for process automation (Freund & Rücker, 2019). In 2005, BPMI merged with the Object Management Group (OMG), who took over the initiative. Thereafter in 2011, OMG released BPMN 2.0 and changed the

method's name to Business Process *Model and* Notation. A more detailed standard for business process modeling was created using a wider range of symbols and notations (Lucidchart, n.d.).

BPMN 2.0 is part of OMG's "triple crown" of process improvement standards, which also includes CMMN (Case Management Model Notation) and DMN (Decision Model Notation). The standard differs from the unified modeling language (UML) used in software design. Also, the BPMN 2.0.1 specification has been published as International Standard ISO/IEC 19510:2013 (IBM, 2022).

Advantages and disadvantages of BPMN

According to Benedict et al. (2019) adopting a modeling standard will gain advantages such as the business stakeholders (such as business users, process analysts and technical developers) having a common symbol set, language and techniques through which to communicate. Furthermore, process models can be imported and exported among various tools as well as they in some tools can transform the modeling notation into an execution language.

Another advantage mentioned by Freund and Rücker (2019) is that one becomes more independent from certain tools when it is not necessary to learn a new notation every time the tool changes. More than 100 BPMN tools exist and many of them are free. Additionally, the chance is big that partners such as customers, suppliers and consultants are familiar with BPMN and as a result, the communication around process models increases (Freund & Rücker, 2019).

Adapting a modeling standard also brings disadvantages such as the required training and experience it takes to use the full set of symbols correctly. Furthermore, different modeling tools may support a different subset of the notation. Especially in BPMN 2.0, it is difficult to see relationships across multiple levels of a process (Benedict et al., 2019).

2.3.3 The basic elements of BPMN

This chapter provides the basic elements of process modeling using the BPMN language. BPMN provides a comprehensive set with more than 100 symbols for modeling different aspects of business processes. Similar to other contemporary notations, the symbols describe specific relationships such as workflow and order of precedence (Benedict et al., 2019). There are four main elements in a BPMN diagram, namely: flow objects, connecting objects, swimlanes, and artifacts (Lewis, 2020; Lucidchart, n.d.; EdrawMax, 2022; Lynch 2022).

Flow Objects

Flow objects are the key elements describing the process. The three main flow objects are activities, events and gateways (see Figure 4).

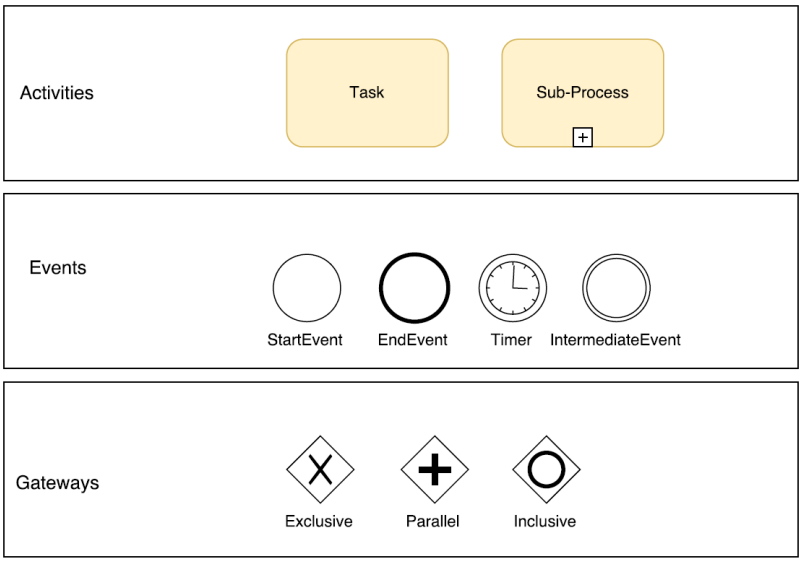


Figure 4. BPMN flow objects (Suchenia, Ligęza & Wiśniewski, 2017)

Activities

Activities are rounded rectangles, describing the work that must be completed within a process (Suchenia et al., 2017). There can be several BPMN symbols and meanings for activities, the ones below in Table 1 are mostly used.

Table 1. *Activity symbols in BPMN with explanation*

Symbol	Name	Description
Task	'None' task	A task is the most basic level of an activity and cannot be broken down further (Lucidchart, n.d). Then 'none' task type has no symbol inside and is the simplest one.
User task	User task	This task type represents an activity carried out by a human (Vliegenthart, 2020)
Service task	Service task	A service task represents any automated activity meaning no user is involved in this process step (Vliegenthart, 2020)
Collapsed sub-process	Collapsed sub-process	This symbol indicates a set of tasks categorized together in the lower level as a separate process (Suchenia et al., 2017).

	Call activity	A call activity is a global sub-process that can be reused at various times in the diagram (EdrawMax, 2022). Identified by its thick outer frame and the plus sign in the lower edge.

Events

Events are circular symbols describing something that happen during the time of the process, and these are divided into start, intermediate and end events. The start event serves as a trigger to show its beginning and under what conditions the process begins. The end event represents where the process ends. Lastly, the intermediate event indicates what happens between the start and end event (Suchenia et al., 2017).

An event represents things that happen straightaway, for example, an invoice has been received, whereas an activity represents units of work that have a duration (e.g., an activity to pay an invoice) (Dumas et al., 2018). By adding various icons to the events, more content can be retrieved. The previous event symbols in Figure 4 are associated with no action however, dedicated icons can depict different kinds of events to give them further context. The examples below in Table 2, are contained within start event symbols although they can be combined with any event type.

Table 2. *Event symbols in BPMN with explanation (Lucidchart, n.d)*

Symbol	**Name**	**Description**
	Message symbol	Trigger the process, facilities intermediate processes or finishes the process
	Timer symbol	A time, date, or recurring time and date can trigger, aid or complete the process
	Conditional symbol	A process begins or continues once a business condition or business rule is met

Gateways

Gateways are represented by diamond-shaped symbols that are used to control the divergence and convergence of a token. Thus, it will determine the branching, forging, merging and joining of paths between flow objects (Naoum, El Hichami, Al Achhab & El Mohajir, 2016). Importantly, is to know that a gateway is not a task, facts and needs have to be determined before reaching

a gateway (Harmon, 2019). Furthermore, an internal symbol indicates the type of behavior control, and the most typical gateways can be found below in Table 3.

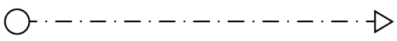
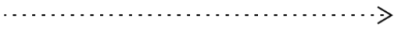
Table 3. *Gateways symbols in BPMN with explanation*

Symbol	Name	Description
	Exclusive gateway	Based on the condition breaks the flow into one exclusive path (Lucidchart, n.d). Officially, BPMN uses two symbols for exclusive gateways with identical meanings (Harmon, 2019)
	Inclusive gateway	This gateway breaks the flow into one or more flows based on the conditions (Lucidchart, n.d)
	Parallel gateway	Parallel gateways do not await a certain condition, they take place simultaneously and are not dependent on each other (EdrawMax, 2022)

<u>Connecting objects</u>

Connecting objects are illustrating how different flow objects connect with one another. There are three types of connecting objects: sequences, messages, and associations. These types are presented below in Table 4.

Table 4. *Connecting object symbols in BPMN with explanation*

Symbol	Name	Description
	Sequence flow	Shows the sequential order in which activities are performed (EdrawMax, 2022)
	Message flow	Depicts messages that flow across between two process participants (Suchenia et al., 2017)
	Association	Represents any kind of association or relationship between artifacts and other objects (EdrawMax, 2022)

Swimlanes

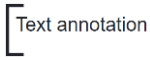
A pool represents major participants in a process (see Figure 5). Different pools can stand for a different company but are still involved in the process. The division inside the pool is represented by swimlanes that show the activities and flow for a certain role or participant (Lucidchart, n.d). Arranging the flow of activities and tasks across swimlanes makes it easy to visualize handoffs in the work and where the responsibility of performance changes. Lanes represent performers and can indicate roles, organizations, or any other entity or combination (Benedict et al., 2019).

Figure 5. Pool and swimlanes in BPMN

Artifacts

Artifacts are tools used to add more information relevant to the model but not to individual elements within the process (Lucidchart, n.d). There are three different types of artifacts: data object, group and annotation (see Table 5).

Table 5. *Artifacts symbols in BPMN with explanation*

Symbol	Name	Description
	Data object	Represents what data is required for an activity (Lucidchart, n.d)
	Group	To group different activities, however, these do not affect the flow (EdrawMax, 2022)
	Annotation	Allows the modeler to describe additional parts in the model (Lucidchart, n.d)

2.3.4 Process instances and tokens

A business process can be used as a model that helps the business to structure its work. The company will go through the process time after time, each of which will be handled according to the model. This observation leads to the key concepts in BPM, business process models and business process instances. Each time this process is processed, the model is considered a business process instance (Weske, 2007).

Start and end events have an important role as they indicate when a process instance starts and completes. A process instance is a process carried out in reality (Freund & Rücker, 2019). For example, a new instance in a cash-to-order process is triggered whenever a purchase order is received and completed when the order is fulfilled. Imagine this process being carried out at a seller's organization. This instance will run several times of the same process and each instance being independent of the others. Once a process instance has been initiated, the notion of a token is used to identify the progress (or state) of that instance (Dumas et al., 2018).

A token can show which process paths must or may be used during a process instance (Freund & Rücker, 2019). Tokens are created at the start event and flow throughout the process model until they are destroyed in the end event. These are depicted as colored dots on top of a process model when simulating the process model or when viewing in an execution engine (Dumas et al., 2018).

2.3.5 Modeling guidelines

Defining Business Process Model and Notation (BPMN) guidelines is important because it is a comprehensive modeling language that can be overwhelming for beginners. The same situation can be modeled in different ways using BPMN which complicates standardized modeling and mutual understanding when reading models. Additionally, guidelines function as a hands-on support to orientation, which especially for beginners increases the acceptance of the notation. Furthermore, it makes modeling easier and faster while ensuring high-quality process models (Freund & Rücker, 2019).

Which guidelines to be used depends on what needs to be achieved with BPMN. Different guidelines are needed depending on if the goal is process documentation or requirement engineering for IT projects. The choice of modeling level and thus the choice of method stems from what needs to be accomplished with the modeling (Freund & Rücker, 2019).

A set of modeling guidelines is called the Seven Process Modeling Guidelines (7PMG) that was developed from combined insight from available research. Researchers analyzed large collections of process models and identified many syntactical errors and complex structures

that reduced the pragmatic quality. This guideline is, therefore, helpful to guide users towards lessening such problems (Dumas et al., 2018).

The 7PMG offers a set of guidelines for creating new process models as well as improving existing ones. These guidelines build on the insight that there are multiple ways to describe the same behavior using a process model. In order to achieve a more understandable behavior-equivalent model, 7PMG highlights certain desirable properties that can be used as a reference for modifying process models. Mendling, Reijers and van der Aalst (2009) created the recommended guidelines as follows:

G1 Use as few model elements as possible as larger models tend to be more difficult to understand and have a higher syntactic error rate.

G2 Minimize the routing paths per element. The higher the number of input and output that arcs together for an element, the harder it becomes to understand the model. The number of syntactical errors has a strong correlation with model elements with a high number of routing paths.

G3 Use one start and one end event for each trigger and outcome. The study showed that the number of start and end events is positively connected with an increase in error probability. Additionally, the model is easier to understand.

G4 Model as structured as possible. A model is structured if every split connector follows a respective join connector of the same type. Unstructured models are more likely to include errors as well as people tend to understand them less easily.

G5 Avoid OR (inclusive) gateways where possible. Models that have only AND (parallel) and XOR (exclusive) gateways are less error prone. This is related to the fact that combinations of an inclusive gateway are more difficult to understand than behavior represented by other gateways as well as the implementation complexity of this type can lead to problems.

G6 Use verb-object activity labels. Different labelling styles disclosed that the verb-object style, like “Inform complainant” is less vague and more useful than action-noun labels (e.g., “Complaint analysis”) or labels that follow neither of these styles (e.g., “Incident agenda”).

G7 Decompose the model if it has more than 50 elements. This recommendation is related to G1, which is based on the observation that errors tend to increase with model size. In models with more than 50 elements, the likelihood of errors exceeds with 50 %. Consequently, large models should be split up into smaller ones.

2.3.6 Naming conventions

The difference between guidelines and conventions is essential that the former are suggestions while the latter are set rules. These can be restrictions to the vocabulary, structure, semantics or appearance of a process model (Dumas et al., 2018).

The following naming conventions are recommended. For activities, each label should begin with a verb in imperative form followed by a noun referring to a business object. For example, “Approve order”. The noun may be followed by an adjective and/or an explanation of how the action is being done. In this way, the reader can clearly understand the objective of the task. For instance, “Renew driver license via offline agencies”.

On the other hand, naming events should be done slightly differently. The label should begin with a noun and end with a past particle, e.g., “Invoice emitted”. A past particle is a verb form indicating that something just happened. Similarly, to activity labels, the noun may be prefixed by an adjective, e.g., “Urgent order sent”. Therefore, the name of the start event communicates what triggered the process to start and the label to the end event reveals what conditions hold when an instance of the process completes, in other words, what the outcome of the process is.

Additionally, the first word of an activity and event label should be capitalized. Also, articles should be avoided to shorten the label as long labels may decrease the readability of the model. Furthermore, when naming a process model, one should preferably use a noun, potentially followed by an adjective, e.g., “order fulfilment” or “claim handling” process. The verb that describes the main action can be nominalized to use as a label. For example, the main action “fulfil order” turns into the process label “order fulfilment”. Another possible option is nouns in hyphenated form like “order-to-cash” and “procure-to-pay” which indicates the sequence of main actions in the process.

(Dumas et al., 2018)

2.3.7 Summary of Chapter 2.3.

Business process modeling involves creating representations of existing or proposed business processes to manage and analyze their performance and define changes. It is important to understand the reason behind why a process is being modeled as the level of detail and type of model will depend on its requirements. A reason is to understand and share the process, identify, and prevent issues as well as it is needed for process analysis, redesign and automation.

The models should be stored in business process repositories in order to facilitate business process change. For this, a standard notation should be adopted and used consistently

throughout the organization. Business Process Model and Notation (BPMN) is a language used for process modeling and is the global standard for modeling and automating business processes. BPMN diagrams enables everyone from business analysts, developers, and business managers to speak the same language.

The basic elements of BPMN includes flow objects, connecting objects, swimlanes, and artifacts. Flow objects are classified into three categories: activities, events, and gateways, and they are the key elements of a process. Activities describe the work that needs to be completed, events represent something that happens during the process, and gateways control the divergence and convergence of a token and determine branching, forging, merging, and joining of paths between flow objects. Connecting objects illustrate how different flow objects connect with one another, and swimlanes represent different roles or participants in the process.

The Seven Process Modeling Guidelines (7PMG) are a set of guidelines for creating new and improving existing process models. Modeling guidelines are necessary because BPMN is a comprehensive modeling language that can be challenging for beginners. The section also discusses naming conventions that are recommended for activities and events in a process model.

2.4 Process Automation

Process automation is a topic that can be approached in different ways. Generally, it refers to the intent to automate any part of routine work within a business process. This can range from simple operations within a single process activity to the automated coordination of entire, complex processes. An automated business process also known as workflow is a process that is partially or entirely automated by a software system. The system passes information from one participant to another for action, according to the temporal and logical dependencies set in the underlying process model (Dumas et al., 2018).

The theory of process automation is relevant to this thesis as it provides an initial understanding of the automation concept explaining the relationship between RPA and BPM and how a workflow engine works and its principles in process automation.

2.4.1 RPA vs BPM

Robotic Process Automation (RPA) refers to the use of software robots that can perform manual, repetitive and time-consuming tasks such as extracting data, filling in forms, moving files etc. by mimicking human behavior (IBM, n.d.-b). These robots automate rule-based processes that require interaction with multiple, different IT-system. Therefore, RPA is an application of technology that is governed by business logic and structured input aimed at automating business processes (Benedict et al., 2019).

BPM, on the other hand, is a holistic approach that optimizes and automates business processes from start to finish while RPA technology handles only a small part of a business process. Thus, BPM is an end-to-end solution while RPA can be a compliment to a solid BPM approach (ProcessMaker, 2021). Consequently, BPM and RPA are two sides of the same coin and can be used in conjunction to bring a significant transformative change within an organization (Gogineni, 2018).

2.4.2 BPM and Workflow automation

Business process management (BPM) is a practice that is executed by people, rather than a technology in itself. BPM serves as the initial step towards implementing extensive business process automation. Automation technology can enhance the efficiency of the business by performing tasks with the assistance of software, thereby reducing expenses, complexity, and errors (Red Hat Inc, 2022).

Workflow engine

Process automation can be seen as software development where the workflow engine serves as the complier or interpreter, while the executable process model functions as the program code. When it comes to process automation, utilizing a workflow engine is the preferred method.

To automate workflows or processes, the workflow engine requires a BPMN model that includes all the necessary technical details for execution. During runtime, the engine creates process instances for each run and calculates the control flow to determine the next step. This implementation of the token concept enables the engine to always know what needs to be done next. It is worth noting that automation is not applied to the business process itself, but rather to the control of the process.

Let us follow a simple manual process: A bank customer mails a paper credit application which lands on the desk of a bank accountant. The accountant reviews the application and assesses the applicant's creditworthiness through a credit rating agency's website. As the results are positive, the accountant records the application in BankSoft, a specialized software and then forwards the documents to a manger for approval.

Now, consider the same process automated: A bank customer mails a paper credit application which is scanned into electronic form by a bank clerk. The document is then handled by a workflow engine software which routes it to the bank accountant's virtual task list. The accountant accesses the task list through perhaps the bank's web site or an email program such as Microsoft Outlook, reviews the application on the screen and then clicks a button. The workflow engine software accesses the credit rating agency's website, retrieves the necessary

information, and receives the report. Since the report is favorable, the engine sends the data to BankSoft and creates an approval task in the manager's task list.

The engine distinguishes between two activity types: those that require human interaction and those that run automatically, such as service calls or evaluations of gateways, events, or sentries. User or human tasks are used for human interaction, and engines typically provide a list of tasks similar to an email inbox, indicating which tasks need to be completed. Tasks can be opened to access a preconfigured screen mask for viewing and processing data or making decisions.

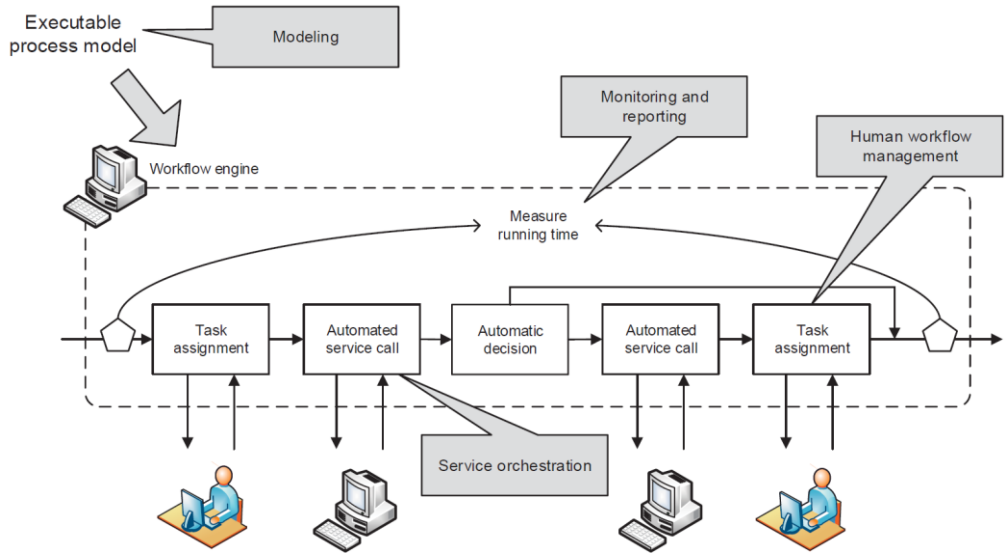


Figure 6. Process automation with a workflow engine (Freund & Rücker, 2019)

Some of process automation's principles are represented in the previous example and can be pictured above in Figure 6.

- Process automation does not mean the entire process is fully automated
- The workflow engine is the primary component of process automation, executing an executable process model
- The workflow engine controls the process by assigning tasks to humans and handling their outcomes
- The engine also communicates with internal and external IT systems for service orchestration
- The workflow engine decides which tasks or service calls to initiate, under what conditions, and according to the result of the task execution or service call. Therefore, the people involved in the process can still influence the operational sequence of an automated process.

(Freund & Rücker, 2019)

2.4.3 Summary of Chapter 2.4.

Process automation involves the automation of routine tasks in a business process using software systems. This can range from simple operations to the automation of entire, complex processes. Robotic Process Automation (RPA) is the use of software robots that can perform manual, repetitive, and time-consuming tasks, while Business Process Management (BPM) is a holistic approach that optimizes and automates business processes from start to finish. In other words, BPM is an end-to-end solution whereas RPA can be a compliment to a solid BPM approach. BPM and RPA are two sides of the same coin and can be used in conjunction to bring significant transformative change within an organization.

Workflow engines are the preferred method for process automation. They require a BPMN model that includes all necessary technical details for execution. The engine creates process instances during runtime and calculates the control flow to determine the next step. Automation is not applied to the business process itself, but rather to the control of the process.

The engine distinguishes between human and automatic tasks and communicates with internal and external IT systems for service orchestration. The engine decides which tasks or service calls to initiate, under what conditions, and according to the result of the task execution or service call. Hence, people involved in the process can still influence the operational sequence of an automated process.

2.5 Business Process Management Systems (BPMS)

The concept of BPMS needs to be explored to understand the general concept of a BPMS and the different components that build up its architecture. This knowledge is required to understand the basics of the functionalities. Furthermore, the theory explains the advantages of implementing a BPMS as well as introduces the concept of iBPMS. This information is necessary to grasp how a process is automated with a BPM solution and which advantages it brings to the organization.

2.5.1 General overview

A business process management suite (BPMS) refers to software products that developed in the past two decades from simple workflow modeling tools to complex integrated toolsets that offer a complete operating platform and environment (Benedict et al., 2019). A BPMS supports the design, analysis, execution, and monitoring of business processes based on explicit process models (Dumas et al., 2018). Nowadays, BPMS can be implemented either on-site or in the cloud (Benedict et al., 2019) and sometimes they are referred to as BPM *systems*, *software,* or *suites* (Pratt & Lutkevich, 2022).

The BPMS software tool can be used to create BPMS applications which are managed and executed by the BPMS tool. Accordingly, a BPMS application describes a business process and incorporates a BPMS engine that will execute the business process in real-time. For example, an application was designed to manage an insurance claim processing process. The process is described by the means of a process diagram and can be examined by both business managers and IT developers. When a claim arrives, the application manages the processing of the claim (Harmon, 2019).

Most BPMS environments can integrate with legacy applications data due to their service-oriented architecture (SOA) which facilitates faster change. BPMSs enable quick redesign of business operations and process execution. (Benedict et al., 2019) and vendors offer various BPMSs with different features that support different phases of the BPM lifecycle (Dumas et al., 2019). Basic BPM suites have modules for modeling and analysis, process repository, rules engines, simulation engines, and performance modeling, monitoring, and reporting. As a result of development, suites can also include newer technologies like low-code/no-code development, extended collaboration, robotic process automation (RPA), artificial intelligence (AI), machine learning and blockchain (smart contracts), referred to as *Intelligent Business Process Management Suites* (iBPMS) (Benedict et al., 2019).

2.5.2 Architecture of a BPMS

The main components of a BPMS include the execution engine, process modeling tool, worklist handler, and administration and monitoring tools. Figure 7 illustrates these components, and their function to enable the BPMS to function effectively.

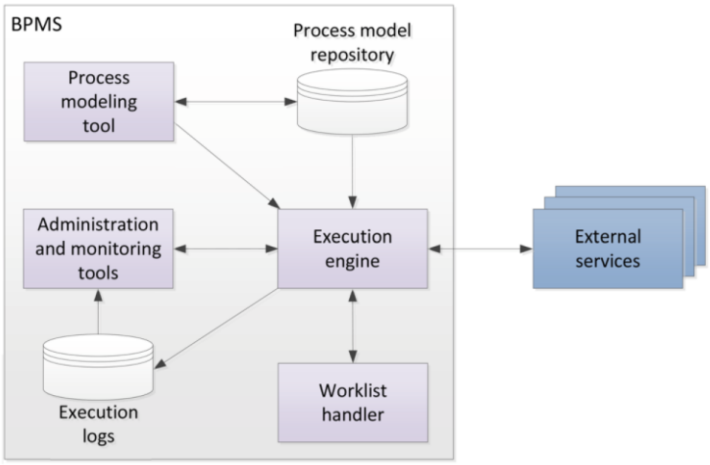


Figure 7. The architecture of a BPMS (Dumas et al., 2018)

The execution engine is central to BPMS as it provides various functionalities, such as creating executable process instances, distributing work to process participants, retrieving and storing required data, and delegating automated activities to software applications across the organization. All in all, the engine continuously monitors the progress of different instances

and generates work items for specific cases, which are then allocated to qualified and authorized resources. The execution engine interacts with the other components of the BPMS, as discussed next.

The process modeling tool component allows users to create and modify process models, annotate them with additional data such as input or output, participants, and performance measures, as well as store, share, and retrieve process models from a repository. A process model can be deployed to the execution engine to be executed. The tool uses the model to determine the order in which activities should be executed, generate work items, and allocate them to relevant parties or external services.

A worklist handler is a component of a BPMS that offers work items to process participants and tracks their completion. It functions like an inbox, allowing participants to see available work items to be executed, complete electronic forms associated with the activity, and signal completion to the engine. Afterwards, the engine determines the next work items that must be performed for the process instance in question. Participants can often control the order and priority of work items and temporarily suspend them or pass on control to someone else. Worklist handlers can be customized for efficient usage and acceptance within an organization.

External services refer to external applications that can be integrated into the execution of a business process. The execution engine can call an external application to perform automated activities, such as assessing the creditworthiness of a client. The external application must expose a service interface for the engine to interact with and provide the necessary data for the activity. Upon completion, the service returns the outcome to the engine and signals the completion of the work item. BPMS can also transfer control over process instances between different organizational units or organizations by interacting with an external BPMS that exposes a service interface. For example, a global insurance company can transfer work items between different time zones to ensure continuous execution of the business process.

Administration and monitoring tools are essential for managing the operational aspects of a BPMS. These tools are used for tasks such as monitoring process performance, handling exceptions, and removing outdated work items. They also provide administrators with visibility into the progress of individual cases, including average cycle times and the fraction of cases that are delivered too late. The execution of a process model is recorded step-by-step, and these execution-related events are stored in the system, which can be exported in the form of execution logs to generate performance dashboards.

(Dumas et al., 2018)

2.5.3 Intelligent Business Process Management (iBPM)

iBPM suites (iBPMS) have developed into a more intelligent and advanced system, unifying business rules and AI analytics capabilities within the BPMS to make intelligent BPM a reality. iBPM is a digital transformation discipline that includes an automation technology component that aligns business objectives to execution. Several trends have influenced the evolution of iBPM, making it the core engine of transformation for digital enterprises, such as process participants and process intelligence (Benedict et al., 2019).

Some iBPMS platforms (also called digital process automation platforms) have robotic automation available. Next-generation iBPMSs support the entire spectrum of work automation, including structured, cognitive, and AI-assisted tasks. Additionally, dynamic case management has emerged as a more powerful model to handle ad-hoc work and provide more effective work orchestration than flowcharts and swimlanes (Benedict et al., 2019).

The term intelligent BPMS (iBPMS) was introduced by the research firm Gartner Inc. and is now widely used by BPM vendors to emphasize how advanced technologies, such as real-time analytics, machine learning, complex event processing, business activity monitoring and other systems, have made process automation even more data-driven and dynamic. Additionally, iBPMS products also include advanced social and collaboration capabilities (Pratt & Lutkevich, 2022).

However, this can be debated as Harmon (2019) mentions that analysts have introduced pseudo transitions that do not account for too much. Gartner has announced for readers that there are BPMS tools that focus on case management and “intelligent BPMS” which Harmon believes is nonsense. This is a result of the relatively small BPMS market and vendors are taking every opportunity they can find. Furthermore, iBPMS is more related to Gartner’s marketing concerns than with the realities of the BPMS market (Harmon, 2019).

2.5.4 Advantages of introducing a BPMS

This section examines the reasons why organizations may find it beneficial to adopt a BPMS to automate business processes. Four main advantages will be discussed, including reducing workload, flexible system integration, providing execution transparency, and enforcing rules (Dumas et al., 2019).

Workload reduction

The use of a BPMS provides workload reduction for organizations in several ways. Firstly, it automates the transportation of work items by dispatching them electronically, eliminating delays caused by manual processes. Secondly, it coordinates tasks by using the process model to determine which activities need to be performed and in what order, saving someone time in

deciding what to do next. Thirdly, it saves coordination time by signaling completed work to ensure work is not laying around in case of work handoffs as BPMS signals the status of work items at all times to ensure that progress is being made. Lastly, it gathers all relevant information needed to carry out a task, eliminating the need for employees to manually collect information. This assumes that the organization has digitalized its documents, which often accompanies a BPMS implementation. Some vendors offer integrated suites of BPMS and Document Management System (DMS) functionality.

Flexible system integration

BPMS was initially popular due to the increased flexibility that organizations achieve with the technology as it can provide organizations with flexibility in managing and updating their business processes as well as their applications. This since it is more convenient to update the description of a business process without having to inspect the application code. Additionally, BPMS allows for the modification of an application without changing the order of how things on the business process level unfold.

BPMSs also enable the means to "glue" together separate systems, allowing them to play their due role in the business processes they support. However, a BPMS does not offer a direct solution to the problem of redundant storage of information across different IT systems. Therefore, through thorough information analysis, it is necessary to map which data is used and available for the BPMS to operate as an integrator between existing systems.

Execution transparency

Business Process Management Systems (BPMSs) can provide valuable operational and historical information on the way that business processes are executed. These two types of information may be useful to generate business insights from BPMS data: Operational information, which relates to recent, running cases, can be used to manage individual cases, participants, or specific parts of a business process. Historical information, in contrast, covers more cases over an extended period of time and can be used to determine the performance of a particular process or its conformance to particular rules.

Regarding the former category, one may think of average cycle times, the number of completed process instances over a particular period, and the utilization of resources. The latter category covers issues such as exceptions that have been generated or the number of instances that did not meet a specific deadline.

Rule enforcement

Using a Business Process Management System (BPMS) not only leads to more efficient execution of business processes but also ensures that they are carried out in a precise and

consistent way exactly as designed. This adherence to predefined rules is considered a quality benefit that helps organizations fulfill their promises. This can be particularly useful in ensuring compliance with regulations and governance frameworks, as well as enforcing separation of duties controls in financial transactions.

Enforcing rules has become increasingly important due to the rise of various governance frameworks, particularly in the financial and professional service sectors, which require company executives to install management controls and ensure their proper execution. Obviously, BPMSs can assist in fulfilling these requirements.

(Dumas et al., 2019)

2.5.5 Summary of Chapter 2.5.

Business Process Management Systems (BPMS) refers to software products that were developed from simple workflow modeling tools to complex integrated toolsets that offer a complete operating platform and environment. A BPMS supports the design, analysis, execution, and monitoring of business processes based on explicit process models.

Basic BPMS suites have modules for modeling and analysis, process repository, rules engines, simulation engines, and performance modeling, monitoring, and reporting. As a result of development, suites can also include newer technologies like low-code/no-code development, extended collaboration, RPA, AI, machine learning and blockchain, referred to as Intelligent Business Process Management Suites (iBPMS).

A BPMS consists of the execution engine, process modeling tool, worklist handler, and administration and monitoring tools. The execution engine is central to BPMS as it enables functionalities such as creating process instances, distributing work, storing data, and delegating automated activities. The process modeling tool allows for creating and modifying process models, annotating them with additional data, and storing and sharing them. The worklist handler offers work items to participants and tracks their completion, functioning like an inbox as it allows participants to see available work items and complete electrical forms.

Implementing a BPMS provides several advantages for organizations, including workload reduction, flexible system integration, execution transparency, and rule enforcement.

2.6 A method framework for BPMN

The theory of a method framework for BPMN (Business Process Model and Notation) can be applied to projects that require increase technical support for developing process automation in iBPM. Furthermore, the theory also highlights how to prepare an operational model to an executable process and finally, how to implement a process with executable models where a five-step method is described to convert a conceptual process model into an executable one.

2.6.1 General overview

Freund and Rücker (2019) developed a practical framework for applying BPMN to help decide which BPMN symbols and constructs to use in certain situations as well as knowing when to hold back to maintain simplicity. The primary focus of the framework is on projects that require increased technological support for their processes, particularly those that require modeling of the target state. However, the modeling patterns demonstrated can also be applied to other scenarios, including discovery, documentation, and analysis of current-state processes.

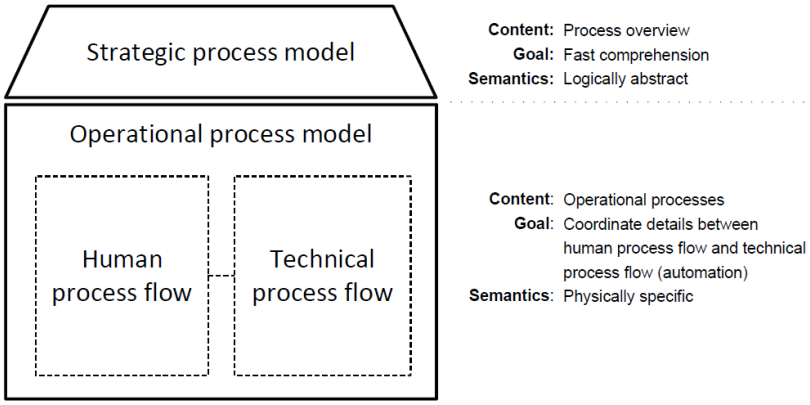


Figure 8. Camunda BPMN framework (Freund & Rücker, 2019)

The Camunda BPMN framework seen in Figure 8, differentiates between strategic and operational process models. The main audience for strategic process models is process owners and process managers, with process participants and process analysts as a secondary group early in the project. The strategic model is designed to be a general, results-oriented representation of the process, aimed at quickly conveying an understanding to an audience with no special BPMN knowledge. The process is depicted in a few simple steps, without showing any errors or variations.

The operational process model investigates the operational details of the actual process, including both human and technical process flows, which are modeled accordingly. Human flows are managed by participants, while technical flows are managed by software, preferably a workflow engine. The two flows can interact, with a human triggering a technical flow by

calling a software function, or a technical flow requiring a participant to send an email or assign a task. In this case, the human flow is triggered by the technical flow.

(Freund & Rücker, 2019)

2.6.2 Operational process model

Purpose and benefits

At the operational level process models starts to reveal operational details in the form of human and technical flows. Process participants use these models daily, while process analysts examine them to identify improvements. The operational process model serves as a starting point for technical process implementation, ideally by a workflow engine. At this level, the operational process model describes more detail than the strategic model which leads to a problem.

The challenge is reconciling the perspectives of process analysts, participants, and engineers. The process analyst is concerned about how the work is done and how it can be done better, while questions from the process participant are about how he or she should do the work. Furthermore, questions that arise from the process engineer are what the engine must achieve in terms of implementing technology.

However, successfully meeting this challenge yields benefits such as consistent process logic, improved understanding between business and IT and how respective party impact each other, and more extensive and immediate monitoring and reporting on the process. Ultimately, mastering the operational level results in a common language between business and IT in process modeling.

(Freund & Rücker, 2019)

Model requirements

The operational process diagrams must be both syntactically and semantically correct, unlike the strategic level where some semantic irregularities are tolerated. For projects with technical implementation, the technical model will be executed. Therefore, the process engineer needs to get all questions answered to reach the desired outcome (Freund & Rücker, 2019).

Procedure from strategic to operational model

To create an effective operational process model, it is important to strike a balance between precision and complexity. One way to achieve this is by providing different views of the process specific to each participant so that they can focus on their own tasks without being distracted

by the details of what others do. Also, the workflow engine should be treated as a participant with its own pool that the process engineer can focus on.

In creating the process model, it is crucial to differentiate between orchestration and collaboration. Each participant should have their own pool, which presents their tasks as a closed process. The diagram that shows the whole collaboration should be reserved for the process analyst who probably can handle the complexity. This approach is important because human activities are almost always involved in a process, and these need to be represented in the model.

The process analyst plays a major role in achieving a differentiated model by comprehending the process from different participants' points of view and modeling the process accordingly. This involves reviewing the target state process at the strategic level, resolving lanes into separate pools, modeling human flows, modeling the work done by participants that are supported by the workflow engine, modeling technical flows, and finally, finalizing other requirements such as templates, data and business rules.

Once the model is developed, it should be shared with the concerned people by using a tool with good presentation functions. The ability to expand and collapse pools is particularly valuable since this feature avoids having multiple different diagrams with unnecessarily modeled pools.

(Freund & Rücker, 2019)

2.6.3 Preparing for process automation

The process model has multiple tasks at the operational level, not just describing it from an organizational perspective. The most interesting task is achieving a seamless transition from functional to an executable process model. An executable model can directly communicate with a workflow engine to combine human and service orchestration. This approach is central to the IT perspective on BPM while another alternative would be to implement the process logic in a general programming language like Java or C# (Freund & Rücker, 2019).

Designing for support by a workflow engine

The technical implementation of a process can be discussed and documented using the process models created for each participant. To better understand the expectations of automated processes, participants can be viewed as software users interacting with the workflow engine. In this scenario, the workflow engine is treated as a participant with whom the user communicates through message exchange. Figure 9 below shows the coordination between two participants and the workflow engine as another participant, but still here with the pool collapsed (Freund & Rücker, 2019).

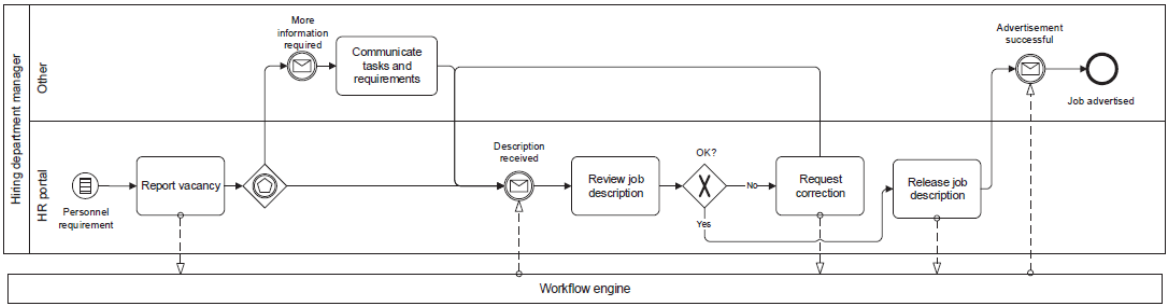


Figure 9. Example of different pools with participants and engine (Freund & Rücker, 2019)

Required processes of the workflow engine

To define the first version of the technical flow, the process analyst needs less input from process participants and can instead consult with the process engineer to determine how to implement the process with the workflow engine. A collaboration diagram is used to show the pools of human participants and expands the pool of the workflow engine as a participant, which is divided into different lanes. The engine should be divided into one lane for fully automated tasks, like interface calls (service tasks) and internal program fragments (scripts tasks). Whole sub-processes can also be stored in this lane. Another lane should be created for each participant that includes the tasks for humans to complete although, delegated by the workflow engine. The process steps of the engine are, therefore, determined by the behavior of the user participants (Freund & Rucker, 2019).

The collaboration diagram illustrated in Figure 10, shows the technical process flow which is executed in the workflow engine. Mixing control instances in a single pool when attempting to turn a functional process model into an executable one is a common problem that the collaboration diagram solves. People and workflow engines typically have separate decisions to make within a process and if control instances are not segregated into appropriate pools, creating an executable model in a workflow engine can be challenging (Freund & Rucker, 2019).

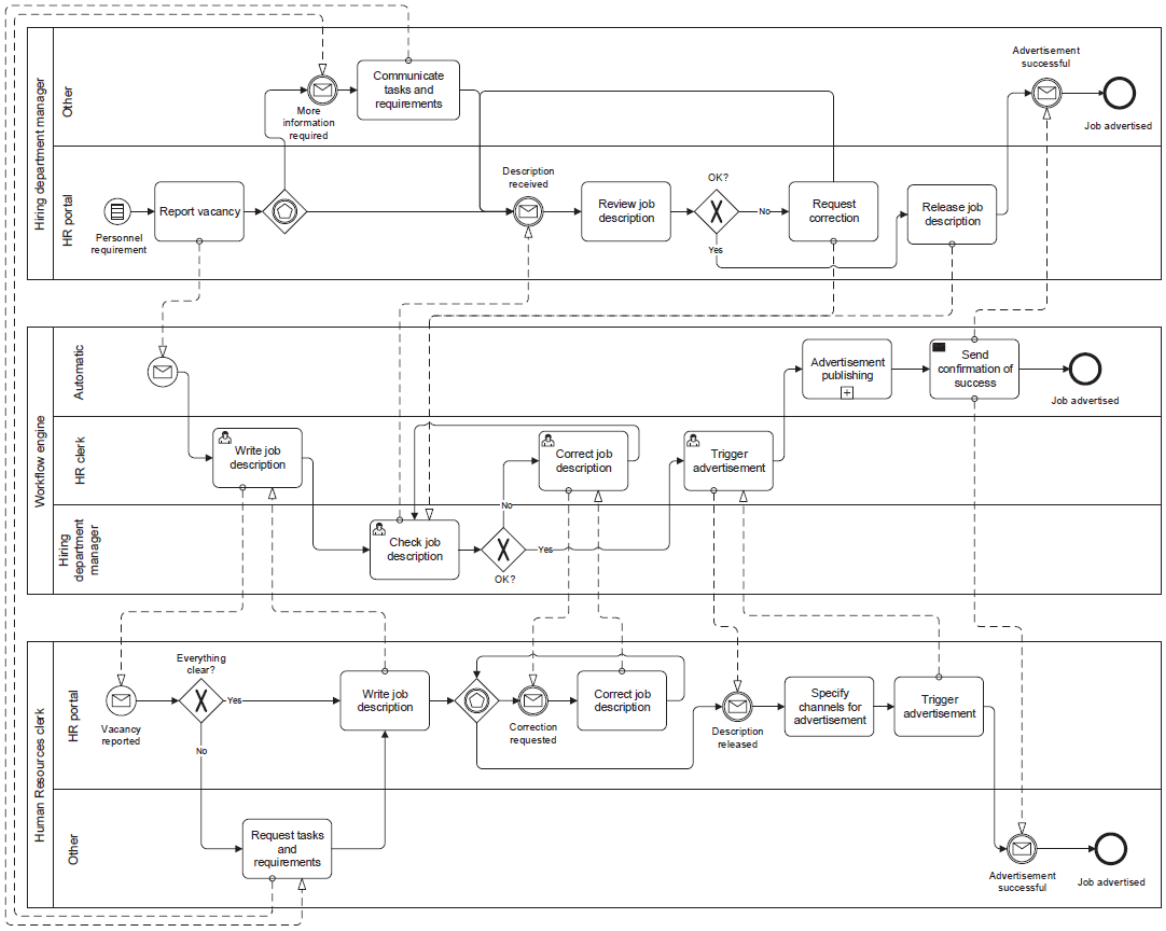


Figure 10. Example of divided responsibilities in different pools (Freund & Rücker, 2019)

Another advantage of this approach is the possibility to still present optimized views for the target groups of users. The process analyst can see the whole collaboration diagram, the process engineer sees the engine's pool and the process participants see their own pool as the other pools are collapsible. Thus, the pools can contain additional information that is not part of the engine's pool. Freund and Rücker (2019) conclude that this approach is the only practical way for aligning business and IT in a BPMN process model.

Further requirements

The process engineer may be able to implement the process from the diagram shown, but there are still issues that need to be addressed, such as the templates to be displayed and the exact tasks in a notification or description. These are typical requirements for any software project thus, they do not affect the process logic. These requirements should not be documented directly in BPMN but rather linked to the process at appropriate points. Other tools besides BPMN, such as graphic screen designs, class diagrams, decision tables, and text, are also typical requirements in the development of process applications (Freund & Rücker, 2019).

When implementing BPM projects, software components such as business logic and rules, screen flows, and data transformations often need to be implemented beyond the workflow

engine. Business logic and rules can be packaged as services, while screen flows can be modeled using UML activity diagrams. Data transformations can be handled through an Enterprise Service Bus (ESB) or script tasks within the workflow engine (Freund & Rücker, 2019).

2.6.4 Converting conceptual into executable process model

Previously, process modeling has been explored to be used for documentation and analysis purpose. However, these process models are intentionally abstract in nature as they do not provide technical implementation details. Therefore, they must be systematically reworked into executable process models in order to be interpreted and automatically executed by a software system, such as a BPMS (Dumas et al., 2018).

This chapter proposes a five-step method for converting a conceptual process model into an executable one using the BPMN language. Dumas et al. (2018) propose the five steps as follows:

1. Identify automation boundaries
2. Review manual tasks
3. Complete the process model
4. Bring the process model to an adequate level of granularity
5. Specify execution properties

These steps will make the conceptual model less abstract and more IT-oriented. However, it is crucial to ensure that the process model is syntactically correct before proceeding with these steps, as behavioral errors like deadlocks can lead to the BPMS getting stuck while executing an instance of the process model (Dumas et al., 2018).

Step 1: Identify automation boundaries

The first step is to identify the different types of tasks as depending on their nature, may not easily be implemented automatically or it might not be possible to implement via a BPMS. As a result, the principle driving the first step is that not all processes can be automated. Based on this knowledge, to identify which parts of the process can be coordinated by the BPMS and which parts not, one should distinguish between three types of tasks, automated, manual and user task (Dumas et al., 2018).

Automated tasks are performed by the BPMS itself or by an external service while manual tasks are performed by process participants without the support of any software. User tasks are something in between the two previous as they can be performed by a participant with the assistance of the BPMS' worklist handler or an external task list manager. The automated and user tasks can be coordinated by a BPMS whereas manual tasks cannot. The distinction

between the different tasks is captured in BPMN via specific markers on the top-left corner of the task box (Dumas et al., 2018).

The next step is to review the manual tasks and assess whether there is a way to connect them to the BPMS. In cases where this is not possible, it must be considered whether or not it is convenient to automate the rest of the process without these manual tasks (Dumas et al., 2018).

Step 2: Review manual tasks

The principle of the second step is that if the tasks cannot be seen by the BPMS, it does not exist. Thus, one needs to find a way to support manual tasks via technology or otherwise, isolate these tasks and automate the rest of the process. There are two ways of linking a manual task to a BPMS. Firstly, implement via a user task if the participant involved in the manual task can notify the BPMS of completing the task using the worklist handler in the BPMS. For example, the task to "Retrieve product from warehouse" can be checked out or checked in the work item back into the BPMS engine. Alternatively, the warehouse worker can notify the worklist handler once the completion of the task. In this way, the manual task can be turned into a user task (Dumas et al., 2018).

Secondly, a task can be automated by integrating technology with the BPMS to notify the engine of work item completion. For example, the warehouse worker can use a barcode scanner to scan the picked-up items and if the device is connected to BPMS, scanning the barcode will signal to the engine that the task is completed. In this case, the manual task can be implemented as a receive task that will be waiting for the notification from the scanner or, secondly, as a user task handled by a worklist handler connected to the scanner whereas the worker will be notified of the new work item by the BPMS engine and by scanning the item it signals the work item's completion to the BPMS engine (Dumas et al., 2018).

Step 3: Complete the process model

After defining the automation boundaries and reviewing the manual tasks, it's important to ensure that the process model is complete. This involves considering two principles: (i) exceptions are the rule, and (ii) tasks cannot be handed off without data. Conceptual process models often overlook certain information if deemed irrelevant or assumed to be common knowledge, however, this information may be highly relevant for a process model to be executed. For example, a process model may focus only on ideal scenarios, neglecting negative situations that may arise during execution (Dumas et al., 2018).

To address the first principle, it is essential to handle all exceptions with appropriate exception handlers. This includes compensating for tasks that cannot be completed correctly as one cannot assume that the other party will respond to tasks or that systems always will be

functional. Similarly, one cannot assume that a task always leads to a positive outcome, for example, an order may not always be confirmed (Dumas et al., 2018).

The second principle requires specifying all electronic data objects that are required as input and output by each task in the process. For example, the task "Request raw materials from Supplier" needs the list of raw materials to be ordered. In conceptual models' data objects are not relevant as the only aspects relevant to the specific modeling purposes are documented. Conversely, in an executable model where a software engine has to run the model one needs to ensure that each task has the required input and output electronic data objects (Dumas et al., 2018).

Step 4: Bring the process model to an adequate level of granularity

The fourth step involves adjusting the level of granularity in the process model to ensure that it is suitable for implementation. The tasks in a conceptual model may either be too abstract or too detailed, and it is necessary to decompose or aggregate them accordingly. For example, sequential tasks that are assigned to the same resource can be combined, while tasks that require multiple resources should be decomposed into finer-grained tasks that can be assigned to different resources (Dumas et al., 2018).

The principle driving this step is that a BPMS adds value if it coordinates handoffs of work between resources. The goal of a BPMS is to coordinate and manage handoffs between resources, whether human or non-human. If a BPMS cannot do this effectively, it adds no value between tasks (Dumas et al., 2018).

At the end of the fourth step, a to-be executed model should be achieved that contains the right elements and has the right level of granularity to be automated with a BPMS. However, at this step, the model is still independent of the specific BPMS technology to be used for automation. Thus, software engineers may be supported by process analysts in the incremental transformation of a conceptual model into a to-be-executed model (Dumas et al., 2018).

Step 5: Specify execution properties

To fully execute the model, one needs to specify the execution properties of each model element according to the BPMS. For example, thinking that a service task "Check stock availability" requires a purchase order as input to contact the warehouse ERP is not enough. It needs to be specified which specific service provided by the ERP system to be used to check the stock levels, the location of its interface in the network, the format of its input object (purchase order), and the format of its output object (stock availability). Such implementation details are called execution properties and are required to obtain a fully executable process model. According to Dumas et al. (2018) these properties include:

- Variables, messages, signals, errors, and their data types
- Data mappings
- Service details for service, send and receive tasks, and for message and signal events
- Code snippets for script tasks
- Participant assignment rules and user interface structure for user tasks
- Task, event, and sequence flow expressions
- Other BPMS-specific properties

The execution properties are stored in the BPMN interchange format, which is a textual representation of a BPMN model in XML format whose intention is to support the interchange of BPMN models between tools and also serve as input to a BPMN execution engine. BPMN modeling tools provide a visual interface to edit most of these non-graphical properties, but a basic understanding of web technologies such as XML and XML Schema (XSD) is necessary for implementing an executable process model (Dumas et al., 2018).

Referring back to the example in Figure 10, where the lane of all participants was visible, only the workflow engine's pool will be used as input for executing the technical flow as seen below in Figure 11. Even though this is the technical process flow it does not look too technical, this is a result of the details necessary for automation are hidden in the underlying model, so to say under the hood, which exists in the XML file (Freund & Rücker, 2019).

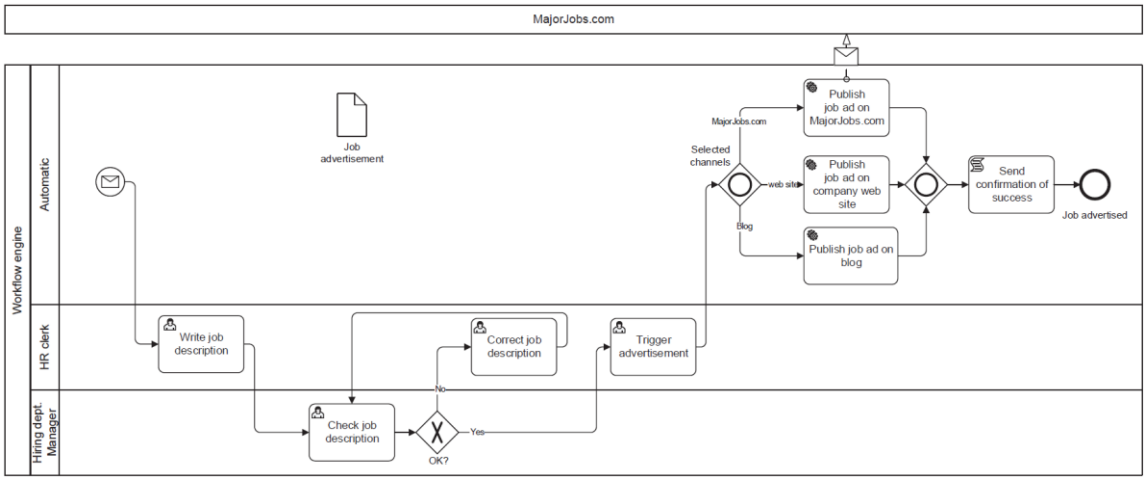


Figure 11. Executable process model (Freund & Rücker, 2019)

The five-step section discussed what is required to turn a process model into an executable one in a vendor independent manner. The final step is to take a process model and implement it using a BPMS of choice (e.g., Activiti, Bonita, Bizargi, Camunda, IBM, Oracle, YAWL) (Dumas et al., 2018).

2.6.5 Summary of Chapter 2.6.

A practical framework for applying Business Process Model and Notation (BPMN) was developed by Freund and Rücker (2019) to help decide which BPMN symbols and constructs to use as well as know when to hold back in order to maintain simplicity. The focus is on projects that require increased technological support for their processes. The framework includes two levels of process modeling: strategic and operational process models. The strategic level is designed to be a general, results-oriented representation of the process aimed at quickly conveying an understanding of the process, while the operational level investigates the operational details of the actual process, including both human and technical process flows, which are modeled accordingly. Ultimately, mastering the operational level and overcoming the challenges results in a common language between business and IT in process modeling.

To create an effective operational process model, it is important to balance precision and complexity. The model must be both syntactically and semantically correct, unlike the strategic level where some semantic irregularities are tolerated. The process model should provide different views of the process specific to each participant, and the workflow engine should be treated as a participant with its own pool. It is crucial to differentiate between orchestration and collaboration. Each participant should have their own pool, which presents their tasks as a closed process. The diagram that shows the whole collaboration should be reserved for the process analyst who probably can handle the complexity.

When preparing for process automation, the process model must achieve a seamless transition from a functional to an executable process model. An executable model can directly communicate with a workflow engine to combine human and service orchestration. This approach is central to the IT perspective on BPM while another alternative would be to implement the process logic in a general programming language like Java or C#.

A five-step step method proposes how to convert a conceptual process model into an executable one using the BPMN language in five steps. The first step is to identify automation boundaries by distinguishing between automated, manual, and user tasks. The second step is to review manual tasks and assess whether there is a way to connect them to the BPMS. The third step is to ensure that the process model is complete by handling all exceptions with appropriate exception handlers and specifying the electronic data objects that are required as input and output by each task in the process. The fourth step is to bring the process model to an adequate level of granularity by decomposing tasks into subtasks and aggregating subtasks into higher-level tasks. Finally, the fifth step is to specify execution properties such as the order in which tasks are executed, how long tasks can take, and the resources required to perform the tasks. Before proceeding with these steps, it is crucial to ensure that the process model is

syntactically correct as behavioral errors like deadlocks can lead the BPMS getting stuck while executing an instance of the process model.

2.7 Challenges and practical tips

This chapter will consider the challenges when modeling for workflow automation and practical tips on how to overcome technical challenges when modeling and preparing for process automation. Additionally, organizational challenges will be discussed such as change management and psychological fears that are important to consider for a successful implementation of automated processes in iBPM.

2.7.1 Modeling and workflow automation challenges

Unstructured workflow

BPMN focuses on business processes, but some processes are not well suited for modeling or automation in BPMN. These are processes that do not always behave in a predictable and repeatable way. Such unstructured processes could be one of a doctor arriving at an accident with badly hurt people, the actions of the doctor cannot be drawn in a BPMN diagram but instead, the doctor will make a decision based on knowledge and experience but also in reaction to the immediate response to the scene. This is the reason why the CMMN (Case Management Model and Notation) standard was invented beside BPMN. CMMN or other similar tools or solutions can approach cases where each is different and cannot be structured homogeneously (Freund & Rücker, 2019).

BPMN dilemma

BPMN presents a series of symbols and methodology that expresses itself as rules for graphically combining them, this is called syntax. The meaning of the symbols and constructs that can be modeled with the symbols are called semantics. Unfortunately, simply knowing the symbols is not enough to create useful process models. If one were to take the easy way by saying the process model is not syntactically correct as well as it is not unambiguous although the main thing is that the consumer understands it. This attitude is wrong because when BPMN is applied syntactically incorrectly one loses all benefits of standardization. A standard is meant for models to be modeled correctly, some BPMN tools will not even enable syntactically incorrect modeling. Additionally, semantic inaccuracies or inconsistencies create the risk that the model will be misunderstood. This risk is particularly high if an inconsistent target state process model were sent to IT for implementation.

Therefore, a process model to be used in a workflow engine must be correct, precise and consistent. Also, two contradicting objectives need to be reconciled. First, one must make the model easy to comprehend for different consumers as they must understand and accept the process model, this helps to reach an agreement. However, secondly, since the process model must meet the requirements of formal modeling, there is an unavoidable level of complexity to it which makes it harder to achieve the former understanding that leads to agreement.

Failure to reconcile these objectives and to bridge the understanding between business and technology is the main reason process models have had limited success in the past. BPMN alone will not succeed and successful use of it depends on whom one communicates with and about what. Different process models are needed to coordinate and present for different audiences. BPMN may be a common language for business and IT, but the phrasing will remain different.

The understanding that precision and formal correctness of a process model must vary depending on the modeling objective and expected consumers is essential for the work with BPMN.

(Freund & Rücker, 2019)

The limits of formalization

BPMN is based on the premise that the course of a process can be defined as an unambiguous control flow and the more precise modeled the more narrowed the range of people's actions defined. If this approach were applied entirely, any process would turn into an industrial assembly line where the work of people is meticulously planned to leave no room for them to maneuver. Thus, this approach is not always popular, whereas, in various internet forums, the topic is discussed in ideological terms, as they view it as contributing to the increased technocratization of society.

One practical solution that Freund and Rücker (2019) mention is to leave white spots in process models. White spots refer to sections in a process or sub-process that cannot be defined with absolute clarity. However, this can have both negative and positive impacts:

- Negative: There may be uncertainty about how the process should be carried out due to a lack of knowledge for various reasons, this is something to seek to change.
- Positive: The process may be carried out well, but the knowledge related to it resides in the hands of the people carrying out the tasks. Therefore, it is modeled of an implicit nature which is acceptable.

The ad hoc sub-process in BPMN can provide the process analyst with the freedom to document non-binding tasks that can be worked through in any order or whether they are executed at all is completely up to the process participant. Seen below in Figure 12, is a sub-

process of the ad hoc type modeled. However, ad hoc sub-processes can rarely be executed in an engine, hence, one should check with the vendor of choice or consider alternative approaches to implement such unstructured phases (Freund & Rücker, 2019).

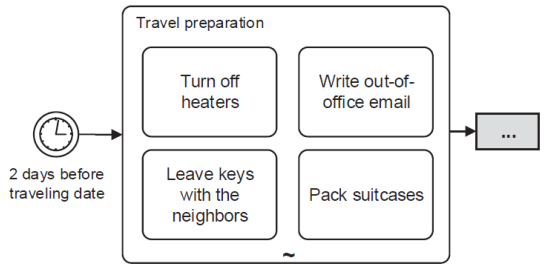


Figure 12. Ad hoc sub-process (Freund & Rücker, 2019)

2.7.2 Technical challenges

The low-code trap

A challenge when people get familiar with the concept of a workflow engine, a common belief arises that the magical BPM suite will solve everything. Ideally, we supply the suite with models developed by the business before having IT systems automatically integrated and human workflow management just happens to work. Thereafter, the idea is to create a dashboard of key performance indicators that enables the business to identify process issues in real time and solve them independently.

However, in practice, this scenario is too good to be true. The truth is that developing process applications is always a type of software development. The hope that it can be taken on by business users in the future is tempting but after all, comprehensive wizards and forms are necessary to develop process applications in a model-driven way. Therefore, the complexity of these wizards and forms may overwhelm the average business user.

The company's IT department needs to figure out the BPMS to help with the development. Although, software engineers cannot apply their prior knowledge of programming languages as the technology is hidden behind the wizards and forms. Ironically, the goal that was to make development faster and easier is prevented. Freund and Rücker (2019) realized that this is where the core problem with the classic BPM suite lies. For companies that have been carrying out software development, for instance, in Java, the following disadvantages arise.

It appears that conventional BPMS are stuck in the middle, neither fully one thing nor another. They are as unsuitable in comparison to existing software development as they are to off-the-shelf application products. Furthermore, they do not provide an out-of-the-box solution for process automation. This does not mean that BPM software is a bad idea for process

automation, on the other hand, it means that the correct approach is not as straightforward as one might wish.

In practice, a hybrid approach is the most effective, where certain parts of the process are model driven, while other parts such as, complex interfaces are created through classic programming. Consequently, it must be accepted that software development will require software developers in the future.

(Freund & Rücker, 2019)

Modeling or programming

When using a BPMN engine another question is which aspects to be expressed through technical process models and which requirements may be better addressed through classical software development. As is frequently the case, there is no universal solution to this question. The factors listed below might seem insignificant, however, Freund and Rücker (2019) state to not disregard them:

Technology and architecture meaning depending on the workflow engine and the overall architecture used, to execute certain requirements can be either simple or more complex within a process. Depending on the engine, it allows different possibilities such as integrating Java code, connectors script language and the possibility to access web services.

Existing infrastructure such as systems or services can be reused or integrated when starting a new project. For example, a process can be initiated using an existing scheduler rather than the workflow engine itself. It is important to consider these external conditions.

Roles within the project need to be acknowledged to consider the existing expertise and know-how within the project. Usually, there are developers involved who can quickly implement certain functionalities with classic programming, but it may take them a longer time to accomplish the same using the workflow engine. On the other hand, trained process engineers work better with process models than with programming languages.

One common sight is that once a workflow engine has been procured, there is an urge to use it regardless of circumstances. Consequently, detailed process models are developed, making it nearly impossible to comprehend. These models are not useful for communicating with the business and are equally difficult to maintain as classical programming code. Additionally, the IT department will dislike the more detailed models which make success all about finding the right granularity.

(Freund & Rücker, 2019)

Redesign before automation

A mistake is to build information technology on top of an existing as-is flowchart before redesigning it for two reasons. Firstly, information technology (IT) can be an expensive investment, and cheaper solutions, such as redesigning processes or employee training, may be more effective. Secondly, despite the investment, automating a flawed process can magnify the issues instead of solving them. Therefore, it is crucial to first employ process design principles, benchmarking, best practices, and Lean thinking to identify areas that require improvement before considering automating an as-is process. Failure to do so can result in a faster, but more expensive and still ineffective process.

To achieve the best results, organizations must have a clear understanding of their existing processes. IT may not be the solution in every case. After benchmarking best practices and using design principles, the process improvement team should envision a new and improved process. At this point, IT should be engaged to discuss their current and future capabilities, allowing for the integration of innovative process ideas with enabling IT tools.

(Benedict et al., 2019)

2.7.3 Organizational challenges

Change management

The introduction of a BPMS can also be challenging from an organizational perspective as it is rooted in the fact that BPMSs interfere directly with how people perform their work. As a result, sensitive change management is needed (Dumas et al., 2018). Awareness that most people dislike change is important as one considers opportunities to make changes. Change causes discomfort and requires learning new things which can result in employees making mistakes as they as trying out the new procedures. Firstly, opportunities to make changes need to be identified, secondly, ensure that the change will benefit the organization, thirdly, sell the idea to all stakeholders affected by the change (Harmon, 2019).

By some, this may be preferred to change management, but no matter the naming, it requires its own set of skills. People resist change and normally this is overcome only when someone explains how the change will benefit them. However, that requires that the person handling the communication can put himself into the needs and interests of each process's stakeholders and manage to communicate with them in terms they understand (Harmon, 2019).

Psychological fears

Introducing a BPMS requires that the interest of different stakeholders is balanced since they normally have conflicting performance objectives and strive for the same resources. However, not only do political motives play a role when trying to understand an existing process also

psychological motives matter. People do not always tend to give away how work is done, or then, they tend to focus on describing the worst possible exceptions when asked to describe their role in a process. This tendency has been referred to as the reason “why modelers wreck workflow innovation”.

Additionally, the perspective of the user when introducing the BPMS to work needs to be cautiously considered. Some concerns and fears of using a BPMS might be the feeling of a big brother watching given that a BPMS records all the events that are involved in executing a process, including who did what piece of work and at what time. From a change management perspective, it would be self-defeating to ignore this concern. Therefore, the organization needs to clarify how this information will be used and which positive effect can be expected from the usage of this information. Before the process participants can appreciate what the BPMS means for their job, a hands-on trying out might be needed for them to experience what it is like to use a BPMS.

Another fear by end-user of BPMSs is that their work will take on a mechanistic trait, similar to working in a chain gang. Although this fear is partly genuine, the BPMS will indeed handle the allocation and routing of work. However, it can be argued that these tasks are not the most valuable or exciting parts of the job which is precisely the reason why they could be automated. In situations where the employees spend a large amount of time finding information, the BPMS can be an attractive mechanism help in that sense.

Furthermore, the configuration of the BPMS plays a significant role in determining whether the mechanization effect will occur. For instance, pushing a single work item at a time to an employee versus a range of work items, allows an employee to choose based on their preference which can make a huge difference in how the BPMS is perceived.

(Harmon, 2019)

2.7.4 Summary of Chapter 2.7.

The theory in this chapter mentions that BPMN is not suitable for modeling unstructured processes and therefore, introduces Case Management Model and Notation (CMMN) as a potential alternative. BPMN needs to be modeled syntactically correct when using the symbols and rules of combining them otherwise the BPMN loses all benefits of standardization. The risk is particularly high if the process model is needed for IT implementation to be modeled in a correct, precise and consistent manner. Failure to reconcile the understanding between business and technology is the main reason process models have had limited success in the past.

Furthermore, it suggests that leaving white spots in the model, as a practical solution for defining sections of a process that cannot be defined with absolute clarity. Finally, it suggests that ad hoc sub-process in BPMN can function as a way to provide freedom to the process analyst by documenting tasks that can be worked through in any order. However, this way is rarely executable in an engine.

Practical tips on how to overcome challenges in process automation are specifically, the low-code trap, finding the balance between modeling and programming, and redesigning processes before automation. In practice using a BPMS will not magically solve everything in a simple way, developing a BPMS application is always a type of software development. Business users can to some extent develop it by themselves, however, the complexity of the wizards and forms necessary can overwhelm the average business user. Thus, it needs to be accepted that software development requires software developers in the future.

Another challenge is the need to redesign a process before automating them. This is because automating a flawed process can magnify issues instead of solving them. Therefore, it is crucial to employ process design principles, benchmarking, best practices, and Lean thinking to identify areas that require improvement before considering automating an as-is process.

Organizational challenges such as change management are necessary to overcome resistance from employees as a BPMS interferes directly with how to people perform their work. Hence, the change needs to benefit the organization and thereafter, the idea needs to be communicated to all employees affected by the change in terms they understand. In addition to this, one needs to consider the psychological fears an implemented BPMS brings to the end-user in the form of concerns related to a mechanistic approach to work and the fear of being monitored.

3 METHODOLOGY

In the following chapter, the methods for answering the research questions and producing the findings of the thesis are described. The research is conducted for a multinational manufacturing and service company that will be referred to as the case company. The research took shape as a qualitative research approach with a case study strategy. The data will be collected through a theoretical review and by conducting focus group interviews. The reasons for this will be elaborated on in this chapter.

3.1 Research method

The aim of this research is to find out how the case company can improve and automate business processes with iBPM and to discover why resources should be allocated for iBPM automation.

Considering the first research question, the automated business case that is in production use needs to be investigated to understand what went well and where problems occurred during the development and execution. Furthermore, the second research question was regarding the advantages and disadvantages of the case study to grasp why resources should be allocated for iBPM automation. Qualitative research was used as the subjects for both questions best can be distinguished in communication with the research population related to the case study (Verhoeven, 2022).

In order to not consider one perspective of the automated case study, this research was split into three different focus group interviews that aimed at receiving different viewpoints from the process owners and managers, developers and key users. Due to the fact that their perspective on how they look upon different topics may differ. Combining the different internal stakeholders in this way will produce more comprehensive research results that enhance the reliability and validity of the research.

3.2 Theoretical validation for method

In the following, the theoretical background and validation for choosing the previously mentioned approach are defined. The general method used is qualitative research as this approach enables a more open approach to the research population by verbally asking open questions that lead to more in-depth information from the interviewees in contrast to the numerical information collected from a questionnaire or survey in quantitative research methods. Additionally, qualitative research is carried out in the “field” where the questions

address how people experience things in certain situations as the researcher might be interested in their ideas, experiences, and meanings (Verhoeven, 2022).

In addition, as there is only one automated iBPM business case that is in production use in the case company, there are not enough resources to perform an extensive quantitative study. Also, by using a qualitative research approach the researcher can gain the answers needed from the interviewees by the possibility to ask open questions and elaborate on the replies when needed which is not possible in a quantitative research approach.

The view of qualitative research by researchers is that the results are less reliable than those based on quantitative research. However, other opinions are that numbers and figures are not sufficient for the issue at hand and rather use a research method that listens to what people have to say (Wester, 1991).

3.3 Research strategy

The decision to choose a case study was decided based on the research questions. Yin (2018) states that if the questions seek to explain a current condition or setting with questions such as “how” or “why” a social trend works, then case study research will be relevant. Both research questions one and two have that structure, and at the same time, require certain information from the participant about iBPM automation. Considering case studies, one is allowed to focus in-depth on a “case” while retaining a holistic and real-world perspective, for example, to study small group behavior, organizational and managerial processes or international relations (Yin, 2018).

A case study is according to Yin (2018) the most challenging of all social science endeavors. The goal is to design a case study by collecting, presenting, and analyzing the data fairly. Even though a case study is a distinctive mode of research, many researchers have viewed case studies as a less desirable method than for example, an experiment or survey. Reasons for this might be that case studies have played a well-known role outside the scope of the research area. They might have been recalled as teaching-practice case studies, popular case studies or case records. However, such case studies are non-research studies that do not follow any explicit research method. Therefore, it is important when doing a research case study to highlight the methodic procedure and report all of the evidence fairly in order to overcome confusion (Yin, 2018).

Therefore, this research is conducted as a qualitative case study due to the research questions’ structure as well as the need for a comprehensive focus on the topic of iBPM automation in the case company which makes a case study a fitting research strategy.

3.4 Research population

The research population for this research consists of the employees related to the automated case study. The participants for the three focus groups are chosen to represent the role they had during the development and currently as of today in the case study. The population approached to take part in the research, also called a sample, may or may not be selected randomly. For this research, the sample method was non-probability samples which are not drawn randomly (Verhoeven, 2022). Instead, the population was chosen based on their involvement with the case study as well as their knowledge and experience of iBPM process automation which explains why this method of sampling was decided.

This research involved six of seven members of the development core team of the case study as one person was unable to participate due to maternity leave. These included the process automation lead, process automation developer and the process owner core team consisting of four members. In addition, the research also consisted of four key users that were involved during the development and testing of the automated solution.

Consequently, it can be stated that the research's participants are consciously chosen to represent different functions that entail all the development phases of the case study such as the planning, executing, testing and maintaining of the automated business process. Therefore, they were targeted based on certain characteristics and their experience with the automated case study in iBPM in which they were actively involved. For that reason, it was ensured that each focus group could bring as many different perceptions as possible to the discussion by challenging each other's viewpoints and thus, improving the accuracy of the overall outcome.

The focus groups were held in three groups depending on the function and responsibility of the participants. The first focus group was comprised of the process owner core team, all of whom were in managerial positions. The second group consisted of the process automation lead and process automation developer at the case company. Lastly, the third group contained four key users of the automated case study who were working in the same position before and after the automated business case was taken into production.

3.5 Data collection method

The data was collected by the researcher to gain knowledge by reviewing the literature as well as analyzing existing material in the case company. Additionally, focus groups were held in a semi-structured way whereas a questionnaire with mostly open-ended questions was used to collect the needed data to answer the research questions. Since the participants of the focus

groups are located in different locations, the interviews were conducted online using Microsoft Teams.

Prior to the focus groups, the questions were sent out together with the meeting invitation one week in advance of the discussion to give the participants enough time to familiarize themselves with the scope of the research. Moreover, the agenda throughout the focus groups have been designed with the purpose of asking questions concerning the participants' role and responsibility related to the case study. The questions were largely based on the research's sub-questions and divided into the following main topics:

1. Best practices and guidelines
2. Advantages and disadvantages
3. Challenges and lessons learned
4. Changes to the daily job
5. Improvements and new ideas

In order to review the development process of the case study, semi-structured interviews were held with three different focus groups. In preparation, slightly different questions were prepared for the interviews to focus on the participant's role in the case study. However, the questions can be considered as a guideline to still leave room for follow-up questions to be asked based on the interviewee's answer.

Firstly, the focus group consisting of the process owner core team, questions were asked questions regarding the advantages and benefits, such as, what added value iBPM automation brings the case company as well as *"Have these benefits met your expectations, and/or have there been any unexpected results?".* The aim was to understand how they view the advantages as well as the disadvantages. Furthermore, questions related to the guidelines and challenges during the development were asked. The aim was to understand what lessons they learned during the case study and what advice they would give regarding future automation projects to the case company.

Secondly, the questions targeted to the process automation lead and developer were aimed at the maintopics mentioned above, although, they were targeted at the practical aspect of the way of working. Questions such as *"What were some best practices or guidelines that you followed during the development and implementation of the case study?"* and *"What would be an effective way of working towards an executable process?"* were asked. The aim was to cover the relation to the theory as well as to the research questions of this research.

Thirdly, the focus group involved the key users did discuss topics such as changes to the daily work as well as the benefits to themselves and the team, example questions were *"What are*

the biggest changes to how your work was done previously?" and *"Have you noticed any changes in the attitudes or behaviors of team members since the implementation of iBPM technology?"*. Furthermore, a topic discussed concerned the improvements and what could have been done differently throughout the development process. The aim was to reflect on the automated case study and dive deeper into how it has impacted the participants' work-related tasks.

However, questions regarding the technical implementation and programming of the process model in the automaton engine were not considered. Instead, the questions focused on the course from planning, modeling, analyzing, and preparing the process model to be ready for implementation in a BPMS. By using this approach and involving three focus groups was central to determine how the case company can automate processes with iBPM automation as well as to combine the advantages and disadvantages to finally, answer the research questions.

3.1 Theoretical validation for data collection method

In the following, the theoretical background and validation for choosing the previously mentioned method are defined. The data collection method of focus groups was chosen since people can sometimes be reserved to disclose information in one-on-one interviews, yet when they are in a group of like-minded people, they are more willing to share information (Verhoeven, 2022). Therefore, a focus group is chosen as the data collection method in order to group people together who did the development together to receive more comprehensive and reliable replies.

Semi-structured interviews were conducted rather than open interviews as the research questions are related to a certain topic that needs to be addressed accordingly. In semi-structured interviews information that needs to be collected is split into several subthemes. Additionally, the interviewer does not need to follow a strict order of the subjects as the goal is to deal with all the needed subjects during the interview. Usually, an open question gets asked with each new subject and thereafter, the interviewer uses listening skills to get as much information as possible on the subject (Van der Molen & Gramsbergen-Hoogland, 2005).

An open interview was not suitable for this study as in an open interview only the theme is decided. An open question starts the interview and afterwards, the interviewee can freely follow their train of thought to say what they consider important (Van der Molen & Gramsbergen-Hoogland, 2005). To receive reliable answers to the set research questions, the interview needs to be performed in a more structured way. For this reason, the open interview was not fit for this study.

3.2 Procedure

In the following the procedure of the research is explained presenting an overview of the planning, preparation, and execution of the research. In consultation with the case company, it was determined who will be participating in the research. Due to the limit of one automated iBPM business case, it was decided to include the whole development core team, process automation lead, developer as well as key users of the process.

All the participants were first contacted via email to inform them about the research and thereafter, the invitation was sent to schedule the focus group interviews. The preparation email sent to the participant can be found in Appendix 1. The focus groups each contained two, four and four participants that were chosen to be a mixture of the various functions in order to enhance a proper discussion and include various perspectives. All three focus group interviews were recorded to make it easier to analyze the data and draw a reliable conclusion.

Furthermore, the participants were provided with the questions prior to the focus groups to enable a more in-depth discussion. As the interviews were semi-structured, the list of questions prepared by the researcher can be found in Appendix 2. Additionally, the interviews have been transcribed to ensure a reliable analysis of the data as well as a high quality of the study. These transcripts can be requested by the researcher as they were not attached for privacy reasons.

The case study explored is a semi-automated process that handles the preparation, check-out and return of software packages stored in a document management platform. The steps likely to automate are automated whereas some activities require end-user decisions and such steps are performed with the help of tasks being automatically assigned to the user. The aim was to formalize and automate a process in which different internal stakeholders can cooperate.

Moreover, the business case automated with iBPM was the first of its kind in the case company. Some reasons why this process was automated is due to the unnecessary manual work, difficulty to locate the right documents, trackability issues, and no traceability. Since the process went into production use in October 2022, the number of requests is closer to 3000 with an amount of more than 450 unique users.

4 RESULTS

In this chapter, the results of the focus groups will be presented with directions towards the theory from the theoretical framework in Chapter 2. The data for the results were received in two different parts of the research. Firstly, based on the theoretical review that lays as a foundation to the research. Secondly, three focus groups were held with the process owner core team, process automation lead and developer and key users of the automated business case. Hereby, referred to as the case study.

The main purpose of the interviews was to ask in-depth and follow-up questions if needed and to verify the outcomes by the case study to identify practical guidelines of iBPM automation as well as the pitfalls and benefits of the automated case study. Each of the following sub-chapter is based on the research's sub-questions as defined in the objective section of Chapter 1.

4.1 What are guidelines and best practices when developing process automation?

In this sub-chapter, it will be described which practical guidelines the focus groups identified when developing process automation in iBPM. Overall, a total of eight topics could be identified in the focus groups, as presented in Table 6 below. Each of these will be further described in the coming sub-chapter. However, it needs to be emphasized that the order of the following paragraphs was determined without any level of importance.

Table 6. *Guidelines and best practices for iBPM automation found during the focus groups*

	Name of the guideline or best practice
1	Defining and understanding the process
2	Maintaining guidelines and documentation
3	Collaboration between different stakeholders
4	Dividing new automation projects into different levels
5	Learning by doing
6	Creating small demo automation
7	Developing in small fractions
8	Creating successful automation

Defining and understanding the process

One key point emphasized by two of the focus groups is that the process being automated must be well-defined, and the business logic should be clear beforehand. To achieve this, it is helpful to have a technical process diagram created by the process owner as a basis for the automation.

This diagram will assist in planning the development phase by identifying necessary APIs and any additional tool-related developments required. By understanding these options early on, potential problems in the later stages of development can be minimized. Furthermore, it is important to have a clear definition of the desired outcome of the process, so that the automation goals are well-defined. Ideally, the end-users should have the final say in how the automation is implemented, as they retain the best knowledge of the optimal solutions and work methods for the tasks being automated.

Another point that the focus group found was the importance of mutual understanding between developers and businesspeople regarding how the process operates. Moreover, developers need to grasp the complexities of the process and understand the reasons behind each step. Therefore, a clear understanding increases the likelihood of building an automation correctly and failing to communicate the requirements adequately to the developing team will result in a lack of clarity and understanding.

Likewise, the theory confirms the importance to clearly define the process steps that will be automatically executed. At the operational level, the process model contains details including both human and technical process flows and the operational process model will serve as a starting point for the technical model to be executed. Ultimately, mastering the operational process model results in a common language between business and IT in process modeling.

Additionally, it is beneficial to approach the project from a practical standpoint by initially planning how the steps would be performed manually by a person in order to achieve the needed objectives and only then should the automation process begin.

Maintaining guidelines and documentation

The developing team of iBPM projects is currently creating and maintaining a set of guidelines on how to program the technical executable process model. It was mentioned in a focus group that this is a best practice that can be used across different divisions in the case company. For instance, general features such as sending emails are documented in easy how-to guides that can be followed when other divisions in the case company start building process automation in the BPMS. However, this takes a lot of time and effort and is an ongoing work in progress to add new instructions and keep them updated.

Collaboration between different stakeholders

Another identified best practice is to use collaboration tools such as ticketing platforms, for instance, JIRA or Azure DevOps, that can help collect information in a structured way. This enables to see the difference between the developed tasks and those that are still to be deployed. Another advantage is that all project-related information is centralized in one place.

Therefore, it is a good method to send messages with links to these applications that point to where the information is written instead of scattering information across different emails and chat threads.

At the beginning of the case study, this type of collaboration tool was not used although, one participant said that at that point they did not miss it. However, in hindsight *"it would have been wise to do its structured from the beginning in some kind of a tool"*. By utilizing DevOps, the requirements and the progress of the project can be tracked and kept in one place, easily accessible to everyone.

Dividing new automation projects into different levels

To better understand the requirements of a new business process to be automated, it was mentioned from a participant to divide the projects into three different levels based on the scope of the process. There are three different types of process automation scopes: fast-paced, middle-paced, and project style. The fast-paced process will potentially only require two people, the business process developer and the process owner. In contrast, the project style is a large project with its own budget, etc. The case study was developed in this style as it was quite big and a lot of people were involved, around 7-8 in the core team. The middle-paced approach falls between these two extremes.

Learning by doing

According to all focus groups, the importance of learning by doing was mentioned. When starting to develop a process automation, one needs to keep in mind that it is not possible to build a process in one day. It will take time to learn and develop the necessary skills. One example that was given was to start developing a proof-of-concept case with only a few features in order to become familiar with the available tools and the possibilities for automation.

Furthermore, it was mentioned that since the case study was the first business case automated in iBPM, the development took quite a long time and it was a learning journey for all involved. However, as more processes will be automated, the time required will decrease, and the development path will hopefully become similar to that of creating RPAs in the case company. One participant mentioned that the aim is to create value with iBPM in a comparable way, whereas automations are rapidly created.

In addition to learning how the iBPM application works, it was mentioned that learning about other applications connected to iBPM is also important. For example, software programs where documents are stored and retrieved, as this is not as straightforward as one might believe.

However, it was concluded that the time spent to learn about the tool, platform, or other applications is definitely worth it. According to a participant, any solution used by the case company requires time and effort to maintain the ability to provide a return on investment of a certain tool, platform, or process as well as business process automation including iBPM and RPA.

Creating small demo automation

The focus group recognized that business users may struggle to understand what an iBPM automation looks like and how it can benefit them. During the preparation phase, the business process needs to be modeled in the BPMN standard in the form of a tactical model before the automation phase can continue. Following this, a small proof-of-concept demo can be created to showcase what some process steps look like in the BPMS and demonstrate the execution of the process diagram in the workflow engine. For instance, this demo can include automated email notifications, task assignments, and the orchestration of different teams. It is at this point that businesspeople start to comprehend the potential of this type of automation for their business.

Consequently, as a participant stated: *"people have a lot easier to discuss and comment something they can see on the screen and can understand"* as generating interest becomes challenging without something tangible to demonstrate. A small automation demo will stimulate people to generate new ideas and suggestions as they can watch a programmed demo and thus, gain a deeper understanding of its implications. At the same time, this knowledge will be shared by people and start to grow by itself, and one can only expand by there. Therefore, this approach should be regarded as a best practice for enhancing people's understanding of how iBPM automation can be utilized.

Developing in small fractions

The focus group also identified a general best practice of developing automation in small fractions rather than attempting to deploy large portions of the process all at once. This approach allows for the testing and confirmation of each small part to ensure that everything is functioning properly before moving forward. Any issues that arise can be addressed promptly, and the risk of dealing with numerous bugs from deploying large sections at once is minimized.

Creating successful automation

During the focus group, it was identified that achieving the first successful iBPM automation in the case company was crucial. The case study has been in production since October of last year and has had hundreds of unique users. The aim was to create a successful case that would set

"the ball spinning" allowing iBPM automation to gain traction. A participant mentioned that this effect is gradually becoming apparent. By dedicating effort to each automated process, the success rate will increase, thereby opening people's eyes to the possibilities presented by iBPM automation.

4.2 How to overcome pitfalls and what are associated risks with iBPM automation?

Next, the participants' views regarding pitfalls and challenges that may occur during the development or use of an iBPM automation are considered. Overall, a total of nine topics could be identified in the focus groups, as presented in Table 7 below and these will be elaborated on in the following sub-chapter. However, it needs to be emphasized that the order of the following paragraphs was determined without any level of importance.

Table 7. *Risks and pitfalls of iBPM automation found during the focus groups*

	Name of the risk or pitfall
1	Addressing faults in the process
2	Resistance to change
3	Improper usage of iBPM technology
4	Updates and changes in tools
5	Data integrity in databases
6	Poorly defined requirements and instructions
7	Lack of understanding among end-users and developers
8	Issues during the testing phase
9	Not enough specialists in the case company

Addressing faults in the process

Regarding iBPM automation or automation in general, it is essential to be aware that if something goes wrong in the process, it will continue to go wrong consistently, potentially affecting numerous process instances. Therefore, it is important to monitor the process and ensure that there is always a process owner and process expert involved. Their role is to react quickly in case of errors in the process design or other external factors that may cause the process to go wrong.

To lessen this risk, the theory points out two reasons to redesign an existing as-is flowchart before building automation on top of it. The first reason is that information technology can be expensive and redesigning a process may sometimes be more effective. The second reason is

that despite the investment, automating a flawed process can magnify the issues instead of solving them. Failure to address faults in a process before automation will only lead to a process that fails faster and therefore, the faults in the process need to be addressed.

Resistance to change

In a focus group, it was noted that there exist opinions from end-users that rather want to work in the way it was done before automation as they would prefer to manually perform the steps instead of relying on a system to hand over the activities to them. Furthermore, it increased the administrative workload for mechanical workers who typically did not spend much time on such tasks. Previously, they had direct access to the resources to perform their jobs. However, with the new changes, they now need to make access requests as part of their office work, and sometimes the BPMS cannot grant access automatically due to metadata issues. This requires a human key user to manually correct the problem before the access can be granted.

As a result, there have been negative comments about the change, and the key user mentions that by explaining the necessary requirements and the reasons for automating the process, for example, to comply with traceability requirements from authorities, the end-users understand the need to adapt to the new way of working.

The findings align with the theory about change management and the difficulty to address changes in an organization. Due to the fact that iBPM directly interferes with how people perform their job, it can be challenging from an organizational perspective. The fact that change causes discomfort and people often resist changes, it has to be continuously addressed how to handle the communication with stakeholders.

Improper usage of iBPM technology

One of the risks is the attempt to solve a problem with iBPM that originated from another application or tool. This opinion was expressed by a participant in a focus group. In this case, the existing software used for managing document storage and sharing does not meet the requirements demanded by authorities. For this reason, iBPM was considered an alternative solution to address the limitations of the original tool. However, during the focus group, a concern was raised that using iBPM in this manner is similar to applying *"a patch for a patch for a patch".* It was suggested that sometimes it is essential to investigate whether the original tool is indeed the best software for the intended usage, rather than relying on iBPM as an alternative solution.

Furthermore, when incorporating other similar products or developing additional functionalities within the case study, the BPMS must be adapted accordingly. In this scenario, the iBPM process needs to be modified while the original software handling tool remains

unchanged. The personal perspective of the participant is that this approach may not result in the best terms of quality, functionality or workload as the iBPM software is being used merely as a patch to address the problem. Nevertheless, iBPM fulfills its intended purpose, but the question that arises is whether it is the best solution for the specific problem. The theory supports the thinking by mentioning that IT may not always be the best solution in every case. Due to this the organizations should benchmark best practices and use design principles to envision a new and improved process. In this stage, IT should be involved to discuss current and future capabilities to allow for process improvement with enabling IT tools.

Updates and changes in tools

An issue that may arise with iBPM automation is the challenge caused by updates and changes to the tools or software used within the automated business case. This is because automation often involves the connection to different software and tools, for instance, software handling platforms, technical request tools, and customer webpages, any updates or changes to these applications could potentially disrupt the automated processes. Therefore, it is essential to consider the impact of updates and changes of the interconnected system to minimize risks.

Data integrity in databases

Another risk associated with automated processes is the accuracy of the data stored in databases connected to the BPMS. As one participant mentioned, *"in case of bad data, the project will fail".* Therefore, ensuring correct master data in the software where it is stored is vital for the success of automation projects. However, it is important to note that this risk applies to any automation tool, not just iBPM automation. When automated processes operate on incorrect data, the end result can be disastrous. Therefore, maintaining accurate data is crucial to ensure a process that runs without faults.

Poorly defined requirements and instructions

During the testing phase, the participants responsible for the testing expressed that the information provided was lacking. The procedure was not clearly defined, and participants felt they had to figure out how things should be done on their own. It was mentioned that the instructions should be clear and easy to understand, even to the extent that *"a monkey"* could follow them during the testing phase. Therefore, the requirements and instructions should have been better finalized in order to spread the needed knowledge across each phase.

Lack of understanding among end-users and developers

Another challenge identified during the focus group was a lack of understanding between end-users and developers during the early stages of the development since the end-users might

think that the developers know their businesses and concepts. This causes problems when there is no clear understanding of terms and their relationship to the process. For example, there was confusion about what a “multi-file document” meant and how it was related to the process. The lack of clarity made it difficult for developers to fully comprehend the businesspeople’s intentions when they used specific terms and expressions for certain things as they know exactly what happens in a process. In addition to this, if there is a collaboration between multiple end-user groups, they might to some extent use different terminology for the same concepts which further hinders effective communication.

In the case study, this was added later in the project in the form of a common page where requirements, instructions, and other relevant information were published. In this way, one can define terms that later on in the project will become very natural. However, they are not beforehand. By defining and documenting these terms from the beginning of the project, it will become easier for everyone to communicate and maintain a shared understanding throughout the entire project.

Issues during the testing phase

A point that emerged during the focus group discussion was how to effectively handle the testing phase of the automated process before implementing it in the production environment. In the case study, the testing phase took place during the summer months, which created challenges in finding suitable time slots for testing. Additionally, people were located in different time zones which further complicated the scheduling of testing sessions. Also, the tool itself had some issues during this period, leading to a lack of clarity during the testing phase, as concluded by the participants.

Not enough specialists in the case company

The uncertainty about how many specialists there are in the case company to support iBPM automation was identified during a focus group. There are a few very dedicated people that are performing a good job related to this. However, what happens when iBPM automation expands and there are more processes automated, which will lead to an increased demand for iBPM services. If not adequately addressed, the risk exists that issues might not be prioritized correctly, which can result in a problematic situation.

4.3 How does automation bring advantages and added value to the case company?

Next, the participants of the focus groups' view regarding the advantages and added value that iBPM automation generates are considered. Overall, a total of ten topics could be identified, as presented in Table 8 below and these will be elaborated on in the following sub-chapter. However, it needs to be emphasized that the order of the following paragraphs was determined without any level of importance.

Table 8. *Advantages and added value of iBPM automation found during the focus groups*

	Name of the advantage or added value
1	Reducing manual and repetitive tasks
2	Time savings
3	Streamlined process with user guidance
4	Traceability and rule enforcement
5	Tracking and visibility of process instances
6	Orchestrating teams and involving human action
7	Breaking boundaries between departments and teams
8	Use of the BPMN 2.0 standard
9	Adaptable and flexible iBPM tool
10	Easy to use and few issues

Reducing manual and repetitive tasks

One of the significant advantages of process automation, including iBPM automation, is its ability to reduce manual and repetitive tasks. Therefore, processes that do not require a lot of human interaction should be automated. Since the implementation of iBPM automation to the case study, the workload has significantly decreased and made daily tasks easier to handle for users. Furthermore, the automation has improved the overall efficiency of the process, reducing the time required for performing *"boring"* and manual tasks. This supports the theory's claim that business process automation simplifies and accelerates operations as the technology enables the user to focus on critical tasks when freeing them from repetitive routines. However, it is important to note that even with automation, there may still be certain manual steps involved. Some participants in the focus group expressed a wish for a fully automated process without any human interaction.

Time savings

The case study showed that automation led to time savings by reducing the need for rework. While time might not be saved during normal events, automation ensures that work is done

correctly the first time, eliminating the need to redo previous mistakes. This saves time and resources in the long run and increases overall efficiency as supported by the theory. Whereas it is mentioned that a BPMS can reduce workload and therefore save time in several ways. Firstly, the transportation of work is done electronically which eliminates delays that happen in manual processes. Secondly, as the system coordinates tasks it saves someone time in deciding what to do next. Thirdly, when the task is completed, the system moves on which prohibits that work is laying around and ensures that progress is being made. Lastly, all the relevant information is gathered for the employee to carry out a task, saving time for the person to manually collect the information. Therefore, optimizing existing processes and introducing more structure to new processes increases efficiency.

Streamlined process with user guidance

Another valuable benefit highlighted in the focus group was that the process gets streamlined through automation which is supported by the theory as modern process automation can streamline complex workflow and provide transparency. Before the automation of a process, processes often rely on manual communication channels, such as emails which could be inefficient and time-consuming. With automation in place, an employee can start a process, and the system guides them through the entire business process while providing up-to-date data and necessary information to perform each task. This is a significant benefit for example, when a new employee joins a team and confirms the statement from the theory that a clear workflow reduces the learning curve in an employee's onboarding process which enhances the productivity as well as engagement. This streamlined approach ensures consistent and correct execution of the process. Additionally, making changes to the process becomes easier within the automation framework, as the system can automatically adapt to the newly defined path.

Traceability and rule enforcement

One of the requirements for automating the case study was the need to track the location of software, including who downloaded it, made changes, and uploaded it back. Before changing the process, the whereabouts of software were unknown, leading to employees relying on outdated versions with obsolete data, resulting in significant issues. Before the implementation of iBPM automation, meeting these requirements from authorities meant hiring additional personnel to keep up with the demands and maintain process quality. However, with iBPM automation, this need was eliminated, allowing the organization to meet the requirements without increasing the number of people, while simultaneously maintaining high-quality work processes.

The findings align with the theory's content that using a BPMS ensures that the business processes are carried out in a precise and consistent way as designed. Thus, organizations can

ensure to stay compliant with regulations and governance frameworks. The traceability feature and rule enforcement provide a distinct advantage and added value to the case company by addressing these concerns.

Tracking and visibility of process instances

The automation in iBPM provides a visual representation of the running process instances in the platform's cockpit. The process instances are displayed in the form of a visual process model drawn in BPMN, allowing the administrators to track the history of each instance. This visibility enables the identification of bottlenecks and areas that require additional resources, supporting the theory's statement that eliminating redundancies and bottlenecks improves productivity as resources can be allocated to more high-priority tasks. Furthermore, administrators of the case study can view a dashboard in the cockpit that shows the status of each process instance which enhances tracking and visibility. The dashboard also highlights any issues or deviations from the expected path, helping to identify areas for process improvement and gain insights into the actual workflow.

Orchestrating teams and involving human action

During a focus group, it was highlighted that the iBPM concept is beneficial for orchestrating different teams and individuals. This finding aligns with the theory's statement that process automation provides transparency by defining task owners along the process, fostering accountability and improving communication among teams. Moreover, the automated process handles as many tasks as possible automatically but when human involvement is required, the process provides the necessary flexibility for human decision-making, such as approvals and general input. Therefore, the BPMS can coordinate and manage handoffs of work between resources, whether human or non-human. In these cases, iBPM automation provides added value as humans can be involved naturally at any point in the process, after which the process seamlessly continues. In comparison to RPA, where humans cannot interact with automated processes, iBPM automation offers value by enabling human involvement within the workflow.

Breaking boundaries between departments and teams

iBPM automation can break silos and boundaries between different departments and teams which is something that the participants in the focus group every once in a while get to hear about how the work is done within the case company. As a user performs a task, such as approving or adding information, the system automatically moves on to delegate the next task, which may involve another person in a different department that might even be located in another country. The theory affirms that transparent and consistent end-to-end processes allow for clear visibility into who is responsible for a task. Consequently, this breaks down barriers, facilitates collaboration and enables multiple departments to work together.

Use of the BPMN 2.0 standard

An identified advantage of both modeling and programming the executable process model in the BPMS is the utilization of the BPMN 2.0 standard. The technical implementation of automation also relies on the BPMN standard, which was mentioned during the focus group as a real advantage. Therefore, the original process model can be imported and exported to the other tool in which the process is transformed into an executable process. Furthermore, this approach ensures that the automation is not solely based on plain code, allowing both IM and business teams to at least understand the business logic with the BPMN model.

The theoretical review confirms that BPMN establishes the connection between business and technology as everyone from business analysts, developers and business managers "speaks the same language" when the standard has a common symbol set, language and techniques through which to communicate. Moreover, the BPMN standard serves as a unified way of working within the case company, which presents a significant advantage. Previously, there was no standardized approach to drawing business processes, resulting in processes being documented using various methods such as paper sketches, Microsoft Visio, PowerPoint, and Excel. This lack of a common way of working has now been addressed with the adoption of the BPMN standard.

Adaptable and flexible iBPM tool

The iBPM tool used in the case company offers a real advantage since it can be customized to meet specific needs. The flexibility of the system allows the possibility to develop new automation features based on specific process requirements. If a process needs a specific feature, it gets evaluated if the same feature can be used for other processes as well and thereafter, the new feature can be developed and implemented in the tool accordingly. On the other hand, if another type of solution was utilized which could not be easily adapted, numerous organizational changes would have been necessary to achieve the same results.

Another great advantage is the possible flexibility with the created automation in the BPMS. If there is dissatisfaction with certain aspects, such as the order of process steps or the layout of user tasks, they can be easily modified. Initially, during the development of the case study, there was uncertainty regarding the system and its possibilities. However, as more knowledge was gathered, the participants started to recognize many future opportunities with the iBPM system. They spot big opportunities to expand in a fairly easy way and that is an opportunity that sets it apart from other tools that may have been specifically designed to fit only one certain functionality. Consequently, iBPM automation, coupled with the in-house tailored solution, enables the incorporation of new functionalities that may not have been feasible with a purchased solution.

Easy to use and few issues

During a focus group, participants expressed positive acceptance from the end-users regarding the new way of working with the automated process. Generally, when introducing a new system this often faces some resistance to change. However, the participant was pleasantly surprised by how fairly easy it was to adopt the new system. While there naturally were some complaints, the users have understood the need for a new way of working, and how it will serve themselves and also, they found the tool easy to use.

Overall, one participant says that the automated process led to very few issues. The time it took to have the automated process up and running might have taken longer than first estimated but once it was implemented it caused very few issues. It was mentioned that the development went smoothly and it "*turned out better than I maybe had anticipated*". Overall, positive reactions towards the development and implementation of the process in iBPM from the focus group.

4.4 What are disadvantages of automating business processes in iBPM?

In this sub-chapter, it will be described how the focus groups perceive the disadvantages of iBPM process automation. In total was seven issues identified, as presented in Table 9 below and these will be elaborated on in the following sub-chapter. However, it needs to be emphasized that the order of the following paragraphs was determined without any level of importance.

Table 9. *Disadvantages of iBPM automation found during the focus groups*

	Name of the disadvantage
1	Limitations to ad hoc process
2	Dependency on a tool
3	Additional work related to data management
4	Decrease in quality for the case company
5	Perception of iBPM automation
6	Lack of an example of iBPM automation
7	Long and complicated development process

Limitations to ad hoc process

During a focus group, it was identified that iBPM automation can have certain limitations depending on the case and process. If a process is very strict and restricts individuals from performing ad hoc actions, iBPM automation may not be suitable. Therefore, it is important to as a participant said, *"find a balance between what can be programmed as a process and what should not"*. Some processes are simply not suitable for automation in this manner. This aligns with the theory as processes that do not behave in a predictable and repeatable way are not suitable for modeling or automating in BPMN. However, in BPMN there is an ad hoc sub-process that can enable the modeling of non-binding tasks that can be worked through in any order. Even though it is possible to model an ad hoc process, these can rarely be executed in an automation engine.

Dependency on a tool

Another point raised in the focus groups was the stressful situation of being dependent on a tool for accessing documents, particularly in urgent situations. While the BPMS platform can automatically provide access when all parameters are in order, issues may arise that require human intervention and therefore, will cause delays until the next working day. In addition to this, cases occurred when there was a break in the system and the people cannot utilize the

process as supposed to. Due to the fact that the old way of working is not possible anymore, everyone using this process is dependent on the automated application.

Additional work related to data management

For the automation engine to function properly, data and metadata need to be accurately maintained in various tools. One participant noted that this has created some extra work, however, it is a manageable side effect that needs to be addressed. Previously, it was possible to search for specific documents, but now the data must be correctly linked in the tools connected to the automation to ensure that the correct files are located. Despite the additional work, the participant states that *"more issues were expected related to this than it actually has caused".*

Decrease in quality for the case company

A participant in the focus group believed that the development of the automated case study did not bring profitability to the case company in terms of quality. The disadvantage lies in the time required to align the project with daily job requirements and regarding new developments of various additional process steps in the automated solution. Furthermore, weekly follow-up meetings with the whole team were mentioned, which did not provide significant benefits to the participants. However, the overall conclusion was that the final result was highly beneficial for the case company, even though the individual participants did not perceive that the way it was achieved is a benefit.

Perception of iBPM automation

During the focus group, it was identified that the participant's understanding of iBPM automation was to achieve a 100% fully automated process, eliminating the need for manual steps. However, as mentioned in Chapter 2.4, iBPM automation, as opposed to Robotic Process Automation (RPA) involves orchestrating different teams, assigning user tasks to users, automating service tasks, and integrating APIs and RPAs into the process.

Unlike RPAs, iBPM automation allows for tasks that require human perception and decision-making, which a computer cannot perform. RPAs are designed to fully automate repetitive, rule-based processes without human interaction. Therefore, the goal of iBPM automation is not merely to automate a few steps but to design end-to-end automation that encompasses the entire scope of a process, including user tasks that are assigned automatically by the engine. Supported by the theory as BPM and RPA are two sides of the same coin and can be used in conjunction with each other. However, BPM is an end-to-end solution while RPA technology handles a smaller part of a business process.

Additionally, during the focus group, participants expressed a desire to automate even more tasks, as they mentioned that the software is located *"in a file and not a book".* Although the new automated way of working is faster than the previous manual approach and brings additional benefits, manual actions are still required, which falls short of their expectations for full automation.

Lack of an example of iBPM automation

A recognized pitfall was the difficulty for businesspeople to grasp the concept of iBPM automation when they had no previous real-world example to reference. Without a tangible demonstration of an automated project, it was challenging for them to envision how the system would look and function. In the case study this caused an issue in the beginning for the businesspeople to understand what the process would look and feel like in the end as they were just told it would work.

This issue could have been mitigated by following a best practice mentioned in the previous sub-chapter of the guidelines, which suggested creating a small proof of concept demo early in the development process. Such a demo would have showcased some of iBPM's features and provided users with a glimpse of what to expect.

Long and complicated development process

Another disadvantage when developing iBPM automation is the lengthy and complex path from planning to execution. According to the focus group, the initial stages of the case study were slow, as it took time to establish a mutual understanding between the business and developers.

Furthermore, the testing phase can be quite extensive before deploying an automated process into production use. One reason for this is the flexibility provided by the tool for developer to make changes according to business needs, which requires a lot of testing before going live to ensure the expected functionalities behaves as expected. During the focus group, it was emphasized that deploying inadequately tested products in a production environment leads to problems as it was stated that *"when you take things to production use with products that are not well tested then the issues start".* Therefore, it was concluded that extensive testing is a vital part of developing big automation projects, such as the case study being discussed.

5 CONCLUSION AND DISCUSSION

The aim of this research was to provide an understanding of how the case company can improve business processes with iBPM automation while exploring the added value of automated processes. In order to evaluate these aspects, a theoretical review was considered as well as the case study within the case company was explored. Consequently, the two following main question for this research have been defined:

RQ1: *How can the case company effectively improve and automate business processes with iBPM?*

RQ2: *Why should the case company allocate resources for iBPM process automation?*

In this chapter, these results are summarized and discussed answering the research questions. Thereafter, additional limitations and considerations of this research are presented together with suggestions for future research for the case company. Finally, a closing word from the researcher is provided.

5.1 Automate business processes with iBPM

The first part is how to improve and automate business processes in iBPM whereas the theoretical review and the studied case study will be evaluated to understand how the case company best can develop process automation in iBPM while at the same time, overcoming and avoiding pitfalls. Throughout the executed theoretical review two BPM lifecycle models were presented to provide a strategy for organizations to systematically improve business processes.

To address the first research question and discuss the findings, the Camunda BPM lifecycle (Figure 2) will serve as the foundation where the stages of developing process automation will be elaborated on. Freund and Rücker (2019) developed the Camunda BPM lifecycle model which provides a practical approach to automate and improve business processes. This model focuses on describing one process at a time and the cycle gets triggered when either an existing process needs to be improved or a new process is introduced.

Process survey

For an existing process, the initial stage is the *process survey* which involves examining the process through workshops or interviews to identify the objectives, participants, and IT system requirements. The results of this study show that during this phase it is important to use a common page where requirements, instructions and other relevant information are gathered. Terms and definitions can be defined and documented in order for everyone in the project to

efficiently communicate and maintain a shared understanding. One possibility is to use collaboration tools such as JIRA or Azure DevOps to structurally collect information and keep track of work tasks. This will prohibit the pitfall that there is confusion and lack of understanding regarding terms and their relationship to the process as people might use different terminology for the same concepts.

Process documentation

Next, the *process documentation* stage where the findings from the previous stage are documented in a current state process model which will identify weak points and their causes from the current process. Another finding of this study is that during this stage, the utilization of the BPMN 2.0 standard is a huge advantage. Both the business and IM are able to understand the business logic as they "speak the same language". The business logic of the process to be automated should be well-defined during this stage to ensure a common language between the businesspeople and IT.

A pitfall during this stage, is the modeled processes in BPMN are syntactically wrong, as it then could lose all benefits of the standardization. Therefore, in Chapter 2.3 provides the basic elements of process modeling and some basic modeling guidelines and naming conventions. It is recommended to address faults in the process at this stage and redesign the current stage process model before automation for cost-effectiveness and to avoid magnifying existing issues. Due to the fact that automating a flawed process just results in a process failing faster.

Process analysis

The next stage is *process analysis* for process models which has identified weak points is the *process analysis* stage where one needs to diagnose problems, search for causes and estimate the potential for process improvements. In this study, it was found that solving identified problems with iBPM technology could become a risk if the problems are originating from other software tools. A concern that arose was that iBPM automation is used as a patch to cover up issues and limitations of the existing software that are used. Therefore, careful investigation of the original tool should be considered before deciding to improve the process with automation technology to question whether iBPM is the best solution for the current problem.

Process design

The next stage for an existing process is *process design*, which is also where the lifecycle begins for a new process. The identified weak points from an existing process in the process analysis stage, serve as the starting point for another process design. The outcome is a modeled target state process model which serves as a starting point for the technical process implementation.

This study found that the process being automated should be well-defined and the business logic should be clear to facilitate a common language between the business and IT. Another important finding during this stage is to include the end-users' input as they possess the knowledge of the process in order to find optimal solutions and suitable work methods.

Freund and Rücker (2019) developed a practical framework when applying BPMN on projects that need technological support and modeling of their target state. As mentioned in the literature review, the Camunda BPMN framework (Figure 8) differentiates between strategic and operational process models. The strategic model provides a general overview with simple steps and no deviations, while the operational model investigates the operational details of the process, which includes detailed human and technical process flows accordingly modeled in BPMN.

One finding is that for projects with technical implementation, the technical model will be executed and therefore, must the model be modeled syntactically and semantically correct. Another finding is a challenge of this stage is to reconcile the perspectives of process analysts, participants, and engineers as they have different views on the process. For example, the process analyst considers how the work is done and how it can be improved, process participants reflect on how the work should be performed, while the process engineer wonders what the engine must achieve in terms of implementation technology. However, successfully meeting this challenge results in a consistent process logic, improved understanding between business and IT and how respective party impact each other.

When reviewing the literature according to Freund and Rücker (2019) it is important to strike a balance when modeling the operational target state process model. As mentioned, one way is to provide different views of the process specific to each participant, meaning that each participant as well as the workflow engine has its own pool in the BPMN model. In their own pool which represents their own tasks to be performed, they cannot see and be distracted by which tasks other participants perform. The full, open collaboration diagram should only be viewed by the process analysts who probably can handle the complexity. In the literature review it can be seen in Figure 9 the coordination between two participants and the engine although the pool is collapsed, while in Figure 10, the full collaboration diagram can be seen. Another advantage of this approach is the possibility to present optimized views for the target groups of users. The process analyst can see the whole collaboration diagram, the process engineer sees the engine’s pool and the process participants see their own pool as the other pools are collapsible.

Another finding in the literature review for the *process design* stage is by Dumas et al. (2018) which proposes a five-step plan to convert a conceptual or "strategic” process model into an

executable process model. They mention that the current state process model created initially in the lifecycle is abstract in nature and does not provide the technical implementation details needed to be executed by a BPMS software system. Therefore, the five steps are as follows:

1. ***Identify automation boundaries*** to recognize tasks suitable for automation whether they are automated, manual or user tasks. Thereafter, access the feasibility of connecting manual tasks to the BPMS.

2. ***Review manual tasks*** as the principle is that if the task cannot be seen by the BPMS, it does not exist. Thus, there is a need to find a technological solution to support manual tasks by utilizing the BPMS worklist handler to notify task completion.

3. ***Complete the process model*** by ensuring two principles. Firstly, handle exceptions with appropriate exception handlers and secondly, specify electronic data objects that are needed as input/output for each task in the process.

4. ***Bring the process model to an adequate level of granularity*** for suitable implementation. Decompose or aggregate tasks as needed as tasks assigned to the same resource can be combined while tasks that require multiple resources need to be decomposed. The principle is that BPMS adds value by coordinating work handoffs between resources. In the end, a to-be executed model is ready to be automated with a BPMS.

5. ***Specify execution properties*** to execute the model to the BPMS. Define the implementation details such as variables, data mappings, service tasks, script tasks, participant assignment rules and user interface structure for user tasks, and more. Properties are stored in the XML format for interchange and execution.

Process implementation

The next stage is the *process implementation* that results in an updated current state process model that corresponds to the target state model documented in the previous phase. During this phase, the process automation is implemented in the BPMS. The results of this study show that maintaining guidelines and documentation for programming technical executable process models is a best practice as these can be used by different divisions within the case company. The aim is to have clear and understandable guides documented for general features such as how to program the BPMS to send emails. However, documenting and maintaining such guidelines requires significant time and effort and is an ongoing work task to keep them updated.

Another finding is to implement small fractions at a time in the engine instead of deploying large portions at once. This will minimize the risk of dealing with numerous bugs and enable the process engineer to address any issues that arise. Testing and confirming that each small part works before moving forward will enable a successful process implementation.

In the literature review, it is mentioned that the process model is implemented as an IT project as well as a change in the business or organizational procedures. Whereas the process engineer may be able to implement the process from the collaboration diagram (Figure 10), even though the execution properties still need to be addressed. However, these requirements do not affect the process logic and they should not be documented directly in the BPMN but rather linked to the process at appropriate points. For implementing an executable process model, a BPMN modeling tool provides a visual interface to edit most of the non-graphical properties, even though, a basic understanding of web technologies such as XML and XML Schema is necessary.

For the implementation of the process in the BPMS, in the figure referred to previously, only the workflow engine's pool will be used as input for executing the technical flow (Figure 11). Even though this the technical process flow modeled in BPMN does not look so technical since the details necessary for automation are hidden under the hood as an XML file as mentioned in the literature review.

The results of this study considering the pitfalls during the implementation phase were five identified challenges in the focus groups. One challenge that was found is the risk that updates and changes in tools can occur since iBPM automation involves connecting different software and tools to the process flow. A second challenge is the data used in databases that need to be kept accurate to allow for a successful automation. Thirdly, a pitfall is poorly defined instructions during the testing phase that lacks clarity in the explained procedure. Therefore, one needs to ensure that the instructions are clear and easy to understand. The fourth identified pitfall is resistance from the user to the new way of working which will require a sensitive change management which is consistent with the findings from the literature review. Regarding the mentioned pitfalls and challenges, these need to be carefully considered to ensure a successful implementation of the new automated business process.

Process controlling

The final stage before the lifecycle will start over again is the *process controlling* phase. The key activity during this phase is to continuously monitor and analyze the individual process instances to find weak points. If needed the 'current state process model' should be adjusted to configure a direct solution. In cases of improvement, the lifecycle starts over again with the systematic *process analysis* of the weak points.

The current investigation found that achieving successful iBPM automation in the case company is crucial where the aim is to initiate iBPM automation to gain traction. Therefore, dedicating effort to each automation process will increase the success rate which in turn will open people's eyes to the possibilities of iBPM automation. However, automated processes in iBPM bring both advantages and disadvantages that will be considered in the following sub-chapter.

5.2 Allocate resources for iBPM process automation

The second part of this research aims to understand why future resources are required for iBPM automation in the case company. The literature review and the findings from the focus groups will identify why resources should be allocated for iBPM projects within the case company. The combination of the findings will be presented by summarizing the advantages and disadvantages of iBPM process automation, which will ultimately lead to a conclusion regarding the allocation of resources.

5.2.1 Advantages of automated processes with iBPM

To start, the advantages and benefits will be taken into account. Throughout the executed field research and the literature many key aspects regarding the added value an iBPM automation gains. To summarize some of the factors that were found both during the panels and the literature review that argue that iBPM automation adds value to an organization are as follows:

1. Increased efficiency and cost savings
2. Enhanced employee and customer experience
3. Automation and optimization of business processes
4. Execution transparency and rule enforcement
5. Streamlined processes and reduced complexity

The first point is the fact that automated processes enable organizations to optimize their processes and therefore, lead to **increased efficiency and cost savings**. With the possibility to identify and address bottlenecks, eliminate redundancies, and reallocate resources to high-priority tasks, organizations are able to enhance productivity and reduce operational costs. This aligns with the findings from the panels where it was noted that iBPM automation reduced manual and repetitive tasks which made daily tasks easier to handle and resulted in improved overall efficiency.

The second point that was found is similar to the previous point as BPM tools contribute to an **enhanced employee and customer experience** by eliminating repetitive work and enhancing information accessibility. Due to this, employees can focus on value-adding tasks,

which results in increased job satisfaction and productivity. Another finding is that automation results in a clear and streamlined process which reduces the learning curve for new employees as the process will guide them through the entire process.

The third point is that **automation and optimization of business processes** lead to smoother running processes and decreased cycle time. Additionally, automated processes lessen the need for manual intervention which minimalizes the potential for human errors while also saves valuable time when there is no need to redo previous mistakes. Furthermore, time is saved due to the fact that automation can eliminate delays, coordinate tasks, and gather relevant information for the users.

The fourth point is that automating processes contributes to **execution transparency and rule enforcement** which provides clear visibility into the execution of process instances and ownership of tasks. The BPMS provides operational and historical information on executed process instances which can be used to generate business insight and monitor process performance. Moreover, the documented processes facilitate collaboration and allow the organization to make decisions to enhance process performance. The study found in the panels that traceability and rule enforcement possibilities with iBPM automation ensures compliance with regulations and governance frameworks.

The fifth point of implementing iBPM automation is **streamlined processes and reduced complexity** in systems and processes. Manual process steps are digitized and restructured which streamlines the process landscape and at the same time, reduces the number of people involved. Resulting in enhanced transparency, accountability, and communication among teams. The results from the study also found that iBPM automation can break down silos between departments and teams to facilitate collaboration.

This outcome of the research ties in well with the advantages and benefits found in the literature review. From the panels, it can be concluded that the iBPM process automation is a real benefit to the case study even though, the panels identified various challenges and disadvantages that result from an automated process. These disadvantages will be considered in the following section.

5.2.2 Disadvantages of automated processes with iBPM

During the panels, disadvantages resulting from automating processes with iBPM were identified. The findings from the interviews regarding disadvantages are closely related to the challenges from the theoretical review. Hereby, it is important to emphasize that the challenges, pitfalls and risks associated with process automation are closely intertwined with the disadvantages. Therefore, the disadvantages are concluded based on the risk they might have on the case company leading to an unsuccessful development and implementation of iBPM automation. Throughout the executed field research, five key aspects of disadvantages were determined:

1. Limitations to unstructured workflow
2. Training and experience with the BPMN standard
3. Dependency on a tool
4. Long and complicated development process
5. Perception of iBPM automation

The first issue is the BPMN modeling and automation's **limitation to unstructured workflows**. In reviewing the literature, processes that do not behave in a predictable and repeatable way are not suitable for iBPM automation. In BPMN there is an ad hoc sub-process that can provide the possibility to document non-binding tasks that can be executed in any order. However, these can rarely be executed in an automation engine.

The second issue is the **training and experience of the BPMN standard** as simply knowing the symbols is not enough to create useful process models. The disadvantage will show itself when the process model is modeled syntactically incorrect as it then loses all benefits of standardization. Additionally, the literature found that semantic inaccuracies or inconsistencies create the risk that the model will be misunderstood. This risk is particularly high if an inconsistent target state process model were sent to IT for implementation.

The third issue is the **dependency on a tool** in this case the BPMS that controls and coordinates the process automation. This disadvantage can show itself when the user is dependent on the tool to give them access to documents, particularly in urgent situations. In cases where all parameters are in order, the BPMS grants access automatically but when issues arise that require human intervention it causes delays until the next working day. Moreover, as the BPMS is connected to several tools and software, changes and updates to these could potentially disrupt the automated process. Similarly, the data stored in databases that the BPMS uses need to be correctly maintained to ensure faultless process execution. Therefore, it is essential to acknowledge and address these risks to prevent them from becoming disadvantages of the automated workflow.

The fourth issue is the **long and complicated development process** iBPM automation requires to ensure a functional process execution. According to the panels, the path from planning, developing, executing and testing is a long process even though, it finally, ended up with fewer issues and concerns than anticipated. However, the procedure to the end result was long including issues such as communication issues, lack of shared understanding among teams, extensive testing phase and ongoing weekly follow-up meetings. Nevertheless, the panels did conclude that the benefits outweigh the disadvantages in the automated case study despite the fact that the road was long.

The fifth issue is the **perception of iBPM automation** within the case company as the participants of the panels want a fully automated process with no human interaction needed. However, whereas RPA automates all process steps of only a small part of a process, iBPM automation is a holistic approach that automates a process from start to finish as it can include human actions where needed. They are both two sides of the same coin and used in conjunction they bring significant change to an organization. Moreover, a BPMS can "glue" different systems together allowing them to play their due role in the process they support. Therefore, the aim might not be to fully automate everything but to utilize the advantage to involve system tasks and human tasks within the automated process.

Finally, to acknowledge and address these disadvantages is crucial to mitigate risks and ensure a successful implementation of iBPM automation in the case company. Consequently, the advantages and disadvantages will be considered in the next sub-chapter to apprehend why resources are needed for iBPM automation in the case company.

5.3 Combination of the outcomes

To sum it up, regarding the first research question on how to automate processes in iBPM, there is a clear connection between the Camunda BPM lifecycle and the Camunda BPMN framework that can be used to go through all the phases to have an executable process modeled in BPMN. For automation projects, the technical process flow is used to execute the process in the workflow engine. In addition to this, Dumas et al. (2018) proposed a five-step plan to ensure the technical details are in place for the process to be implemented and executed in the BPMS. It can be concluded that the results gained from the literature review and the panels should be used as a guideline and best practice for future iBPM automation projects within the case company.

To address the second research questions to why resources should be allocated for iBPM process automation it can be concluded that both the path towards an executable process as well as the issues regarding challenges and pitfalls need to be managed, or at least minimized,

and this can be done by ensuring available resources for iBPM process automation. Due to this, it is important to proactively develop an action plan on how to overcome these challenges to ensure a successful development path to an automated iBPM process.

Finally, the abovementioned topics build the foundation for the recommendations that will be presented in Chapter 6. The recommendations will help the case company to minimize the risks and stay ahead of challenges to lay a solid foundation for future automation projects.

5.4 Limitations and considerations of the research

Within this research, some limitations need to be addressed. First of all, the business case manager of the case study was not able to participate in the study. Even though, the role and responsibility the person had during the development of the case study was discussed during the panels. Another limitation is the fact that no actual end-user of the process was included in the study. It would have been valuable to hear from a user that did the work task both before and after the process was automated to gather their opinion if iBPM automation. Nevertheless, this does not have a negative impact on the results of this research, the viewpoint from both the leading person in the form of the business case manager as well as the end-users of the case study would have provided valuable insights. Furthermore, the return on investment and the pay-back time related to iBPM automation was not available and therefore, not considered for the case study. Hereby, it is suggested for future research to also consider how to estimate savings from automation.

In regard to the measuring instruments, the focus groups acted as a good way to gather various perspectives together and enabled the participants to challenge their perceptions. However, the risk of holding focus groups was that the participants would agree on points where they would have had a different opinion if they were interviewed individually. While the researcher tried to balance the focus groups by asking questions individually to each participant to ensure they all got the chance to speak up, there is no guarantee that all participants agreed on the outcomes of the focus groups or dared to speak up in case they disagreed.

5.5 Further research

A suggestion for future research is to interview persons from different business units to gather an understanding of their business processes and how they are managed. There is a need to understand the maturity level of the processes and what opinions there are about improving business processes. Additionally, the researcher advises to investigate the viewpoint of the business experts regarding process modeling in the BPMN standard as well as getting an understanding of what is required to proceed with future process automation.

Another suggestion for future research relates to the value iBPM automation adds. During this research, it has been found that process automation can gain numerous advantages for the business. However, it should be investigated what kind of processes and especially, which ones gain the most value of automation. It is important to identify the processes that can generate the highest value through automation.

Furthermore, it is suggested that the case company spread the word about iBPM automation to other business units. The new technology needs to be presented to people in a way that they see the potential it can add to their team and to the company as a whole. As of now, it is difficult to convince people to perceive the benefits of iBPM automation without a real, understandable example. Therefore, the second division within the case company that recently developed a iBPM proof-of-concept demo needs to be utilized to show some of the features and potential of iBPM automation.

Another challenge within the case company will become how to sell the idea of yet another technology to the members of the management. Future research is needed to explain why iBPM is needed next to RPA as another IT system. Hereby, the researcher advises the case company to dedicate both time and resources to ensure members of business units, management, and businesspeople understand and apprehend the real benefits of iBPM automation.

5.6 Closing words

Throughout the journey of writing the thesis, I would like to express my gratitude towards everyone who has supported me in finding a project as well as during the entire execution period. First of all, I would like to thank my supervisor Mikael Ehrs from Novia University of Applied Sciences for his continuous feedback, guidance and support to complete this report. Without the motivation Mikael handed me during the uncertain and unclear moments, I would most likely not have had the courage to finish the thesis.

Secondly, I would like to thank my supervisor at the case company to take on this project and the individuals who closely supported me throughout the entire journey. I am thankful for their assistance in selecting a research topic, finding suitable participants, and aiding in planning the interviews. Finally, I would also like to thank everyone who has participated in the research process and given me their full engagement during the focus group interviews.

6. RECOMMENDATIONS

In this chapter, recommendations will be given based on the results of this research. The aim of these recommendations is to provide the case company with a clear overview of actions they can take in order to improve and secure the development of iBPM automation. In total, there will be six recommendations as listed in Table 10 below. For each recommendation, it will first be elaborated on why it is recommended followed by an overview of the actions to perform.

Table 10. *Recommendations to the case company*

	Recommendation
1	Effective communication
2	Increase understanding of iBPM automation
3	Utilize the Camunda BPMN framework
4	Complement modeling tool with a feature to collapse pools
5	Encourage learning of the BPMN standard
6	Recognize the demand for software developers

6.1 Effective communication

The first recommendation regards communication as it is essential that there is open and clear communication throughout the entire development process. During this research, three key points were found to be considered for the case company. Firstly, there is a need for the project core team to define terms and definitions that are brought up during the workshops and interviews. There needs to be a clear understanding of the terminology so that everyone has a shared understanding of what needs to be accomplished, who is involved, and which IT systems are used. Questions such as what, where, how and why need to be clearly understood by all parties. Therefore, it is important that the terms that are used have the same meaning to everyone so that everyone talks about the same thing. Sounds simple, but it is an important step to ensure that there are no misunderstandings.

Secondly, it was found during the study that the requirements and instructions could have been communicated better. The recommendation is to maintain a mindset that there is always room for improvement even though it might be believed that things are communicated well enough. Due to this, the instructions and requirements should be critically viewed to notice any point of the procedure that could have been explained better. For example, throughout the study, it was noted the information provided during the testing phase of the case study could have been clearer and easier to understand. Therefore, all such instructions given should be double-checked so that users have the knowledge needed to not doubt how they should perform the tasks.

Thirdly, it was found that the use of collaboration tools such as JIRA or Azure DevOps certainly helped to collect the information in a structured way. Therefore, it is also a future recommendation to maintain the best practice of using such tools during the course of an automation project. It will gain visibility to view the tasks that have been developed and those that are still needed to be worked on. Another best practice is to uphold all project-related information in one centralized place. When clarifying or adding information to open topics, it should be pointed to these applications instead of having information laying around in different emails and chat threads. Therefore, the recommendation is to utilize collaboration tools such as DevOps, to keep the requirements and the progress of the project in one place, easily accessible to everyone.

6.2 Increase understanding of iBPM automation

During the research, it was found that many business users have difficulties grasping the concept of iBPM automation on how it functions and how it can benefit them. It was noticed that first after the users saw a small demo of how the process steps can look like in the BPMS, they started to comprehend what the potential of this type of automation has for their business.

Therefore, the second recommendation is to spread the word about iBPM automation in the form of a real example to the business units to stimulate people to generate ideas and suggestions as they gain a deeper understanding of its implications. Another benefit of this approach is that the knowledge will be shared with other people and start growing by itself. Hence, this approach should be regarded as a best practice for enhancing people's understanding of how iBPM automation can be utilized.

Similarly, another recommendation is to focus on achieving successful iBPM automation in the case company at this early stage. To critically analyze which process is suitable for automation as some processes are simply not suitable for automating in a BPMS. The aim should be to create successful cases that will set the ball spinning to allow iBPM automation to gain traction. As identified in this study, it starts to slowly be apparent the effect that the first case study has on the case company. By dedicating effort to each automated process, the success rate will increase, thereby opening people’s eyes to the possibilities presented by iBPM automation.

6.3 Utilize the Camunda BPMN framework

The third recommendation is to utilize the Camunda BPMN framework introduced in theory Chapter 2.6, as it is a great way to visualize the needed cornerstones to an executable process model that can be implemented in a BPMS. The recommendation to utilize the practical framework by Freund and Rücker (2019) is regarding the preparation of converting the initial

strategic process model into an operational process model consisting of both a human and technical process flow. The framework is used for projects that require technical support and modeling of the target state process model that is used for implementation. The practical framework can help decide which BPMN symbols and constructs to use in certain situations to know when to hold back to maintain simplicity.

During the process design stage (seen in Figure 2) where the aim is to generate a target state process model, there are a few things to be considered. Firstly, the strategic process model should be modeled to give a picture of the general process overview aimed at quickly creating an understanding of the process for people who has no special BPMN knowledge. This process model should be described with only a few simple steps without including any errors or deviations.

The operational model, on the other hand, should investigate the details of the actual process. The model should be split into a human and technical process flow whereas the human flow is managed by participants and the technical flow is managed by software, preferably a workflow engine. However, these two flows can interact triggering one or the other. Important when modeling the models are that the operational model unlike the strategic model where some semantic irregularities are tolerated must be modeled syntactically and semantically correct. Meaning that the models need to follow the rules of combining the symbols and ensuring that the intended behavior of the process is captured. Another recommendation will be suggested to encourage the learning of the BPMN 2.0 standard.

Another issue is that the operational process model needs to include more details than the strategic model which leads to a problem. The challenge will be to reconcile the perspective of the process participant, process analyst and engineer as they all are concerned with different matters in the process as already mentioned in other sections of the thesis. Due to the fact that the technical model will be executed, the process engineer needs to get all questions answered to succeed to reach the desired outcome of the automation. In the next recommendation, a suggestion of how this challenge can be met is given.

6.4 Complement modeling tool with a feature to collapse pools

The fourth recommendation relates to how one can increase the possibility to successfully meet the challenge mentioned above which in turn will lead to a more consistent process logic and improve the understanding between parties. It is important to strike a balance between precision and complexity when creating an effective operational process model. One way to achieve this is to provide different views of the process depending on the participant so that they can focus on their own tasks without being distracted by the details of what others do.

The workflow engine should also be treated as a participant with its own pool that the process engineer can focus on.

These separate pools represent the participants' tasks as a closed (collapsed) pool. In this way, the orchestration can be seen between different stakeholders and the workflow engine while the whole collaboration diagram should be reserved for the process analysts as this diagram shows all open pools. This was depicted in Figure 9 where the coordination between two participants and the workflow engine can be seen while the engine has its pool collapsed. In other words, the activities performed by the engine are not visible to confuse the other participants. On the other hand, in Figure 10, the full collaboration diagram can be viewed that has all the pools open showing all the tasks of the participants. Whereas the process analyst can see the whole collaboration diagram, the process engineer sees the engine's pool and the process participants see only their own pool.

Therefore, it is recommended the case company to implement the feature to open and close pools in the BPMN diagram as this possibility is currently lacking. Another advantage of this that the theoretical review also supports, is that once the model is developed it should be shared with the concerned people by using a tool with good presentation functions. The ability to expand and collapse pools is valuable since this approach allows for optimization of the views presented for different target groups of users and prevents having multiple process models with unnecessarily modeled pools.

6.5 Encourage learning of the BPMN standard

The fifth recommendation is to encourage learning of the BPMN standard as a result of the significant importance it has to all the stages of process improvement and development. Process modeling is a method that affects all the stages in the Camunda BPM lifecycle (Figure 2), especially process documentation and process design. BPMN was developed to improve process automation and to establish the connection between business and technology even for businesspeople without IT knowledge. Furthermore, process modeling is the prerequisite to conduct process analysis, redesign and automation and the models can then be imported and exported among the tools to transform the model into an executable language. At the case company, both the process repository and the automation engine are built on the BPMN 2.0 standard.

The symbols and methodology of BPMN 2.0 expressed as rules of combining them are called syntax. The meaning of the symbols and constructs that can be modeled with the symbols are called semantics. Due to the fact that when BPMN is applied syntactically incorrect it loses all benefits of standardization. However, some BPMN tools do not even allow for syntactically

incorrect modeling and also semantic inaccuracies, or inconsistencies create the risk that the model will be misunderstood. The risk is particularly high if such an inconsistent target state model were sent to IT for implementation. Therefore, a process model used in a workflow engine must be correct, precise and consistent. This recommendation is especially important as the main reason process models have had limited success in the past is the failure to bridge the understanding between business and technology. However, depending on the modeling objective the precision and formal correctness of a process model must vary and this understanding is essential for the work with BPMN.

Another argument as to why the BPMN 2.0 standard is worth learning is that it is becoming the global standard notation. The theoretical review highlighted that there exist many BPMN tools, and the chance is big that partners such as customers and suppliers are familiar with the notation which increases the communication around process models. One advantage is that everyone speaks the same language as they have a common set of symbols and techniques through which they communicate. This recommendation is suggested as training and experience are required to use the full set of symbols correctly as BPMN provides a comprehensive set with more than 100 symbols.

6.6 Recognize the demand for software developers

A common belief when getting familiar with the concept of a workflow engine is that the "magical" BPMS will solve everything. The suite is supplied with models developed by the business, integrating IT systems and the human workflow management just happens to work. After this, it would be possible to simply create a dashboard of KPIs that enables the business to identify process issues in real-time and solve them independently. However, it is in practice not that simple.

The fact is that developing process applications is always a type of software development. Even though citizen developer tools are enabling users across the business to identify and improve processes, the hope that the whole development can be taken on by them in the future is not possible. Comprehensive wizards and forms are necessary to develop process applications which may overwhelm the average business user.

Due to this, the sixth and last recommendation is to adopt a hybrid approach is the most effective, where certain parts of the process are model-driven, while other parts such as, complex interfaces are created through classic programming. The theoretical review confirms that consequently, it must be accepted that software development will require software developers in the future.

7. REFERENCES

Benedict, T., Kirchmer, M., Scharsig, M., Franz, P., Saxena, R., Morris, D., & Hilty, J. (2019). *BPM CBOK Version 4.0: Guide to the Business Process Management Common Body of Knowledge*. (4th ed.). ABPMP International.

Datarundown. (2022). *The Complete Guide to Business Process Management (BPM) Lifecycle*. Retrieved March 15, 2023, from https://datarundown.com/bpm-lifecycle/

Devi, A. (2021). *5 Steps in a Business Process Management Life Cycle*. HappyFox Inc. Retrieved March 15, 2023, from https://blog.happyfox.com/steps-in-business-process-management-life-cycle/

Dumas, M., La Rosa, M., Mendlin, J. & Reijers, H. A. (2018). F*undamentals of business process management.* Second edition. Springer-Verlag GmbH, Berlin, Heidelberg.

EdrawMax. (2022). *BPMN Symbols and Meanings*. Edrawsoft. Retrieved February 22, 2023, from https://www.edrawmax.com/article/bpmn-symbols.html

Fortune Business Insights. (2021). *Business Process Management Market to Exhibit 12.0% CAGR by 2028; Introduction to Cloud-based Applications Will Augment BPM Market Growth: Fortune Business InsightsTM*. Retrieved March 24, 2023, from https://www.globenewswire.com/news-release/2021/12/15/2352259/0/en/Business-Process-Management-Market-to-Exhibit-12-0-CAGR-by-2028-Introduction-to-Cloud-based-Applications-Will-Augment-BPM-Market-Growth-Fortune-Business-Insights.html

Freund, J. & Rücker, B. (2019). *Real-Life BPMN: Using BPMN and DMN to analyze, improve, and automate processes in your company*. Fourth edition. Lakewood, Colo: CreateSpace Independent Publishing Platform.

Gogineni, C. (2018). *What is the difference between RPA and BPM?* ComTec Info RPA. Retrieved March 24, 2023, from https://www.comtecinfo.com/rpa/what-is-the-difference-between-rpa-and-bpm/

Harmon, P. (2019). *Business Process Change: A Business Process Management Guide for Managers and Process Professionals*. Fourth edition. Enterprise Alignment, San Francisco, CA, USA.

Object Management Group®. (n.d.). Bu*siness Process Model & Notation (BPMN).* Object Management Group. Retrieved April 19, 2023, from https://www.omg.org/bpmn/

IBM. (2022). *The Basics of Business Process Modeling and Notation (BPMN).* Retrieved March 24, 2023, from https://www.ibm.com/cloud/blog/bpmn

IBM. (n.d.-a). *What is Business Process Management?* Retrieved March 15, 2023, from https://www.ibm.com/topics/business-process-management

IBM. (n.d.-b). *What is Robotic Process Automation (RPA)?* Retrieved March 24, 2023, from https://www.ibm.com/topics/rpa

Lewis, L. (2020). *Understanding BPMN Diagrams and Symbols*. ProcessMaker. Retrieved February 22, 2023, from https://www.processmaker.com/blog/bpmn-diagram-and-symbols/

Lucidchart. (n.d.). *What is Business Process Modeling Notation*. Retrieved February 22, 2023, from https://www.lucidchart.com/pages/bpmn

Lynch, A. (2022). *What is BPMN - Definition, Elements and Purpose*. Edrawsoft. Retrieved February 22, 2023, from https://www.edrawsoft.com/what-is-bpmn.html

Malak, H. A. (2022). *BPM Lifecycle: 5 Stages to Business Process Excellence*. The ECM Consultant. Retrieved March 14, 2023, from https://theecmconsultant.com/what-is-bpm-lifecycle/

Megginson, L. C. (1963). Lessons from Europe for American Business. *Southwestern Social Science Quarterly, 44*(1), 3-13.

Mendling, J., Reijers, H. A., & van der Aalst, W. M. P. (2009). Seven Process Modeling Guidelines (7PMG). *Information and Software Technology, 51*(2), 337-352.

Naoum, M., El Hichami, O., Al Achhab, M., & El Mohajir, B. E. (2016). *A probabilistic method for business process verification: Reachability, Liveness and deadlock detection.* 4th IEEE International Colloquium on Information Science and Technology (CIST), Tangier, Morocco. DOI:10.1109/CIST.2016.7805029

Petersen, M. (n.d.). *An Introduction to Business Process Management (BPM).* GBTEC Software AG. Retrieved March 14, 2023, from https://www.gbtec.com/resources/bpm-business-process-management/

Pratt, M. K., & Lutkevich, B. (2022). *What is business process management? An in-depth BPM guide*. Tech Target. Retrieved March 22, 2023, from https://www.techtarget.com/searchcio/definition/business-process-management

ProcessMaker. (2021). *The Difference Between RPA and BPM*. Retrieved March 24, 2023, from https://www.processmaker.com/blog/difference-between-rpa-bpm/

Red Hat Inc. (2018). *What's business automation?* Red Hat. Retrieved March 24, 2023, from https://www.redhat.com/en/topics/automation/whats-business-automation

Red Hat Inc. (2022). *What is business process management?* Red Hat. Retrieved March 24, 2023, from https://www.redhat.com/en/topics/automation/what-is-business-process-management

Suchenia, A., Ligęza, A., & Wiśniewski, P. (2017). Overview of Verification Tools for Business Process Models. *Communication papers of the Federated Conference on Computer Science and Information Systems, 13*(1), 295-302.

Verhoeven, N. (2022). *Doing Research: The Hows and Whys of Applied Research*. Sixth edition. Bom uitgevers Amsterdam.

Vliegenthart, P. (2020). *All BPMN 2.0 Level 1 Elements.* Inveskills.com. Retrieved February 22, 2023, from https://www.inveskills.com/bpmn/all-bpmn-2-0-level-1-elements/

Weske, M. (2007). *Business Process Management: Concepts, Languages, Architectures*. Springer-Verlag Berlin Heidelberg Berlin.

Wester, F. (1991). *Strategieën voor kwalitatief onderzoek*. Coutinho B.V.

Winn, K. (2022). *Identify Automation Opportunities in 4 Steps*. Apexon. Retrieved January 24, 2023, from https://www.apexon.com/blog/identify-automation-opportunities-in-4-steps/

Yin, R. K. (2018). *Case Study Research and Applications: Design and Methods*. Sixth edition. Los Angeles, SAGE.

APPENDICES

Appendix 1 – Preparation email to focus group participants

Dear all,

You may have heard from X that I will be reaching out to you to request interviews for my bachelor's thesis. I am currently exploring the topic of process automation in iBPM and would like to invite you to share your experience and insights regarding the automated X business case.

Your knowledge is highly relevant to both my thesis but also, even more importantly, in supporting process automation in X as we have just started our iBPM journey.

I have understood that you are all very busy. Therefore, I will ensure that everything goes smoothly, and the meetings are kept short and straight to the point. I will send personal invitations to the interviews, including the questions in advance. The interviews will be conducted in groups, allowing for open discussions when necessary.

I and my team will greatly appreciate your time for this. Please let me know if you have any questions or concerns. Thank you, and I look forward to speaking with you soon!

Best regards,

Sofia Nylund

Appendix 2 – Interview questions

Interview question 1 – Manager/process owner core team

- Could you please shortly introduce yourself?
- What were the main reasons for automating the case study?

Advantages and disadvantages

- What were the results from the case study, and how did it benefit/bring added value to the company?
- How did you measure the success of the automation project?
- Have these benefits met your expectations, and/or have there been any unexpected results?
- What are the long-term benefits and potential opportunities that you see from investing in iBPM automation?
- Have you noticed any disadvantages that come out of iBPM automation?
- In your opinion, are the advantages worth the disadvantages?

Challenges / HOW-TO

- What were some best practices or guidelines that you followed during the development and implementation?
- What challenges did you face during the development? Can you elaborate on how you overcame them?
- What lessons did you learn from the automation project that you would do differently in future projects?
- What advice do you give for other divisions within the case company looking to automate business processes using Camunda BPM?
- Did the case study spark new ideas for projects that could be automated in a similar way?

Interview question 2 – Process automation lead and developer

- Could you please shortly introduce yourself?
- In which way are you involved in iBPM automation? What are your responsibilities?

Advantages and disadvantages

- What are the benefits of iBPM automation for the case company? How is it value-adding?
- What are the long-term benefits and potential opportunities that you see from investing in iBPM automation?
- Have you noticed any disadvantages that come out of iBPM automation?
- In your opinion, are the advantages worth the disadvantages?

HOW-TO

- What were some best practices or guidelines that you followed during the development and implementation of the case study?
- According to you, what would be an effective way of working towards an executable process?
- How did you make sure that the collaboration and communication went smoothly and effectively between the different teams?

Challenges and lessons learned

- What challenges did you face during the development of automating the case study? Can you elaborate on how you overcame them?
- What lessons did you learn from the automation project that you would do differently in future projects?
- Are there any future developments that IM is thinking about implementing now after the first automated business case?
- What advice do you give for other divisions in case company looking to automate business processes using Camunda BPM?

Interview question 3 – Key users

- Could you please shortly introduce yourself?

Changes to your daily work

- How has the automated case study affected your daily work in comparison to before?
- What are the biggest changes to how your work was done previously?
- Have you noticed any changes in the attitudes or behaviors of team members since the implementation of iBPM technology?

Advantages and disadvantages

- In your opinion, what are the benefits of iBPM automation for yourself / your team? Can you give examples?
- Have you experienced any challenges or negative effects while using the automated WoW? If yes, can you elaborate on them?
- In your opinion, are the advantages worth the disadvantages?

Improvements and new ideas

- Looking back on the project, is there anything you would have wanted to be done differently?
- Did the case study spark new ideas for projects that could be automated in a similar way?