UNIVERSITY OF LJUBLJANA
SCHOOL OF ECONOMICS AND BUSINESS

MASTER'S THESIS

HYPERAUTOMATION: INTRODUCING AN IBPMS TO OPTIMIZE BUSINESS PROCESSES

Ljubljana, September 2021 MARLENA FISCHER

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LIST OF ABBREVIATIONS

AHP	Analytical Hierarchy Process
AI	Artificial Intelligence
API	Application User Interface
BAM	Business Activity Monitoring
BPM	Business Process Management
BPMN	Business Process Model and Notation
BPMS	Business Process Management Suite
CMMI	Capability Maturity Model Integration
CoE	Center of Excellence
CSF	Critical Success Factors
EAI	Enterprise Application Integration
GUI	Graphical User Interface
IA	Intelligent Automation
iBPMS	Intelligent Business Process Management Suite
KPI	Key Performance Indicator
ML	Machine Learning
MCDA	Multi Criteria Decision Analysis
NLP	Natural Language Processing
OCR	Optical Character Recognition
ROI	Return on Investment
RPA	Robotic Process Automation
SaaS	Software as a Service
SOA	Service Oriented Architecture
UML	Unified Modeling Language
UX	User Interface
WSDL	Web Services Description Language
XML	Extensible Markup Language

INTRODUCTION

We are currently living in a time of profound economic and social upheaval. Automation and digitalization are completely redefining many areas in our daily lives and the world of work. With the Internet of Things the real and virtual world has become highly interconnected. In this context we often use the words like digital revolution or digital transformation. Constant changes in the environment such as disruptive technologies and changing customer needs require companies to adapt quickly in order to remain competitive. Covid-19 has shown the importance of becoming digital. Due to the pandemic many employees switched to remote work. The crisis changed the mindset of many, realizing that the digital transformation helps organizations to adapt faster to disruptive events, developing an operational resilience (Almeida, Santos & Monteiro, 2020, p. 97).

Moreover, the pandemic reflected the vulnerabilities of our systems and networks. A highly affected industry was the logistics sector. Logistic companies usually connect different markets resulting in many organizations relying on their global value chains (e.g. Apple, H&M, Nestle). Due to Covid-19 some countries started to put up temporary exportation bans as well as restrictions. Although borders remained open for road freight, border controls caused delays and supply bottlenecks. Furthermore, air freight with which a majority of goods is delivered in passenger aircrafts suffered greatly. Such disturbances of supply chains pointed out the importance of a smoothly running logistics. Taking a look at the logistics sector, we see that the digital age has been transforming the industry for a while. Famous examples are the e-tailers Alibaba and Amazon which use all sorts of technologies to support their services and products. However, many other logistic service providers struggle to keep on track, as fast responsiveness and operational efficiency require the support of technologies. Comparing the logistics sector to the telecom, banking or retail sector, the logistic sector runs behind in regard to digital transformation. One reason is the complexity of the systems and processes as many players (e.g. intermediate shippers) are involved which makes it difficult to standardize the used technologies. On top of that the coordination as well as organizational requirements are immense. Another barrier is the lack of resources such as attracting the right people with the necessary skills or lack of monetary resources. Moreover, many institutions or individuals are resistant to change, fearing e.g. continuous surveillance as transparency is increased. It is difficult for many logistic service providers to identify the right technology within a certain context as well as securely manage and protect the data throughout the various integrated systems (Cichosz, Wallenburg & Knemeyer, 2020, pp. 210- 222).

Current trends in the German logistics sector are Blockchain, Cloud-Computing, Data Analytics and Artificial Intelligence (AI) (Statista, 2020). For the years 2020 and 2021 Gartner identified a new trend in the area of process automation called “hyperautomation” which can be adapted to various industries. It is a concept which definitely gives new food for thought about a company’s capabilities. Hyperautomation means to “*[…] automate as*

many business and IT processes as possible using tools like AI, machine learning, event-driven software, robotic process automation, and other types of decision process and task automation tools." (Gartner, 2020c, p.12). Hyperautomation goes beyond just automating rule-based tasks (Deloitte, 2020, p.9). Software-bots coupled to the concept of hyperautomation could take over complex tasks of professionals such as fulfilling a business process manager's role (Lasso-Rodriguez & Winkler, 2020, p.19). In our fast changing world hyperautomation promises to promote organizational efficiency as well as competitiveness (Bornet, Barkin & Wirtz, 2021, p. 25).

But how do companies get started with hyperautomation? Although this word is used in many articles, only a few real-live case studies can be found. As the topic is quite new, this is no surprise. According to Gartner, an intelligent Business Process Management Suite (iBPMS) is important for an enterprise-wide hyperautomation initiative as it focuses on a strategic end-to-end process automation rather than tactical task automation (Gartner, 2020b). Agarwal et al. (2020, p.5) state that iBPMS and Robotic Process Automation (RPA) are the core components of hyperautomation as RPA centers on automating repetitive tasks whereas the iBPMS focuses on long running processes. Furthermore, iBPMS is a solution which enables the coordination of people, machines, things as well as the full business process lifecycle (Agarwal et al., 2020, p.5).

As not many real-life examples exist yet, the thesis will contribute to acquire new findings in the field of hyperautomation. People who are new to the concept of hyperautomation will be able to gain a general understanding of its state of the art. In particular, the evaluation of the role of iBPMS as a component of hyperautomation will deliver new insights to the research area. Therefore, the thesis can be an important asset for further research in hyperautomation. Furthermore, the thesis will deliver new insights for managers who are planning the implementation of iBPMS within their organization. Thereby, one main goal of the thesis is to deliver practical considerations to companies for implementing iBPMS. The developed iBPMS selection criteria can also be helpful for managers who are planning to evaluate different iBPMS. The thesis is carried out in collaboration with a German logistic company and the findings of this study contribute to deliver essential insights to support the iBPMS decision-making process of this particular company. Thereby, the opportunities and challenges of introducing the iBPMS as well as the pros and cons of the specific iBPMS vendors are identified. With the findings of the thesis the following research questions are answered:

- *"Is the iBPMS a useful tool to start implementing the concept of hyperautomation?"*
- *"What are key considerations for selecting an iBPMS provider?"*
- *"How can the process be optimized with the implementation of the iBPMS?"*

For the thesis a qualitative study approach is used. Thereby, secondary data is gathered with a literature review as well as primary data through a single case study analysis and interviews. The case study and the interviews use the insights gathered through the literature

review. Therefore, the research is based on the already existing theoretical foundation. The literature is collected in a structured way by using a keyword search in different databases. Due to the topic scientific books and papers as well as business articles from trustworthy sources such as Gartner or Deloitte are used to provide the reader with the newest insights on the market. The case study is carried out in conjunction with a German logistics company. To answer the proposed research questions several interviews within the company have been conducted and three business processed analyzed. To receive further information on the iBPMS two external interviews with providers have been carried out.

The thesis begins with Chapter 1 describing the term hyperautomation as well as its key elements. Afterwards, the author presents the opportunities and challenges connected to the topic. Lastly, a short description of different providers explaining their approach to hyperautomation is given. Chapter 2 delivers an in-depth analysis of iBPMS and the broader theoretical framework of BPM. This theoretical know-how is an important basis for a successful iBPMS implementation. Moreover, the chapter presents the developed selection criteria by the author. The practical work is presented in Chapter 3. This chapter illustrates the used methodology, the as-is and to-be business process models and evaluates two iBPMS. Within the comparison of these two iBPMS the developed selection criteria are put into practice. Chapter 4 answers the research questions and critically reflects the carried out research work. To conclude the thesis, a short summary with the key findings as well as an outlook of the topic is given in Chapter 5.

1 HYPERAUTOMATION

Automation is an invisible companion in our lives. It can be little things such as Amazon automatically filling out invoice and delivery data for our orders, to automation technologies making it possible to land rockets on the Mars. Automation is "*the technique, method, or system of operating or controlling a process by highly automatic means […] reducing human intervention to a minimum*" (Dictionary.com, 2021). In the last two decades automation has supported companies in lowering costs, automating many physical tasks, and driving productivity. Recent emerging process automation solutions are RPA and Intelligent Automation (IA) and within this context a new concept called hyperautomation is introduced. This chapter provides the reader with an overview of hyperautomation by explaining the term and components thus describing its opportunities and challenges. In addition, some examples of hyperautomation by different providers are presented.

1.1 Definition

All hyperautomation definitions have in common stating that hyperautomation consists of multiple tools (Table 1). Within the concept of hyperautomation processes can be end-to-end automated in a smart way by combining RPA, AI and other automation technologies (Ferreira, Rozanova, Dubba, Zhang & Freitas, 2020, p.1; Watson et. al., 2019, p. 4).

Combining different technologies acquires new capabilities. Thereby, the components of hyperautomation are designed with intuitive user interfaces to facilitate accessibility (Bornet, Barkin & Wirtz, 2021, pp. 40-41). Moreover, hyperautomation can be applied universally across different industries.

Table 1: Hyperautomation Definitions

	Hyperautomation Definition	**Key Terms**
Gartner (2019a)	*"Hyperautomation deals with the application of advanced technologies, including artificial intelligence (AI) and machine learning (ML), to increasingly automate processes and augment humans."*	- Advanced technologies - Automate processes & augment humans
Gartner (2020c)	*"Hyperautomation is a process in which businesses automate as many business and IT processes as possible using tools like AI, machine learning, event-driven software, robotic process automation, and other types of decision process and task automation tools."*	- Automate all possible business & IT processes - Combine tools
Deloitte, (2020, p.4)	*"Hyperautomation brings together several components of process automation, integrating tools and technologies that amplify the overall ability to automate business processes."*	- Combine process automation tools
Lasso-Rodriguez and Winkler (2020, p. 7)	*"Hyperautomation happens to be a recent technological term, which involves automation of knowledge work with a broad business scope and technologies integrated with a responsive workforce, mostly combining RPA with ML and/or further AI functionalities."*	- Automate knowledge work - Integrate technologies with people
Bornet, Barkin and Wirtz (2021)	*"[..]IA has been given different names, including Hyperautomation (by Gartner) […]. By connecting capabilities, IA increases the breadth and depth of the impact of each technology involved."*	- Connect capabilities of different technologies - Higher impact of technologies

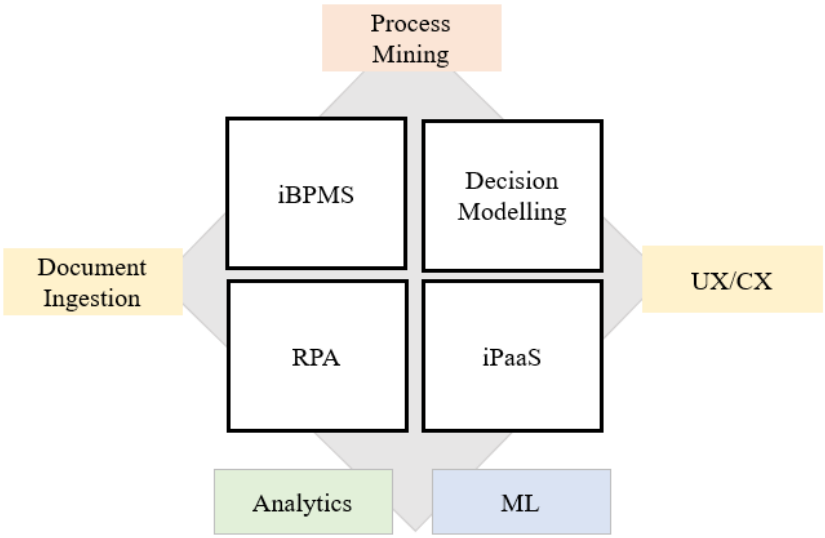
Adapted from Gartner (2019a); Gartner (2020c); Deloitte (2020); Lasso-Rodriguez and Winkler (2020); Bornet, Barkin and Wirtz (2021).

The term hyperautomation is sometimes used synonymously with IA (Bornet, Barkin & Wirtz, 2021, p.25). Other authors argue that IA means merging AI with RPA (Deloitte, 2017, p.9) and the concept of hyperautomation goes beyond these two technologies. For this thesis the definition of hyperautomation by Gartner (2019a) is used.

With hyperautomation highly efficient processes requiring minimal human interference can be created (Bornet, Barkin & Wirtz, 2021, p.39). Such automated processes are called "straight-

through" as no manual intervention is necessary. Intelligence is achieved by combining AI to the different components which makes it possible to e.g. process unstructured data. Hyperautomation also encompasses the activities such as discover, analyze, design, automate, measure, monitor and reassess (Gartner, 2019a). These activities are the key elements described by multiple business process lifecycles.

Figure 1: DigitalOps Toolbox



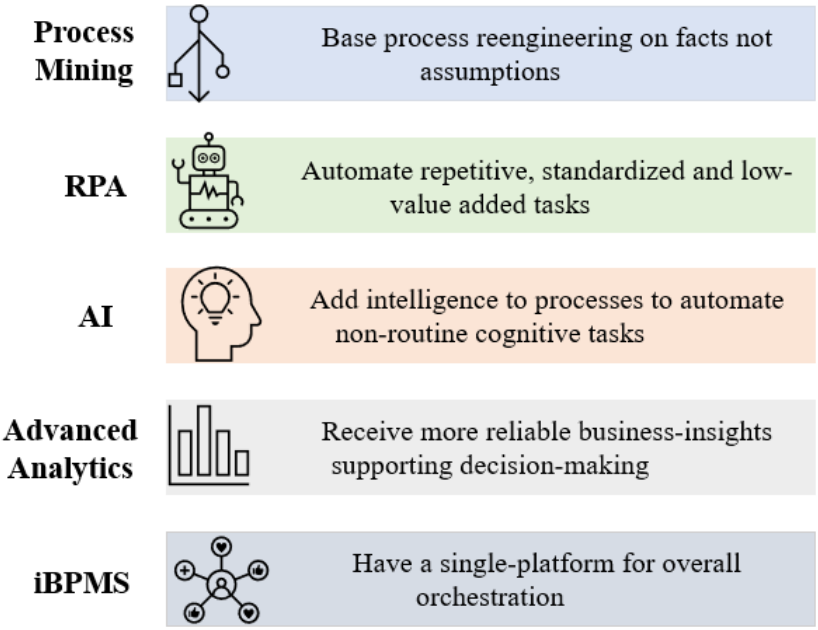
Adapted from Gartner (2019b).

The roadmap to hyperautomation according to Gartner (2019b) begins by defining a vision and objectives for the digital business initiative. The foundation towards a successful hyperautomation transformation requires inter alia top-management support, center of excellence (CoE), change management as well as vendor and partner selection (Bornet, Barkin & Wirtz, 2021, p.35). The next step is to identify use cases for the business process optimization such as identification and prioritization of hyperautomation opportunities. Afterwards, the adequate tools (DigitalOps toolbox) need to be identified, assessed and an investment plan developed (Gartner, 2019b). Figure 1 illustrates the DigitalOps toolbox described by Gartner. In an ecosystem with DigitalOps tools, the different technologies complement each other e.g. RPA enables task automation, iBPMS facilitates dynamic orchestration and with AI intelligent automation can be achieved (Gartner, 2019b).

1.2 Components

Hyperautomation comprises different tools which can be combined to automate business processes and augment humans more efficiently (Deloitte, 2020, p.4). Some of the key components within the concept of hyperautomation are briefly introduced below. Figure 2 summarizes their role within hyperautomation.

Figure 2: Component Overview



Source: Own work.

1.2.1 Process Mining

Process mining helps to discover, monitor and improve processes by retrieving operational data from e.g. enterprise systems. The foundation of process mining are event logs which contain the necessary records such as e.g. timestamps or case IDs. Event logs are digital traces which help to mirror the current process flow by providing a visual picture of the process sequence as well as possible variants. Process mining facilitates the discovery and the elimination of bottlenecks. Additionally, non-value adding activities can be identified, substituted or eliminated. Many mining tools offer the possibility to drill down and filter from the big picture of the process (aggregated view) to a detailed perspective. This increases the transparency and companies benefit from process mining as they get new insights into the process from its end-to-end visualization. With process mining the focus is shifting from "what" to "why", with companies focusing on the reason why e.g. a delay is happening rather than questioning its existence (Reinkemeyer, 2020, pp. 3-9).

1.2.2 Robotic Process Automation

RPA automates repetitive, routine and predictable tasks by imitating human actions within systems. This is useful as nowadays most communication and sharing of information between different parties or systems is done in a digital manner and RPA supports companies to process the high volume of data (Ribeiro, Lima, Eckhardt & Paiva, 2021, p. 52). Moreover, employees can focus on more creative and complex tasks. RPA is usually implemented to increase productivity and effectiveness as it reduces errors. It is considered

a non-invasive integration technology as it is connected to applications via the user interface (Deloitte, 2020, p. 12). RPA identifies elements e.g. its values and properties within the applications (Ribeiro, Lima, Eckhardt & Paiva, 2021, p. 52). According to Gartner (2021b), RPA tools *"[..]perform "if, then, else" statements on structured data, typically using a combination of user interface (UI) interactions, or by connecting to APIs to drive client servers, mainframes or HTML code. An RPA tool operates by mapping a process in the RPA tool language for the software "robot" to follow, with runtime allocated to execute the script by a control dashboard*."

Currently RPA is lacking the ability to encompass processes involving many exceptions and is rather focusing on rule-based processes. However, RPA coupled to AI makes it possible to work with unstructured data, automate non-routine tasks, thus assigning RPA cognitive tasks like e.g. interpretation of audio. Many RPA-vendors such as Automation Anywhere or UiPath already offer RPA incorporating features coupled to AI techniques such as cognitive automation or image recognition (Ribeiro, Lima, Eckhardt & Paiva, 2021, pp. 53-54). Nevertheless, within the concept of hyperautomation RPA is targeting to fulfill tasks rather than jobs and therefore other technologies should be combined (Lasso-Rodriguez & Winkler, 2020, p.7).

1.2.3 Artificial Intelligence

AI is the study of computer programs which contain certain features of the human mind like learning or solving problems and are therefore classified as intelligent (Cambridge Dictionary, 2021). Intelligence is a mental capability of the human brain and its biological neutral network is often used as a fundament for AI solutions. AI capabilities are usually compared to the cognitive functions of the human mind such as learning, reasoning, perceiving, planning etc. (Wang, 2019, pp. 7-15). AI consists of different sub-areas like ML, Optical Character Recognition (OCR) and Natural Language Processing (NLP). With AI also complex processes in different areas can be carried out e.g. customization in the manufacturing industry (Ribeiro, Lima, Eckhardt & Paiva, 2021, p. 53).

The strong proceedings in the field of AI offer new possibilities. Steady progress is made in automating non-routine tasks which require creativity, problem-solving, judgement or intuition. Such cognitive tasks demand for IA. However, compared to RPA, IA is much more expensive and time consuming thus its field of application remains rather narrow (Table 2). The challenge for fully automated systems is to cover the large number of different choices. With reinforcement learning, utilizing a trial-and-error methodology, we are trying to close this gap.

Table 2: RPA vs. IA

	RPA	**IA**
Automation	Automation of routine tasks (repetitive, methodical, rule-based tasks)	Automation of non-routine tasks (requires thoughtful considerations)
Ability	Follow instructions	Come to conclusions
Field of application	Broad (automates any suitable task)	Narrow (application targets to deliver meaningful and insightful outputs)
Market	Maturing	Emerging
Implementation and ongoing costs	Lower	Higher
Implementation time	Weeks	Months

Adapted from Deloitte (2017).

1.2.4 Advanced Analytics

Within the age of big data, tools are necessary which collect, store and process the high amount of information. Advanced analytics goes beyond traditional Business Intelligence (BI) as it focusses on making predictions and recommendations for the future rather than focusing on the current situation. According to Gartner (2021c), advanced analytics encompasses techniques like "*[…] data/text mining, machine learning, pattern matching, forecasting, visualization, semantic analysis, sentiment analysis, network and cluster analysis, multivariate statistics, graph analysis, simulation, complex event processing, neural networks.".*

1.2.5 Intelligent Business Process Management Suite

The role of the iBPMS is to orchestrate processes, applications and people for successful automation. Thereby it offers a single platform where all the different services such as RPA can be integrated and managed (Deloitte, 2020, p. 13). Detailed information about iBPMS is provided in Chapter 2.

1.3 Opportunities

Hyperautomation supports a seamless system integration throughout the organization. It connects different applications and operations and therefore supports data sharing (Forbes, 2020). Additionally, automation increases productivity and hyperautomation makes it possible to automate complex processes with high exception rates. Hyperautomation allows companies to become digitally more agile thus promising a higher return on investment (ROI) as time

and money is saved (Deloitte, 2020, p. 9). Moreover, hyperautomation enables operational excellence and resilience (Gartner, 2020d). These are two key capabilities needed in today's fast changing environment. Resilient companies handle market changes better which makes it possible to secure their position in the market.

Hyperautomation resolves the current limits of automation technologies. With hyperautomation end-to-end business process automation is possible. With AI and ML intelligence is added to the automated tasks making it possible to automate cognitive ones. It is now feasible to process semi structured and unstructured data. According to Forbes (2019) the amount of unstructured data increases yearly by 55-65%. Unstructured data can e.g. be found in E-Mails, webpages and audio-files. Being able to analyze and act on unstructured data can give a competitive advantage.

Since many processes and task become hyperautomated, employees' work will have a higher value e.g. tasks like planning and strategy. Thereby the detailed real-time insights enabled through hyperautomation will support human decision-making (Forbes, 2020). According to Gartner (2019a), hyperautomation creates a digital twin of the organization. This is a digital copy of the real-world system or entity based on real-world data (Qi et al., 2019). Therefore, the digital twin also supports making predictions and better decision-making. Automation enables almost 100% accuracy since automated processes are less prone to errors, promising a constant quality. Human errors, for example incorrect data entry, omission of process steps or mistakes in business rule application are eliminated.

Hyperautomation could be efficient in the logistic industry as it is able to handle the complex logistic processes. Moreover, it could increase operational efficiency by optimizing processes. By creating a digital twin, the logistic company could increase transparency e.g. real-time shipment tracking across the whole supply chain or real-time detection of bottlenecks within processes. Working with real-time data enables to act right away and therefore offer a better customer experience.

1.4 Challenges

The current articles written by research companies (e.g. Gartner), magazines (e.g. Forbes) or by service providers (e.g. UiPath) rarely describe any challenges of hyperautomation. Most papers only elaborate on opportunities but not the drawbacks. One reason for this could be the novelty of the topic and the missing practical examples. Service providers also want to advertise their products and services and therefore only promote its benefits.

Hyperautomation can be applied to any business function however the drawback is that no "out of the box" solution for a specific area is offered. This increases the coordination effort for the company as modifications according to the business needs are required. As human tasks shift to being more complex or getting completely replaced, a scenario is that the employment numbers will decrease as some job functions will not be necessary anymore (Deloitte, 2020, p. 10). Other authors discard such a scenario, arguing that automation

complements humans rather than replacing them (Calkins, 2020). Nevertheless, in the future different human skills and capabilities will be needed.

Hyperautomation requires a high amount of data in order to reach its full potential (Forbes, 2020). Companies doing many things "offline" have a disadvantage. Without data decision making is difficult and ML is not possible. Therefore, data must be saved and shared in a digital form thus synchronized throughout the systems to be able to work with the most current data. Through collecting large amounts of data, save handling of data is crucial as any data breach could have an immense negative effect on customer trust and company's reputation.

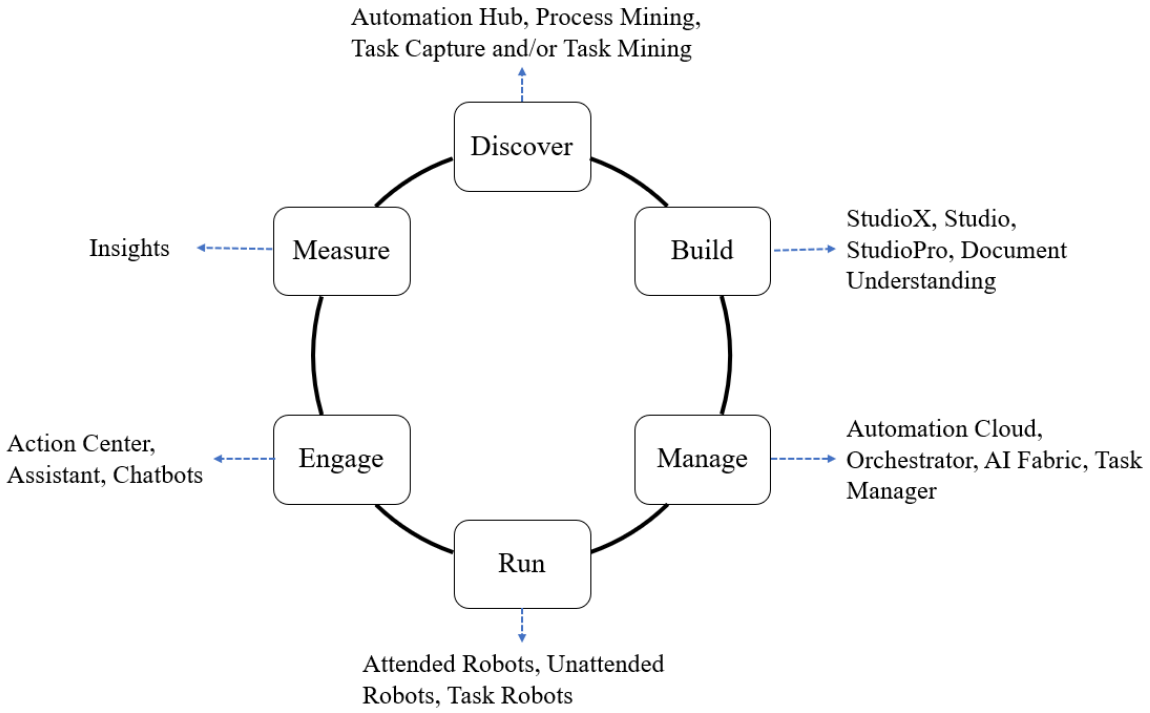
In the past a typical barrier for automation was IT-readiness, encompassing the existing infrastructure and systems. Another barrier was process fragmentation which has a negative impact on process management. Moreover, many companies lack an organizational solution in form of a Center of Excellence. Therefore, in most cases third-party-vendors with ready solutions or necessary skills need to be consulted (Watson et al., 2019, p.6). Currently service providers suggest acquiring a combination of their solutions to achieve hyperautomation (see Chapter 1.5.). Thereby little has been published about the necessary time, capabilities and costs of achieving hyperautomation and no best practices can be found.

1.5 Providers

Big software providers such as UiPath, Microsoft, Appian or SAP have already recognized the potential of hyperautomation. Furthermore, many advisory and consulting firms like PwC and EY have taken up the topic of hyperautomation. This thesis will shortly describe the perspective of UiPath and SAP on hyperautomation and their suggestion for implementation to provide the reader with a current overview of hyperautomation offers in the real world. UiPath was chosen by the author as it is one of the leading companies in the field of RPA according to Gartner. As mentioned before, RPA is one of the key components of hyperautomation. SAP was selected as it provides software and systems which cover multiple business units such as purchasing, procurement, marketing or accounting. The universal adaptability of the hyperautomation concept in different areas and different business processes is one of its key characteristics.

The global management consulting firm Zinnov compared multiple RPA vendors and named UiPath as the leader of "hyper intelligent automation" in 2020. UiPath offers an integrated platform which aims to automate the whole process lifecycle from end-to-end (Figure 3). Thereby, UiPath provides a platform which is able to combine different solutions such as RPA, Process Mining, Task Mining, Document Understanding AI, StudioX as the design canvas, Automation Hub and the Automation Cloud. All of these are solutions developed by UiPath and AI can be applied to many of the listed components such as RPA or Process Mining (Iafrate, 2020). Acquiring the listed UiPath solutions and implementing them efficiently in the mentioned areas of the process lifecycle paves the way to hyperautomation.

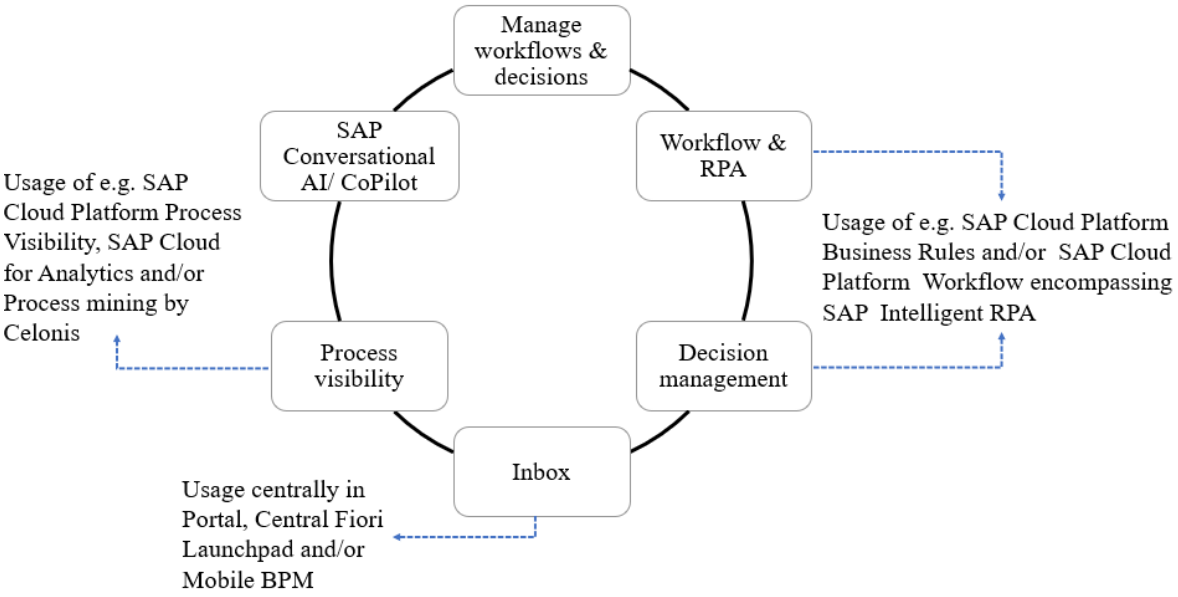
Figure 3: UiPath Lifecycle



Adapted from Kahlon (2020).

According to SAP some of its customers such as Hewlett Packard Enterprise (HPE) and Murphy Oil have already implemented hyperautomation by combining different SAP solutions. HPE combined conversational AI, intelligent RPA and Service Ticket Intelligence within the SAP Business Technology Platform. By doing so, HPE was able to offer their customers a convenient user experience. Thereby the implementation time only took a few weeks. Murphy Oil also implemented their hyperautomation initiative in a really short period of 12 weeks. The company improved its operations by utilizing SAP Data Intelligence Machine Learning and AI, intelligent RPA, conversational AI as well as the SAP Cloud Platform Integration Suite (Schroetel, 2020). Figure 4 illustrates their concept of intelligent BPM. For the components, different solutions by SAP but also third parties (e.g. Celonis) are suggested.

Figure 4: SAP Intelligent Business Process Management



Adapted from Verma (2020).

SAP and UiPath show that hyperautomation could already be achieved by combining multiple solutions. The two software providers are advanced in the area of AI which is the "fuel" of hyperautomation. Nevertheless, many companies already have different systems in place and therefore most likely would not begin with hyperautomation from scratch but build upon their existing system infrastructure. The two providers do not touch the topic whether it is possible to integrate e.g. self-programmed apps of companies or other third-party applications to their platforms. In Chapter 3 the author will also shortly consider hyperautomation in conjunction to the software providers Microsoft and FireStart.

2 BUSINESS PROCESS MANAGEMENT SUITE

With the emergence of intelligent automation and increasing interconnectedness of devices, BPM is everywhere (Palmer et al., 2015, p.15). The daily produced data is growing inexorably in exponential form and data is sometimes referred to as the new "oil" since customer, supplier, third-party and internal company data become increasingly indispensable. BPM is a useful approach not only to manage data but also to derive a value from it (Palmer et al., 2015, p.41). With innovative technologies such as iBPMS different applications can be connected and managed within a single platform, increasing effectiveness by eliminating the disadvantages of siloed applications. This chapter provides the reader with theoretical background on different BPM areas, focusing on (i)BPMS. Moreover, it introduces different iBPMS selection criteria as well as important implementation considerations.

2.1 Theoretical Background

2.1.1 Processes and Workflows

The two terms processes and workflows are sometimes used interchangeably. However, from a theoretical perspective they have different characteristics which distinguish them from each other. Gadatsch (2020) made a helpful distinction, summarized in Table 3. In general, processes describe "what" is done to achieve the business strategy while workflows describe "how" the strategy is achieved from an operational perspective (Gadatsch, 2020, p. 13). Many iBPMS cover both, the broader picture of processes and the detailed view of workflows.

Table 3: Processes vs Workflows

	Process	**Workflow**
Goal	Analyzing and designing processes according to (strategic) goals	Specification of the technical execution of processes
Design level	Conceptual level	Operational level
Level of detail	General description of the work step	Detailed description how the work step is executed by the employee or software program

Adapted from Gadatsch (2020, p.13).

2.1.2 Business Process Management

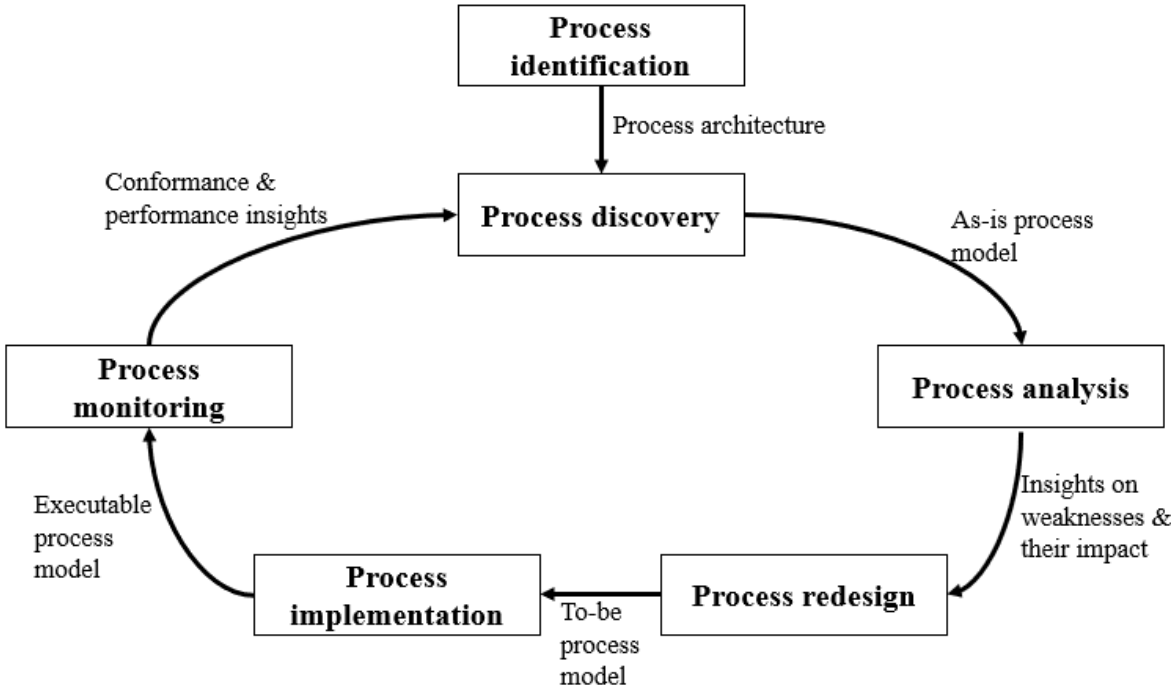
BPM is a management approach and discipline which has been one of the main business priorities for decades. It is assumed to be the most implemented management method within organizations (Szelągowski & Lupeikiene, 2020, p. 579). BPM plays an essential role as process design influences a company's efficiency, costs, agility and compliance. Thereby, BPM techniques and tools facilitate to control, analyze and optimize business processes (Oruthotaarachchi & Wijayanayake, 2021, pp.1-2). Tools supporting the BPM approach offer e.g. the possibility to model business processes with notations such as Unified Modeling Language (UML) and Business Process Model and Notation (BPMN) and to manage the whole Business Process Lifecycle (Wasilewski, 2016, p.586). Nevertheless, the traditional view on BPM has changed over the years as processes have become more dynamic, intelligent, and agile (Szelągowski & Lupeikiene, 2020, pp. 582-583).

2.1.3 Business Process Lifecycle

According to multiple authors, BPM can be seen as a continuous cycle. This thesis introduces the BPM lifecycle conceptualized by Dumas, La Rosa, Mendling and Reijers (2018) as it is often cited in academic papers. The starting point of the BPM lifecycle,

illustrated in Figure 5, is process identification in which a problem is posed, and a process is specified for optimization. The outcome of this step is an updated map of the process architecture.

Figure 5: BPM Lifecycle



Adapted from Dumas, La Rosa, Mendling and Reijers (2018, p.23).

After the process is identified, its as-is-situation is examined and modelled. This step is followed by process analysis in which bottlenecks within the process are classified and documented. Based on these insights the next step is process redesign. Here the changes for improving the processes are investigated and evaluated. Unsuitable changes are discarded and the outcome is a to-be-process model encompassing the best changes. Afterwards, the implementation phase puts the to-be-model into practice. This step goes hand in hand with change management. Subsequently the process is continuously monitored. In case of detecting deficiencies, the process passes the BPM lifecycle again (Mendling, Dumas, La Rosa & Reijers, 2019, pp. 3-4).

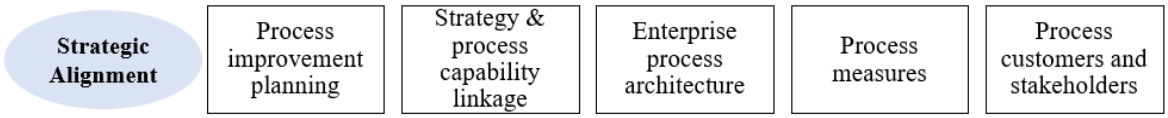
The BPM lifecycle can give companies a good starting point for BPM as well as guidance for managing activities in an efficient sequence for successful BPM. Within the process cycle different technologies can be applied to support each activity e.g. process mining by Celonis for process discovery or the Camunda platform to model and simulate processes. A key requirement for being flexible in today's world are ad-hoc adaptions of the process if e.g. deficiencies during the process runtime or external factors outside the process demand for it. A company should therefore plan how they can ensure the dynamic adaption of processes.

2.1.4 Business Process Management Maturity Model

Many authors have carried out research in the field of BPM in particular how to succeed. A BPM maturity model evaluates the as-is situation of a company's BPM capabilities. Thereby the maturity defines how advanced the organization is in regard to specific process capabilities. The maturity model usually describes multiple stages, levels or steps. This also allows companies to see how they can further enhance their practices to reach the next BPM stage. A popular maturity model is the Capability Maturity Model Integration (CMMI) which analyses the organizational and process maturity. It is functioning like a "diagnostic tool" which can be applied to various industries, following the motto "one-size-fits-all". According to vom Brocke and Rosemann (2015), BPM is not just about executing tasks which cover the Business Process Lifecycle but also about organizational behavior and capabilities. The authors introduced six factors which should also be considered when analyzing the maturity. Thereby the two factors "methods" and "information technology" are sometimes combined as their key areas of capabilities are identical. All factors are briefly described below (vom Brocke & Rosemann, 2015, pp. 112-120):

Strategic Alignment: This element is about the organizational approach to BPM. The BPM initiative must be aligned to the organizational strategy and a priority to satisfy stakeholders' needs to push its success. By defining valuable Key Performance Indicators (KPIs) and implementing them, organizations can monitor their performance in significant areas. The key capability area for strategic alignment is illustrated in Figure 6.

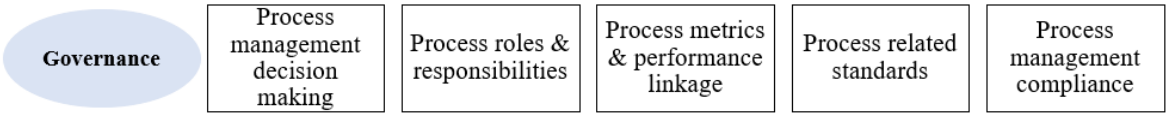
Figure 6: Strategic Alignment Capability Area



Adapted from vom Brocke and Rosemann (2015).

Governance: Governance is about how and by whom the BPM initiative is managed. It defines and assigns roles to people, giving them certain responsibilities and decision-making power. The coordination of BPM highly influences compliance. The key capability area for governance is illustrated in Figure 7.

Figure 7: Governance Capability Area

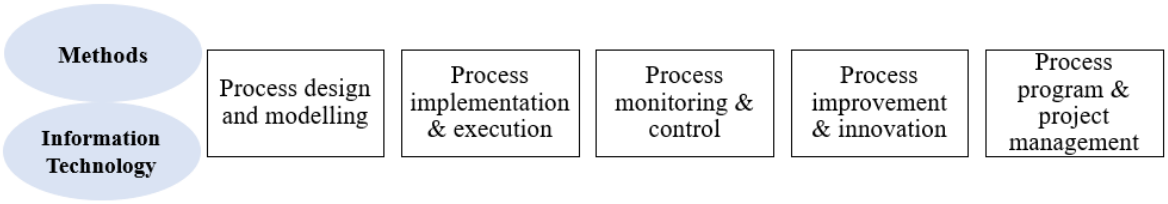


Adapted from vom Brocke and Rosemann (2015).

Methods: These are tools and techniques used for BPM activities in the different business process lifecycle stages. For each step, another approach or different tools might be handy. The key capability area for methods is illustrated in Figure 8.

Information Technology: The technological perspective on BPM which focuses on the necessary systems and software. The required IT might also vary throughout the different business process lifecycle stages. Thereby IT can support and facilitate the execution of BPM activities. The key capability area for IT is illustrated in Figure 8.

Figure 8: IT and Methods Capability Area



Adapted from vom Brocke and Rosemann (2015).

People: This capability area considers the human factor such as people who are involved in the BPM initiative by managing or performing BPM tasks. Hereby the human know-how and skills play an essential role for planning, leading and executing BPM activities. The key capability area for people is illustrated in Figure 9.

Figure 9: People Capability Area

Adapted from vom Brocke and Rosemann (2015).

Culture: Culture are the values and beliefs which shape the organizational environment. It is an invisible force influencing people's behavior and attitudes e.g. being resistant to changes. Without a culture supporting the principles of the BPM initiative, all BPM approaches are doomed to fail. The key capability area for culture is illustrated in Figure 10.

Figure 10: Cultural Capability Area

Adapted from vom Brocke and Rosemann (2015).

The factors by vom Brocke and Rosemann show that companies should have a certain set of capabilities or acquire these capabilities to ensure successful BPM. These capability areas can be adapted to all types of companies.

2.1.5 Business Process Management Suite

A BPMS is an information system whose capabilities support the whole business process lifecycle (Pourmirza, Peters, Dijkman & Grefen, 2017, p. 43). This statement is supported by Gartner (2021a) which defines BPMS as *"[..] the leading application infrastructures to support BPM projects and programs. A BPMS supports the entire process improvement life cycle – from process discovery, definition and design to implementation, monitoring and analysis, and through ongoing optimization. Its model-driven approach enables business and IT professionals to work together more collaboratively throughout the life cycle."*. The predecessor of the BPMS is the workflow reference architecture which was introduced by the Workflow Management Coalition in the 1990s. Nowadays BPMS are widely used.

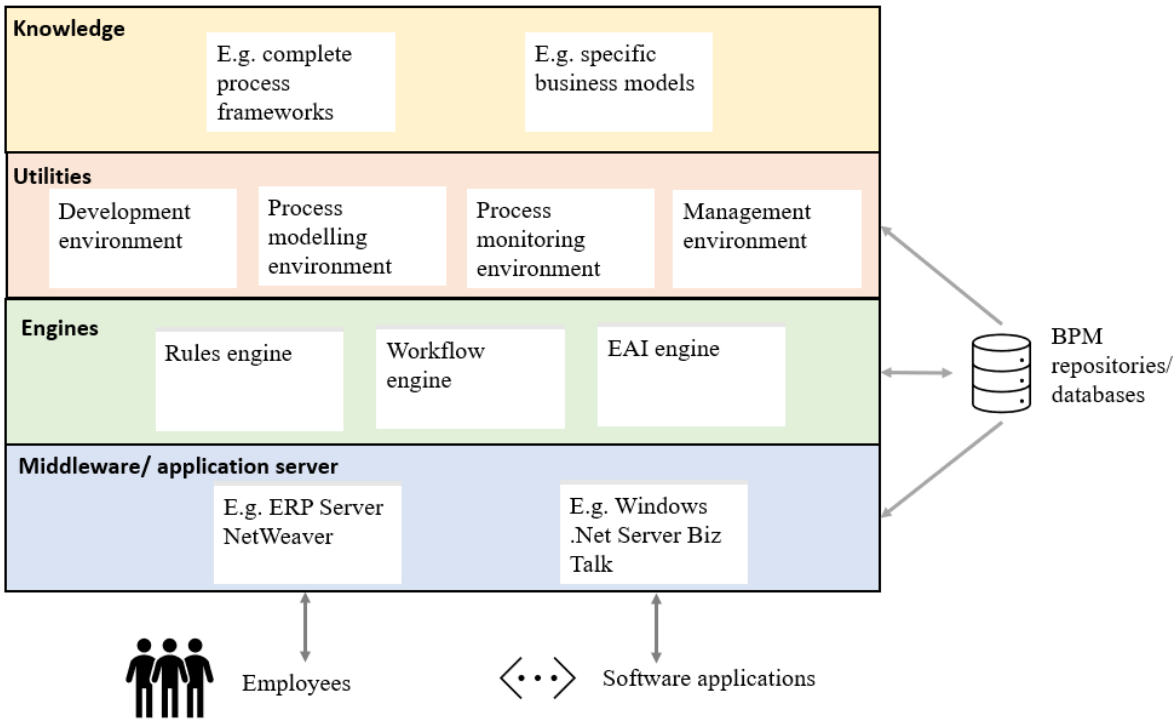
In most cases, the BPMS can be accessed via a web-browser. With the BPMS management is supported e.g. receiving notifications if a task is almost due or if an error occurs during the process. Filho and Costa (2013, pp. 492-494) defined seven criteria for BPMS. First, the "module of modelling and orchestration" which implies that the BPMS uses a notation language to graphically illustrate processes thus offering features for process orchestration. Second, "usability" of the BPMS by offering user friendly interfaces. Third, the "support for business rules" giving companies the opportunity to implement certain rules to obtain more control. Fourth, "Business Activity Monitoring (BAM)" for analyzing and reporting purposes. The fifth criterion is "Enterprise Service Bus" based on the Service Oriented Architecture (SOA) to support scalability and expandability of the system e.g. adding new services via XML or WSDL. Sixth, an important factor is "security" indicating that the BPMS must be reliable, e.g. with access and authorization rules, but also available, minimizing system interruptions. Seventh, "portability", the BPMS must be able to be transferred to other environments e.g. easy installation within diverse infrastructures being able to coexist with other independent systems.

From an architectural perspective, the BPMS runs as a layer above software applications (Oruthotaarachchi & Wijayanayake, 2021, p. 5). This extends the software architecture as another layer is added, and therefore increases complexity, particularly when many different systems are already integrated. Nevertheless, it is difficult to ensure data consistency through all the systems (Allweyer, 2014, pp. 42-43). According to Shaw, Holland, Kawalek, Snowdon and Warboys (2007, p. 92) the BPMS architecture needs to cover social systems to manage human processes and technical systems to manage machine-based processes. This means that BPMS also needs to manage human tasks e.g. processing human responses to a request (Harmon, 2014, p. 387). Furthermore, a BPMS consists of multiple engines which manage the execution of business processes, e.g. routing information, moving data from

databases or executing business rules. The BPMS orchestrates the process execution, supports workflow coordination and operates as a central point of control for business processes (Oruthotaarachchi & Wijayanayake, 2021, p. 5).

The architectural style of BPMS can be divided into two main classes, first the component-based style and second, the layered style. The component-based style is modifiable as matching functionalities are clustered into components. The components can be accessed via APIs. This architectural style can be easily changed, nevertheless its drawback is complexity. In the layered architectural style each functionality is classified into a layer (e.g. a layer for process logic and a layer for application logic). Each layer offers a service which can be used by the layers above. Within a strictly layered architecture the services can only use the layer directly below, whereas within a loosely layered architecture they can utilize all the layers below. Due to the independence of layers, the modifiability, flexibility and scalability is high. The drawback is that especially with strict layering the performance can decrease (Pourmirza, Peters, Dijkman & Grefen, 2017, p.51).

Figure 11: BPMS Architecture



Adapted from Harmon (2014, p. 400).

Over the years the architecture has changed as BPMS must now be flexible (Pourmirza, Peters, Dijkman & Grefen, 2017, p.47). Figure 11 illustrates how a BPMS architecture could look like. The application server manages the infrastructure and is therefore responsible for tasks like load balancing or clustering. The BPM engine is responsible to coordinate all processes and routing of tasks and therefore it is often called the workflow engine. An Enterprise Application Integration (EAI) engine makes it possible to integrate third-party

applications through their API or via adaptors. The rule engine applies the business logic and should offer the possibility for non-programmers to edit business rules. Moreover, the BPMS needs to offer different environments e.g. for modelling. Some also provide a pre-defined knowledge-basis (knowledge layer) which companies can utilize e.g. frameworks such as SCOR (Harmon, 2014, pp. 400-401).

2.1.6 Intelligent Business Process Management Suite

The term iBPMS was first introduced by Gartner in 2012. An iBPMS is a low-code or no-code application development platform which enables users to change procedures and models in a dynamic way by facilitating ad hoc process changes (Szelągowski & Lupeikiene, 2020, p. 584). This business process agility demands iBPMS to offer options to add new capabilities or reconfigure processes in a timely manner. According to Saraeian, Shirazi and Motameni (2018) many classical BPMS lack the ability to manage uncertain situations. This is a drawback since our dynamic environment often makes it difficult to make predictions. A BPMS is considered "intelligent" if it offers real-time analytics, complex-event processing, expanded business activity monitoring (BAM) and interfaces to mobile tools or social media (Wasilewski, 2016, p. 587). Such higher intelligent capabilities distinguish the term iBPMS from BPMS. However, in practice the two terms are often not differentiated as most BPMS have some intelligent capabilities nowadays.

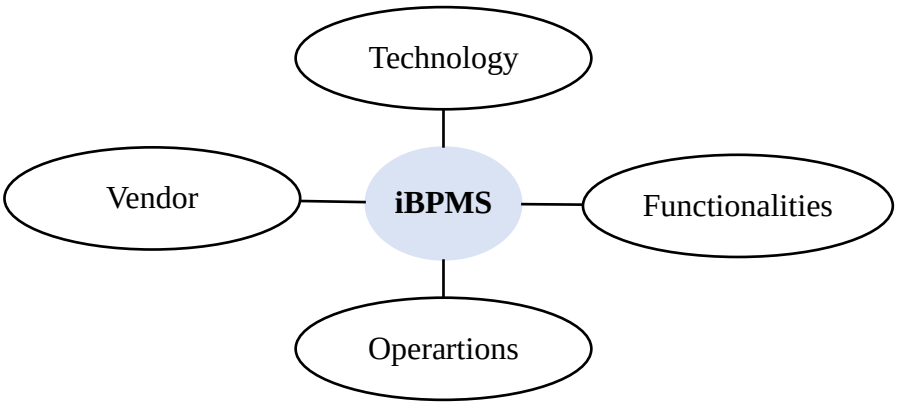
According to Gartner's Magic Quadrant IBM, Appian and Pegasystems are one of the main leaders of iBPMS (Gartner, 2020a). In general, each iBPMS needs to cover certain functionalities. When considering iBPMS capabilities, it is important to mention that the required capabilities change with time e.g. the yearly Gartner reports introduced new and omitted other iBPMS capabilities. From an architectural perspective the iBPMS needs to be able to support such intelligent capabilities. This can be e.g. via a Runtime Analytical Behavior component to make predictions based on big data analytics (Pourmirza, Peters, Dijkman & Grefen, 2017, p. 56). The iBPMS must also support process automation (e.g. IoT, RPA, ML/AI) as well as process knowledge acquisition (e.g. through process mining, predictive and real time analytics, AI/ML) (Szelągowski & Lupeikiene, 2020, p. 585).

An iBPMS plays an essential role in business transformation as it offers different analytical options, business process automation, process discovery, thus enabling process orchestration (Wasilewski, 2016, p. 586). By using these capabilities, companies can continuously improve their processes. Moreover, iBPMS is particularly handy when it comes to coordinating long-running processes or coordinating processes in which many exceptions are the norm. Long-running means that during the process many waiting times for the next trigger exist, resulting in long execution times (Junior, Rosa & Lins, 2014, p.496). This is the case, when e.g. the responsible staff need to give their approval. Furthermore, iBPMS is able to deal with complex orchestration of processes and systems.

2.2 Selection Criteria

This subchapter introduces selection criteria which can be used by companies to compare iBPMS in four different areas (Figure 12). It is important to note that the different areas should not be considered separately as most of the criteria are connected e.g. monitoring on one hand is viewed from a technological perspective (e.g. system and application monitoring) and on the other hand from a business perspective (e.g. real time activity monitoring). The following selection criteria aim to show whether a specific iBPMS could be suitable for a company.

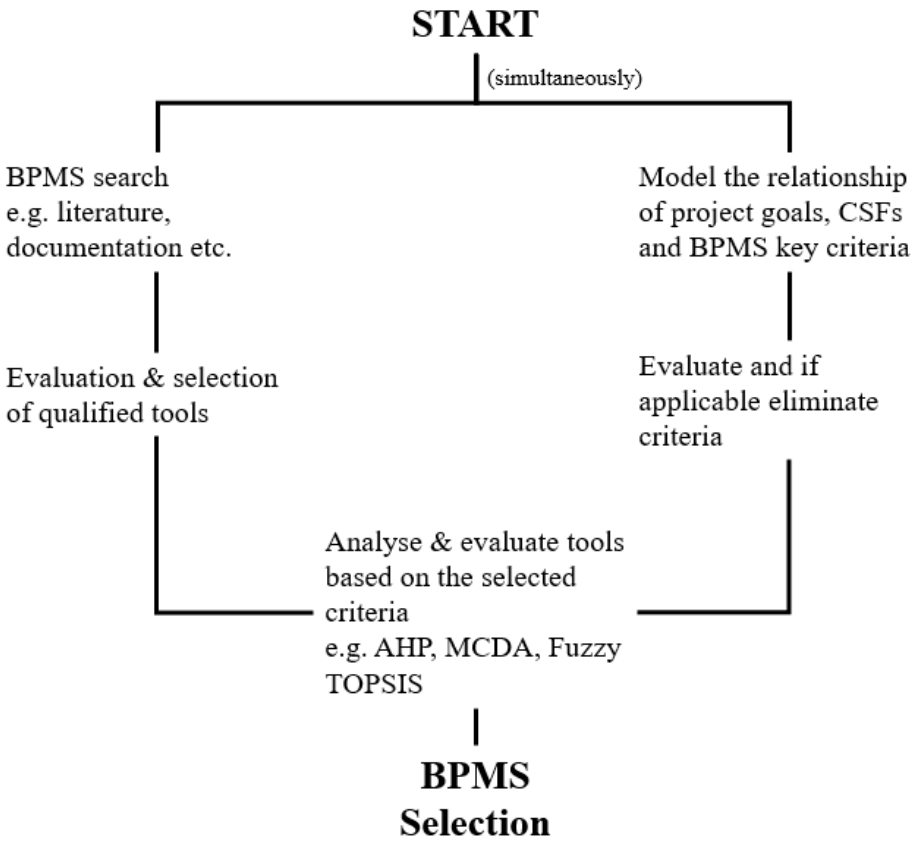
Figure 12: Evaluation Overview



Source: Own work.

Before going into detail about specific selection criteria, it is useful to give an overview of the (i)BPMS selection process. Indihar Štemberger, Bosilj-Vukšić and Jaklič (2009) propose to start simultaneously with the BPMS selection by searching for BPMS tools as well as identifying selection criteria (Figure 13). The number of BPMS should be reduced to a few based on their suitability for the company and afterwards the selected tools must be approved by top-management. Project goals and Critical Success Factors (CSFs) help to identify the key requirements of the BPMS. From these requirements the relevant selection criteria are derived. Afterwards, the criteria are evaluated and non-important criteria can be discarded. Techniques such as e.g. Analytical Hierarchy Process (AHP), the Multi Criteria Decision Analysis (MCDA) or Fuzzy TOPSIS help to evaluate the different BPMS in conjunction with the identified criteria and therefore support decision making (Indihar Štemberger, Bosilj-Vukšić & Jaklič, 2009). Lastly, the results must be analyzed, evaluated and discussed and an informed decision is made.

Figure 13: Overview BPMS Selection Process



Adapted from Indihar Štemberger, Bosilj-Vukšić and Jaklič (2009).

When evaluating iBPMS, the technological part plays an essential role (Table 4). The current system landscape (e.g. environment based on Microsoft or SAP) highly influences the selection as iBPMS from the same provider usually best complement their landscape and ensure a seamless integration. Integrating the iBPMS to other internal and external systems strongly relies on the used middleware. Moreover, modelling notations must be supported as business process modelling is an integral part of BPM.

Table 4: Technical Selection Criteria

Technical Aspects	
Criteria	**Description**
Deployment options	The iBPMS offers the desired deployment option (cloud, hybrid, on-premise)
Software and hardware	The iBPMS software and hardware requirements can be met
Intelligent mobility	The iBPMS can be accessed via different devices such as tablets, smartphones etc. through e.g. native app or web app
Updates	The iBPMS can be updated without any major disruptions

(table continues)

Table 4: Technical Selection Criteria (continued)

Criteria	Description
Back-ups	The iBPMS regularly makes encrypted back-ups
Web browsers	The iBPMS supports the desired web browsers
Orchestration	The iBPMS offers an orchestration engine
Integration	The iBPMS can be connected to the desired systems and applications
Notation support	The iBPMS supports the desired notations and is able to import and export models (e.g. BPMN 2.0 for modelling business processes and Decision Model and Notation (DMN) to model different decision rules)
Modelling of organizational charts and enterprise architecture	The iBPMS is able to model organizational charts and enterprise architecture (e.g. according to TOGAF)
Object and document repository	The iBPMS offers a storage location for different artefacts in which data files can be uploaded, managed and shared
Change-Log	The iBPMS shows the change history in which e.g. the time, changed object and responsible person is tracked
Usability	The iBPMS is user-friendly e.g. intuitive GUIs, drag & drop options, different language support, search functionalities etc.

Adapted from Dunie, Schulte, Cantara and Kerremans (2019); Gartner (2020a); Hahn, Winkler, Friedrich, Tamm and Petruch (2012); Pourmirza, Peters, Dijkman and Grefen (2017); Silva, Poleto, de Carvalho and Costa (2014); Bosilj-Vukšić, Brkić and Tomičić-Pupek (2018).

When it comes to functionalities, iBPMS offers diverse features (Table 5). Due to the limited scope of the thesis, only a few important functionalities are described. However, the desired functionalities can vary within each company.

Table 5: Functional Selection Criteria

Functionalities	
Criteria	**Description**
Automation	The iBPMS automates end-to-end processes
Support options	The iBPMS offers users support options e.g. detailed error support messages or user manuals.
Templates	Pre-built templates for different processes with the option for customization are offered
Reports	The iBPMS can generate reports which can be customized
Visualization	The iBPMS is a visual modelling tool which offers management dashboards
Context interaction management	The iBPMS analyzes contextual data from external applications

(table continues)

Table 5: Functional Selection Criteria (continued)

Criteria	Description
Process discovery	The iBPMS supports process mining such as detecting bottlenecks and optimization areas
Intelligence	The iBPMS offers intelligent services such as AI, ML, NLP etc.
Real-time business analytics	The iBPMS provides insights e.g. via predictive analytics -this capability supports decision making
Case Management	The iBPMS is suited for situational adaptiveness of business processes based on unique scenarios typically involving complex interactions
Collaboration/ Human interaction management	The iBPMS facilitates collaboration of stakeholders e.g. via offering real-time chat or video chat options
Flexibility	The iBPMS offers possibilities to adapt processes and models after the go-live

Adapted from Dunie, Schulte, Cantara and Kerremans (2019); Gartner (2020a); Hahn, Winkler, Friedrich, Tamm and Petruch (2012); Pourmirza, Peters, Dijkman and Grefen (2017); Silva, Poleto, de Carvalho and Costa (2014); Bosilj-Vukšić, Brkić and Tomičić-Pupek (2018).

Operations is about how the iBPMS manages people and business process as well as monitoring and controlling the entire system after the go-live (Table 6). This step is crucial for ensuring compliance. By e.g. setting up business rules or assigning roles to users, the iBPMS is able to forward the different activities and tasks to the appropriate entity. However, the assigned user might not always be available (e.g. being on vacation or sick leave), therefore management of temporal replacement is also crucial. This is important when a process is not fully automated but requires human interaction. To quickly react to failures or exceptions the iBPMS must generate warnings and error messages as well as ad-hoc informing the adequate person.

Table 6: Operational Selection Criteria

Operations	
Criteria	**Description**
Authentication	The iBPMS offers the desired authentication method e.g. possibility to connect the iBPMS to the current authentication infrastructure (e.g. active directory)
Roles & rights management	Employees can be assigned different roles encompassing different rights -within the iBPMS these roles & rights can be managed
Business Rules and Decision Management	iBPMS offers a rule engine which supports policy implementation and decision management engine for human and automated decision logic. Business rules and restrictions can be implemented in the iBPMS

(table continues)

Table 6: Operational Selection Criteria (continued)

Criteria	Description
Process responsibility	The iBPMS is able to assign process and task responsibilities
Employee training	The amount of training which is needed to use the iBPMS e.g. for end-users and developers
User number	The iBPMS is able to upgrade and downgrade user numbers
Monitoring & control	The iBPMS constantly monitors itself during operations and informs the appropriate users if e.g. the system, processes or activities fail

Adapted from Dunie, Schulte, Cantara and Kerremans (2019); Gartner (2020a); Hahn, Winkler, Friedrich, Tamm and Petruch (2012); Pourmirza, Peters, Dijkman and Grefen (2017); Silva, Poleto, de Carvalho and Costa (2014); Bosilj-Vukšić, Brkić and Tomičić-Pupek (2018).

Lastly, the vendor himself plays a key role (Table 7). Due to usually limited monetary resources or limited investment budgets, the implementation and ongoing costs are crucial. Additionally, implementation time is important. The reputation of the vendor acquired through e.g. customers or Gartner's Magic Quadrant influences decision making as a company demands for a reliable provider. Thereby being able to trust in a long-term partnership as well as the vendor delivering adequate support are important selection criteria.

Table 7: Vendor Selection Criteria

Vendor	
Criteria	**Description**
Price	Implementation and ongoing costs
Experience & reputation	The vendor has significant experience, other customers are satisfied
Implementation	Approximate duration and required vendor support to implement the iBPMS
Running iBPMS	The needed vendor support after the iBPMS go-live
Vendor progress	The vendor monitors the trends on the market and constantly tries to improve the iBPMS
Training	The vendor offers training

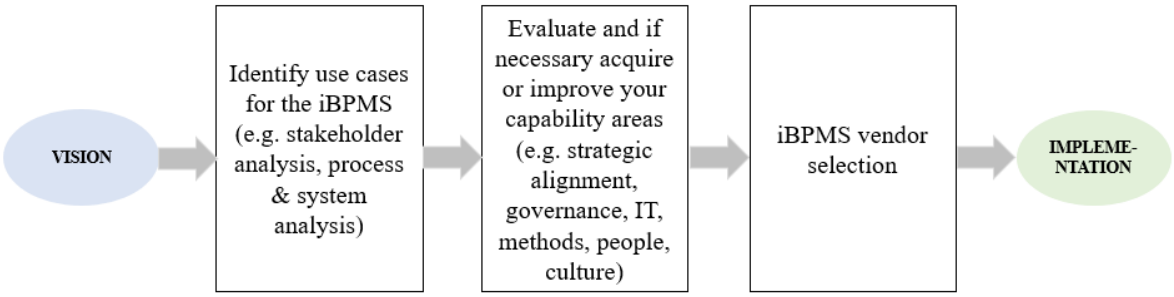
Adapted from Dunie, Schulte, Cantara and Kerremans (2019); Gartner (2020a); Hahn, Winkler, Friedrich, Tamm and Petruch (2012); Pourmirza, Peters, Dijkman and Grefen (2017); Silva, Poleto, de Carvalho and Costa (2014); Bosilj-Vukšić, Brkić and Tomičić-Pupek (2018).

2.3 Considerations for Implementation

Figure 14 shortly summarizes the key considerations for implementing iBPMS. The interest to implement a new technology usually arises from having a vision. It is important to first identify the use cases for the iBPMS in order to know if the technology is suitable for the

organization. In case the iBPMS is a fit, it is essential to have or develop certain capabilities in order to ensure a successful implementation. Afterwards, a suitable iBPMS vendor is selected.

Figure 14: Implementation Considerations



Source: Own work.

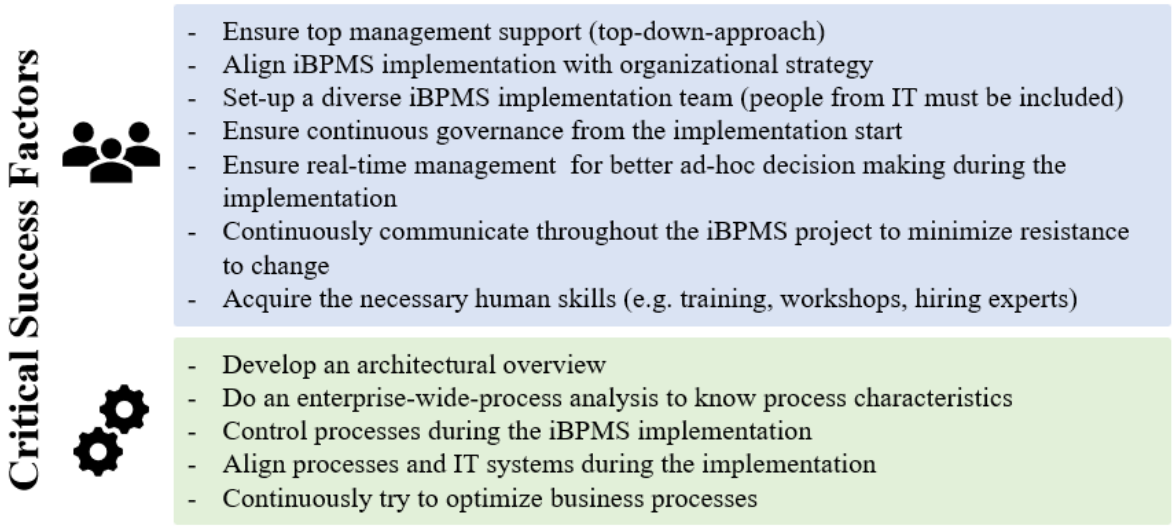
There are different reasons why companies implement iBPMS. iBPMS can increase compliance, improve productivity and deliver a better customer experience. Such factors can give the company a competitive advantage. Another reason for iBPMS implementation could be to embrace digital business transformation within the company, generate new revenue streams or introduce new business models, products and services. Implementing an iBPMS can directly reduce process execution costs and increase product quality as well as indirectly influence factors such as e.g. customer loyalty (Fiodorov, Sotnikov & Telnov, 2021, p.334). However, an iBPMS is only suitable for companies which plan to integrate multiple of their processes within their suite as the investment costs are rather high (Alleweyer, 2014, p.43). iBPMS offer intelligent business process automation also executing unstructured and semi-structured processes where no standardized process flow exists (Szelągowski & Lupeikiene, 2020, p. 586). This is an advantage as it could add new value. iBPMS adoption is also influenced by factors like the offered capabilities, the compatibility with the existing systems, the implementation cost as well as vendor offerings and reputation (Bosilj-Vukšić, Brkić & Tomičić-Pupek, 2018, p. 197). It is important that companies know which core functionalities of the process deliver the most value. Many iBPMS ensure traceability by offering analytics to track, monitor and evaluate the current process (Miers, 2006, pp.42-43). To measure the state of the process, companies must ensure that they implement KPIs to capture important information throughout the iBPMS. This also helps to track the performance in regard to the set targets. iBPMS could support monitoring by e.g. offering the option to develop dashboards. Moreover, the iBPMS should provide different control mechanisms (Miers, 2006, pp.44-46).

Over the years many articles about the success and failure of BPM initiatives have been published. BPM goes hand in hand with iBPMS and therefore its influencing factors can also be applied to the introduction of iBPMS. The maturity model by vom Brocke and Rosemann, described in Chapter 2.1.4., gives a glimpse of all the important underlying factors such as

people, culture, governance, strategic alignment, methods and information technology. These aspects complement the findings by Oruthotaarachchi and Wijayanayake (2021, p.6) who state that the success of BPM initiatives depends on the strategy, people, process- and IT architecture, optimization and process management, project management as well as standards and measurements. A study carried out by Castro, Dresch and Veit (2018 pp. 246-250) with different experts working in the field of BPM identified several Critical Success Factors. Thereby top management support, alignment of goals with overall strategic planning, managing resistance to change, having clearly defined responsibilities, aligning IT and BPM, continuous monitoring, as well as investing in human capital (e.g. hiring experts) are the most important CSFs. According to Ravesteyn and Batenburg (2010a) it is important that iBPMS implementation is a top-down approach indicating that the iBPMS initiative and key decisions should be promoted by managers.

When starting the iBPMS implementation, governance as well as a general overview of processes and the IT architecture are essential. During the implementation, controlling the processes (e.g. with metrics) is important as processes and work procedures are going to change. Moreover, continuous communication throughout the whole implementation project is a key to success (Ravesteyn & Batenburg, 2010b). Figure 15 illustrates some important CFSs. All in all, it can be concluded that iBPMS implementation is not a quick process since it demands deep understanding of the whole organization.

Figure 15: iBPMS Critical Success Factors



Adapted from Ravesteyn and Batenburg (2010b).

Although much research was carried out on BPM success, many companies struggle to align the core elements of BPM such as people, culture, governance, technologies, and methods (Oruthotaarachchi & Wijayanayake, 2021, p. 2). Particularly companies with little BPM experience tend to only focus on the technical perspective of iBPMS implementation (Ravesteyn & Batenburg, 2010a). Another challenge is that companies which want to

implement iBPMS need to be able to adapt to changes as continuous process improvement is one of the core BPM disciplines (Miers, 2006, p.40). This indicates that a process can always be designed more efficiently and companies need to develop strategies to regularly analyze, and if applicable, improve business processes. Therefore, understanding the end-to-end process and discovering bottlenecks as well as requirements are necessary skills to change efficiently (Miers, 2006, p.40). Moreover, competitors or shifting customer preference could also force companies to change. Not meeting the described CFSs can also be a reason for failure.

Cichosz, Wallenburg and Knemeyer (2020) recommend several factors for a successful digital transformation of logistic service providers. As digital transformation is one of the drivers of iBPMS adoption, the factors are shortly described as they can also be helpful to take into consideration. Appendix 2 detailly illustrates all the required capabilities of logistic service providers. The stated capabilities support the developed maturity model by vom Brocke and Rosemann (2015). Leadership is the main driver for success as good leaders are able to inspire their employees in order to give them security but also convince them to take the "new journey". When it comes to culture, the employees must proactively be engaged via a bottom-up-approach (e.g. workshops and training) but nevertheless must know that the customer (customer-centricity) is the most important player who needs to be satisfied. Moreover, employees must be flexible, which can be supported by agile organizational structures (e.g. focus on teamwork and cross-functional teams) in order to react to the changing customer needs which is crucial for logistic service providers' success. For the digital transformation journey the key managers and partners must be on board and regularly informed via meetings. IT strategy and business strategy must go hand in hand and the business resources accordingly divided. Additionally, to acquire the necessary technological knowledge, logistic service providers could partner up with technological companies. As logistic processes are usually highly complex, data integration is crucial in order to efficiently analyze data and receive valuable information. Moreover, big data repositories play an essential role as with increasing amounts of data gathered from e.g. warehouses or transportation tracking via sensors the data must be saved and evaluated in order to optimize the logistic processes (Cichosz, Wallenburg & Knemeyer., 2020, pp. 223-228).

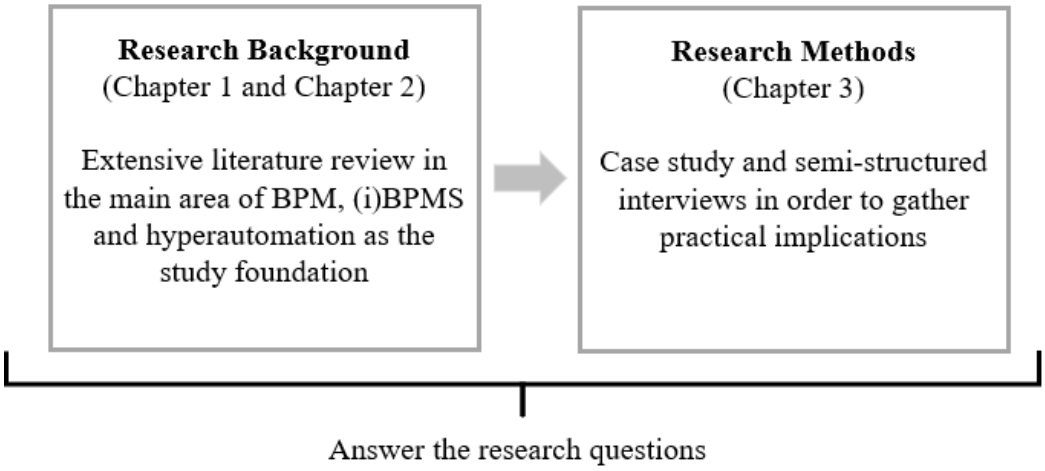
3 CASE STUDY

This chapter represents the practical part of the thesis. It describes the chosen methodological approach of the author and introduces the case study company as well as three different business processes by the company. Moreover, the two iBPMS by Microsoft and FireStart are shortly described from a technical, functional, operational and vendor perspective. Additionally, their specific approach to hyperautomation is regarded. After describing the iBPMS, the two systems are compared and the key findings are summarized.

3.1 Methodology

This thesis uses qualitative data gathering techniques. To answer the proposed research questions, a single case study in combination with interviews has been chosen as the methodological study approach. Figure 16 provides a general overview of the research methodology.

Figure 16: Research Design



Source: Own work.

Case studies are useful as they provide a real-life example by gathering data from institutions and people within their "normal" settings. Case studies are an in-depth inquiry which aim to "*look at relationships and processes*" thus using "*many methods and sources of data*" (Thomas, 2021, p.11). The case study is carried out in cooperation with a single company and is used in the explanatory phase of the thesis helping to answer the proposed research questions. Thereby the selected company, in particular their journey of automating their internal processes by implementing an iBPMS, is studied. By carrying out a case study, the key challenges and key considerations during the iBPMS selection process are evaluated and presented in detail. The company has already narrowed down their iBPMS selection to two systems, one by the company FireStart (FireStart BPM Suite) and the other one by Microsoft (Power Automate Platform). Power Automate has been chosen as it is included within the Office 365 license and FireStart iBPMS due to its support of Microsoft products as well as the previous experience from one of the top managers with the provider and suite. Moreover, three internal processes of the company are analyzed. These internal processes were chosen by the company as they identified a need for optimization. To model the as-is and to-be processes the BPMN 2.0 is used. As a modelling tool the open-source modeler by CAMUNDA is utilized by the author as it offers all the necessary modelling functionalities. To visually highlight the involved systems within a process, the author assigned different colors for each system for a better visualization.

To obtain a detailed insight into the company's working methods, the author conducted interviews with an employee managing the RPA initiative and an employee in charge of Microsoft Power Automate. After modelling and understanding the three processes of the company as well as capturing the key requirements of the company for the iBPMS, two "external" interviews were carried out (Appendix 3). One interview was directly conducted with the company FireStart which offers the Firestart iBPMS. The other interview was with Akoa, a strategic partner of the case study company which offers diverse services inter alia for Microsoft Power Automate. All of the interviews were held in a semi-structured way as this interview type offers more flexibility thus gaining deeper insights (Foresti, Guijt & Sharma, 2007). Moreover, all interviews were conducted online via Microsoft Teams.

3.2 Case Study Company

Due to confidentiality reasons no information revealing the identity of the company is included. The case study firm is a German logistic company operating in several countries. It started its digital transformation journey a few years ago with the goal to modernize its IT infrastructure. As mentioned in the introduction of the thesis, the logistics sector is in a period of upheaval due to new emerging technologies and the urgent need to be able to react quickly to changes. Due to Covid-19 the firm wants to further accelerate its digital transformation journey. Thereby it is important to the company to single out a suitable iBPMS in order to be prepared for future challenges. The iBPMS should function as a holistic orchestration tool to manage and control all systems and processes.

In general, the system landscape of the company is very heterogenous encompassing applications from diverse providers. Moreover, many of the tools are outdated which makes it difficult to connect systems. Currently different areas are being transformed in regard to future oriented technologies and working methods. The company has switched to Office 365 and is using multiple Microsoft tools such as Microsoft Teams for communication. Furthermore, it implemented several UiPath applications (e.g, UiPath Orchestrator, UiPath Studio and UiPath Document Understanding) to automate tasks with RPA. Currently UiPath is one of the leading companies in the field of RPA as it offers a holistic system as well as being far advanced in regard to AI, ML and unattended bots. Therefore, it is definitely an RPA provider with which companies could achieve a leading edge. The case study company is satisfied with their RPA provider choice as they benefit from intelligent automation options. The UiPath Orchestrator makes it possible to efficiently monitor, manage and deploy the bots. Nevertheless, if no bot is free, delays can occur since tasks are performed in queues and not parallelly. All in all, connecting UiPath to the iBPMS is one key criterion.

It is important to mention that the company is already using Microsoft Power Automate as it is included in their Office 365 license. However, using Power Automate has not been an official initiative yet and therefore only a few employees use the platform for their personal needs e.g. to create a workflow to forward E-Mails or deposit data in SharePoint. At present

no Power Automate connectors to third-party systems have been self-programmed as it is sufficient for the employees to use the existing offered Microsoft connectors. Together with connectors to other systems Microsoft also offers a variety of workflow templates. According to the employees of the case study company, the provided workflow templates are helpful to get an idea how to model a workflow but are rather built from scratch in particular complex flows. The employees consider Microsoft Power Automate a convenient tool as it does not require much training and the strong Microsoft community on the internet usually helps to resolve errors. Nevertheless, Power Automate does not come with a companywide admin center which means that the company does not have a general overview of the implemented workflows by their employees. This means that workflows remain private to the user who created it which is critical as the company has no control over the created flows and in case of an employee leaving the company the workflow cannot be accessed anymore. However, Microsoft offers a governance tool called Center of Excellence with which the whole Power Platform can be managed. The company is currently planning to implement the CoE.

The case study company is also developing its own apps with Microsoft Power Apps. Like Power Automate, Power Apps belongs to the Microsoft Power Platform. All in all, it can be said the system environment of the company is mainly focusing on Microsoft products. The comparison of Power Automate and FireStart helps to select the most suitable system for the company's individual requirements.

Before going into more detail about the individual business processes, the author shortly explains the working methods of the employees on the example of the request for quotation process (RFQ) as the author was most involved within this project. The author was part of the "Digital Workspace and Enterprise IT" team in the case study company. This team consists of employees from different business areas working on improving internal processes. The company prioritizes projects based on the defined added-value. In general, the team follows an agile working methods approach. This was also the case in the RFQ process, meaning that the project took place in small iterative steps. Within the RFQ process the business solutions department was the "customer" whose requirements should be fulfilled. The first step was to capture the end-to-end as-is process together with the department. During this step the main bottlenecks as well as requirements from the customer were identified. Afterwards, the team made a brainstorming session on what could be done to make the process more efficient and which technologies can be applied. Thereby the team focused on the outcome, namely a more automated process in which the business solutions employees are unburdened with the low-value-added tasks. Focusing on the outcome rather than the individual tasks really helped to get more creative ideas. Since employees with different knowledge e.g. RPA and Microsoft Power Automate were included, they provided ad-hoc feedback if the ideas were feasible and explained further functionalities of the technologies which might be useful. For the team it was important to not only fulfill the requirements of the department but also to go one step further by showing how the process

could be changed if the technologies were implemented. After the to-be-model was developed, a meeting was scheduled with the key employees of the business solutions department. The to-be model was explained step by step and questions answered. The customer required the RPA bot to have its own user account in a specific portal as well as the necessity to change the password of this user account every 180 days. The business solutions department then accepted the to-be model and gave the team the order to get started with the project. To constantly and actively inform the business solutions department, regular meetings were scheduled to talk about the project progress and answer questions if applicable. This means that the concerned department was deeply involved in the reengineering process.

3.2.1 As-Is-Processes

The case study company copes with the challenge that many business processes are only partly documented. This is a drawback since implementing the end-to-end processes within iBPMS requires to know the precise sequence as well as all the possible exceptions of a process. To capture the as-is business processes, meetings with the involved employees have to be scheduled. For the thesis a maintenance process, a purchase to pay process (P2P) and a request for quotation process are analyzed. Due to confidentiality reasons only little sections of each process are described.

3.2.1.1 As-Is Maintenance Process

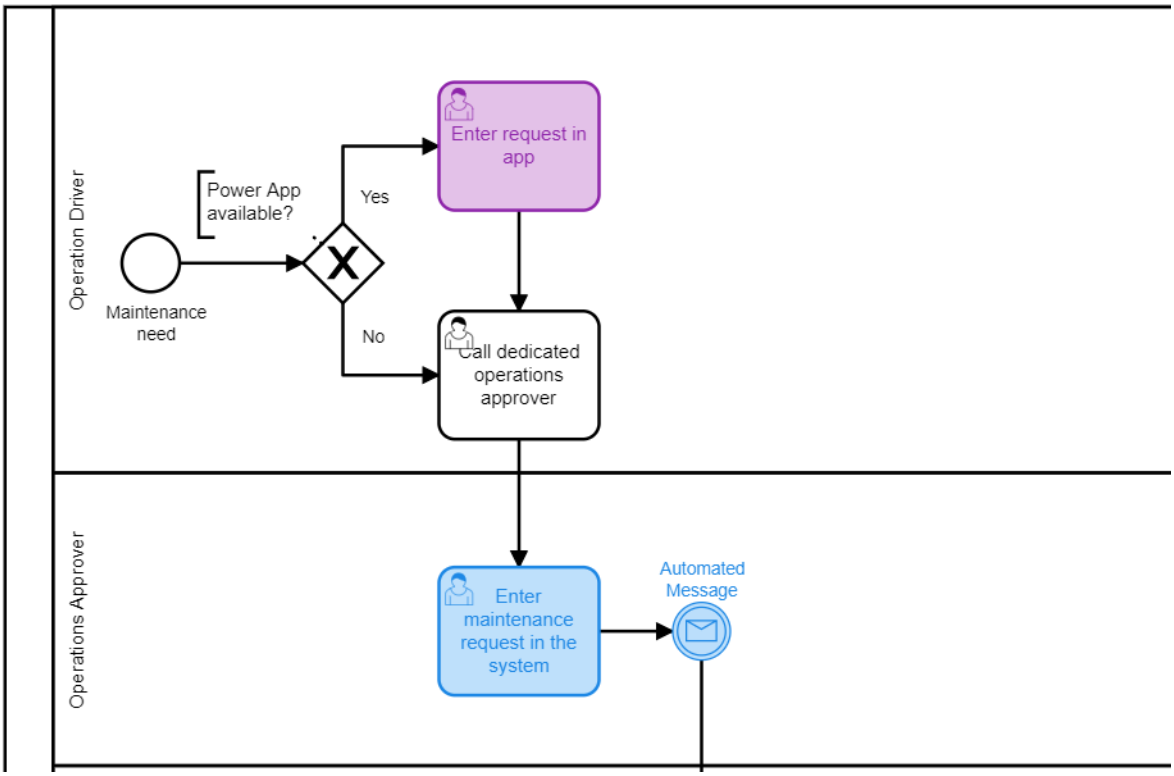
The maintenance process involves multiple systems such as Doxis (green) for document management, SAP Business ByDesign (yellow) for the invoicing process, Netprocess Waveware (blue) as the facility-management tool as well as Power Apps (purple) to capture the maintenance request. The involved roles in the process are the operations driver, operations approver, purchasing department, supplier as well as the accounting department.

The maintenance process is triggered when damages on equipment, buildings or forklifts are discovered and the operations driver reports the maintenance request (Figure 17). Currently some maintenance requests are registered via telephone and on specific sites via the self-developed Power App of the company. The Power App is in its testing phase, which causes double entries in the facility management tool. All maintenance requests have to be reported to the operations approver who manually enters the request in the facility management system. Registering request via phone could potentially lead to misunderstandings and requires employees to be constantly available in order to answer the calls.

The adequate suppliers are determined and entered into the facility management system by the purchasing department. When all the required information is filled out, the supplier is informed about the maintenance request via an automatically generated E-Mail. Afterwards, the supplier contacts the operations approver via E-Mail in order to determine a date for the

on-site inspection of the damage. However, the supplier does not always coordinate meetings with the involved site. Such misunderstandings waste time and demand further internal coordination efforts.

Figure 17: As-Is Maintenance Process Start



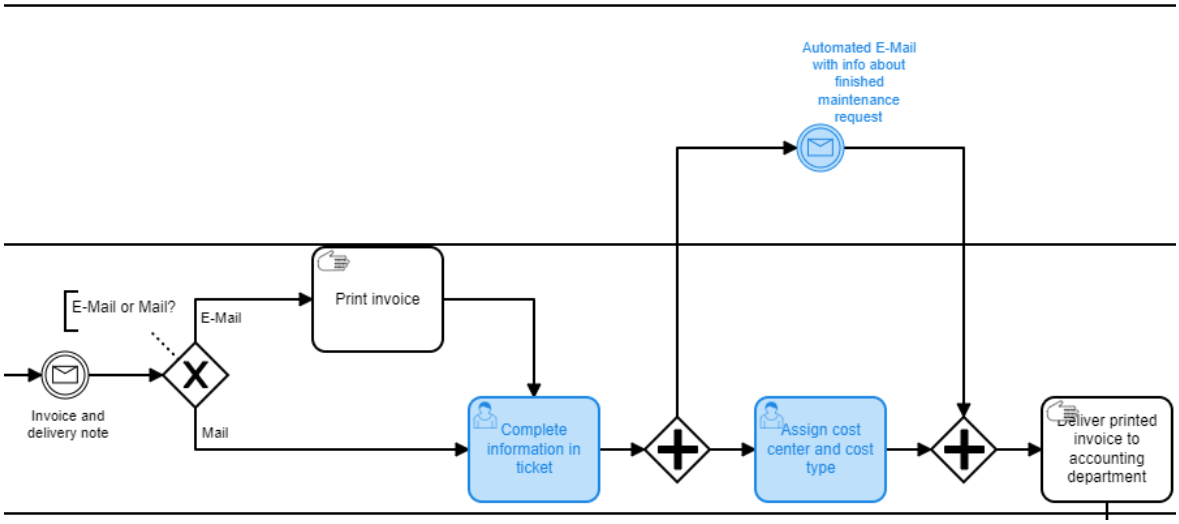
Source: Own work.

At the on-site meeting the supplier directly repairs the damage or sends an estimated cost offer of the service via E-Mail to the purchasing department (e.g. when costs of repair are higher than a specified amount or extra products need to be ordered). In such cases the estimated cost offer for the service has to go through several approval activities. When the maintenance is carried out, the operations approver signs the documents of the supplier for acceptance of the service and afterwards informs the purchasing department via E-Mail. Figure 18 illustrates how the invoice and delivery note are received by the purchasing department. The two documents are sent by the supplier to the purchasing department. The invoices are delivered either by E-Mail or Mail. If received via E-Mail the invoice has to be printed out for the accounting department. This is an environmentally unfriendly as well as time consuming procedure.

A major bottleneck within the process is that no information is exchanged whether the maintenance was carried out correctly with the accounting department. Moreover, the accounting department does not check the as-is status in the facility management tool. This

can be a drawback as invoices might get paid although the maintenance is still not fully accepted by the case study company e.g. further work of the supplier is required as well as dealing with complaints. Furthermore, the received invoice is manually checked by the accountant. Since manual tasks are more prone to errors, approving "wrong" invoices could be a threat as especially the national and international accounting principles must be properly fulfilled or the company faces high fees. Afterwards, the data has to be manually entered in Doxis and then the invoice is generated and booked in SAP Business ByDesign.

Figure 18: As-Is Maintenance Process Invoice Delivery



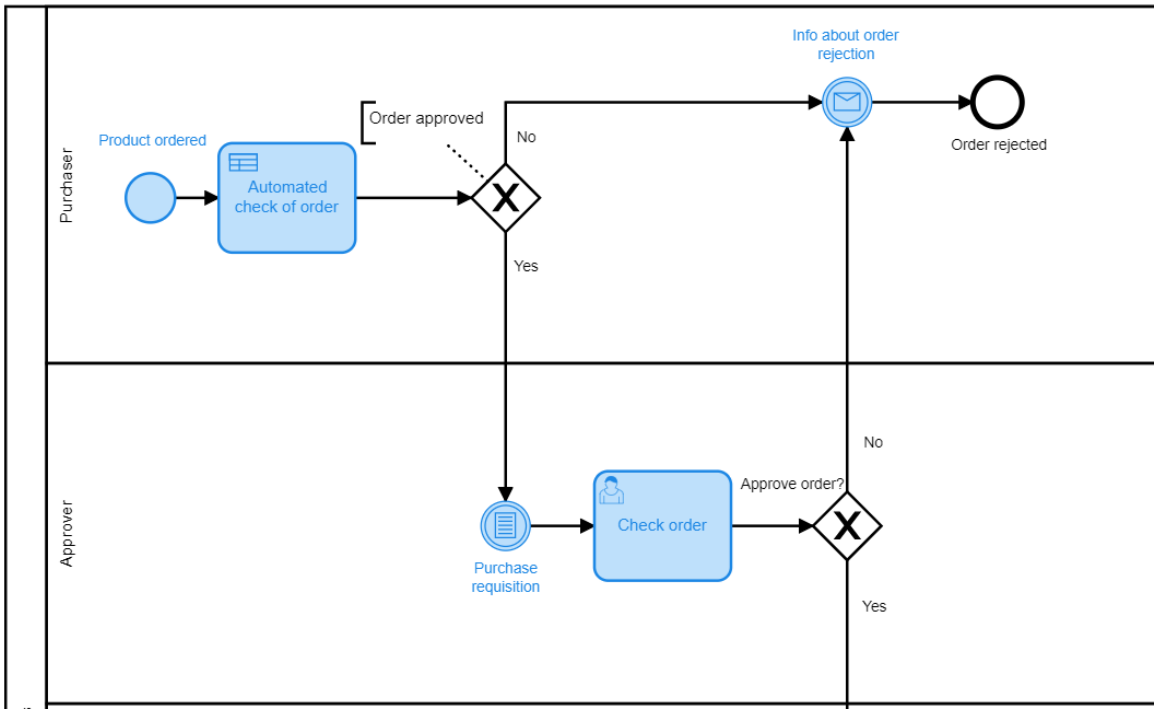
Source: Own work.

All in all, the maintenance process has a low standardization as many deviations occur and the automation level is low. One reason for this could be that many tasks are performed by humans which makes the process more prone to errors and time consuming. Throughout the process a major challenge is data consistency among all systems. Moreover, one system has to be manually updated with data every month. Keeping data up-to-date manually is a repetitive tasks and can easily lead to errors. Lastly, the communication and coordination between the involved departments is insufficient, which results in data silos.

3.2.1.2 As-Is Purchase to Pay Process

The P2P process involves two systems. One system is the purchasing tool (blue) of the contracted supplier and the other SAP Business ByDesign (yellow) for the billing activities. The roles within the process are those of the purchaser, approver, supplier and accounting department.

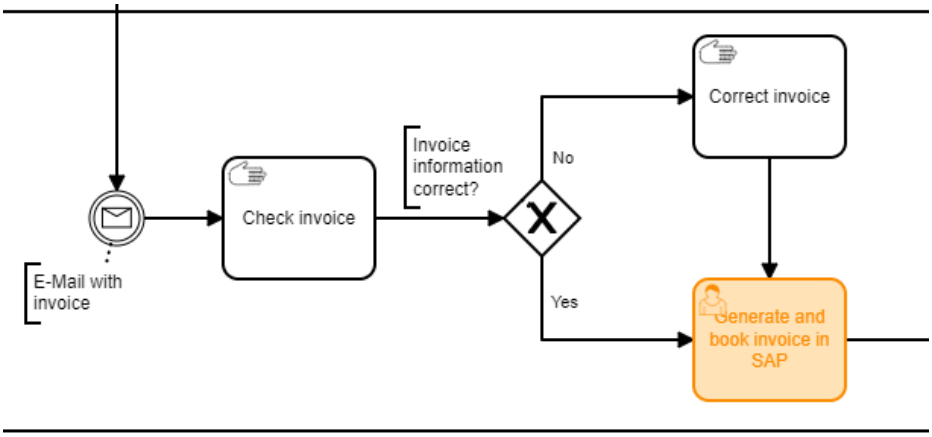
Figure 19: As-Is Purchase to Pay Process Start



Source: Own work.

The process is triggered when the purchaser has a need for a product and orders it in the purchasing tool (Figure 19). A potential threat could be that a lot of employees from different departments can place orders in the system. As no prior checking of the order is done e.g. via dedicated employees, this might be a threat as no control mechanism exists and below a certain monetary limit the purchase order is directly approved.

Figure 20: As-Is Purchase to Pay Process Invoice Delivery



Source: Own work.

The involved supplier contracts many sub-suppliers. In some cases the sub-suppliers send the order confirmation to the employee who placed the order and in other cases directly to

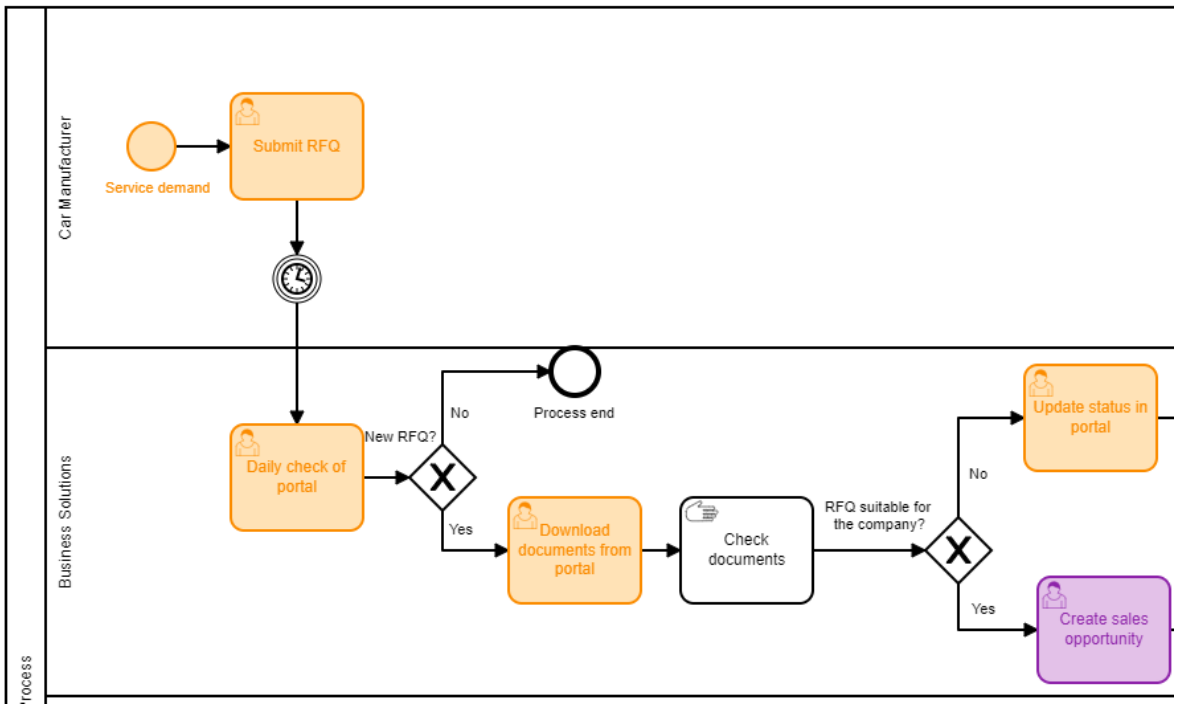
the accounting department. The products are sent to the purchaser and then have to be checked by the employee in charge. When everything is correct, the purchaser selects a specific field in the purchasing system to approve the order. In the P2P process all invoices are sent by the supplier to the accounting department via E-Mail (Figure 20). The invoices are then manually checked. When all the information is complete and correct (e.g. cost center) the invoice is generated and booked in SAP.

All in all, the P2P process only has a few deviations and automation is quite high. Moreover, different business rules are implemented in the purchasing system such as monetary limits for purchase order approval which function as a control mechanism. The coordination between employees could be improved and receiving the invoice directly via the purchasing tool could facilitate invoice checking for the accounting department due to higher transparency. Moreover, data consistency could be increased and time saved via an interface between SAP Business ByDesign and the purchasing tool.

3.2.1.3 As-Is Request for Quotation Process

The RFQ process for a German car manufacturer involves several systems inter alia the external car manufacturer portal (yellow), SharePoint (green), a customer management system called Gedys (purple) and a system for contract management named Otris (blue). The involved roles are the customer (car manufacturer), the business solutions department, a dedicated approval person and the operations department.

Figure 21: As-Is Request for Quotation Process Start

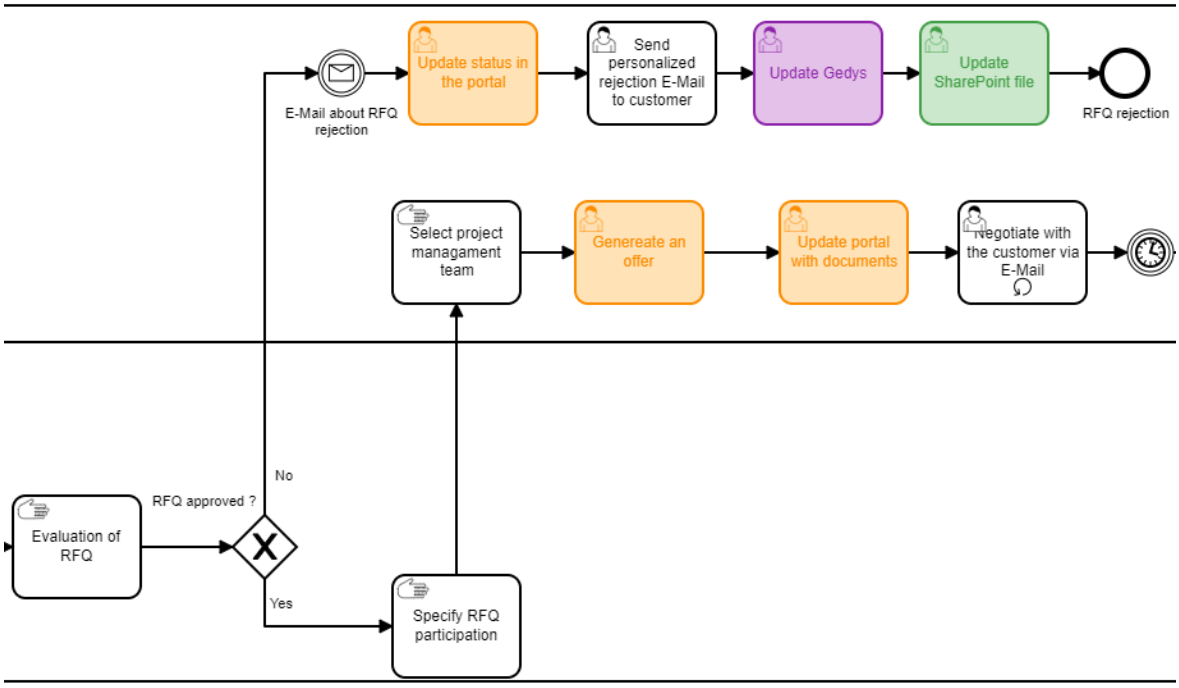


Source: Own work.

Figure 21 illustrates the starting phase of the process. The RFQ process is triggered when the car manufacturer submits an RFQ. However, a dedicated business solutions employee has to check the customer portal every day in order to determine the new request. The daily check of the portal is an inefficient task as it has a high potential for automation due to its repetitiveness.

The business solutions employee has to download the documents from the portal in order to examine them. At present this has to be done on the personal storage space of the employee. If the request is not suitable for the company, the employee writes a personal rejection E-Mail and has to update the car manufacturer portal. In case the request is suitable, a new sales opportunity is generated in the customer management system and a SharePoint folder is created. Moreover, the sales opportunity has to be generated manually in the CRM system. A major bottleneck is the missing connection between SharePoint and the car manufacturer's portal as the employee has to manually check the customer portal on a daily basis in order keep SharePoint up to date with new documents. Again, this is a highly repetitive and time-consuming activity.

Figure 22: As-Is Request for Quotation Approval Decision



Source: Own work.

After the first check by the business solutions department, the approver is contacted via E-Mail to check the RFQ (Figure 22). In case of cancellations the missing connection between the three systems represents again a bottleneck as the information has to be updated manually in all of them. On the contrary, when the request is accepted, a negotiation phase between the customer and the case study company starts. In case of rejection all the different systems

have to be updated with this information manually. When the two companies come to an agreement, the operations department takes over and the project phase starts.

The RFQ process has a high standardization, however the current automation level is low. The process is inefficient due to missing interfaces between the systems which therefore demand human resources to regularly update and check portals. Checking the portal for new requests and updates is a repetitive task. All the involved manual data entries in the different systems are time consuming. Additionally, the repetitive downloading of documents consumes storage space. Nevertheless, the personalized communication with the customer such as personally informing about RFQ rejection and the rejection reasons could positively influence their relationship, therefore the current customer interaction is efficient and value-adding.

3.2.2 To-Be-Processes

The to-be processes are developed with the aim to resolve the identified bottlenecks during the as-is analysis. This chapter describes how the company wants to improve the maintenance, purchase to pay and the request for quotation process. The three to-be models have been developed without considering the iBPMS capabilities as the company is currently not planning to implement the iBPMS for another year. However, the iBPMS later needs to be able to execute the three models, therefore they are used during the external interviews to evaluate the compatibility.

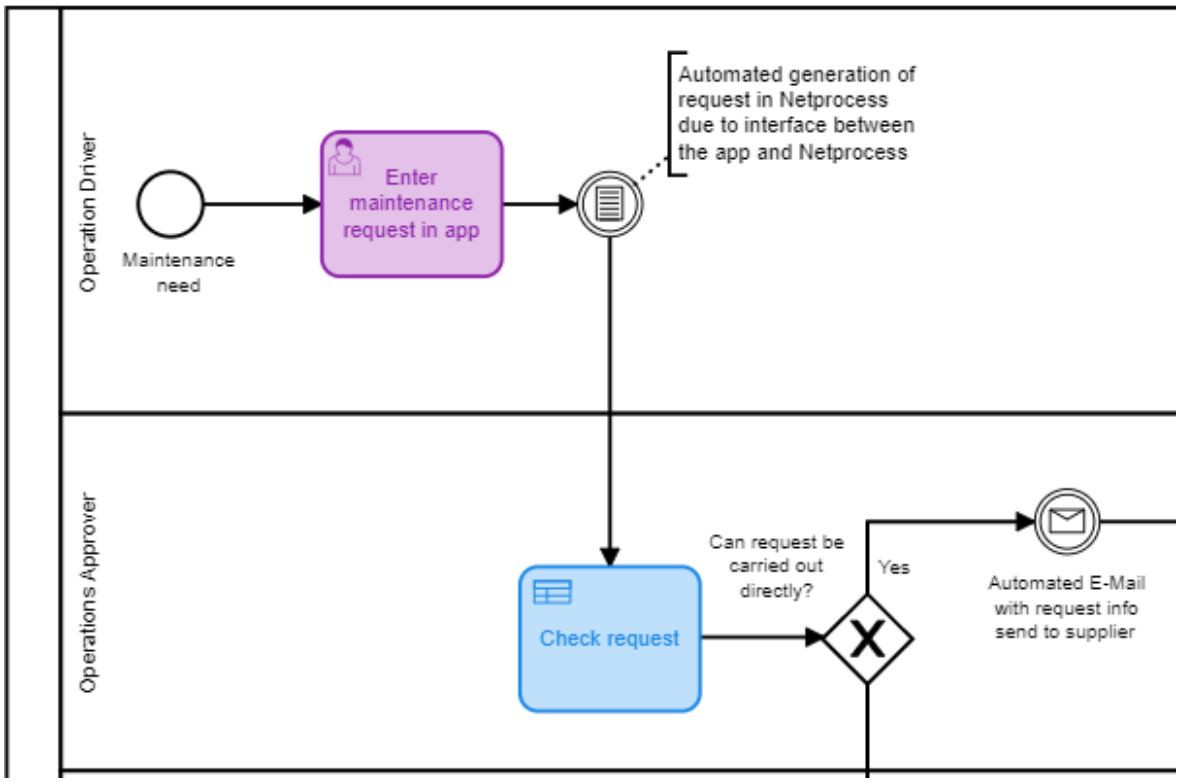
3.2.2.1 To-Be Maintenance Process

In the to-be maintenance process all requests are submitted via a single app (Figure 23). Compared to the as-is process this means that there is a uniform way to report the maintenance needs. The advantage using an app is that the operations driver can directly report the damage via the phone and does not have to waste extra time walking to a computer at the station. Moreover, pictures of the damage can be taken with the phone and attached to the request which supports categorization of the damages. However, it is important to mention that this requires employees owning a work-smartphone or tablet and the company has to ensure a reliable network connection on all sites.

The app is directly connected to the facility management tool ensuring a seamless integration. By adding the option to submit pictures it is now possible for the company to estimate costs more efficiently in order to decide if the maintenance request requires to appoint the supplier. The additional activity of making an initial cost estimation is helpful for the coordination with the supplier. In the to-be process the cost estimation of the supplier is registered in the facility management tool. This step increases transparency for all involved parties and the company can verify whether the invoice matches the initial cost estimation. Moreover, all invoices are directly sent by the supplier to the accounting

department via E-Mail and then stored in the document management system. This resolves the inefficient as well as non-environmentally friendly activity of printing invoices. An interface between the document management system and the facility management system ensures an automated update of data. Additionally, an interface between SAP By Design and the facility management system helps to automatically check invoices as well as update the facility management system when an invoice is booked. These interfaces between the different systems reduce data silos. All in all, the to-be process increases data consistency, transparency as well as the level of automation. Moreover, manual tasks are minimized and the deviations are eliminated.

Figure 23: To-Be Maintenance Process Start



Source: Own work.

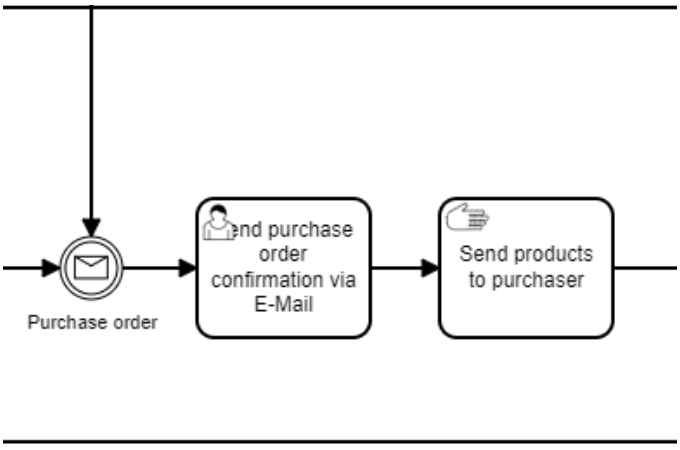
An outlook of the to-be maintenance process with hyperautomation is e.g. to implement image recognition on the submitted pictures to receive a cost estimate with AI. Another idea is to use document understanding to compare e.g. the invoice with the delivery note. The human input within the process will remain important as a lot of the activities do not take place online e.g. the on-premise service by the supplier and assessment of the damage by the employees.

3.2.2.2 To-Be Purchase to Pay Process

In the P2P to-be process two new roles are added. First, the controlling department and second a specific role for invoice checking are involved. The as-is process analysis only detected a few bottlenecks. Figure 24 illustrates how the supplier receives the purchasing order directly via the purchasing system. In the to-be process the order confirmation is always sent by the supplier to the purchaser.

The accounting department has now the task to check the invoice inter alia to compare the entries in the system whether the products have been received and accepted. Afterwards, the invoice checking role is responsible to contact the supplier in case of complaints or if the invoice is approved. The invoice checking role also fills out all the important information in SAP By Design e.g. the ledgers. The controlling department checks the different numbers of the P2P process and if necessary makes a provision. Therefore, the controlling department takes over a monitoring role. However, in the to-be P2P process no changes to the automation level have been carried out although the company could benefit from e.g. the interfaces between the systems when it comes to invoice checking.

Figure 24: To-Be Purchase-to-Pay Process



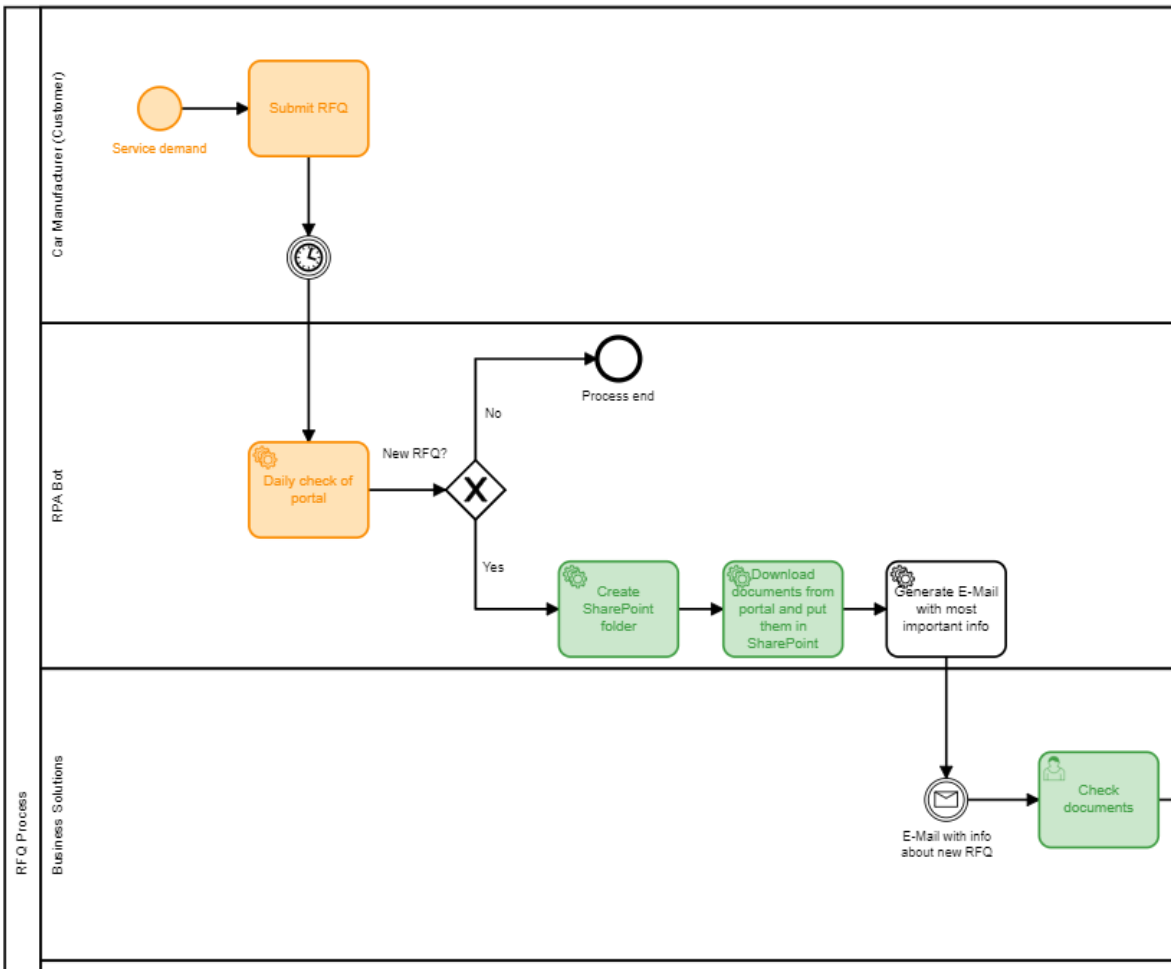
Source: Own work.

An outlook of the to-be P2P process with hyperautomation is to e.g. implement process mining to detect any compliance violations. Since many regulations are set within the P2P processes, process mining could then help to trace down who or what caused the violation. Moreover, the company could implement automated inventory control, meaning when inventory of products gets low, the products are automatically ordered and delivered to the specific site. Lastly, AI based invoice processing extracts the necessary data from the invoice received via E-Mail and inserts the invoice info in SAP Business ByDesign which could save a significant amount of time.

3.2.2.3 To-Be Request for Quotation Process

In the to-be RFQ process RPA is introduced. To illustrate the role of RPA within the process, the bot was assigned to its own swim lane (Figure 25). The car manufacturer portal is checked on a daily basis by a bot on two selected criteria. First, whether a new request has been submitted and second, whether changes have been made to previous requests by the car manufacturer.

Figure 25: To-Be Request for Quotation



Source: Own work.

If a new request is identified, the bot creates a SharePoint folder and extracts all the information from the customer portal and deposits it in the created folder. Afterwards, the bot sends an E-Mail to the business solutions department and informs it about the new request. With this E-Mail the business solutions department receives the most important information as well as the link to the previously created SharePoint folder. Compared to the as-is process, the highly repetitive task of manually monitoring the car manufacturer portal is now taken over by a bot, which saves time and resources. Moreover, employees do not have to download documents on their private storage space anymore as they can examine

the documents via the SharePoint folder. Additionally, the overall transparency is increased since all requests are now documented in the official SharePoint.

Within the SharePoint file two buttons which trigger different actions of the bot can be chosen. If the business solutions employee decides that the request is not suitable, it can be directly cancelled via the button. The employee is asked to choose the request rejection reasons. The different rejection categories have been specified in a SharePoint list in advance. The bot is triggered and moves the whole SharePoint folder to a “not approved” specified folder. Moreover, the bot updates the status to “cancelled” in the customer portal and sends an E-Mail which includes the selected rejection criteria to the employee who submitted the requests. In contrast, when the business solutions employee determines the request as suitable for the company, the acceptance button is selected. In this case the bot creates a new sales opportunity in the customer management system. Additionally, an E-Mail is sent to the approver including two selection options for approval or disapproval which again triggers the bot. All in all, the automation level highly increases due to RPA. It is an efficient tool to automate the repetitive tasks. After decisions have been made, the employees have to trigger the bot which then fulfills different activities. Consequently, the employees have now more time available for other tasks.

An outlook of the to-be RFQ process in regard to hyperautomation is that AI could complement RPA e.g. when unstructured PDF files are uploaded by the car manufacturer, AI can help to extract the necessary information. NLP could also help to understand personalized E-Mails submitted by the customer. Moreover, advanced analytics could support decision making as the company can further analyze why RFQs are implemented or not.

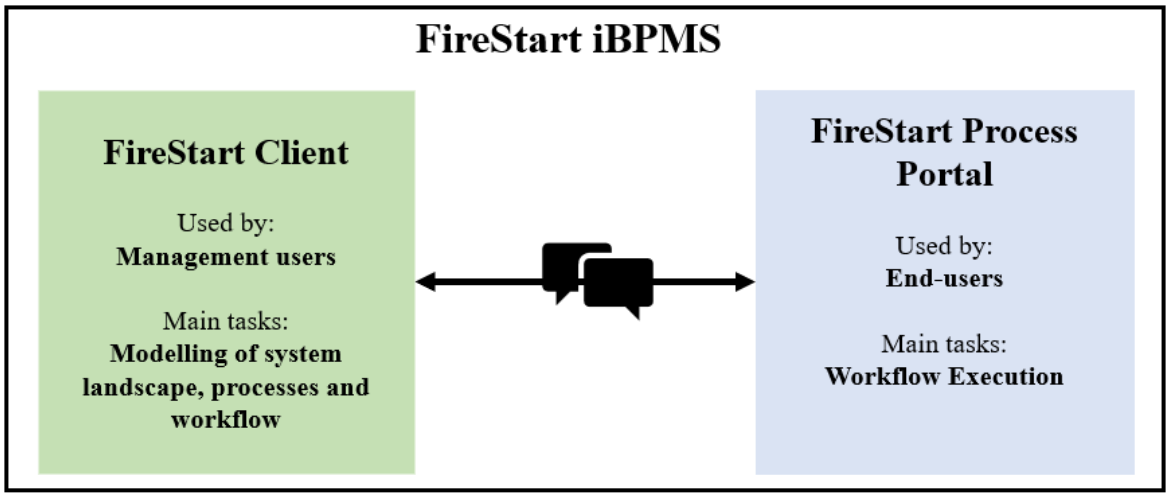
3.3 Business Process Management Suite Provider

This subchapter provides the reader with general information about the FireStart iBPMS and Microsoft Power Automate. The information is based on literature as well as the insights gathered through the interviews. Afterwards the two iBPMS are compared and evaluated.

3.3.1 FireStart

FireStart was founded in 2008 in Austria and has its headquarters in Linz. Its key business area is to provide a low-code iBPMS for company-wide orchestration covering end-to-end processes. Thereby the suite is industry-independent and covers all sorts of business processes. According to the company, their key capability is to connect different systems which ensures seamless processes and increased automation.

Figure 26: FireStart Overview



Source: Own work.

The FireStart iBPMS is divided into two main application systems, the FireStart Client and the FireStart Process Portal (Figure 26). Thereby FireStart also distinguishes the iBPMS users into two types such as the "management users" who work in the FireStart Client and the "end-users" working in the Process Portal. According to FireStart the role of management users should be given to managers and heads of departments within a company as they know the larger process structures best in order to model them. End-users execute the workflows in their day-to-day business. To ensure collaboration between management and end-users, the iBPMS supports communication of the two parties e.g. via comment options on process models.

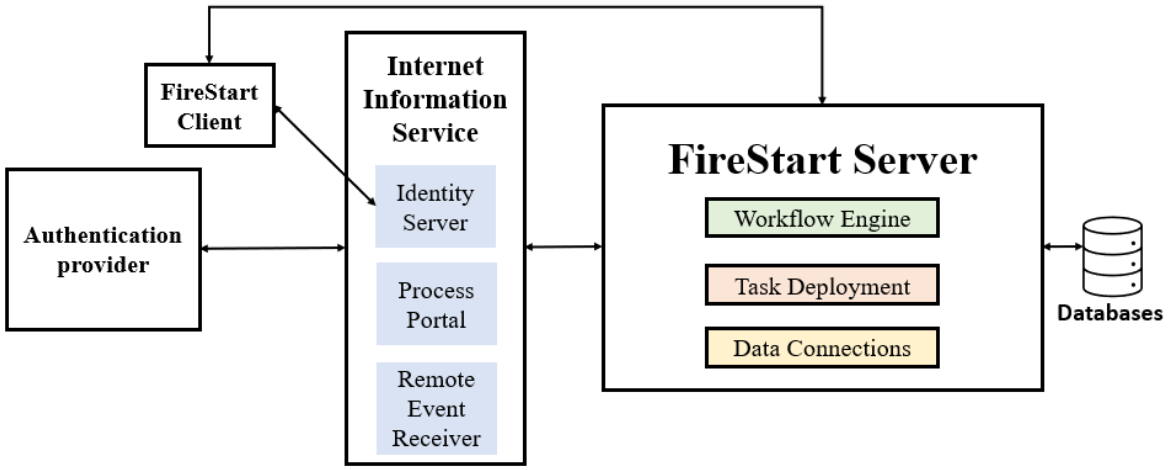
3.3.1.1 Technical Information

At present the iBPMS is only available on-premise. This means that companies have to meet certain technical requirements e.g. storage, processor, software, operating-system etc. in order to install the necessary components such as the FireStart Server, Identity Server, Remote Event Reciever, FireStart Process Portal and FireStart Client. It is important that the company ensures the ability to meet the set requirements in advance. To make sure the installation can be conducted without issues, FireStart offers various checklists which should be completed by companies e.g. filling out information about the IP addresses, the active directory domain, different usernames and passwords. For the deployment of the iBPMS FireStart offers support calls with their technical experts and can help via a remote access throughout the installation processes. Thereby the duration of the iBPMS implementation can vary significantly from one hour up to five days. Generally, updates of the FireStart Client and Process Portal are done automatically whereas updates of the server need to be initiated manually and in this time the iBPMS has to be stopped. FireStart advises companies

to acquire a test server in order to check the impact of the update on e.g. the implemented workflows before updating the production environment.

Figure 27 shortly illustrates the most important components of the iBPMS architecture. The FireStart server is responsible for execution of workflows, task distribution within the different workflows as well as exchanging data with third-party systems. The FireStart server can directly be connected to e.g. a company SQL database. The Identity Server manages the user logins and currently FireStart supports the connection to three authentication providers namely the Windows Active Directory, Azure AD and the Active Directory Federation Services (ADFS). The process portal is a web client which can be accessed via the internet offering employees to e.g. execute the assigned tasks. The Remote Event Receiver is connected to the FireStart Server as well as the third-party systems and is responsible for managing the events triggered by the third-party systems e.g. when new data is added. The FireStart Client is connected to the Identity Server and FireStart Server.

Figure 27: FireStart iBPMS Architecture



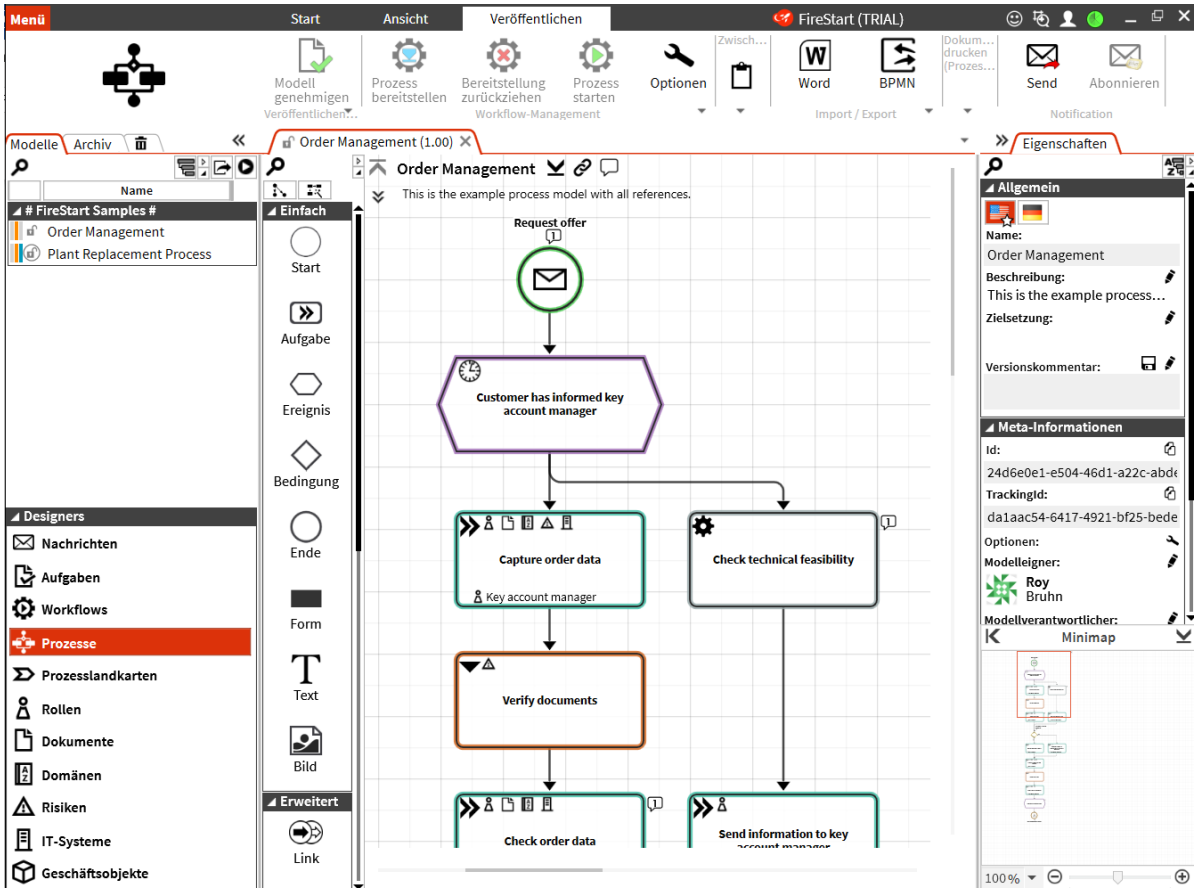
Adapted from FireStart (2021).

To integrate third-party systems to the iBPMS, FireStart uses activities where e.g. a Representational State Transfer (REST) Webservice is invoked. In FireStart business entities represent a data set (item) and are used to connect data from the target system to the source system via mapping. Generally, FireStart provides some standard adaptors e.g. to UiPath, SharePoint and ActiveDirectory. In case the standard adaptors are not sufficient, business entities can be created by using the open data protocol (OData). Interfaces can be created e.g. via REST, Simple Object Access Protocol (SOAP) or via RPA. According to FireStart, RPA is particularly useful if companies want to access systems where they do not have the licenses to e.g. systems by third-parties. If interfaces cannot be created via the mentioned method, the open-source Microsoft PowerShell Script can be used to add systems via coding. The vendor states that there is always a workaround possible and therefore up to now all of its customers have been able to integrate the desired third-party systems.

FireStart follows a one-platform approach, therefore orchestration of the different systems is important. As shown in Figure 27 the different FireStart components are connected to the third-party systems. To align all the different systems for orchestration, it is necessary that a bigger framework of the company is defined. This requires a company to specify the IT-landscape, organizational-landscape and different role-models within the systems. Afterwards the specified components can be accessed and used in e.g. process modelling, meaning that no additional intervention is necessary after the relationships have been defined and set up.

The FireStart iBPMS has a high focus on modelling. Within the suite processes have a documentative role and cannot be executed. In this case, when modelling with activities and events etc., FireStart uses the term workflows as they are executable. Within the iBPMS the whole organizational structure is modelled such as the different departments and roles e.g. the specific roles in the accounting or marketing department. By building different structures they can later be directly linked within the workflow e.g. for sending automatic E-Mails to the marketing pool. The iBPMS focuses on BPMN 2.0 and allows the export and import of models.

Figure 28: FireStart Client Overview



Source: Screenshot from the FireStart 30 day free trial.

The FireStart GUI is user-friendly with e.g. drag-and drop option and easy navigation. The suite is currently available in English and German. In contrast, within processes modelling multiple languages can be chosen and automatically translated within the advanced modelling module. Figure 28 gives a glimpse what the FireStart Client looks like.

3.3.1.2 Functionalities

As described in the previous section, the iBPMS supports modelling of processes, IT-maps etc. which provides the company with detailed insights and documentations, increasing transparency. FireStart provides several process templates, e.g. for the P2P process or HR onboarding process. Generally, the modelling of processes is directly supported by one or more FireStart employees who share their expertise with the company during the design phase of a process.

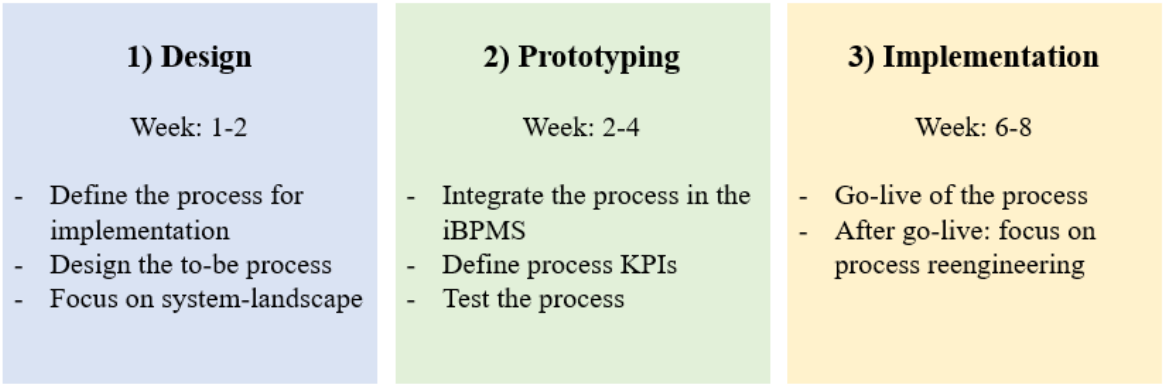
Within the suite the end-users as well as the management users have access to dashboards, which can be customized according to the necessary information. This is a useful visualization option to e.g. keep track of deadlines or KPIs in real-time e.g. about the process cycle-times or process-costs. In addition, FireStart offers the option to design risk models. Such risk models help to determine bottlenecks by assigning monetary costs to a risk e.g. in cases of delays in order to give the company an overview of the current threats within a process. Furthermore, escalation actions (e.g. after a specified interval) can be set up and through version-control each change by who and when is documented. For Business Activity Monitoring the workflow logs are used and analyzed. These options all support monitoring as well as controlling of processes and systems within the iBPMS.

According to FireStart their three main functionalities are process automation, process management and process intelligence. The iBPMS supports intelligent automation since companies can connect different applications to the suite e.g. RPA, Process Mining, OCR etc. However, it requires the company to have such tools in place. By using the iBPMS companies can analyze their intelligent capabilities from a bigger picture. Automation is supported by connecting the different systems which makes e.g. manual data upkeeping between systems unnecessary.

3.3.1.3 Operations

From an operational perspective FireStarts' iBPMS focuses on a top-down approach with the management users on the top as they decide how processes and workflow run. In contrast, the end-users cannot change processes actively and therefore do not have much influence. The duration from the process design up to process implementation can take up to eight weeks. Thereby a process undergoes three stages, namely the design, prototyping and implementation phase. Figure 29 illustrates some of the key characteristics in each stage.

Figure 29: FireStart Process Deployment Process



Source: Own work.

One advantage of the iBPMS is that the current authentication provider of a company can be directly connected to the iBPMS. Another key benefit is that within the iBPMS the permissions can be managed at a highly detailed level e.g. for business entities, documents, IT-systems, process maps etc. which gives companies the option to individually control the different contents throughout the iBPMS. Through a Microsoft Teams add-in, the employees can also receive their tasks via this application if desired.

3.3.1.4 Vendor

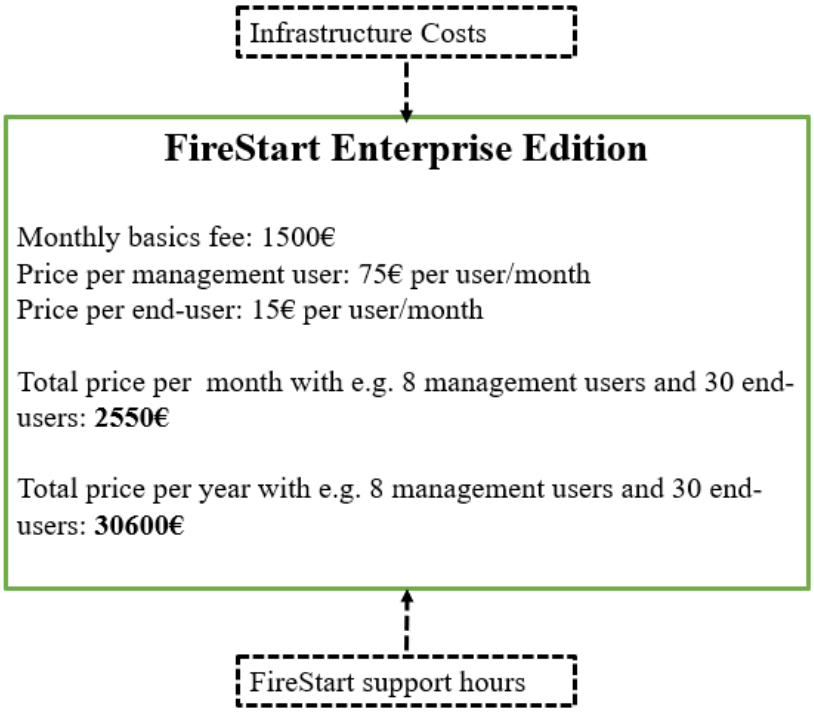
To learn about the FireStart suite, the vendor offers a free of charge documentation-base as well as access to the FireStart Academy in which employees can complete different modules, including various explanatory videos. As particularly management users need a deep knowledge of the iBPMS, the vendor offers the possibility to book workshops on desired topics.

FireStart is partnering up with different companies to deliver a better customer experience. They have a high customer focus e.g. customers can place request for further iBPMS features. In September 2021 FireStart wants to launch a cloud version of the iBPMS called "i-Path" which promises intelligent automation and a better collaboration with third parties by building an ecosystem with the solution.

The iBPMS is offered in three different licensing options: the standard edition, professional edition and enterprise edition. In all three subscription models a basic fee is paid per month as well as a certain price for each management user and end users, which has to be added on top of the monthly basic fee. The basic fee covers the license for the FireStart server as well as the specific functionalities offered within each edition. The standard edition has the lowest price. With this edition process modelling is supported e.g. creating flow charts or BPMN 2.0 models. With the professional edition process modelling as well as workflow automation is supported e.g. having a workflow engine. The most expensive edition is the enterprise

edition. This edition supports process modelling, workflow automation as well as process intelligence e.g. having real time dashboards or a deployment environment. Due to the high dependency on FireStart, the support hours need to be considered as an ongoing cost. These support hours can be individually purchased or booked as a support hour contingent. Additionally, the costs to set-up and maintain the infrastructure for the iBPMS should be regarded as with increasing numbers of users e.g. a second FireStart server might be necessary to ensure high availability, which influences the basic monthly fee. Figure 30 gives an example how much the enterprise edition would costs for 8 managers and 30 end-users per month and per year.

Figure 30: FireStart Subscription Price Enterprise Edition



Source: Own work.

3.3.1.5 Hyperautomation

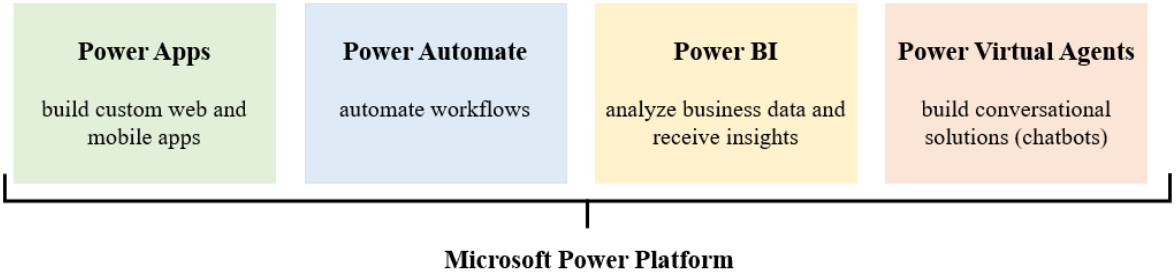
The hyperautomation concept of FireStart iBPMS is to deliver their customers an orchestration platform from which they can connect and manage all the different hyperautomation components. The advantage is that the relationship of the technologies within the end-to-end process becomes evident. Having such a process-oriented perspective on hyperautomated processes delivers new business insights which can be used to further increase performance. In order to realize the concept of hyperautomation with the iBPMS, the company itself has to have an innovative mindset. This means that the company needs to be willing to adopt the different components. FireStart has multiple strategic partners e.g. Celonis for process mining and UiPath for RPA. However, also solutions e.g. OCR or NLP

as well as solutions from non-strategic FireStart partners can be integrated via interfaces to the iBPMS.

3.3.2 Microsoft Power Automate

Power Automate, previously called Microsoft Flow, is a low code platform for designing and automating workflows. It was released in 2016 by Microsoft. Like Power Apps and Power BI, Power Automate belongs to Microsoft's Power Platform. This platform comprises of four Microsoft products which are shortly described in Figure 31.

Figure 31: Microsoft Power Platform



Adapted from Microsoft (2021f).

According to Akoa one of the biggest competitors of Power Automate is UiPath. Although UiPath is known for RPA, the company also offers very efficient automation possibilities such as e.g. document understanding. Moreover, UiPath is highly sophisticated when it comes to unattended automation. Furthermore, Akoa's experience with their customer is, that companies usually use Power Automate since it is free of charge with specific licenses, meaning that no further business costs occur. However, when workflows become more complex, clients have to switch to other licenses.

3.3.2.1 Technical Information

Microsoft Power Automate can be deployed fully via cloud or in a hybrid version. Power Automate can be used right-away, meaning that no lengthy deployment and upkeeping process is needed. A hybrid deployment enables companies to use their own databases e.g. via an SQL connector. This is usually done due to security concerns. For the hybrid version a data gateway must be installed to transfer the data from the on-premise data source to the cloud. The data gateway should be installed directly to a server and afterwards configured. Multiple data gateways within a network build a cluster and therefore support load balancing and high availability (Pearson, Knight, Knight & Quintana, 2020, pp. 159-169). According to Akoa it is advisable to store sensitive data on-premise.

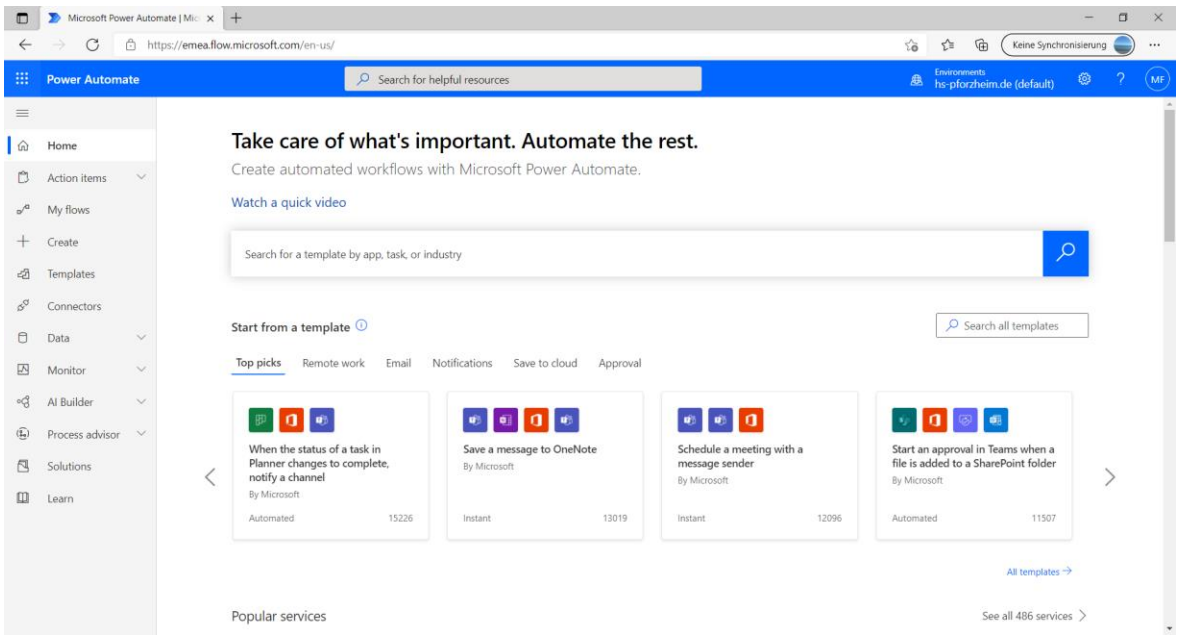
Power Automate comes with over 275 prebuilt connectors to third-party systems allowing data exchange throughout the different platforms. Microsoft connectors act as a proxy

between Power Automate and other applications. Hereby it is important to determine the right permissions so that the connectors perform the right actions (Pearson, Knight, Knight & Quintana, 2020, p. 73-82). When companies build custom connectors, they can use them throughout the whole Microsoft Power Platform. However, connectors can also be restricted to specific environments. According to Akoa it is possible to access third-party system via RPA, nevertheless the advantage of using an API is a more stable connection.

To model workflows with BPMN 2.0, Microsoft Visio can be used and directly connected to Power Automate. Each workflow can be exported as ZIP or JSON. In general Power Automate uses the Workflow Definition Language. According to Akoa Power Automate does not focus on business process modelling and it is not suitable as an orchestration platform. The interviewee from Akoa states that the workflows are de-coupled from each other and therefore the big picture is missing. Akoa regards Power Automate not as a complete solution but in combination with the other Microsoft Power Platform products it is a strong solution, also when it comes to orchestrating all the different systems among the whole Power Platform. Throughout the Power Platform companies can set up different staging concepts e.g. setting up a test, development and production environment. In the testing environment workflows can be checked in advance.

According to Akoa everything from Power Automate is saved in the 365 cloud and if e.g. flows get deleted by accident, Microsoft support needs to be contacted. Nevertheless, companies can also develop their custom solutions for back-ups e.g. exporting flows as JSON. General back-ups of the environment can be actively managed via the overall Power Platform Admin Center.

Figure 32: Power Automate Overview



Source: Screenshot of own Power Automate Platform.

Figure 32 illustrates how Power Automate looks like if accessed via a web browser for the first time. The platform is user-friendly with easy navigation, documentation and multiple language support.

3.3.2.2 Functionalities

Although Power Automate does not directly support modelling of processes, one option offered is the creation of business process flows. These flows function as a guideline for employees as they can see the different stages within a process. Therefore, business process flows support standardization. Moreover, it can be used within long-running processes. Business processes can be directly created via Power Automate with the according license (Microsoft, 2021h).

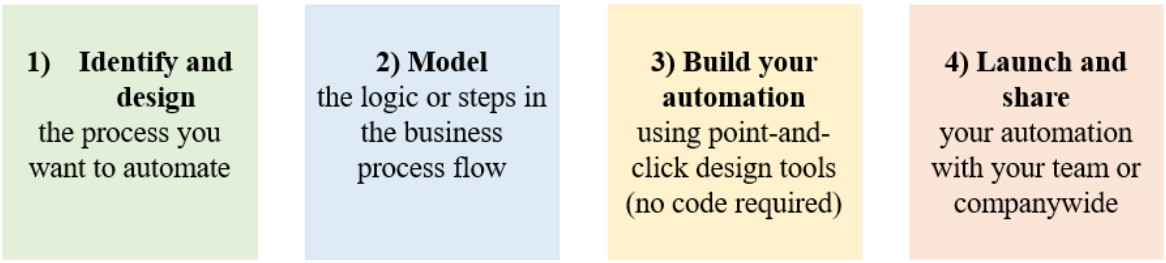
Power Automate offers a variety of templates for different workflow categories which users can customize. The workflow design is intuitive and therefore no coding experience is required. New developments can be executed by "citizen developers". Each flow contains at least one trigger and action. The main three trigger types are event triggers, scheduled triggers and push button triggers. Event triggers can be adapted for e.g. triggering the flow when an E-Mail is received. Scheduled triggers are useful for periodic tasks e.g. sending a weekly report to a supervisor. Push button triggers allow to manually trigger a flow from different devices e.g. mobile phones. Moreover, Power Automate offers the possibility to add dynamic content e.g. adding the person's name to a document if he creates a new item. Users also have the option to build conditional flows. Thereby Power Automate offers the option to implement advanced conditions e.g. "OR" and "AND" conditions or grouping different conditions together (Pearson, Knight, Knight & Quintana, 2020, pp. 82-125). Within the workflow modelling users can directly determine the steps when exceptions occur, however this has to be actively done by the user as according to Akoa no general exception handler exists.

The iBPMS offers intelligent features such as Process Advisory as a process mining tool, the AI-Builder and Ui flows for RPA. With Power Automate especially repetitive tasks can be automated. In Power Automate several employees can work together to build a flow as they see the ad-hoc updates by each other. A disadvantage according to Akoa is that no version-control is provided to see who made the change. For collaboration purposes it is also possible to make comments within a workflow. Building workflows which deal with input of users is one of Power Automates strengths e.g. within approval processes.

3.3.2.3 Operations

Since Power Automate is a Software as a Service (SaaS), the company does not have rollout costs and moreover, the platform follows a "pay as you go" cost mentality meaning that if users are added or removed, the costs for the company are adapted as well.

Figure 33: Power Automate Process Automation Steps



Adapted from Microsoft (2021g).

Figure 33 illustrates the different steps of automating a process. Power Automate provides the option to share workflows by adding users or groups to a flow. Within a workflow it is possible to implement the specific business rules. Users can be granted different access rights e.g. co-owner or read-only user. However, according to Akoa one drawback is the missing option for detailed management of rights e.g. to specific objects or documents.

Power Automate also provides a monitoring ability which gives employees an ad-hoc overview of all the workflows they own or co-own. The concept of Power Automate is a decentralized management. A general administration tool within Power Automate e.g. for managers is missing and companies need to use overall Microsoft Power Platform solutions such as e.g. CoE or the Power Platform Admin Center. This means that there is also no standard "overview hub" for all the flows for administrators. One solution to see all flows within an environment is via PowerShell which requires further installation (Power Apps Administration PowerShell module). In case an employee who has been the only owner of a flow leaves the company, Microsoft calls these flows "orphan flows". Assigning new owner could be e.g. done via PowerShell (cmdlets for administrators) (Microsoft, 2021i).

3.3.2.4 Vendor information

Power Automate offers two subscription models. The free community plan for private usage or a licensing plan for businesses. The two main licensing options within the licensing plan in 2021 are license by user (12,60 € a month per user) and license by flow (from 421,50€ per month for five flows and unlimited users). According to Microsoft (2021c) the license by user plan is a good fit for companies which want to embrace an automation culture throughout the organization as an unlimited number of flows is possible. Any end user who will work with the flow or create the flow then needs to have a license. If desired, companies can also license add-ons such as RPA-bots (126,50 € a month per bot) or the AI Builder (421,70 € a month per unit) (Microsoft, 2021a). With Office 365, Dynamics 365, Windows or Power Apps licenses the usage of some Power Automate features is included (Table 8).

Table 8: Power Automate Licensing Overview

Power Automate Capabilities	**Office 365**	**Power Apps**	**Dynamics 365**	**Windows**
Cloud Flows	Included	Included	Included	-
Business Process flows	-	Included	Included	-
Attended desktop flows	-	-	-	Included
Unattended desktop flows	-	-	-	-
Visualize and analyze processes with the Process Advisor	-	-	-	-
Standard connectors	Included	Included	Included	-
Premium and custom connectors	-	Included	Included	-
On premise data gateway	-	Included	Included	-
Daily Power Platform requests	2000	(varies by license)	(varies by license)	-
AI Builder service credits	-	-	-	-

Adapted from Microsoft (2021e, p.17).

Microsoft provides a lot of information and support to its users e.g. documentation, Microsoft Learn TV, Microsoft learning paths and the option to get certified for different platforms. Moreover, the company has multiple partners providing different services. If the case study company chooses Akoa as their strategic partner for Power Automate, the company will get support on e.g. development requests. However, currently Akoa is not yet offering official training on Power Automate Platform.

3.3.2.5 Hyperautomation

According to Microsoft Power Automate is unlocking hyperautomation as "*[…] Power Automate unifies DPA* [Digital Process Automation]*, RPA, and AI within a common, cloud-based service, providing a foundation to create, scale, and execute automated workflows that span Microsoft and non-Microsoft platforms, on-premises and throughout the cloud.*" (Microsoft, 2021b). Power Automate encompasses the capabilities to automate across on-premise and cloud apps as well as modern and legacy apps (Ghosh, 2020). Power Automate focuses on automating workflows with the option to make workflows more intelligent by using tools like Azure Cognitive Services or the AI Builder within a flow (Pearson, Knight, Knight & Quintana, 2020, pp. 73-77). In Power Automate users have the option to utilize Microsoft's RPA solution for automation purposes as well as the Process Advisor for process

mining. The Microsoft AI-Builder enables to e.g. include text recognition or category classification. With the pre-built connectors companies can also take advantage to connect third-party systems via APIs. Power Automate in combination with the Power Platform can enable hyperautomation (Ghosh, 2020). With Power BI advanced analytics is supported, with the Virtual Agents companies can connect chatbots and with Power Apps user interfaces can be created. All in all, no profound IT knowledge is necessary to use the Microsoft products, which makes it feasible for many companies to get started with the concept of hyperautomation.

3.3.3 Business Process Management Suite Comparison

After describing the two iBPMS, the following section provides a tabular comparison. The table summarizes the key findings on the developed selection criteria. Afterwards, the influence of the iBPMS on the to-be process model of the company is described.

3.3.3.1 FireStart vs. Microsoft

To adopt the FireStart iBPMS, certain system requirements have to be met in advance. Since the iBPMS is on-premise, the adaptability is not as fast as e.g. a second server might be needed with increasing numbers of employees or processes. Moreover, configuration and iBPMS set-up requires time and resources. With FireStart a high dependency on the provider is created. On the other hand, Power Automate runs over the Microsoft cloud and different licensing options are offered. Microsoft has a lot of strategic partners as well as a strong community on the internet who companies can use to get support.

At present the case study company does not have a holistic view on its business processes. From the perspective of the process lifecycle, the step of monitoring and controlling processes is missing. This a huge disadvantage since inefficient processes keep running. With Power Automate process owners can monitor their workflows e.g. see the flow lead-time as well as gather information in case of errors. If the company uses Power BI, it can build custom dashboards based on the determined KPIs due to the native connection between the two Microsoft products. With the FireStart Enterprise Edition also real-live dashboards and reports are offered which can be customized. A company which already has a BI-tool can also integrate it in the FireStart iBPMS. One special feature by FireStart is their cost-matrix-analysis which calculates the cost of a process and therefore supports cost-optimization. In general, Power Automate coupled with Power BI as well as FireStart either in the Enterprise Edition or coupled to an BI tool provide companies with new process insights as well as control over performance and other KPIs.

Microsoft Power Automate offers many different features and aims to be used by non-developers as well. This means that also more advanced features such as the AI-Builder do not require thorough background knowledge. If the FireStart suite is adopted, the company

needs to do a lot of modelling e.g. of the system landscape, process maps and flows. This requires a company to know the strategic connection between the systems and processes thus having qualified modelers. If the company does not have the necessary know-how, they can get direct support from FireStart. With the FireStart iBPMS the company will have detailed information and documentation of their business processes. In contrast Power Automate does not require e.g. skills in BPMN 2.0. Compared to Power Automate FireStart requires much more training of employees, especially of the management users and companies need to adopt the necessary know-how. In FireStart the managers are destined to model the processes and workflows whereas in Power Automate every employee can create flows and there is no centralized initiative.

Power Automate as well as FireStart support hyperautomation. In contrast to FireStart, Power Automate already encompasses multiple hyperautomation components like AI, process mining and RPA. FireStart offers some advanced features e.g. for modelling, exception handling or analytics but the other key hyperautomation components need to be acquired separately and then connected to the iBPMS. Nevertheless, FireStart has multiple strategic partners for the intelligent components, whereas according to Akoa, the offered features by Power Automate e.g. the Ui-flow are quite new and not that far advanced. This means, although the features are offered, they might not be as efficient as tools from other providers. Both iBPMS support process automation. However, with FireStart the user gets the important overview of the interrelationship between different processes as well as an orchestration platform which highly increases the added-value as more insights are received. Power Automate is more efficient when used in connection with the other Power Platform products. With the already offered Microsoft features it is "easier" to get started with hyperautomation due to the native integration of different systems within processes. Table 9 summarizes the key findings on the FireStart and Microsoft iBPMS.

Table 9: iBPMS Comparison

Criteria	FireStart BPM Suite	Microsoft Power Automate
Deployment options	On-premise	Cloud & hybrid
Software and hardware	Specific software and hardware requirements have to be fulfilled e.g. Windows operating system, minimum 8GB RAM , minimum Dual-Core (2,4 GHz) processor etc. The prerequisites are provided in the FireStart documentation database.	Generally, Power Automate can be used via various browsers without specific requirements. When using the Power Automate Desktop specific prerequisites have to be fulfilled e.g. for storage, RAM, Microsoft Edge or Google Chrome browser etc. The requirements can be found on the internet.

(table continues)

Table 9: iBPMS Comparison (continued)

Criteria	FireStart BPM Suite	Microsoft Power Automate
Intelligent mobility	Access via browser but no native FireStart mobile app offered.	Power Automate offers a mobile app for Android and iOS. The platform can also be accessed via browsers.
Updates	FireStart portals are updated automatically without disruptions. FireStart server has to be updated manually and the iBPMS has to be stopped. Releases with bugfixes are provided.	Frequent releases with new features and bugfixes are provided by Microsoft.
Back-ups	On-premise back-ups possible	Customized solution necessary
Web browsers	Support of different browsers	Support of different browsers
Orchestration	One platform approach supporting orchestration	Orchestration possible among the whole Power Platform and the created environment, not Power Automate itself
Integration	Integration with third-party systems possible	Integration with third-party systems possible
Notation support	Support of different modelling languages	Extra module needed e.g. Microsoft Visio supporting BPMN 2.0, however no connection between the modelled processes and workflow possible.
Modelling of organizational charts and enterprise architecture	Strong focus on modelling e.g. processes, IT-landscape etc.	Extra module needed e.g. Microsoft Visio for flowcharts, organizational charts etc., no direct connection to the workflows possible
Object and Document Repository	Object and document repositories can be integrated	Support to integrate different databases inter alia on-premise repositories via data-gateways
Change-Log	Version-control offered	Extra module needed called Microsoft 365 compliance center to track changes
Usability	User-friendly design	User-friendly design
Automation	End-to-end process automation supported	End-to-end process automation supported
Support options	Error-handling supported, user manuals are externally provided	Error-handling supported, user manuals are externally provided
Templates	Various templates offered	Various templates offered
Reports	Generation of customized reports supported	No report generation

(table continues)

Table 9: iBPMS Comparison (continued)

Criteria	FireStart BPM Suite	Microsoft Power Automate
Visualization	Visual representation of processes and customizable dashboards offered	Visual representation of processes but limited statics (dashboards) to owned/co-owned flows
Context interaction management	Interaction with external data possible	Interaction with external data possible
Process discovery	Not directly supported, external process mining provider necessary	Process mining offered with Process Advisory by Microsoft as well as possibility to connect third-party providers
Intelligence	Advanced analytics and advanced modelling offered. Supporting third-party intelligent solution	Directly offering intelligent Microsoft solutions like RPA, AI, process mining etc. as well as integration of third-party solutions
Real-time business analytics	Real-time analytics supported	Limited to the owned or co-owned flows, advanced analytics requires Power BI
Case Management	Creating processes is a rather static process, however workflows targeting unpredictable changes can be built	In the workflows different actions when exception occur can be set up
Collaboration/ Human interaction management	Collaboration within the portals can be improved, generally collaboration tools like Microsoft Teams are supported	Power Automate and Microsoft Teams connection possible for a better collaboration, comments within workflows possible
Flexibility	Making changes is supported	Making changes is supported
Authentication	Authentication via Windows AD, Azure AD and SAML possible, the FireStart Identity Server manages the login	Authentication with Microsoft 365, Azure AD or other on-premise systems possible
Roles & rights management	Very precise restrictions on e.g. documents can be made which highly increases control	Only limited restriction possibilities
Process responsibility	Manager users are in charge of processes	Assignment of owner and co-owners
Business Rules and Decision Management	Different individual requirements and rules can be implemented	Different individual requirements and rules can be implemented
Employee training	High amount of training necessary in particular for management users	Low amount of training needed

(table continues)

Table 9: iBPMS Comparison (continued)

Criteria	FireStart BPM Suite	Microsoft Power Automate
User number	Possible adaption of infrastructure necessary with increasing number of users	No barriers for adding and removing employees since the infrastructure is provided by Microsoft
Monitoring & control	Overall monitoring and control options of the iBPMS	Limited monitoring and control to the owned/co-owned workflows
Price	Licensing model	Licensing model
Experience & reputation	FireStart is not widely known, however customers like Swarovski have used the suite for a long time	Microsoft is one of the main software leaders worldwide having a good reputation
Implementation	FireStart is needed to guide the implementation of the suite	No direct support for the implementation required
Running iBPMS	General dependency on the provider also after the Go-live	No direct support needed
Vendor progress	Focus on individual customer request however in regard to innovations rather slow as e.g. the cloud version will be introduced this year	Microsoft is a very innovative company
Training	FireStart offers to book workshops and support hours	Training is usually provided by a Microsoft partner

Source: Own work.

3.3.3.2 To-Be Process Outlook

With both iBPMS the three to-be processes can be realized. The different systems can be either integrated with APIs or RPA via the user interface. According to FireStart their new cloud product “i-Path” could e.g. support the maintenance and P2P process as they plan to directly include the third parties to improve collaboration and build an ecosystem. As already described, this product is not yet officially launched and therefore no information is available about its feasibility. As a working method FireStart often uses customized forms which update the data with different sources in the background. In general, FireStart offers company-wide orchestration meaning that the iBPMS manages all the different involved systems after they have been connected to the platform. In contrast, Akoa states that particularly processes with many 365 office applications are suited to be implemented with Power Automate due to the native integration. From the three to-be processes the RFQ process has the highest potential as it involves SharePoint and many automated E-Mails. For the other processes custom-connectors are necessary which require coding. Power Automate itself does not provide orchestration rather the general Microsoft Power Platform is used for orchestration purposes. With this a graphical surface to manage the APIs is offered. Both

iBPMS can support synchronization of data, reducing data silos. Additionally, the iBPMS cover multiple aspects of the BPM Lifecycle:

- Process discovery: FireStart provides an overview of the overall architecture by modelling business processes. Microsoft Power Automate offers a process mining tool called Process Advisor.
- Process analysis: FireStart uses the modelled processes to gather new insights. With the Microsoft process mining tool deviations and bottlenecks can be identified.
- Process redesign: In both suites process as well as workflow changes can be implemented in a timely manner.
- Process implementation: Power Automate can be set up with a testing environment ensuring a seamless implementation. In FireStart the prototyped process can also be tested prior to its go-live.
- Process monitoring: Both suites monitor the processes and flows in real-time. With dashboards the as-is performance can be monitored. Moreover, the suites offer the possibility to implement business rules within the iBPMS which support control.

4 DISCUSSION

This chapter aims to answer the three research questions of the thesis. Based on the findings of the case study and the interviews the results and practical implications are presented. Lastly, the limitations of the study are described.

4.1 Results and Discussion

The research shows that an agile working style in combination with a cross-functional team supports innovative ideas e.g. when modelling to-be processes. Small meetings were scheduled and the key end-users invited in order to discuss the different process models as well as documenting further requirements. With the iterative approach idea generation was supported. Moreover, the key end-users were satisfied for being involved within the transformation process and the continuous communication helped to answer open questions. It was useful to shortly introduce the technologies such as RPA to the end-users to give them a general understanding of the functionalities. It is advisable for the case study company to assign a responsible person to the role of process owner to ensure further coordination and improvement of the business processes. Furthermore, KPIs should be defined and implemented. The comparison of the FireStart and Microsoft iBPMS has showed the main differences. The case study company pursues the goal to implement a platform which supports overall orchestration. Therefore, it is only advisable to use Power Automate in conjunction with other products of the Power Platform as it does not provide the required functionalities when used alone. In case the company chooses Power Automate, different modules have to be added in order to cover the key functionalities of an iBPMS. Nevertheless, Microsoft has developed many solutions which companies can integrate to the

platform based on their individual requirements inter alia intelligent services such as the AI Builder. In regard to hyperautomation companies benefit from the native integration as well as the low-code focus of Microsoft products which could be used within workflows in Power Automate. The FireStart iBPMS covers the typical iBPMS features often mentioned in literature such as modelling, orchestration, advanced analytics etc. With the FireStart suite e.g. the different APIs among systems can be managed without further human intervention due to the orchestration capability. However, most of the hyperautomation components have to be acquired separately from other providers which is less convenient compared to a provider offering native integrations. The key practical implications of the thesis are the following:

- Get a general understanding about the IT and process landscape.
- Define the desired outcome of implementing the iBPMS.
- Become familiar with the broader picture of the BPM discipline.
- Narrow down the iBPMS comparison to a few providers. Consider the functional, technical, operational and vendor selection criteria to compare and evaluate iBPMS on various areas. Ensure that the predetermined key requirements are met by the iBPMS.
- Define use cases for the iBPMS e.g. by analyzing different business process models and understand how the processes are changed with the implementation of a suite.
- Determine the desired training options of end-users as well as the responsible employees for the iBPMS initiative.

Research question 1: Is the iBPMS a useful tool to start implementing the concept of hyperautomation?

According to Gartner, the path of hyperautomation starts with simple automation involving task automation as well as event processing. This means that businesses should first focus on e.g. automating single tasks. To transform the business an iBPMS is essential since it provides the company not only with an end-to-end perspective on processes but also with an orchestration platform. With iBPMS companies have the opportunity to make bigger changes on organizational operations which means that they have a high potential to increase the level of automation of end-to-end processes and therefore support the concept of hyperautomation. With providers starting to offer cloud based iBPMS the access and implementation of the suite becomes feasible to more companies.

The case study company already adopted RPA to support task-automation. Thereby the company has trained specific employees to become experts in this area. The to-be RFQ process which involves RPA illustrates the advantages of the technology. The agile working method of the company as well their approach to actively involve end-users in the process redesign phase is successful. The employees see RPA as an opportunity to take over some of their reoccurring tasks. They were also open-minded and actively participated in the team presentation of the to-be RFQ process model. Moreover, the interview with an employee of the RPA team within the company indicated that RPA by UiPath goes beyond simple task

automation towards intelligent automation. The iBPMS by Microsoft also illustrates an approach in which with the adoption of the suite the usage option of technologies such as AI, Process Mining and RPA is provided. This demonstrates an already existing interrelationship between different hyperautomation components. This makes it difficult to suggest one specific technology as the hyperautomation starting point.

In contrast to RPA no quick wins are feasible with iBPMS. The company should acquire know-how in the general field of BPM since it is tightly coupled to iBPMS. Moreover, an iBPMS is complex and therefore requires dedicated personnel for its management and set-up. Besides the required knowledge, a company must also focus on change management. As opposed to RPA, an iBPMS could change entire processes and not only single tasks. Due to the involved process transformation, employees could be assigned to new tasks, suddenly facing different procedures or dealing with new technologies. Therefore, an iBPMS as a starting technology requires a higher focus on employee training and change management. In particular companies which are not so innovative could struggle to introduce hyperautomation due to the lack of experience. This could be the case when Power Automate is introduced and end-users generate workflows without prior modelling or coordination with managers. This might result in the go-live of (partly) false flows.

An advantage of starting the hyperautomation journey with a suite is that businesses can research which tools by different providers could be integrated more easily to the iBPMS e.g. UiPath and Celonis with the FireStart iBPMS or Microsoft products with the Microsoft iBPMS. This implies that when starting with iBPMS, the alignment of the other tools is facilitated since native connections can be determined in advance. In addition, if iBPMS are adopted first, the company has a deeper know-how about its processes and could then prioritize the implementation of other technologies based on the urgency e.g. realizing that a process could be highly optimized with intelligent document understanding or the need for advanced analytics. However, the system landscape has to be updated and processes have to be reengineered if e.g. AI and RPA are added posterior. Nevertheless, an iBPMS must be able to handle such changes as it is one of the main reasons for its adoption, namely combining different technologies, processes and people within the suite. According to the case study company the iBPMS is essential for hyperautomation. With the iBPMS the company would be able to orchestrate their systems. The processes are currently running in silos and no overall tool for monitoring and control exists.

In conclusion, an iBPMS can be a useful tool to get started with hyperautomation since companies become aware of their processes and therefore can better determine the key technologies required. Moreover, more native integration with other components can be ensured. However, starting with an iBPMS is a big change initiative and employees could struggle since they have no prior experience with automation technologies.

Research question 2: "What are key considerations for selecting an iBPMS provider?"

The case study shows that it is helpful to regard the technical, functional, operational as well as the provider perspective of an iBPMS. By considering these four areas, an understanding of the bigger picture of the iBPMS is created. This supports companies to determine the most suitable suite. Choosing an iBPMS which best matches the organizational goals ensures sustainability. As the implementation of a suite has a high impact on the organization, the selection has to be carefully carried out. The developed criteria can be used during the iBPMS selection phase, functioning as reference points for the iBPMS evaluation.

During the research phase it was difficult to receive information on all the developed criteria. The information on the websites or other documentation is often limited. In particular the provided information about the FireStart iBPMS was little compared to the Microsoft iBPMS. The advantage of Microsoft is that it is one of the key software leaders and therefore has a strong community which continuously shares its experiences.

In the first step of the iBPMS selection the case study company chose two iBPMS for the evaluation. The choice fell on Power Automate and the FireStart iBPMS due to their support of Microsoft products since the company switched to Office 365 and adopted various other Microsoft applications. After the two iBPMS were determined, the author interviewed the manager of the case study company who is also responsible for the iBPMS initiative. Orchestration and on-going costs were defined as the key requirements of the company. During the research it was important to prioritize the selection criteria based on the company needs in order to receive the necessary information.

All in all, the developed selection criteria create a holistic view which supports decision making. In practice it is difficult to receive information on all criteria, therefore companies should prioritize the criteria based on their individual requirements. If desired, companies could use assessment methods like e.g. AHP or MCDM for the iBPMS evaluation.

Research question 3: "How can the process be optimized with the implementation of the iBPMS?"

The three evaluated business processes show how diverse processes within a company can be in regard to e.g. the degree of automation, standardization or the involved parties and systems. Thereby complexity increases when third parties such as customers or suppliers are involved due to the required coordination efforts. Implementing an iBPMS can support the overall management as it is a one-platform approach. With the iBPMS managers receive a company wide overview of their processes and systems which delivers new insights as data silos within the company are broken. In particular compliance can be increased since the iBPMS delivers an ad-hoc digital image of the process reporting deviations and errors. Moreover, not only management is supported but also the automation level can be increased. With an increased automation level the process runtimes can be decreased. By connecting systems via interfaces to the iBPMS, companies can easier keep the data among the systems up to date. Thereby specifically tasks like data maintenance can be automated. Additionally,

the iBPMS helps to analyze, detect and resolve bottlenecks resulting in increased productivity.

The iBPMS evaluation shows that suites require different skills. The FireStart iBPMS focuses highly on modelling capabilities. This skill goes hand in hand with process optimization. By modelling processes as well as organizational structures and the IT landscape, a company-wide understanding is created. With such a comprehensive view processes can be optimized. In contrast, the iBPMS by Microsoft has its main focus on automation. Processes could be modelled with an additional module, though this is not a common practice in Power Automate. Therefore, the processes are usually not changed when implemented in the iBPMS.

All in all, iBPMS help to discover, analyze, design, automate, measure, monitor and to reassess processes which are the main characteristics of the BPM lifecycle. The case study has shown that also complex processes can be implemented within different suites. As different systems can be combined within a processes, a company can also derive more value from data. Furthermore, connecting hyperautomation components to the processes can make them more intelligent and efficient which can save time as well as costs.

4.2 Limitations

It is also important to mention the limitations of this research. As the thesis only focuses on a single case study, it is difficult to generalize the findings. Furthermore, the case study demonstrates a snapshot as the author's time at the company is limited to five months. Therefore, the author is only involved in the evaluation phase but not the deployment phase of the iBPMS. Being a part of the whole iBPMS implementation phase could deliver further insights since the actual impact of the suite on the IT-infrastructure, processes and employees can be better evaluated. That also applies to the implementation of the to-be process models. Additionally, further research could be carried out on how iBPMS handle non standardized processes or unstructured data.

The developed selection criteria were only tested with the case study company. Within the study they provided a helpful overview on the different areas of each iBPMS which were useful to the company. Receiving further feedback by companies could help to evaluate their usability. However, since the criteria are based on several different sources, they represent a summary of the general key requirements from different literature.

The scientific literature on hyperautomation is limited, which makes it difficult to receive an objective view on the topic. In particular most of the evaluated sources describe the role of RPA within hyperautomation whereas the content on the interrelationship between hyperautomation and iBPMS is hardly present. The two interviews with Akoa and FireStart described the interrelationship from an iBPMS vendor perspective. Thereby two different iBPMS approaches to hyperautomation were presented. Due to the lack of practical

implications, it is not possible to make a declaration which approach is more efficient when companies want to start their hyperautomation journey. The findings of the study provide the reader with an example of how companies can approach the topic, however as the study is limited to one company the findings are not representable.

CONCLUSION

The thesis provides the reader with a theoretical background on hyperautomation and iBPMS. Thereby two iBPMS, one by FireStart and the other one by Microsoft, are evaluated and their approach to hyperautomation presented. The research shows that iBPMS can highly differ in their characteristics. The FireStart suite focuses on a model-driven approach whereas the Microsoft suite focuses on the operational rather than the conceptual level of process design. A thorough evaluation is necessary to select a suitable suite. The thesis proposes several selection criteria covering the technical, functional, operational and vendor perspective. With the iBPMS comparison the case study company receives further insights into the different suites supporting them in their decision making process. Moreover, different practical implications are presented which can support the case study company during the actual implementation of the iBPMS. Additionally, the opportunities as well as the challenges of hyperautomation and iBPMS are described.

Within the research the RFQ, P2P and maintenance process of the company are analyzed and afterwards redesigned to resolve the identified bottlenecks. Based on the to-be process models the thesis examines the influence of introducing an iBPMS and gives a short outlook on hyperautomation. Companies can particularly benefit from iBPMS as a result of an increased level of automation as well as managing different systems, processes and people from a single platform. Furthermore, iBPMS focus on the entire business processes. Therefore, iBPMS are a key component for the concept of hyperautomation as e.g. it is possible to implement AI to a process model to manage unstructured data (e.g. images). Managers receive further insights into processes due to the offered real-time analytical options of an iBPMS e.g. the interrelationship of the different technologies within the processes. Based on the insights different processes can be efficiently redesigned.

In the future more and more companies will combine different technologies within processes as they offer various advantages. For this reason the awareness and implementation of the concept of hyperautomation will increase. The thesis shortly describes challenges within the logistics sector in particular its competitiveness as well as the complex business processes. The case study company could benefit from hyperautomation due to increased customer satisfaction and thus gain a competitive advantage. The evaluated iBPMS show that the suites are able to adapt quickly to changes. Moreover, most providers continuously introduce new iBPMS features and focus on providing a low-code/no-code suite. Future work can be based on the implementation of context aware adaption of business process models. As the research is limited to a single company and focusses on the iBPMS selection phase, further

research can be carried out with companies from other industries to evaluate the opportunities and challenges of iBPMS, in particular of straight-through processes. Furthermore, the influence of hyperautomation on employees could be examined as more cognitive work will be carried out by technologies.

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APPENDICES

Appendix 1: Povzetek (Summary in Slovene language)

Gartner je hiperavtomatizacijo opredelil kot ključni trend za leti 2020 in 2021. Pri konceptu hiperavtomatizacije gre za združevanje zmogljivosti različnih orodij za povečanje avtomatizacije in zmanjšanje človekovega vključevanja v poslovne procese. To magistrsko delo se osredotoča na vrednotenje paketov inteligentnega upravljanja poslovnih procesov (iBPMS) v širši sliki hiperavtomatizacije. Agarwal et al. (2020, str. 5) navaja, da sta iBPMS in robotska avtomatizacija procesov (RPA) osrednji sestavini hiperavtomatizacije, saj se RPA osredotoča na avtomatizacijo ponavljajočih se nalog, medtem ko lahko iBPMS obvladuje zapletene, dolgotrajne procese. Poleg tega so iBPMS rešitev, ki omogoča usklajevanje ljudi, strojev, procesov in celoten življenjski cikel poslovnih procesov (Agarwal et al., 2020, str. 5).

Raziskava je potekala v sodelovanju z nemškim logističnim podjetjem, ki razmišlja o uvedbi sistema iBPMS za avtomatizacijo in orkestriranje svojih poslovnih procesov. V ta namen smo ocenili dva iBPMS, enega razvija Microsoft, drugega pa FireStart. Ta dva ponudnika iBPMS je podjetje izbralo zaradi podpore Microsoftovim izdelkom in ugleda. Za primerjavo obeh sklopov sem na podlagi pregleda literature razvila več izbirnih meril. Poleg tega so bili dokumentirani in analizirani trije poslovni procesi podjetja za proučevanje primerov (takšni kot so in bodoči) za oceno vpliva iBPMS na posebne procese. Na podlagi pregledane literature je študija primera v povezavi z opravljenimi intervjuji namenjena odgovoru na naslednja raziskovalna vprašanja:

- *Raziskovalno vprašanje 1: "Je iBPMS uporabno orodje za začetek izvajanja koncepta hiperavtomatizacije?"*
- *Raziskovalno vprašanje 2: "Kateri so ključni vidiki pri izbiri ponudnika iBPMS?"*
- *Raziskovalno vprašanje 3: "Kako je mogoče proces optimizirati z izvajanjem sistema iBPMS?"*

Magistrsko delo kaže, da so iBPMS pomembni za hiperavtomatizacijo, saj zagotavljajo potrebno platformo za povezovanje različnih sistemov. Upravitelji lahko pridobijo z iBPMS npr. boljše odločanje na podlagi celostnega pogleda ter učinkovitega usklajevanja sistemov, procesov in zaposlenih. iBPMS je lahko dobro izhodišče za hiperavtomatizacijo zaradi več vmesnikov med sistemi. Procesi, ki se izvajajo v sistemu iBPMS, bi se lahko nato razvili še korak dlje z razvojem inteligentnejših procesnih modelov, ki temeljijo na umetni inteligenci, uvedbi procesnega rudarjenja ali uporabi robotov RPA za izboljšanje avtomatizacije opravil. Za izbiro ustreznega iBPMS se lahko uporabijo uvedena merila za izbor, ki zajemajo funkcionalno, tehnično, operativno in prodajno perspektivo. Razvita merila podjetjem dajejo splošen pregled nad paketom. Ker pa je raziskava omejena na eno samo študijo primera, ugotovitev ni mogoče posplošiti. Kljub temu pa teza bralcu daje praktične posledice in jo je mogoče uporabiti za nadaljnje raziskave na področju hiperavtomatizacije.

Appendix 2: Success factors and capability areas of logistic service providers

Table based on Cichosz, Wallenburg and Knemeyer (2020, pp.224-225):

Success factors	Capabilities
Leadership	• *Leaders monitor market trends, seize technological opportunities and translate them into business opportunities* • *Leaders develop and communicate the digital transformation vision* • *Leaders inspire and motivate employees to be part of the digital transformation* • *Leaders shape supportive organizational culture for the digital transformation* • *Leaders empower employees and cascade digital transformation decisions down* • *Leaders, supported by system and procedures, execute and govern the digital transformation*
Supportive organizational culture	• *Communicating and sharing company's norms, values, beliefs and attitudes via meetings, presentations and workshops* • *Creating a supportive work environment with trust, empowerment* • *Building agile organization structure via project management, fluid teams, flexible processes, people's openness to collaboration and change* • *Bottom-up initiatives proactively improving processes and services* • *Employees actively ask questions* • *Mistakes are accepted and not punished*
Employee and partner engagement	• *Programs communicating digital transformation vison and goals* • *Programs to get the right level of management sponsorship* • *Programs to bring-in new ideas* • *Programs encouraging cross-boundaries collaboration* • *Workshops building strengthening "growth mindset"*
Aligning business and IT strategies	• *Digital transformation vision and goals as a part of digital business strategy* • *Pursuing aligning actions to reconfigure resources and redefine the strategy* • *"Dynamic synchronization" of business and IT strategies and resources* • *Building agile organization for fast adaptation to changing environment* • *Communicating aligned strategy to the public in a comprehensive way*
Process standardization and data integration	• *PMO – Project Management and Organization* • *Lean management* • *Simplification and standardization programs* • *Best Practice Library*

	• *Establishing KPIs* • *Real-time data and applications integration*
Employee training and skills development	• *Workshops building digital awareness and enhancing digital skills* • *Workshops strengthening "growth mindset"* • *"Training the trainer" programs* • *Developing business cases to present reference practices* • *Creating environment for "on-the-job" learning*
Agile transformation management	• *Building agile organization for fast adaptation to changing environment* • *Small cross-functional teams* • *Iteration during innovation development process* • *Communication and collaboration with clients* • *Pilot projects for checking barriers and gaining know-how in innovation* • *Mixing methods if applying only agile method is impossible*
Leveraging internal and external (technological) knowledge	• *Using big data repositories as a source of knowledge* • *Programs stimulating collaboration with technological suppliers* • *Programs stimulating collaboration with startups, e.g. corporate accelerators, speed-dating summits* • *Pilot projects for checking barriers and gaining know-how in innovation*

Appendix 3: Interview Question Areas.

Predetermined question areas for interview with FireStart and Akoa:

1. **General Information about the iBPMS**
   - 1.1.Deployment
   - 1.2.Implementation
   - 1.3.Price
   - 1.4.Training

2. **Process related questions**
   - 2.1.Process administration
   - 2.2.Process modelling, templates and reports
   - 2.3.Steps in the systems from modelling to the go-live
   - 2.4.Handling of process changes
   - 2.5.Introduction of the three to-be process models and their realization

3. **Orchestration**
   - 3.1.Technical background
   - 3.2.Integration of third-party systems
   - 3.3.Management

4. **Hyperautomation**
   - 4.1.Hyperautomation introduction
   - 4.2.Hyperautomation realization of the iBPMS

5. **Conclusion**
   - 5.1.Summary of key benefits
   - 5.2.Future outlook