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Master's Thesis

BPMN for Modelling Business Processes in a Hotel Industry

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CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Economics and Management

DIPLOMA THESIS ASSIGNMENT

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Informatics

Thesis title

BPMN for Modeling Business Processes in a Hotel Industry

Objectives of thesis

The aim of this master thesis is to develop a BPMN (Business Process Model Notation) model tailored specifically for the hotel industry. This industry-specific BPMN will serve as a comprehensive framework for modeling various business processes within hotel operations. By focusing on the unique needs and dynamics of the hotel sector, this BPMN aims to provide a standardized and efficient approach to process modeling.

Methodology

The methodology focuses on the theoretical aspects of business processes, including Business Process Management (BPM), and covers aspects such as process identification, discovery, analysis, redesign, implementation, and monitoring. It also discusses models and modeling techniques relevant to business processes, including Business Process Modeling Notation (BPMN) and its application in business process modeling. The chapter focuses on specific techniques for business process modeling, with process mapping as a key methodology.

The practical part of the methodology includes a detailed description of the BPMN model developed for the hotel industry, outlining its components, structure, and functionality. The chapter also elucidates the process flow depicted in the BPMN model, including justifications for model events and integration with worker scripts.

The practical implementation of the BPMN model is focused on challenges encountered during the process, such as Zeebe Client and Node Version Compatibility, errors in Camunda Cloud Modeler, syntax mistakes in XML and JavaScript, JavaScript errors, and parsing issues with JavaScript Job Worker.

The proposed extent of the thesis

60-80 pages

Keywords

Keywords: BPMN, business, flowchart, process, payment

Recommended information sources

Glykas, M. 2013. Business Process Management Theory and Applications. Berlin, Springer. ISBN: 978-3-642-28409-0

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Prague on 31. 03. 2024

Declaration

I declare that I have worked on my master's thesis titled ***"BPMN for Modeling Business Processes in a Hotel Industry"*** by myself and I have used only the sources mentioned at the end of the thesis. As the author of the master's thesis, I declare that the thesis does not break any copyrights.

In Prague on 31.03.2024 ____________________________

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BPMN for Modeling Business Processes in a Hotel Industry

Abstract

This master's thesis presents the development of a BPMN (Business Process Model Notation) model tailored specifically for the hotel industry. The aim of this research is to provide a comprehensive framework for modeling various business processes within hotel operations.

Drawing upon insights from the literature review, the thesis proceeds to develop a BPMN model that accurately captures and represents the diverse processes within hotel operations. This model is designed to address key areas such as process identification, discovery, analysis, redesign, implementation, and monitoring, while also accounting for the specific requirements and nuances of the hotel industry.

The practical implementation of the BPMN model is detailed, including the description of the model, explanation of the process flow, analysis of challenges encountered during implementation, and additional amenities provided by the model. Through meticulous attention to detail and consideration of real-world scenarios, the BPMN model offers hotel managers and stakeholders a standardized and efficient approach to process modeling.

Overall, this thesis contributes to the advancement of business process management in the hotel industry by providing a robust framework for understanding, analyzing, and optimizing various aspects of hotel operations. The developed BPMN model holds significant potential for enhancing operational efficiency, improving guest experiences, and driving overall success in the competitive hotel industry.

Keywords: BPMN, business, flowchart, process, payment

BPMN pro modelování podnikových procesů v hotelnictví

Abstrakt

Tato diplomová práce představuje vývoj modelu BPMN (Business Process Model Notation), který je přizpůsoben speciálně pro hotelový průmysl. Cílem tohoto výzkumu je poskytnout komplexní rámec pro modelování různých obchodních procesů v rámci hotelového provozu.

Na základě poznatků z rešerše literatury práce pokračuje ve vývoji modelu BPMN, který přesně zachycuje a reprezentuje různorodé procesy v rámci hotelového provozu. Tento model je navržen tak, aby se zabýval klíčovými oblastmi, jako je identifikace, zjišťování, analýza, redesign, implementace a monitorování procesů, a zároveň zohledňoval specifické požadavky a nuance hotelového průmyslu.

Praktická implementace modelu BPMN je podrobně popsána, včetně popisu modelu, vysvětlení toku procesů, analýzy problémů, které se vyskytly při implementaci, a dalšího vybavení, které model poskytuje. Díky pečlivé pozornosti věnované detailům a zohlednění reálných scénářů nabízí model BPMN manažerům hotelů a zúčastněným stranám standardizovaný a efektivní přístup k modelování procesů.

Celkově tato práce přispívá k rozvoji řízení podnikových procesů v hotelnictví tím, že poskytuje robustní rámec pro pochopení, analýzu a optimalizaci různých aspektů hotelového provozu. Vyvinutý model BPMN má významný potenciál pro zvýšení provozní efektivity, zlepšení zkušeností hostů a celkový úspěch v konkurenčním hotelovém průmyslu.

Klíčová slova: BPMN, obchodní, vývojový diagram, proces, platba

Table of content

1. Introduction

In today's dynamic business environment, the effective management of processes is crucial for the success of organizations across various industries. In particular, the hospitality sector, and more specifically the hotel industry, faces unique challenges and complexities in managing its operations efficiently. With the increasing demand for personalized and seamless guest experiences, there is a growing need for standardized frameworks to streamline and optimize business processes within hotels.

The aim of this master thesis is to address this need by developing a tailored BPMN (Business Process Model Notation) model specifically designed for the hotel industry. BPMN has emerged as a widely accepted standard for visualizing and documenting business processes, offering a common language for stakeholders to communicate and collaborate effectively. By customizing BPMN to the specific requirements of the hotel sector, this model aims to provide a comprehensive framework for modeling various aspects of hotel operations.

The development of an industry-specific BPMN for hotels is essential for several reasons. Firstly, it enables hotels to map out and understand their internal processes in a structured and standardized manner. This clarity facilitates process optimization, resource allocation, and decision-making, ultimately enhancing operational efficiency and guest satisfaction. Secondly, by tailoring BPMN to the unique needs and dynamics of the hotel industry, this model can capture the intricacies of hotel operations more accurately, ensuring that all relevant processes are adequately represented.

Through this master thesis, we seek to contribute to the ongoing efforts to improve process management in the hotel industry. By developing a specialized BPMN model, we aim to empower hotels with a powerful tool for process modeling and optimization. This industry-specific BPMN has the potential to revolutionize the way hotels manage their operations, driving innovation, efficiency, and competitiveness in the hospitality sector.

2. Objectives and Methodology

2.1 Objectives

The aim of this master thesis is to develop a BPMN (Business Process Modeling using BPMN) tailored specifically for the hotel industry. This industry-specific BPMN serves as a comprehensive framework for modeling various business processes within hotel operations. By focusing on the unique needs and dynamics of the hotel sector, this BPMN aims to provide a standardized and efficient approach to process modeling.

2.2 Methodology

The methodology focuses on the theoretical aspects of business processes, including Business Process Management (BPM), and covers aspects such as process identification, discovery, analysis, redesign, implementation, and monitoring. It also discusses models and modeling techniques relevant to business processes, including Business Process Modeling Notation (BPMN) and its application in business process modeling. The chapter focuses on specific techniques for business process modeling, with process mapping as a key methodology.

The practical part of the methodology includes a detailed description of the BPMN model developed for the hotel industry, outlining its components, structure, and functionality. The chapter also elucidates the process flow depicted in the BPMN model, including justifications for model events and integration with worker scripts.

The practical implementation of the BPMN model is focused on challenges encountered during the process, such as Zeebe Client and Node Version Compatibility, errors in Camunda Cloud Modeler, syntax mistakes in XML and JavaScript, JavaScript errors, and parsing issues with JavaScript Job Worker.

3. Theoretical part

The purpose of this part is to offer a concise summary of the topics that are significant for this thesis. These concepts include business processes, models and modelling, and BPMN illustration.

3.1 Business Process

There are many different ways that processes might be classified. An example of this would be Recker & Mendling (2006), who distinguish between manufacturing procedures and office activities. They also further separate procedures into material processes, processes involving information, and business processes. Recker & Mendling (2006) point out that certain academics differentiate between office operations and machine-executed processes. Furthermore, they remark that production processes can be differentiated from coordinated activities. Having said that, the exclusive focus of this study is on business procedures. The following are some descriptions of the methods used in business:

- In accordance with the BPMN definition, a business process is a predetermined collection of business activities that are meant to symbolize the actions that must be taken in order to accomplish a certain business goal. This encompasses the movement of information as well as the utilization of resources (BPMN, 2011).
- According to Krogstie (2016) a business processes is a collection of operations that are carried out in an organized way, either by humans or by tools, having the intention of achieving a certain consequence for the firm.
- According to Recker & Mendling (2006) a business process may be described as the collection of internal actions that are carried out in order to provide service to a client.

The sequence of work is determined by the business operations. The work of businesses may be improved or accelerated by implementing efficient business processes, which only involve actions that are absolutely essential. Business processes have the potential to facilitate the reduction of development expenses (the deployment of applications on time and within budget), the enhancement of quality, the reduction of upkeep expenses, and other benefits. So, regardless of the size of the firm, business procedures are an indispensable component of any and all businesses. According to Recker & Mendling (2006), the way for companies to maintain their competitive edge and to be able to respond to the requirements of the business environment is by collaborating with frameworks that are methodically geared toward processes. Pant and Juric (2008) describe two significant obstacles that must be overcome in order to successfully manage company procedures in the industrial sector:

1. Each organization possesses specific business procedures.
2. Business processes are dynamic and change as time progresses.

Management of business processes ought to be done correctly. For instance Krogstie (2016) stated that business processes have a tendency to become bigger and very complicated with over the course of time. This is something that is undesired and has to be regulated. Furthermore, those processes that are highly complicated are vulnerable to errors, hard to comprehend, and challenging to uphold.

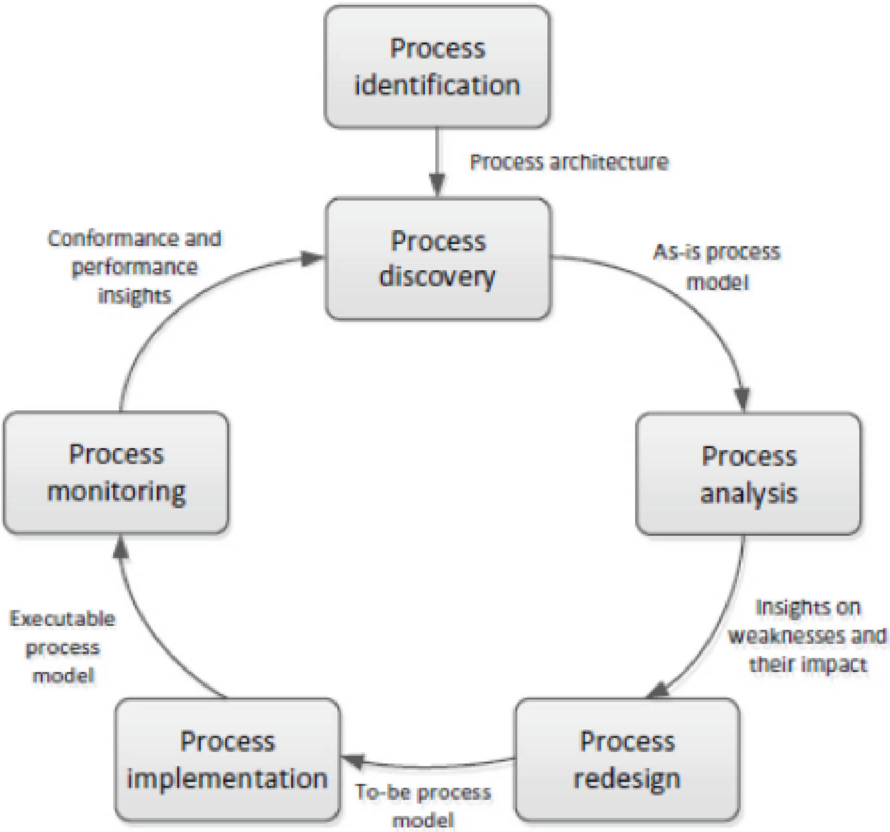
3.1.1 Business Process Management

Business process management, more often known as BPM, is a course of study which is acknowledged by scholars working in this department. As stated by Van der Aalst et al. (2003), business process management (BPM) could be characterized as the process of providing assistance to company operations via the use of approaches, strategies, and technology in order to plan, implement, control, and evaluate operating procedures that include individuals, groups, programs, documents, and additional forms of data.

Weske (2019: 12) asserts that the business process management (BPM) lifecycle is comprised of a number of parallel phases. The stages are organized in a cyclical fashion, which serves to illustrate the logical interdependencies that exist between them. Although these dependencies are present, it does not always follow that the stages must be carried out in a certain temporal order. There are a number of design and development activities that are carried out throughout each of these stages. It is quite unusual for gradual and evolving methodologies to require contemporaneous action in many phases. (Weske, 2019: 13) Hammer asserts that "every good process eventually turns into an awful process" whenever it is not continuously adjusted and modified in order to stay up with the constantly shifting landscape of consumer wants, technological advancements, and competition. The business process management (BPM) lifecycle ought to be regarded as cyclical (Dumas et al. 2018)

BPM may be conveyed by the use of a life-cycle, as seen in Figure 1. A certain result is associated with every stage of the phase, and this output is in accordance with the objective of every stage.

Figure 1: The BMP life – cycle



Source: (Dumas et al. 2018).

3.1.1.1 Process Identification

When businesses start BPM, the BPM staff should initially pinpoint the precise processes related to the issue they aim to resolve. This entails refining the nature of the steps and determining any connections between them. The first stage is process identification, which results in the development of an organizational structure that includes the interrelated processes driving an organization's activity to achieve its objectives. The primary goal of participating in Business Process Management (BPM) is to guarantee that the processes under scrutiny result in constant positive results and deliver the highest possible value to the company's customers. In order to do this, it is crucial to assess the value provided by every step by establishing process efficiency criteria including cost, time, quality, and adaptability. A business may only study its processes thoroughly to assess if they are functioning optimally or require enhancements (Dumas et al., 2018).

Cost-related measurements are a typical measurement of performance utilized in BPM. This involves measures like the expenses associated with goods or personnel needed to execute a procedure. Temporal measurements are commonly utilized in Business Process Management (BPM). This encompasses measurements like cycle time, meaning the duration for completing a process, wait time, that is what it takes needed to fulfill a client order, and productivity, that is a measure of output production in a process. Quality-related metrics, particularly mistake rates, are significant in Business Process Management (BPM). This statistic determines the frequency at which the performance of a procedure results in an unfavorable outcome. Flexibility assessments assess a process's capacity to adjust and sustain its success in the face of shifting or unusual circumstances. Defining metrics for success and their corresponding objectives is a critical aspect of every Business Process Management (BPM) project. It is usually included in the process description step, but in certain situations, it may be postponed until subsequent phases (Dumas et al. 2018).

An organization may assess the success of its operations, pinpoint areas for enhancement, and optimize its activities for optimal efficiency and effectiveness by establishing and evaluating these performance indicators.

3.1.2 Process Discovery

Once the BPM department has identified the necessary operations and performance indicators, the next stage is to get a comprehensive understanding of the business process.

This stage is referred to as process discovery. The primary outcome of this stage is an as-is process model that represents the existing understanding of the way activity is carried out in the company. Process diagrams are crucial for enhancing interaction among parties participating in the BPM project. Diagrams are frequently utilized to represent business processes in a clear and understandable manner. Adopting a modeling language that all stakeholders comprehend helps the process simpler to understand and reduces the chance of misinterpretation when diagrams are created. Nevertheless, it is important to mention that these pictures may still be supported by written explanations. Analysts often use a blend of text and images to record an activity. (Dumas et al., 2018).

The main objective of the process discovery stage is to achieve an in-depth comprehension of the business process, since it serves as an outline for any further analysis or modification. Process models help BPM professionals to visually represent and convey the current status of a process, which is crucial for pinpointing inefficiencies or wasteful areas and executing specific enhancements.

3.1.3 Process Analysis

Once a thorough comprehension of the current process is achieved, the subsequent stage in the BPM project involves detecting and examining any existing flaws throughout the process. This evaluation usually entails evaluating the present status of the process in relation to particular performance metrics. After identifying and analyzing challenges, the following step is to investigate viable solutions. This entails evaluating several solutions for solving an issue, while acknowledging the challenges associated with altering a procedure. Individuals frequently oppose alterations in their work procedures, and adjusting the information systems that facilitate these procedures can be expensive and may need modifications in other companies, such as suppliers. Changing one element of a procedure to solve a problem might lead to unforeseen outcomes and perhaps create other issues in the future. Dumas et al. (2018).

Hence, the BPM team must thoroughly assess all possible solutions and select the one with the highest potential to enhance the process while reducing the risk of adverse impacts.

3.1.4 Process Redesign

Upon examining the problems within a procedure and investigating possible solutions, the BPM team might suggest a revamped iteration of the process. The to-be process design represents the main result of the method redesigning phase. (Dumas et al., 2018) Process design is to ensure that method effectiveness aligns with and meets the procedure's goals as stated by Slack (2022). Table 1 demonstrates how a company's strategic objectives and targets can impact the aims and results of its procedure design and execution.

The evaluation and redesigning stages are tightly linked, and there may be several possibilities for rethinking the process. Every alternative must be carefully examined to enable the team to make a well-informed conclusion on the best suitable choice (Dumas et al., 2018). By doing this, the team can guarantee that the new process design resolves the highlighted concerns and aligns with the organization's performance objectives. Hence, the BPM team must thoroughly assess all possible solutions and select the one with the highest potential to enhance the process while reducing the risk of adverse impacts.

Establishing the right degree of standardization is a crucial objective in process design, especially in bigger firms. Standardization involves establishing a uniform set of activities, methods, and instruments to be used across different processes. In bigger companies, different approaches for the same work may emerge over time, resulting in unpredictability and inefficiency. Offering many techniques can provide people and teams independence and adaptability, but it also results in confusion and misinterpretation. Standardization is crucial for improving efficiency and reducing mistakes or differences in process design (Slack, 2022).

Table 1: Summarizing table of objectives, design and benefits of design.

OPERATION PERFOMANCE OBJECTIVES	TYPYCAL PROCESS DESIGN	BENEFITS OF GOOD PROCESS DESIGN
Quality	• Provide suitable resources that can meet the specifications of products or services. • Free – error fixing	• Services and goods made "on-specification" • Lower waste and recycling, and less work going into the process
Speed	• Minimum throughput time • Output rate appropriate for demand	• Short customer waiting time • Low in-process inventory
Dependability	• Provide dependable process resources • Reliable process output timing and volume	• On-time deliveries of products and services • Less disruption, confusion and rescheduling within the process
Flexibility	• Provide resources with an appropriate range of capabilities • Change easily between processing states (what, how, or how much is being processed?)	• • Ability to process a wide range of products and services • • Low cost/fast product and service change
Cost	Appropriate capacity to meet demand	• Low processing costs • Low resource costs (capital costs)

	Eliminate process waste in terms of: ✓ Excess capacity ✓ Excess process capability ✓ In-process delays ✓ In-process errors ✓ Inappropriate process inputs	• Low delay/inventory costs (working capital costs)
Sustainability	• Minimize energy usage • Reduce local impact on community • Produce for easy disassembly	• Lower negative environmental and societal impact

Source: (Dumas et al., 2018: Slack, 2022)

3.1.5 Process implementation

There are two main parts to the process execution phase: managing organizational change and automating the method of operation. Change in organizational management refers to a set of tasks that are done to alter the way individuals operate within a systém choice (Dumas et al., 2018).

This includes:

- Process collaborators need to be told about the changes and given an account of why they are happening.
- Making a plan for managing change to make sure the shift goes smoothly.
- Participants will get guidance to make sure they are ready to implement the new process.

Also, there needs to be tracking to find and fix any problems that come up during the shift. Process optimization includes the technical modifications that need to be made to the process in order for the new design to work. These changes can be to IT systems, processes, and routines. Both of these things are necessary for the new process to be put into action successfully (Dumas et al., 2018).

3.1.6 Process monitoring

It is important to keep an eye on and analyze the success of a business process once it has been put in place to make sure it meets expectations. In this step, the process is being watched. Analysts can get information about how well a process is working and figure out what changes or improvements need to be made by watching the process. The method is going to get worse as time progresses if it is not constantly watched and improved. Hammer said that even a well-thought-out process can turn bad over time if it isn't changed and improved all the time to keep up with developments in innovation, rivalry, and customer wants. This is why the process tracking step is so important to the success of any BPM project (Dumas et al., 2018).

3.2 Models and Modelling

3.2.1 Business process modelling and models

Nelson and Monarchi (2007) define modeling as a complex process that involves transforming real-world concepts into practical implementations through several steps. The conventional modeling technique places an operation into a sequence connecting input and output (Rosemann & Brocke, 2015). Modelling provides models in the form of diagrams and drawings. Mohagheghi, Dehlen, and Neple (2009) see models as the principal software resource. According to Rosemann & Brocke (2015) models are simplified representations used to clarify and comprehend complicated, uncertain, changing, or assumed aspects of a situation. BPMN models represent business processes and illustrate their operations. BPMN business process models may depict many facets of processes.

White (2004) describes a Business Process Model as a system of visual elements, such as actions and circulation control systems, that determine the sequence in which they are carried out.

There is a great deal of significance attached to the reason for the development of a business process model in BPMN. Among the various applications of business procedure models, some examples include software process improvement, enterprise modeling, active data modeling, and performance administration (Krogstie and Sølvberg, 2000). According to Kluza et al. (2011), the framework of business processes is designed to assist businesses in reflecting their method of activity. This, in turn, will lessen the possibility of developing systems that might not be able to fulfill the needs that have been asked.

- To develop software (Rosemann & Brocke, 2015); Vanderfeesten et al., 2008).
- To aid in various management initiatives (Rosemann & Brocke, 2015)
- To provide a base for trainings (Vanderfeesten et al., 2008).
- To estimate costs and budgets (Vanderfeesten et al., 2008).
- To improve and/or modify business processes (Makni et al., 2010).
- To identify bottlenecks (Pant & Juric, 2008).

- To detect errors early (Rolón et al., 2009).

3.2.2 BPMN modelling and models

There are many various symbols and languages that are employed in the method of modeling business processes. According to Reijers et. el. (2010), business processes are frequently modeled using a language of graphics in order to depict process flow, functions (actors and systems), and records which are associated with the process. The following are some instances of modeling notes that can be used to model company procedures: (BPMN), UML Activity Diagram, UML EDOC Business Processes, IDEF, ebXML BPSS, Activities Decision Flow (ADF) Diagram.

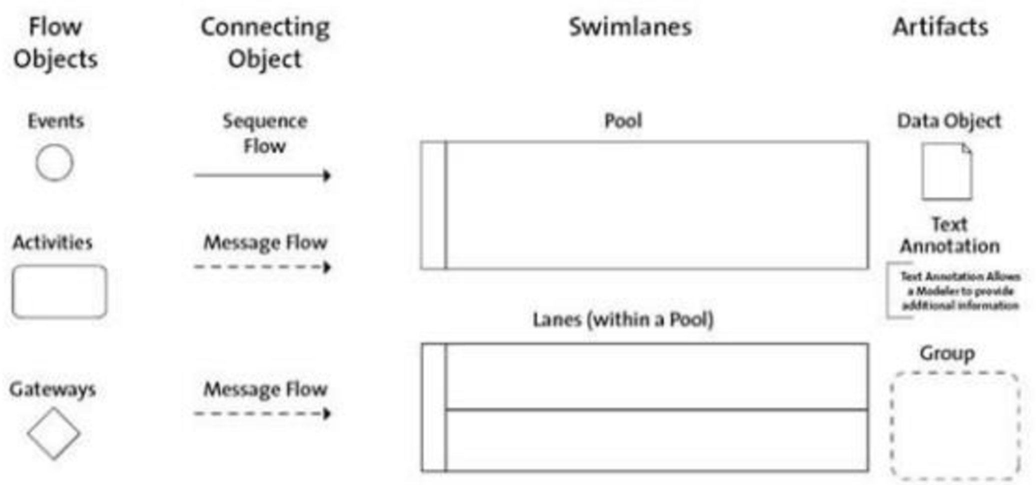
3.2.3 Business Process Modelling

The modeling of business processes is an essential component of business process management (BPM), and that modeling is carried out at various points of the BPM lifecycle with a number of objectives connected to BPM. (Dumas et al. 2018; Beckmann 2011). Without the process modeling, there cannot be a method of business process management that can be implemented in practice. It is important to highlight, however, that the process modeling itself is not the aim; rather, it is a method for modeling operational processes in order to comprehend, analyze, and enhance them (Laamanen 2001). Before commencing the process of modeling, it is essential to have a complete comprehension of the intent behind the creation of the process models. However, the look of the models that are made will change depending on the function for which they are designed. The modeling of processes serves a variety of functions, including the acquisition of an all-encompassing comprehension of the process and the dissemination of that comprehension to people who frequently take part in it. Because participants in the process often engage in tasks that are specialized, it is possible that they may not have a complete comprehension of the complexity of the process. Dumas et al. (2018) viewed process models, as a result, assist in the identification and prevention of problems, as well as providing a better knowledge of the process. It is necessary to take this phase in order to get a comprehensive understanding of business processes before proceeding with process analysis, reconfiguration, or automation.

3.2.4 Business Process Modelling Notation

Business Process Modeling Notation (BPMN) was first presented in 2005 by the Object Management Group (OMG), which subsequently combined with the Business Process Management Initiative (BPMI) (Dumas et al. 2018). The Business Process Model (BPMN) is an established language that is used to graphically express company operations. In its capacity as a notation for business processes, it represents business procedures by means of graphical diagrams. Flowcharting is the method that is used to generate these diagrams, which are sometimes referred to as Business Process Diagrams (BPD) (OMG, 2016). They are designed to make it easier for stakeholders, business managers, and customers to understand the information. On the other hand, it is of the utmost importance to keep in mind that the BPMN framework is completely devoted to the representation of business processes.

Figure 2: Core BPMN Elements



Source: OMG (2016)

Diagrams of business processes, often known as BPDs, are made up of a number of different graphical components that are intended to be readily understood by stakeholders. Even though they seem to be simple, these components are able to effectively represent complex business procedures (Dumas et al. 2018). These components are separated into a variety of categories, such as flow elements, connecting elements, and artifacts (OMG, 2016). A number of components, including events, actions, and gateways, are included in the category of flow elements. These components play important roles in depicting the evolution of processes (OMG, 2016).

There are two components that are employed in the process of organizing activities into distinct graphical groups in order to demonstrate various practical abilities or assignments (OMG, 2016). These components are referred to as lanes and pools. A lane is a sub-partition that spans all of the length of a pool and symbolizes an activity or corporate function. A pool is represented by an actor in a process, and a lane is a sub-partition that exists inside a pool (Dumas et al. 2018). The use of artifacts allows for the expansion of the fundamental notation and the addition of context that is appropriate to a particular modeling scenario. Artists who model may add objects of their own to the method in order to provide more information regarding the way it is carried out. According to OMG (2016), the primary components that are used to define a workflow are tasks, pathways and sequential flows. Artifacts, on the other hand, are only additions of information and data that help to better comprehend the diagram and the whole process.

According to OMG (2016) expresses many kinds of scenarios using BPMN diagrams:

- process flows, which are a route that only depicts a straightforward collection of actions, regardless of the responsibilities that are associated with these activities
- an internal process, which is a depiction of a single function of responsibility inside a process, which is represented by a pool (whether or not it is a flow)
- a method of public collaboration in which several responsibilities of responsibility are stated and are physically depicted as interactions between pools

There is the potential for all three alternatives to cohabit peacefully inside a single BPMN diagram. A BPMN diagram may include flows with or without defined responsibilities (i.e., flows inside or outside pools), as well as pools with or without instances of communication between them, as stated by White (2004) and Object Management Group (2016). Flows may also be included in the diagram. To put it another way, flows could or might not have tasks that are allocated to them.

There are three unique kinds of diagrams that are supported by BPMN 2.0, according to Allweyer (2010). These diagrams include collaboration diagrams, conversation diagrams, and choreography diagrams.

Collaboration diagrams make it possible to see the interactions that take place between processes by illustrating the many roles, services, or persons that make use of pools and lanes. By modeling all of the activities, events, and interactions that occur throughout each step of the business process, these diagrams aim to provide a thorough representation of each stage. Conversation diagrams include depictions of all of the players in the process as well as their connections to one another.

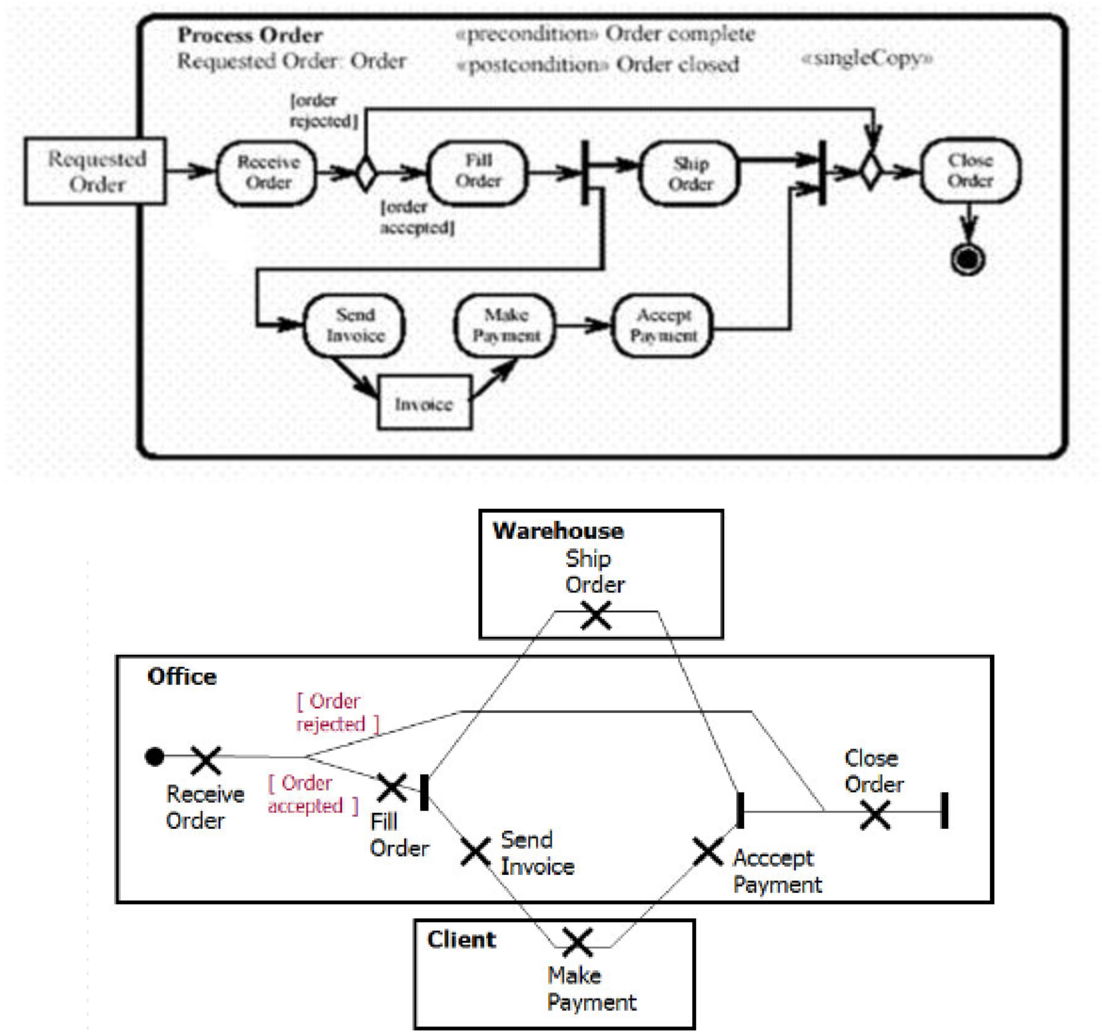
Diagrams of choreography, which are similar to diagrams of collaboration, are used to display the information that is transferred among participants. Each data exchange is represented as an activity in the diagram. In order to effectively portray the business process, modeling choreographic diagrams may be more complicated than they would otherwise be. This is because it is necessary to show a large number of splits, loops, and other events. Given that collaboration diagrams are the most often used in corporate settings (Allweyer 2010), the primary emphasis of this thesis is based on analyzing them in more depth.

3.2.5 Languages to model process

The majority of the time, business processes are modeled using a single form of notation. A description of what BPMN is, as well as its components and applications, has already been provided above. Nevertheless, it is essential to make a reference to the alternatives that are available to this notation and to give the primary characteristics and advantages of all of the other notations.

The Petri Net language, which is based on mathematical symbols, is an alternative method that may be used for the purpose of processes description. In spite of the fact that it is most often used to illustrate distributed systems like web services (Petri and Reisig, 2008), it is also capable of successfully representing processes. Specifically, Color Petri Net (CPN) emerges as a favored alternative, especially in cases requiring traffic across web services (Tan et al., 2009). This decision was made by Tan et al. The fact that Petri Net is not intrinsically focused on business processes is something that should be taken into consideration (See Picture N). Therefore, while adopting this modeling language, it is possible that certain process-descriptive artifacts will be not taken into consideration.

Figure 3:Exemplary Petri Net Diagram

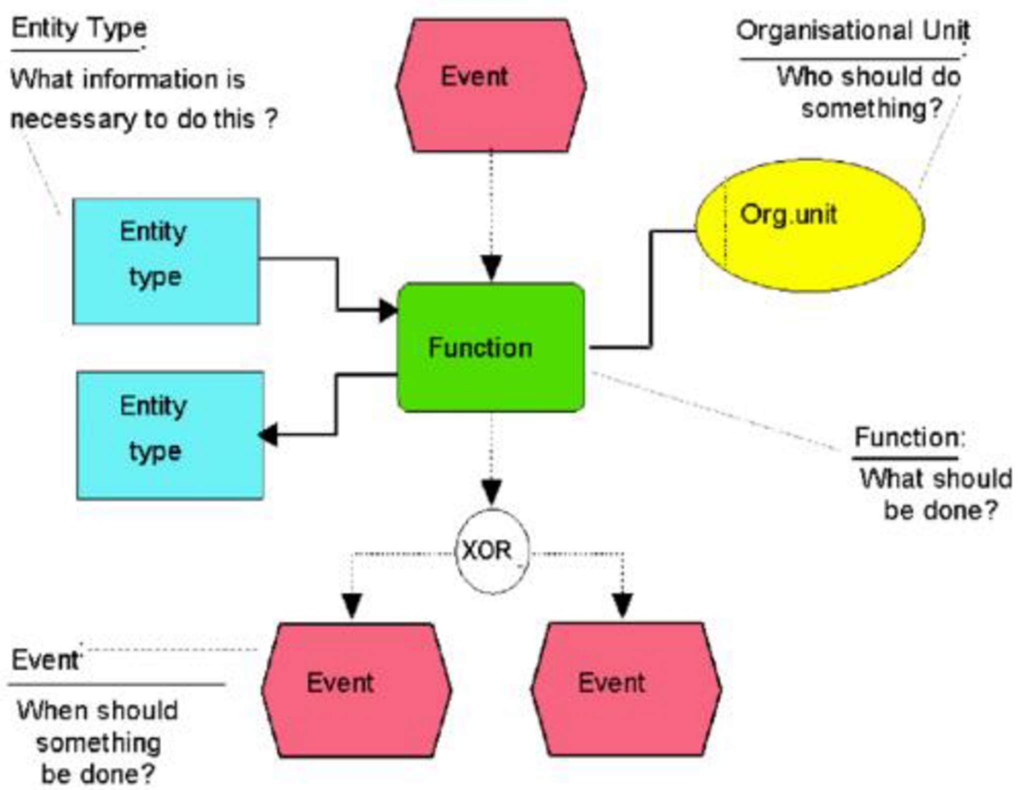


Source: Uottawa (2024)

Another modeling language that is exclusively devoted to processes is the Event Driven Process Chain (EPC), which stands out as a notable example. Furthermore, given the fact that it is process-oriented, EPC is entirely concerned with business concepts. In light of this, the components that are used in this notation consist of identities for the owners of processes, groups of people, supplies, and items, as well as regulators for flows and data, logical connections and associations, events, and functions (Hommes, 2004). EPC, on the other hand, does not lend itself well to defining certain pieces of business logic, such as timers, event handlers, and exception handlers. This is a crucial point to keep in mind.

IDEF, which stands for "Integrated Development Environment," is a functional modeling language that is employed for the purpose of evaluating, creating, restructuring, and combining software engineering research, company operations, or information systems. According to Bravoco and Yadav (1985), the evaluation of software designs is where it really excels. Although it is able to simulating both computer systems and company procedures, its core strength rests in this area. In addition to the fact that its grammar and elements are able to describe the rationale of a company's operations, reading and understanding this language may be difficult owing to the lack of several artifacts that are required for this purpose.

Figure 4: IDEF Diagram

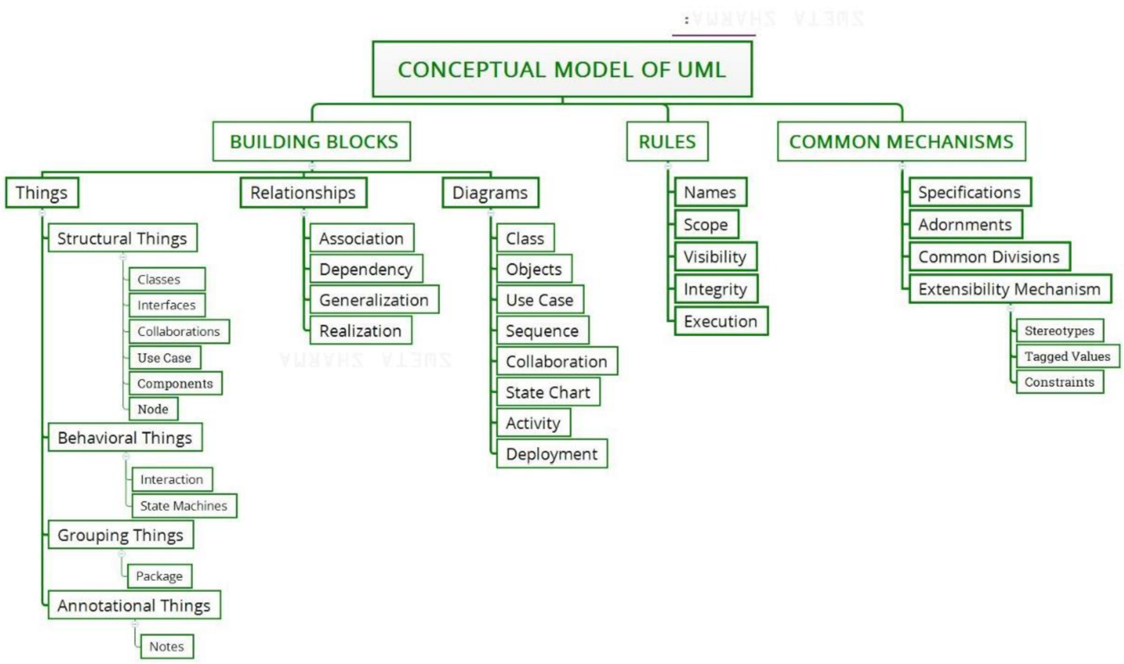


Source: Mouritsen (2007).

In the sphere of software technology, the Unified Modeling Language (UML) has risen to prominence as one of the most renowned and extensively utilized modeling languages. Initially developed by an organization with the goal of leveraging its considerable capabilities, UML, as elucidated by Booch et al. (2005), serves as a standardized method for depicting and visualizing system architectures. However, while there exist similarities between software and business processes, traditional software models often overlook vital components crucial to organizational operations, including personnel, manufacturing infrastructure, and the rules and objectives governing processes.

To address this gap, Eriksson and Penker proposed an extension to UML models that integrates these business-specific components and introduces innovative concepts to enhance modeling capabilities. Their recognition of this discrepancy led to the development of this extension. According to Eriksson and Penker (2000), this expanded framework enables a comprehensive description of processes, encompassing resources, procedures, objectives, and regulations. Nevertheless, the absence of fundamental artifacts inherent to business processes—such as timers, exception handlers, escalation, and compensation—can add complexity when deciphering diagrams.

Figure 5: UML Model



Source: Penker (2000)

Last but not least, Formalized Administrative Notation, often known as FAN, is yet another modeling tool that has the potential to represent business processes. In this notation, the structure and pattern of processes are described, their duties are identified, and the transactions they carry out are defined and integrated. Due to the fact that it is a language that is targeted toward administration, it is often utilized for the purpose of implementing software packages for business resource planning (ERP), customer relationship management (CRM), as well as supply chains.

3.2.6 Patterns of Workflow

The Workflow Patterns Initiative (WPI) was launched with the aim of establishing fundamental standards for business process modeling. Both research organizations and businesses are dedicating their efforts to comprehending and implementing workflow patterns from various perspectives, including control flow, data, resource, and exception management. W.M.P. van der Aalst et el. (2008) and colleagues proposed a set of twenty patterns that outline typical control flows (Workflow Patterns Initiative, 2017). These patterns encompass basic control flow, advanced branching and synchronization, multiple instance patterns, state-based patterns, cancelation and force completion, iteration, termination, and trigger patterns.

However, the interpretation of these patterns can be ambiguous, prompting Russell et el. (2004) to modify them to better align with business needs and flow control requirements. To facilitate the identification of new patterns and modifications, the authors present their patterns using a formal model in Colored Petri-Net for each pattern.

Workflow resource patterns are further categorized into creation, push, pull, detour, auto-start visibility, and multiple resource patterns. These patterns aim to capture the various ways in which resources are utilized and represented within workflows. Similarly, workflow data patterns are classified into three categories: data interaction, data transfer, and data-based routing, to more accurately depict the utilization and flow of data.

However, these patterns do not entirely resolve the ambiguity present in BPMN models, as these models are often derived directly from business needs, making it challenging for business professionals to understand and accurately represent them. Additionally, while the patterns described in Petri-Net models may be difficult to understand, implementing the same patterns in other modeling languages could also present challenges.

Table 1: Overview of 7 process modelling guidelines

Factor	Explanation
G1	Use as few elements in the model as possible
G2	Minimize the routing paths per element
G3	Use one start and one end event
G4	Model as structured as possible
G5	Avoid OR routing elements
G6	Use verb-object activity labels
G7	Decompose a model with more than 65 elements

Source: Mendling et al. (2009).

An exhaustive investigation of the relationships among model framework, mistake chance, and comprehension was carried out by Mendling et al. (2009). This investigation was focused on the prior research that had been undertaken. On the basis of this study, they have established a set of seven process modeling recommendations, which are referred to as 7PMG. These recommendations draw from strong research evidence while yet being accessible to practitioners and practical. These criteria are shown in Table 3, which also includes a summary of them.

It is advised that as few elements as feasible be included in the model (Mendling et al. 2009). This will be done in order to optimize the understandability of the model and limit the risk of mistakes occurring. Research has demonstrated that bigger models are often tougher to comprehend (Mendling et al. 2007a) and have a greater likelihood of mistakes than smaller models (Mendling et al. 2008; Mendling et al. 2007b). This is in contrast to smaller models, which have a lower chance of errors. As a result, it is recommended to keep the model as straightforward as possible by include just the components that are essential (Mendling et al. 2009).

According to Mendling et al. (2009), it is advised that the number of routing pathways per element in the process model be kept to a minimum in order to significantly increase the model's comprehension. As a result of studies, it has been discovered that the representation gets progressively harder to grasp as the degree of a component in the system rises (that is, the number of input and output loops). (Mendling and colleagues 2007a). In addition, research has demonstrated that there is a significant correlation between the number of mistakes in the modeling process and the average or maximum degree of elements included in the model. (Mendling and colleagues 2007b). Because of this, it is recommended to keep the number of routing pathways per element as minimal as possible in order to improve the overall comprehensibility of the model and reduce the risk of mistakes occurring (Mendling et al. 2009)

It is advised that as few elements as feasible be included in the model (Mendling et al. 2009). This will be done in order to optimize the understandability of the model and limit the risk of mistakes occurring. Studies has demonstrated that bigger models are often more challenging to comprehend (Mendling et al. 2007a) and have a greater likelihood of mistakes than less complex designs (Mendling et al. 2008; Mendling et al. 2007b). This is in contrast to smaller models, which have a lower chance of errors. As a result, it is recommended to keep the model as straightforward as possible by include just the components that are essential (Mendling et al. 2009).

When designing a process, it is advisable to utilize only one start event and one end event. This will drastically limit the possibility of mistakes occurring. Specifically, this is due to the fact that it has been discovered that having several start and finish events increases the likelihood of mistakes occurring. (Mendling et. al., 2007b) In addition, the majority of workflow engines necessitate the presence of a single beginning and conclusion node, and models that fulfill this condition are typically simpler to interpret and evaluate. According Aalst et al. (2003). Therefore, utilizing a single start and end event in the design of a workflow is a best practice that has the potential to improve the overall quality of the process and lower the likelihood of mistakes occurring (Mendling et al., 2009).

The use of OR routing components in process models should be avoided as much as feasible, according to the recommendation (Mendling et al., 2009). When compared to models that use OR connections, those that just utilize AND and XOR connectors are typically associated with a lower number of faults (Mendling and colleagues 2007b). In addition, the semantics of the OR-join contain number of confusions, that make it possible for implementation issues and contradictions to arise. From Kindler (2006) in order to minimize the usage of OR routing components in process models, which is a key best practice for decreasing mistakes and increasing overall model correctness, it is recommended that this practice be minimized (Mendling et al. 2009).

As suggested by Mendling et al. (2009), the usage of a verb-object approach is advised for the purpose of naming operations in process models. Compared to other labeling methods, including action-noun labels or names which don't adhere to either style, this kind of labeling style has been shown to be much less confusing and more helpful (Mendling et al. 2010). Also, it is believed to be more concise. An extensive investigation of the labeling styles that are utilized in actual process models has shown that there are two prominent types, in addition to a rest category (Recker et al. 2006). This preference for verb-object activity labels has been established through this method. According to Mendling et al. (2009), one of the most significant good practices for developing process diagrams that are both understandable and helpful is to name activities using a verb-object approach.

When modelling a procedure, it is advised to split apart versions that have more than fifty parts into smaller parts (Mendling et al. 2009). This is done in order to reduce the number of mistakes that occur throughout the modeling process. This is based on research that demonstrates a positive association between the size of a model and its potential of incorporating mistakes. Models which include more than fifty components have a larger than fifty percent probability of incorporating errors (Mendling et al. 2007b). It is recommended that the enormous parts be replaced using a single entrance and exit point by condensing them into an independent model and referring that model from the primary component (Vanhatalo et al. 2009). This is an ideal procedure that should be followed. By adhering to this rule, it is feasible to increase the general correctness and usefulness of the model, as well as lower the risk of mistakes occurring in bigger process models (Mendling et al. 2009).

When it comes to a process model, the 7PMG guidelines are largely concerned with the structure and presentation of the model, rather than concentrating on the substantive components of the model. Consideration should be given to this constraint. Despite the fact that 7PMG provides valuable insights into the structural aspects of a process model, it fails to take into account particular details that pertain to the modeling technique. These details include the notation or language that was used for the creation of the model, as well as the modeling tool, which includes the software package that was utilized to support a particular modeling notation. The heart of the matter is that 7PMG does not go into the particulars of the modeling approach. Despite the fact that these additional elements are strongly connected to the acceptance of 7PMG recommendations, the guidelines do not expressly address them. In light of this, it is very necessary to take into account 7PMG in conjunction with these aspects in order to design process models that are accurate and efficient. The significance of this technique is highlighted by the research carried out by Mendling and colleagues (2009).

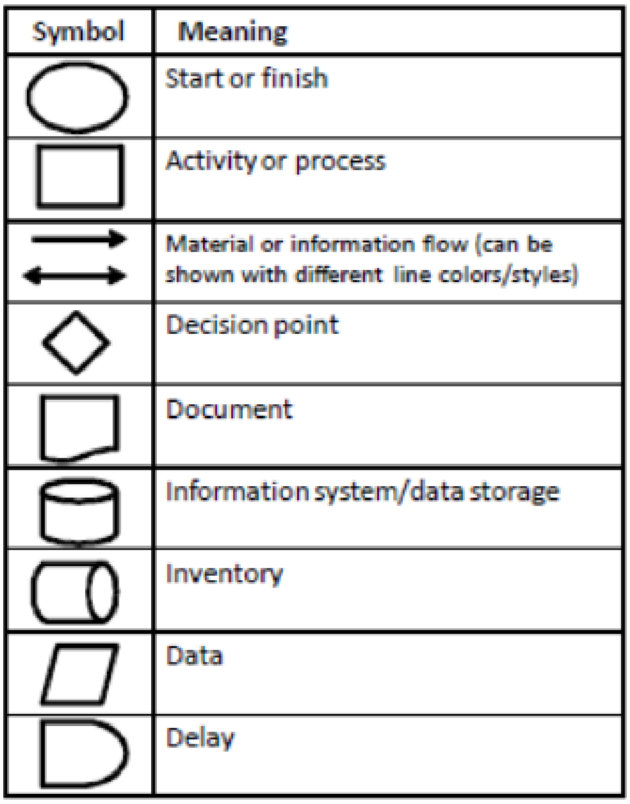
3.3 Business process modelling techniques

The modeling of business processes may be accomplished using a number of different approaches (Aguilar-Savén, 2004). According to Martinsuo and Blomqvist (2010), the essence and objective of a process that is to be represented can sometimes have an effect on the modeling approach and the amount of information that is necessary. According to Aguilar-Savén (2004), selecting the proper process modeling approach and method for a particular study needs thorough evaluation of the purpose of the analysis as well as knowledge with the many modeling possibilities that are accessible. The use of several modeling methodologies is advantageous for accomplishing a variety of goals, even when describing fundamental procedures (Glykas, 2013).

3.3.1 Process mapping

Describe business processes as a result of the links among their numerous operations that bring value to a process, as well as the people, information, and material flows connected with those activities. Process mapping is a method which may be used to describe business processes. According to Martinsuo and Blomqvist (2010) and Slack (2022), The first thing that has to be done is to figure out where the process starts and where it ends, identify the inputs and outputs, and make sure that all of these things are closely connected to the requirements of the consumers. The method is concentrated on giving value to the consumer, which is ensured by this means. It is best to focus on activities that add value, flow of information, and material flows as they transpire while making documentation of the processes in their current state. However, it is possible that it would be more useful to define the procedures that are to be performed by starting at the end and working backwards first. According to Martinsuo and Blomqvist (2010)

Figure 6: The standard symbols that are commonly used



Symbol	Meaning
	Start or finish
	Activity or process
	Material or information flow (can be shown with different line colors/styles)
	Decision point
	Document
	Information system/data storage
	Inventory
	Data
	Delay

Source: (Martinsuo & Blomqvist 2010)

A number of different kinds of tasks are categorized using process modeling symbols in order to make this approach easier to carry out. In order to illustrate the sequence of events and the connections between the various process activities, these symbols can be placed in either a sequential or parallel fashion. Slack et al. (2022) says that Figure 2 displays the standard symbols that are often utilized in flowcharts and process flow diagrams. These symbols are widely used in flowcharts.

As you are in the process of generating a map of the process as it currently stands, it is essential to acknowledge that not all components of the process may satisfy the criteria that are intended, and that the description may be ambiguous and chaotic. Documenting the method that is currently being used, on the other hand, can assist in developing an organized way to work. As a result of the fact that the primary objective of process modeling is to determine the aspects that require advancement, it is essential to maintain a separation between the original model and the model that is wanted to be. An effective method for determining the requirements for developing a process is to conduct a process review, which entails assembling all of the individuals who are engaged in the process and ranking the areas that require improvement in order of importance. For the purpose of properly describing the process that will be implemented, it is essential to make certain that the process model is both easy and attainable. It is recommended that a review of the process that will be implemented be carried out in order to verify that it is in accordance with the best practices and accomplishes the goals that were intended for it. The purpose of this assessment is to ensure that all of the actions that are included in the process that is still to be implemented provide the customer with value, that resources are distributed effectively for each activity, and that any data and resources which are required have been provided for. It is recommended that the to-be procedure be modified to exclude any operations, resources, or systems that do not add to the added value which the consumer receives (Martinsuo & Blomqvist 2010).

When working with processes that are both vast and complicated, it can be challenging to generate thorough process maps. Consequently, it is usual practice to start by mapping the process at a higher, more aggregated level, which is a procedure that is referred to as high-level process mapping. In order to do this, the process is shown as a basic input-transformation-output paradigm, with the complexities of how inputs are transformed into outputs being ignored. Slack et al. (2022) says that the fact that processes that entail significant degrees of uncertainty might not be able to be modeled in great detail is something that should be taken into consideration. On the other hand, processes that are essential for reasons of safety or security must be represented in considerable detail. As a result, prior to commencing the process of modeling, it is essential to determine the necessary content and amount of detail that is required for process modeling. Consequently, this will guarantee that the model that is produced properly depicts the process that is being modeled and that it satisfies the particular requirements of the company (Martinsuo & Blomqvist 2010)

4. Practical Part

The practical part of this thesis aims to solve the real-world problem of hotel reservation management. This involves handling various tasks such as checking reservations, assessing room availability, collecting personal data, processing payments, and managing room assignments. This section applies the theoretical concepts of Business Process Model and Notation (BPMN) to a practical scenario, demonstrating how these principles can be implemented to streamline and improve the efficiency of hotel booking systems.

4.1 Description of the BMPN model

The BPMN model developed for this thesis represents the business scenario of a hotel reservation system. It begins with a Start Event indicating the guest's arrival and progresses through various tasks:

1. **Start Event (StartEvent_1):** This marks the beginning of the process. In your case, it likely represents a guest's arrival at the hotel, initiating the check-in procedure.

2. **Initialize Variable** (**Activity_0xmhybt**): This is where the process starts. It initializes necessary variables for the hotel check-in process. This could be guest information, reservation status, etc.

3. **Check Reservation** (**Activity_00ocwe0**): In this task, the system checks if there is a reservation for the guest. This involves looking up the guest's booking details to confirm their reservation status.

4. **Check Available Rooms** (**Activity_1pap51x**): If the reservation is not confirmed, the system then checks for available rooms. This involves querying the hotel's room database to find empty rooms that match the guest's requirements.

5. **Collect Personal Data** (**Activity_1l50nvx** and **Activity_13omq3a**): These tasks involve collecting personal information from the guest, such as identification, contact details, and payment information. Note that this task appears twice, which could mean personal data collection occurs at different stages, possibly depending on whether a reservation was confirmed or not.

6. **Process Payment** (**Activity_0zokj1e**, **Activity_00pvkhk**): Here, the payment details provided by the guest are processed. This could include charging a credit card or processing digital payments.

7. **Verify Payment** (**Activity_0ab766k**, **Activity_0bf71pq**): After processing the payment, the system verifies whether the transaction was successful. This is crucial to ensure that the hotel receives payment before providing service.

8. **Initiate Room Preparation** (**Activity_0f488vv**, **Activity_08bl2c0**): Once payment is confirmed, this task initiates the preparation of the room, signaling housekeeping to get the room ready for the new guest.

9. **Offer Partner Hotels** (**Activity_1sq6t28**): If no rooms are available, the system might offer alternatives such as rooms in partner hotels.

10. **Activate Amenities** (**Activity_047u6dp**, **Activity_0wlpcrs**): This task involves activating any additional services or amenities the guest has requested or that come standard with their room, like Wi-Fi, television, or spa services.

11. **Room Handover** (**Activity_0n1qbk0**, **Activity_0ddpi5f**): This represents the final stage where the room is officially handed over to the guest, usually by giving them their room key or card.

12. **Send Confirmation Email** (**Activity_0lhs0fq**): Once all the formalities are completed, a confirmation email might be sent to the guest, summarizing their check-in details, room number, and other relevant information.

13. **Increment Retry Counter** (**AvailableRoomsPath**, **Activity_1ghlh3e**): These service tasks might be part of a system designed to handle payment retries or checking room availability multiple times, incrementing a counter each time an action is retried.

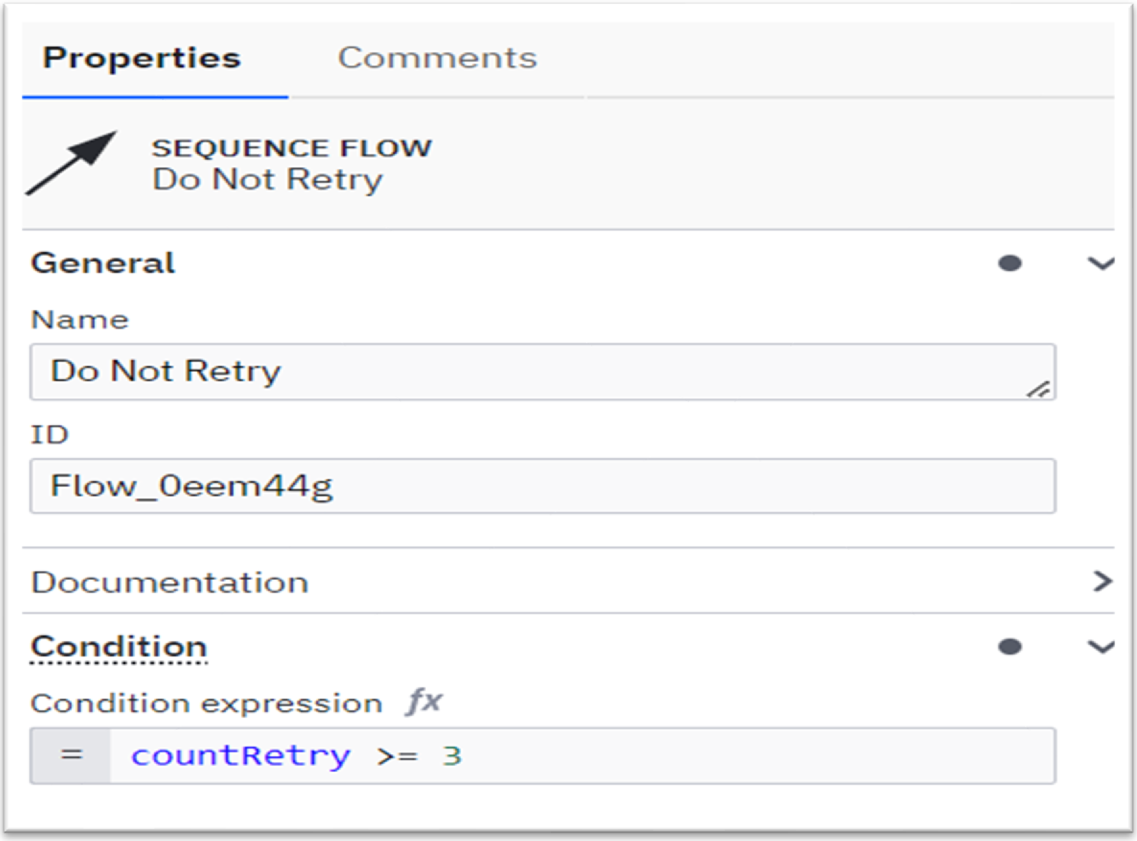
14. **Retry Payment** (**Activity_1jmi7m1**, **Activity_1ee4t6d**): If payment fails, these tasks manage the retry process, possibly with limits on how many retries can be attempted.

15. **End Events (Event_0rkrie9, Event_13wj8ck, Event_0gaeks6):** These represent the end of the process. In a BPMN model, end events indicate where a process will stop. In your hotel check-in model, there seem to be different endpoints depending on the

outcomes, such as successfully completing the check-in, stopping after failed payment attempts, or concluding alternate paths like being redirected to partner hotels.

16. **Exclusive Gateways (Gateway_179c98c, Gateway_0cs6f7f, Gateway_0ef355w, Gateway_0v5xrai, Gateway_06hla6e, Gateway_0ob5la6, Gateway_0akv74o, Gateway_1drd7cf, Gateway_0gf5elh, Gateway_088gmiu, Gateway_0qmzb2e):** These are decision points that affect the flow of the process. Depending on conditions (like room availability, payment verification, etc.), they direct the flow to different tasks or events. This ensures that the process dynamically adapts to different situations, such as when a room is not available or when a payment needs to be retried.
17. **Parallel Gateways (Gateway_1k36zfp, Gateway_0jmy08n):** These gateways are used to split the process into parallel paths or to synchronize parallel paths back into a single flow. For example, preparing the room and activating amenities might happen concurrently to speed up the check-in process.
18. **Service Tasks (Activity_1ghlh3e, AvailableRoomsPath)**: These tasks are typically automated and represent a service being performed, such as a system task that updates the retry counter for payment attempts. They're part of the backend processes that support the check-in procedure.
19. **Sequence Flows (Flow_...):** These are the arrows connecting elements in your BPMN diagram, indicating the order in which tasks are performed. Each sequence flow can be conditional, meaning the direction of the flow depends on certain conditions being met.

Picture 1: Sequence flow



Source: Own processing.

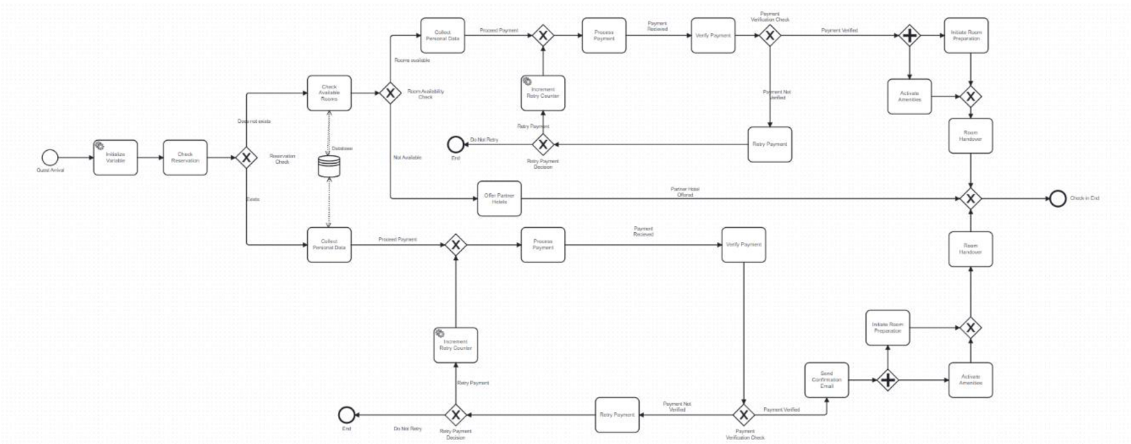
20. **Data Store Reference (DataStoreReference_0qvklqy):** This represents the database or data store that is being used to manage and store information during the process, such as guest details, room availability, and payment information.

The model incorporates decision points (Exclusive Gateways) to navigate different outcomes (e.g., room availability) and uses Parallel Gateways to manage tasks that can occur simultaneously (e.g., room preparation while processing payment). The multiple End Events represent different outcomes of the reservation process, such as successful check-in, redirection to partner hotels due to lack of availability, and payment issues.

4.2 Explanation of the Process Flow

The process starts with the guest's arrival, leading to a reservation check. Based on the reservation status, the flow splits at an Exclusive Gateway: if a reservation is confirmed, personal data is collected; if not, availability is checked. This demonstrates logical sequencing and decision-making within the business process, adhering to BPMN best practices (For better picture See Appendix-1).

Picture 2: BPMN Model of the Hotel.



Source: Own processing.

4.2.1 Justification of the model events:

The model deviates from the "one start, one end" rule due to the nature of the hotel reservation process, which can conclude in multiple distinct scenarios: successful reservation, redirection due to no availability, or cancellation. Each End Event corresponds to these potential outcomes, providing clear termination points that reflect different real-world scenarios of the hotel booking process.

4.2.2 Integration with the Worker Script

The JSON worker script is closely integrated with the BPMN model, particularly in tasks like 'initializeVariables' and 'increment-retry-counter'. The 'initializeVariables' task sets the initial conditions for the process, such as reservation status and room availability, which are crucial for the flow's decision points. The 'increment-retry-counter' task is used within the payment processing phase, demonstrating how the model handles failures and retries in payment processing, a common real-world issue in hotel reservations.

Picture 3: Integration of variables into the model.

```javascript
require('dotenv').config();
console.log("ZEEBE_CLIENT_ID:", process.env.ZEEBE_CLIENT_ID);
console.log("ZEEBE_CLIENT_SECRET:", process.env.ZEEBE_CLIENT_SECRET);
console.log("ZEEBE_CAMUNDA_CLOUD_CLUSTER_ID:", process.env.ZEEBE_CAMUNDA_CLOUD_CLUSTER_ID);
console.log("ZEEBE_ADDRESS:", process.env.ZEEBE_ADDRESS);
const { ZBClient } = require('zeebe-node');

const zbc = new ZBClient({
    camundaCloud: {
      clientId: process.env.ZEEBE_CLIENT_ID,
      clientSecret: process.env.ZEEBE_CLIENT_SECRET,
      clusterId: process.env.ZEEBE_CAMUNDA_CLOUD_CLUSTER_ID,
      gatewayAddress: process.env.ZEEBE_ADDRESS,
    },
    loglevel: 'DEBUG',
});
zbc.createWorker({
    taskType: 'initializeVariables',
    taskHandler: async (job, complete, worker) => {
        const variablesToSet = {
            countRetry: 0,
            reservationConfirmed: Math.random() < 0.7,
            availableRooms: Math.floor(Math.random() * 501),
            paymentVerified: Math.random() < 0.5,
            paymentAttempts: 0
        };
        await job.complete(variablesToSet);
    }
});

zbc.createWorker({
    taskType: 'increment-retry-counter',
    taskHandler: async (job, complete, worker) => {

        let { countRetry, paymentAttempts } = job.variables;
        updatedCountRetry = countRetry + 1;
        paymentAttempts = paymentAttempts + 1;
        console.log(`Incremented retry count: ${countRetry}`);
        console.log(`Payment attempts: ${paymentAttempts}`);
        console.log(`Current retry count: ${countRetry}`);
        console.log(`Incremented retry count: ${updatedCountRetry}`);
        await job.complete({
            countRetry: updatedCountRetry,
            paymentAttempts
        });
    }
});
```

Source: Own.

JavaScript code for Zeebe workers. The code demonstrates two workers: one for initializing variables and another for handling the "Increment Retry Counter" task.

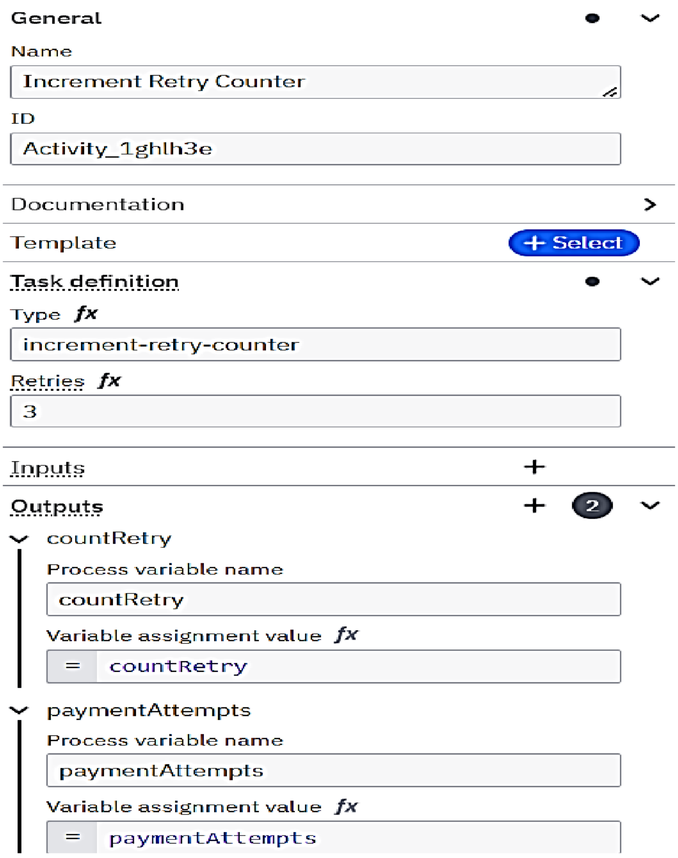
The first worker, initializeVariables, sets initial values for variables such as countRetry, reservationConfirmed, availableRooms, paymentVerified, and paymentAttempts. This initialization is essential for the correct execution of the process, ensuring that all required data is in place.

The second worker, increment-retry-counter, is responsible for the actual incrementing of the countRetry and paymentAttempts variables. It logs the incremented values, showcasing how the process variables change with each execution. This worker directly correlates with the "Increment Retry Counter" service task, demonstrating the backend logic that supports BPMN process execution.

4.2.3 Worker Scripts

The worker scripts are essentially the 'doers' in this setup. They listen for specific tasks (identified by task types, such as initializeVariables or increment-retry-counter) to become available for processing. Once a task of the type they're listening for is created by the workflow engine, the corresponding worker script picks up the task and executes the predefined logic.

Picture 4: Integration process



Source: Own

- **Task Activation**: When the BPMN engine reaches a task that matches a worker script's listening criteria, it activates the task, making it available for processing.
- **Task Fetching and Locking:** The worker script fetches the task from the BPMN engine. The engine then locks this task, ensuring no other workers process it simultaneously, maintaining data integrity and preventing double processing.
- **Variable Passing**: Input variables from the process instance (e.g., countRetry, paymentAttempts) are passed to the worker script. These variables are essential for the script to make logic decisions or to perform calculations.
- **Script Execution**: The worker script executes its logic, which could involve external API calls, calculations, data manipulation, or any other programmed action. For instance, in the increment-retry-counter worker, it increments the retry counter and payment attempts based on the current values passed in from the BPMN process.
- **Completion and Variable Updating**: Once the worker script completes its task, it reports back to the BPMN engine, often updating process variables with new values resulting from its execution (e.g., updated countRetry and paymentAttempts). These updated variables can influence the flow of the process, such as moving to a "Do Not Retry" path if the maximum number of retries is reached.
- **Continuing the Process**: With the task completed and variables updated, the BPMN engine continues executing the next steps in the process based on the updated process variables and the designed flow.

4.3 Analysis and Challenges

4.3.1 Zeebe Client and Node Version Compatibility

The versions of Zeebe Client (zeebe-node@8.3.1) and Node.js (v20.11.1) used in the project were carefully selected to ensure compatibility. The selection of these versions was crucial to ensure that all functionalities of the Zeebe Client could be effectively utilized without compatibility issues. Ensuring that both the client and the environment were updated helped in avoiding unexpected behaviors during process execution.

4.3.2 Error in Camunda Cloud Modeler

The error "Expected result of the expression 'initialize-variables' to be 'STRING', but was 'NULL'" encountered in the Camunda Cloud Modeler was a significant challenge. This issue was addressed by reviewing and correcting the expression used in the BPMN model, ensuring that all expressions returned the expected data types. This involved validating the output of script tasks and ensuring they conformed to the expected string format, thus resolving the error and enabling successful testing of the script tasks within the modeler.

4.3.3 Syntax Mistakes in XML and JavaScript

A critical syntax mistake was identified between the BPMN XML configuration and the JavaScript worker script, particularly in the zeebe:taskDefinition element where the task type must align correctly. The correction involved reviewing and updating the type attribute within the BPMN XML and ensuring it matched the task type specified in the worker script. This alignment was crucial for the proper execution of the tasks defined in the model.

4.3.4 JavaScript Error

The "Uncaught TypeError: Cannot read properties of undefined (reading 'split')" error indicated issues in handling environment variables within the Zeebe Client setup. This was resolved by reviewing and correcting the configuration code, ensuring that all environment variables were properly defined and accessible before being used, particularly in segments of the code where properties like 'split' were applied.

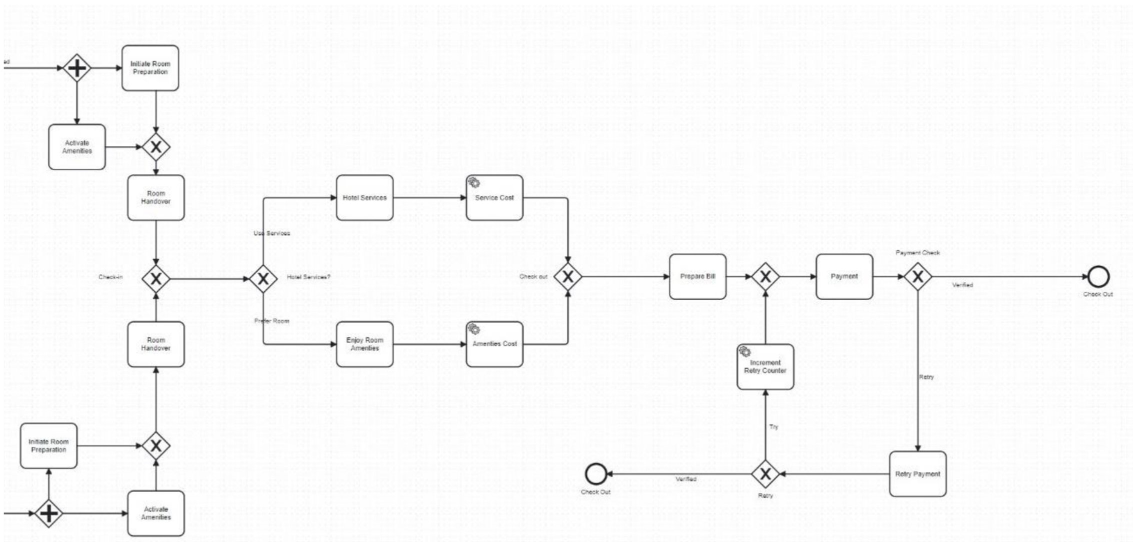
4.3.5 Parsing Issue with JavaScript Job Worker

Aligning the XML configuration with the job worker script was essential for the effective processing of tasks. The challenges here involved ensuring that the BPMN workflow and the JavaScript logic were in sync, particularly for tasks related to initializing variables and managing retries. This required a detailed review and update of both the BPMN model and the worker scripts to ensure consistency and correct logic flow, particularly in error handling and variable initialization.

4.4Additional Amenities

The author also added the additional amenities and service costs that could potentially be used by guests. All transactions are recorded on their card. So, if a guest doesn't want to carry his/her credit card within a hotel. That would simplify the work by just carrying the room-card, where a guest is able to put extra charges on his room and while checking out, the receptionist would see the final bill. The diagram looks the following (For better Picture see Appendix 9.3).

Picture 5: Second BPMN model with additional extra charges



Source: Own processing.

The following Picture demonstrates the variables (obligation) of a guest. The left amount to be paid is 36 $. Eventually, it also demonstrates how many rooms are available. Payment status, reservation and etc.

Picture 6: Variables

Variables

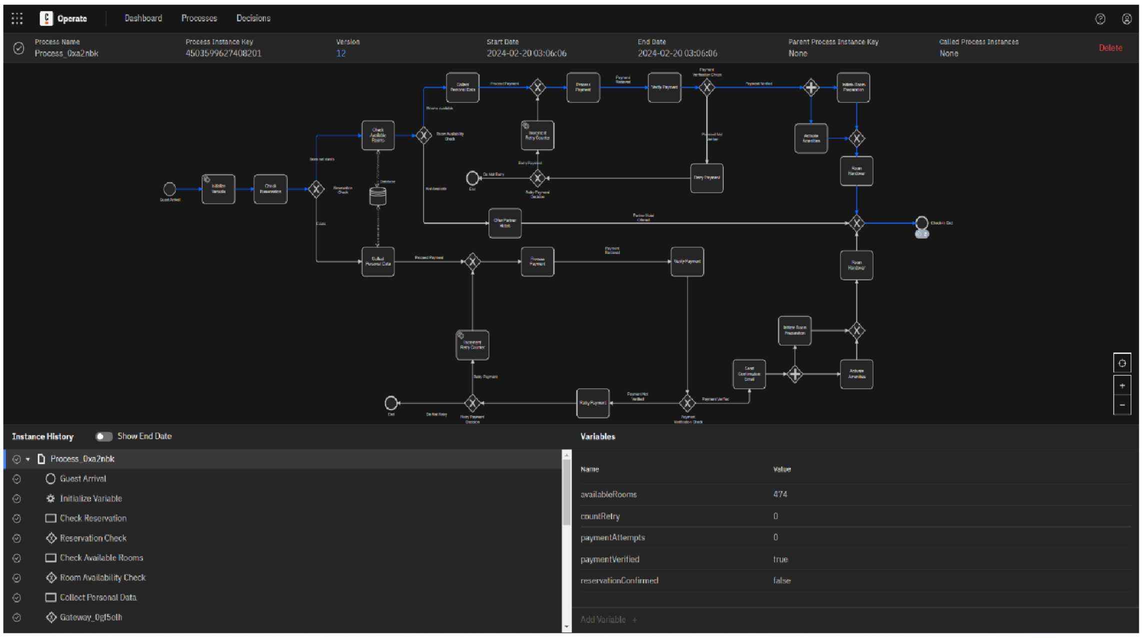
Name	Value
Room	false
Service	true
TotalBill	null
addServiceCostsToBill	36
availableRooms	110
countRetry	0
paymentAttempts	0
paymentVerified	true
reservationConfirmed	false

Source: Own processing.

5. Results and Discussions

The practical part of this thesis demonstrates the effective application of BPMN in addressing a real-world business problem: managing hotel reservations. By integrating theoretical knowledge with practical scenarios, this section showcases the utility of BPMN in improving business process efficiency and handling complex scenarios in the hospitality industry. This contributes significantly to the understanding and application of BPMN in real-world settings, aligning theoretical principles with practical implementation. Below there is 2 version of working proof.

Picture 7: Full version of successful execution



Source: Own processing.

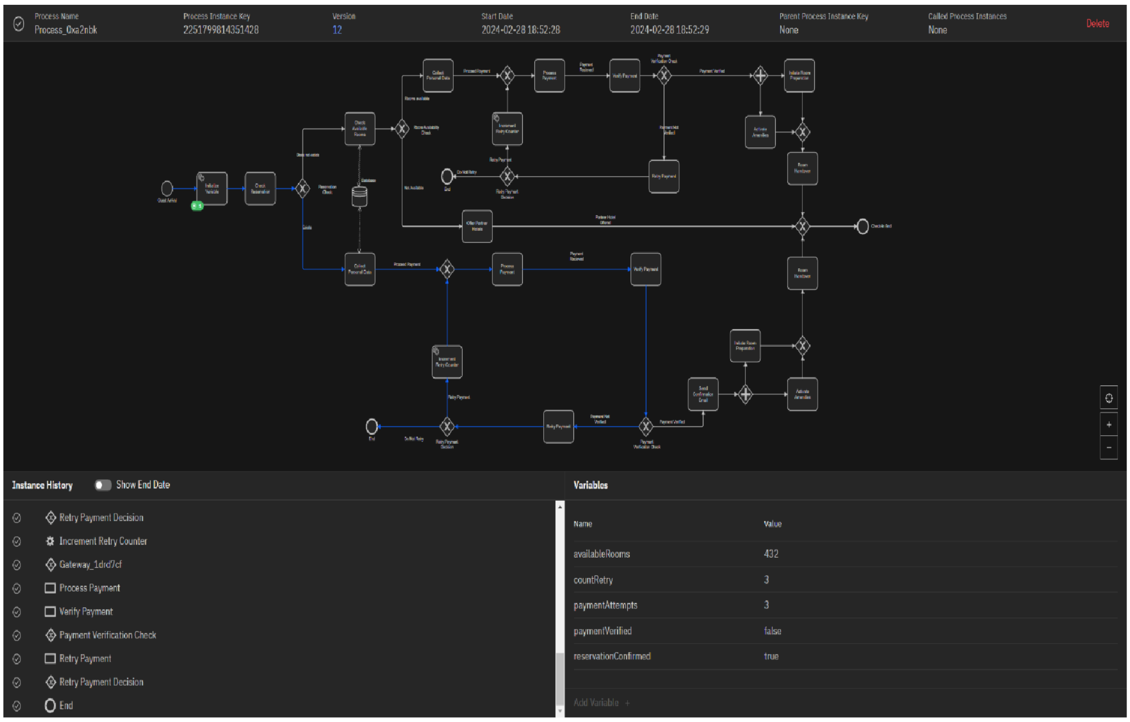
In this scenario:

- The process begins similarly, with a guest arrival and variable initialization.
- However, the reservation is not confirmed (reservationConfirmed = false), leading the process to check for available rooms.
- Since rooms are available, the process collects personal data and proceeds to payment, which is successfully verified this time (paymentVerified = true).
- With payment verified, the room is prepared, amenities activated, and the room handed over to the guest, leading to a successful check-in end event.

Key Variables:

- availableRooms = 474, indicating a sufficient number of rooms.
- countRetry = 0 and paymentAttempts = 0, showing that payment was successful on the first attempt.

Picture 8: Second version of successful execution



Source: Own processing.

This execution path shows a situation where:

- The guest arrives, and variables are initialized.
- The reservation is checked and confirmed.
- Personal data is collected directly, suggesting the reservation was confirmed without needing to check room availability.
- Payment is processed but fails verification (paymentVerified = false), triggering a retry mechanism.
- The retry counter (countRetry) is incremented to 3, and payment attempts are made 3 times (paymentAttempts = 3), all unsuccessful.
- The process tries to handle payment failure but eventually leads to a "Do Not Retry" end event due to the retry limit being reached.

Key Variables:

- availableRooms = 432, indicating there are enough rooms, but this path did not require checking availability.
- reservationConfirmed = true, indicating the guest had a reservation.
- The process ends without successful payment verification, suggesting an issue that prevented the guest from checking in successfully.

These outcomes illustrate the versatility and dynamic decision-making capability of BPMN models in real-world applications. The second scenario demonstrates how the model handles failed payment attempts, ensuring that the hotel can manage such situations gracefully. The first scenario shows a smooth check-in process when reservations are not confirmed upfront but rooms are available, and payments are processed successfully.

This proves the effectiveness of your BPMN model in managing the complexities of a hotel check-in process, including handling reservations, room availability checks, payment processing, and ensuring guests receive their rooms as expected. It highlights the importance of incorporating decision logic and retry mechanisms to handle exceptions and ensure operational continuity.

6. Conclusion

In conclusion, this master's thesis has successfully achieved its objective of developing a BPMN (Business Process Model Notation) model tailored specifically for the hotel industry. Through comprehensive research and analysis conducted in Chapters 3 and 4, various aspects of business processes within hotel operations were thoroughly explored and understood.

Chapter 3 delved into the fundamentals of business process management, including process identification, discovery, analysis, redesign, implementation, and monitoring. This foundational understanding provided valuable insights into the intricacies of hotel operations and the key areas that needed to be addressed in the BPMN model.

Chapter 4 detailed the practical implementation of the BPMN model, including the description of the model, explanation of the process flow, analysis of challenges encountered during implementation, and additional amenities provided by the model. Through meticulous attention to detail and consideration of real-world scenarios, the BPMN model was developed to accurately capture and represent the diverse processes within hotel operations.

By focusing on the unique needs and dynamics of the hotel sector, the developed BPMN model offers a standardized and efficient approach to process modeling. It provides hotel managers and stakeholders with a comprehensive framework for understanding, analyzing, and optimizing various aspects of their operations.

Overall, the successful development of this industry-specific BPMN model holds significant potential for enhancing operational efficiency, improving guest experiences, and driving overall success in the competitive hotel industry.

Finally, all video materials, pictures and evidence of creating the model are attached as appendix in the is.czu.cz for a better orientation.

7. References

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8. List of pictures, tables, figures

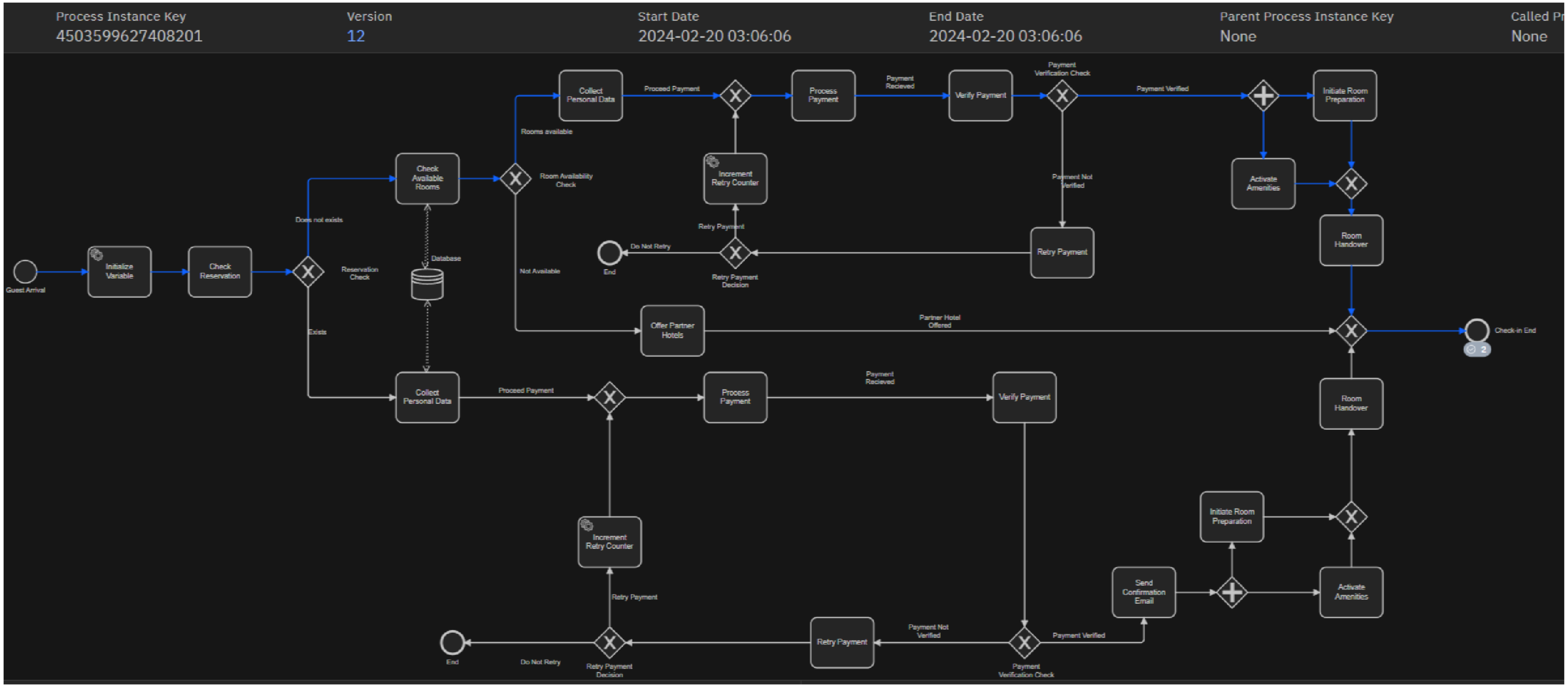
8.1 List of Pictures

8.2 List of Tables

8.3 List of Figures

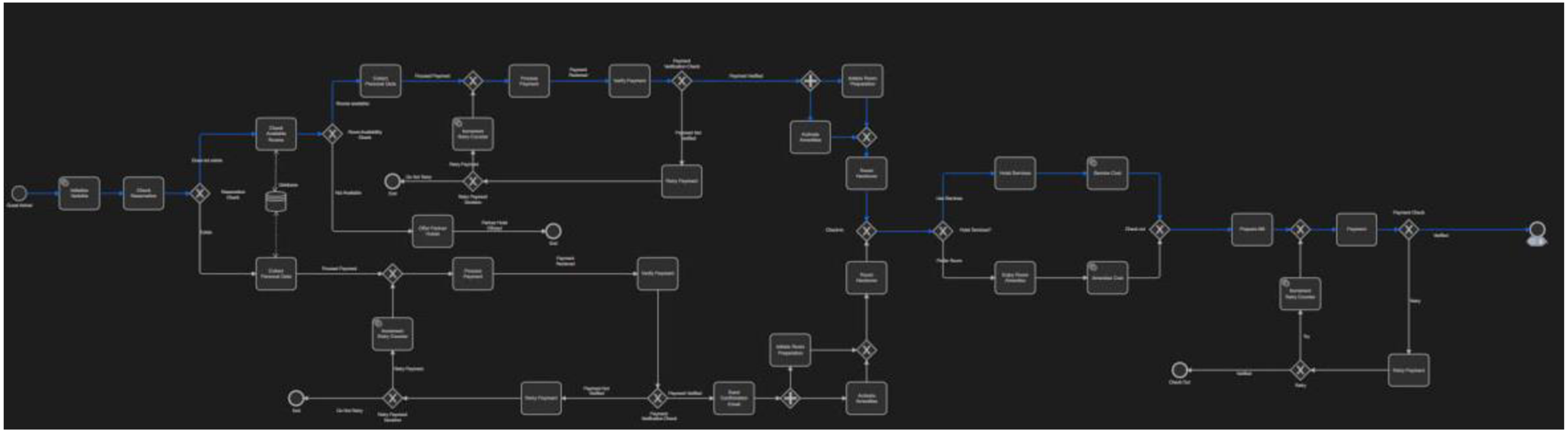
9. Appendix

9.1 Initial Diagram



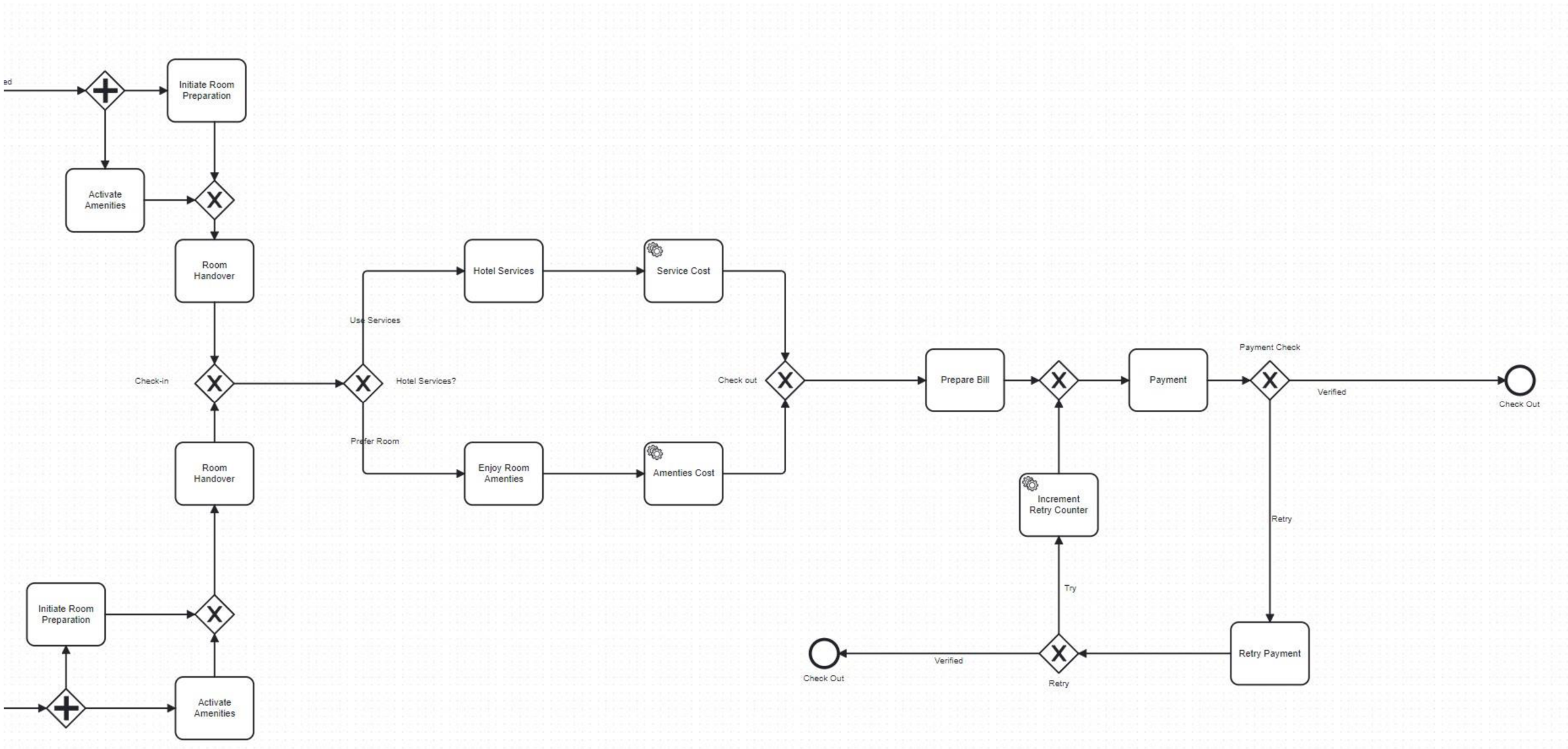
Source: Own

9.2 Second Diagram with Additional Charges-Full



Source: Own

9.3Detailed-charge Diagram



Source: Own

9.4 Variable

Variables

Name	Value
Room	false
Service	true
TotalBill	null
addServiceCostsToBill	36
availableRooms	110
countRetry	0
paymentAttempts	0
paymentVerified	true
reservationConfirmed	false

Source: Own.