Lappeenranta-Lahti University of Technology LUT

School of Business and Management

Master's Programme in Supply Management

Master's Thesis

ASSESSING THE SUITABILITY OF UPSTREAM SUPPLY CHAIN FUNCTIONS FOR DEPLOYING ROBOTIC PROCESS AUTOMATION

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August 2019

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TIIVISTELMÄ

Tekijä:	Tommi Tarkkonen
Otsikko:	Toimitusketjun ylävirran toimintojen soveltuvuuden arviointi ohjelmistorobotiikan käyttöönottamiseksi
Tiedekunta:	LUT School of Business and Management
Maisteriohjelma:	Supply Management
Vuosi:	2019
Pro gradu -tutkielma:	Lappeenrannan-Lahden teknillinen yliopisto LUT
	103 sivua, 17 kuviota, 7 taulukkoa, 1 liite
Tarkastajat:	Professori Jukka Hallikas
	Tutkijaopettaja Mika Immonen
Hakusanat:	Ohjelmistorobotiikka, toimitusketjun hallinta, toimitusketjun ylävirta, automaatio, robotiikka

Tämän työn tarkoituksena on arvioida liiketoimintaympäristön soveltuvuutta ohjelmistorobotiikan käyttöönottamiseksi. Toisin sanoen, ideana on saada ymmärrys tämänhetkisestä ympäristön tilasta automatiikkaa silmällä pitäen. Tämä ympäristö koostuu toimitusketjun ylävirran toiminnoista sekä aktiviteeteista kohdeyrityksen sisällä. Prosessit ja muutosjohtamisen näkökulmat määrittelevät soveltuvuuden tuossa ympäristössä.

Mitä tulee tutkimusmetodologiaan, sekä määrällisen että laadullisen yhdistelmä on valittu. Tämä juontaa siitä, että työssä käytetään puolistrukturoituja haastatteluja, jotka omaavat piirteitä näistä molemmista tutkimusmenetelmistä. Tutkimustavaksi on valittu tapaustutkimus, jossa keskiössä on kohdeyrityksen liiketoimintaympäristö. Puolistrukturoidut haastattelut ja niitä seuraava analyysi tarjoavat kuvan tämänhetkisestä ympäristön tilasta. Siinä löydetään yli 20 alaprosessia, joista osa on soveltuvampia kuin toiset. Henkilöstönäkökulma on riittävällä tasolla. Vastustusta tai esteitä ei juurikaan ole. Prosessimielessä ympäristön kokonaissoveltuvuus sekä valmius eivät ole tällä hetkellä riittävällä tasolla ohjelmistorobotiikan käyttöönottamiseksi. Keskeisiä toimia esitetään soveltuvuuden edistämiseksi, ja samalla havaitaan muitakin automaatioon liittyviä kehityskohteita. Ohjelmistorobotiikkaan liittyen on tarjolla melko vähän akateemista kirjallisuutta, joten tämä työ tuo lisäarvoa sekä käytännön esimerkkejä teoreettiseen näkökulmaan. Sekä uusia soveltuvia että sopimattomia prosesseja esitellään ja tuodaan esille.

ABSTRACT

Author:	Tommi Tarkkonen
Title:	Assessing the Suitability of Upstream Supply Chain Functions for Deploying Robotic Process Automation
Faculty:	LUT School of Business and Management
Master's Programme:	Supply Management
Year:	2019
Master's Thesis:	Lappeenranta-Lahti University of Technology LUT
	103 pages, 17 figures, 7 tables, 1 appendix
Examiners:	Professor Jukka Hallikas
	Associate Professor Mika Immonen
Keywords:	Robotic process automation, supply chain management, upstream supply chain, automation, robotics

The aim of this study is to assess the business environment's suitability for Robotic Process Automation (RPA). In other words, the idea is to obtain an understanding of the current state of the environment for automation. This environment consists of upstream supply chain functions and activities inside the case company. The suitability is determined by processes as well as change management aspects in that environment.

As for the research methodology, a mixed one of both quantitative and qualitative aspects is chosen. This is derived from the fact that semi-structured interviews are used for they have qualities from both types. As for the method, a case study is selected where the business environment represents the case. The semi-structured interviews and the following analysis provide a picture of the current state of the business environment. Over 20 different tasks and subprocesses are discovered of which some are more suitable than others. Employee aspects are adequate. There are no objections or barriers to automation in that regard. Process-wise, the overall suitability and readiness of the environment is not currently in a sufficient level for RPA. Essential actions to further the suitableness are presented, while some other automation development objects are also discovered. There is very little academic work related to RPA, so this thesis brings added value and practical examples to the scholarly perspective. Both new suitable and unfit processes are presented and brought forward.

ACKNOWLEDGEMENTS

Quite a journey this has been. It all started from the very beginning in Sipoo over 20 years ago and continued in Kauniainen, where I attended elementary as well as upper secondary school. Just shortly after becoming an undergraduate, my schooling took me north where I studied a bachelor's degree at the University of Oulu. Three years of studying included participating in a student exchange program at the University of Padua in Italy. After finishing my bachelor's degree in Oulu, the journey yet took me to Lappeenranta. Following some serious hustling, studying and learning, I have finally concluded my studies and about to graduate as a Master of Science in Economics and Business Administration at the Lappeenranta-Lahti University of Technology. The journey is finally coming to an end.

I always thought that it would bring nothing but satisfaction, but in a strange way, it is kind of wistful to leave all this behind. Regardless, all things must come to an end and who knows, maybe the journey will continue later on at some point in the future. Never say never. For now, it is time to embrace new challenges to come.

Before that happens, I would like to thank the LUT staff for providing me valuable advice not only during other courses but also in concluding this thesis in the best way possible. I thank the case company personnel for trusting me this challenging yet so fascinating topic and for guiding me to achieve the desired conclusion. My dear friends in and outside of university, I would like to express my gratitude for support to keep things going. You know who you are. Finally, the biggest thanks belong to my family for always being there for me and supporting me no matter what.

Tommi Tarkkonen
in Espoo, Finland
4.8.2019

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LIST OF ABBREVIATIONS

AI	Artificial Intelligence
API	Application Programming Interface
BI	Business Intelligence
BPA	Business Process Automation
BPM	Business Process Management
BPO	Business Process Outsourcing
CCF	Component Contract File
CoE	Center of Excellence
CRM	Customer Relationship Management
CSM	Customer Service Management
EAI	Enterprise Application Integration
ECN	Engineering Change Notice
ERP	Enterprise Resource Planning
ETL	Extract, Transform, Load
ICT	Information and Communications Technology
IoT	Internet of Things
IT	Information Technology
ITPA	Information Technology Process Automation
KPI	Key Performance Indicator
LOO	Late Open Order
MDM	Master Data Management
MRP	Material Requirements Planning
MSO	Manual Special Order
NPD	New Product Development
OCR	Optical Character Recognition
OTD	On Time Delivery
PDD	Process Design Document
PoC	Proof of Concept
PoV	Proof of Value
PSA	Product and Service Agreement
R&D	Research and Development
RFI	Request for Information

RFP	Request for Proposal
RFQ	Request for Quotation
ROI	Return on Investment
RPA	Robotic Process Automation
SaaS	Software as a Service
SCM	Supply Chain Management
SMEs	Small and Medium-sized Enterprises
S&OP	Sales and Operations Planning
SRM	Supplier Relationship Management
TOM	Target Operating Model

1 INTRODUCTION

Ever since the end of the 18th century, major technological leaps and improvements have gradually resulted in various shifts called industrial revolutions. The first industrial revolution introduced mechanization, the second the usage of electrical energy, and the third the world of digitalization and computerization (Lasi, Fettke, Kemper, Feld & Hoffmann 2014, 239). During and in between these eras, it has been important to somehow improve processes and make them more efficient. How else these shifts would have been possible? In general, process improvement concentrates on proactively identifying, analyzing and improving important business processes on a continuous basis. The aim is to enhance the quality of products and services, remove waste, and being able to maintain the results (Aqlan & Al-Fandi 2018, 261). Now, due to process improvements, rapid advancements in technology, increasing complexity in business environments with increasing data volumes, and the previous revolutions' cumulative effect, the fourth industrial revolution, or Industry 4.0, has gained a foothold in the last decade. It comprises elements of analytics, machine learning, Artificial Intelligence (AI), big data, and the Internet of Things (IoT). (Kapoor 2018) These new technologies are here to make the world a better place and, to some extent, improve business processes. One particular technology fitting to this category is Robotic Process Automation (RPA).

There are two important components in RPA, robotics and automation. The first one addresses designing, constructing, operating and applying robots. It can be seen as a separate field of technology that can be applied to achieve automation. A robot, either a physical or software, is an automatically controlled agent that can be programmed to automate processes and tasks. (Waller 2018, 22) Therefore, robots are automated to achieve more automation, which is defined as using any method that eliminates or reduces human labor (Cheprasov, Huff, Marks, Rudha & Uffelen 2019, 6). It dates a way back to the first industrial revolution and was then in a quite primitive level. The main driver was to perform a task as efficiently as possible by getting as much done as possible at the lowest possible cost. As the development and technology moved forward, so did the concept and drivers of automation. Currently, automation is associated with computers due to the growing digitalization of both businesses as well as societies. The driver is also more human-centered;

automation aims to protect humans from potentially harmful and tedious tasks. (Waller 2018, 20)

RPA is an evolving technology that has huge potential. Digital engagement, analytics, big data, and advancements in Information and Communications Technology (ICT) have contributed to this continuous and increasing development (Borbe, Fisher, Zubler, Parva & Berg 2018, 2). RPA is revolutionizing the way people work and how businesses think about their processes and back-office work since it provides huge improvements in efficiency and cost savings. One important aspect is that it supports companies' knowledge workers by freeing employees from mundane tasks and allowing them to focus on more value-adding activities. As RPA continues to evolve, it has the potential to transform business models completely in various different sectors.

1.1 Background, aim, and scope of the study

One of the most common process improvement methods is lean manufacturing. It is a mindset, a philosophy, and a methodology of which objective is to reduce non-value adding activities and eliminate waste (Caldera, Desha & Dawes 2017, 1546). Likewise, RPA can be seen as a process improvement method. The idea is to transfer mundane and tedious tasks from human employees so they can focus more on value-adding activities. At the same time, the efficiency of the transferred processes increases since software robots happen to carry them out more quickly and error-free. (Kroll, Bujak, Darius, Enders & Esser 2016, 12) Consequently, RPA and lean are very closely connected. In a broad sense, RPA can be seen as a tool in lean manufacturing. Since lean is closely present in everyday life in the case company, interest towards current, viable and prospective automation solutions has arisen. One thinkable and a globally emerging solution could just be RPA. By automation, the aim of the company is to decrease lead times, enhance processes and increase sensibleness of work by getting rid of routine tasks, among other things. Additionally, another motivational factor for the study from the perspective of the case company is to increase awareness of RPA and possibly other automation technologies as well.

The aim of this study is to assess the business environment’s suitability for RPA. Consequently, the main research question is the following:

MQ1: What is the business environment’s overall suitability for RPA?

However, in order to properly answer the question above, four sub-questions are needed:

SQ1: What are the potential benefits derived from RPA?

SQ2: What are the general process criteria for RPA?

SQ3: How the discovered subprocesses reflect on the criteria?

SQ4: How does the case company’s employee aspect affect the initialization?

The questions lead to the scope of the study. Firstly, a business case for automation is created. This includes reviewing the following theoretical aspects:

- Theoretical and actual realized automation benefits. Is it worth it?
- General process and evaluation criteria. How strict are the requirements?
- Change management perspective. What is the employee opinion?

These provide a preliminary ‘go’ or ‘no go’ for RPA. Usually, when creating a business case, current processes are documented and mapped, and a value or assessment report of a new solution is created. However, at this point, these are disregarded because mapping every suitable process and calculating the value and Return on Investment (ROI) would be too difficult for this particular phase. If the mentioned theoretical aspects turn out to be beneficial, it is a preliminary ‘go’ for RPA. This includes discovering potential subprocesses by interviewing personnel and reflecting the general criteria to these identified tasks. Consequently, these subprocesses are then assessed and prioritized according to their suitability. Charts are created to illustrate the most and least appropriate subprocesses. At this point, also employee and change management aspects are taken into account. After the prioritization and analysis, a concluding ‘go’ or ‘no go’ is determined.

1.2 Earlier studies and the research problem

There are relatively little research and academic work regarding RPA, at least when compared to other, more popular cognitive automation technologies, for example, AI. The articles in Table 1 below addresses RPA in a general level and regarding back-office functions such as human resources and auditing, but when it comes to RPA readiness in supply chains or procurement, there is hardly any work available. Consequently, a research gap exists. However, there seem to be lots of internet articles, journals and consultation reports on RPA of which the latest are widely used in this study. They are critically addressed since they are not academic articles and are written by actual RPA consultation companies. Consequently, they may discuss matters from the perspective of a “seller” and offer so-called prepared solutions as well as embellish some actual critical aspects.

Table 1 Previous studies on Robotic Process Automation.

Authors	Article	Key points & findings
Aalst, Bichler & Heinzl (2018)	Robotic Process Automation.	For more widespread adoption, RPA needs to become smarter by other cognitive technologies.
Aguirre & Rodriguez (2017)	Automation of a business process using Robotic Process Automation (RPA): A case study.	In a one-week evaluation period with two different groups, the one with RPA could handle 21 % more cases than the one without RPA.
Asatiani & Penttinen (2016)	Turning Robotic Process Automation into commercial success – Case OpusCapita.	For OpusCapita, the best RPA business model would be the outsourcing partner model. The company would take over the outsourced processes with full controllability from their customers instead of exposing them to RPA.
Fung (2014)	Criteria, use cases and effects of Information Technology Process Automation (ITPA).	Due to cost savings and value-adding capabilities, ITPA is gaining a foothold among IT organizations and outsourcing service providers.

Hindle, Lacity, Willcocks & Khan (2018)	Robotic Process Automation: Benchmarking the client experience.	Examining Blue Prism's survey about its customers' RPA deployments. The survey addressed topics such as overall satisfaction, scalability, adaptability, security, service quality, employee satisfaction, ease of learning, deployment speed, and business value measured by ROI, compliance, agility and user experience of RPA.
Rozario, Moffitt & Vasarhelyi (2018)	Robotic Process Automation for auditing.	The article investigates RPA's usage in auditing. Important considerations prior to the adoption include the reliability of RPA tools and data, privacy and security, and the economics of RPA. The most evident benefits are a reduction of time spent in repetitive processes and reliability, while the possible pitfalls concern stakeholder buy-in and job loss.

1.3 Limitations, conceptual framework, and structure of the paper

This study is from the perspective of the case company and thus, supplier and customer point of views are excluded. The limitation also concerns all other but the operational and upstream activities of Supply Chain Management (SCM) function of the company's business unit. Consequently, included aspects are demand management, manufacturing flow management, Supplier Relationship Management (SRM), sourcing, purchasing and logistics, while Customer Relationship Management (CRM), Customer Service Management (CSM), order fulfillment, product development and commercialization, and returns management are excluded.

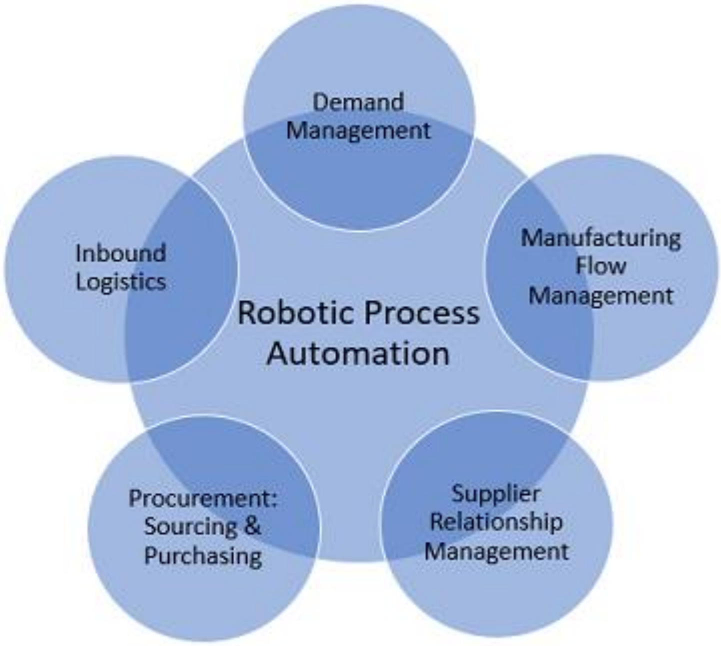

Figure 1 Conceptual framework of the study.

The limitations exist as a result of the chosen conceptual framework of the study, presented in Figure 1 above, which is constructed between the upstream activities of Supply Chain Management and Robotic Process Automation. SCM is addressed in general in chapter 2 after which the focus proceeds to its respective processes in subchapters 2.1, 2.2 and 2.3. RPA is first discussed in a general level in chapters 3 and 3.1 after which the subchapters 3.2, 3.3 and 3.4 review the differences between RPA and cognitive automation, the benefits of RPA, and RPA service providers and tools, respectively. Chapter 4 concerns the aspects a company must consider when deciding to implement RPA. These are explained in more detail in subchapters 4.1-4.6 which contain the following: planning and determining objectives, process criteria, standardization and optimization, stakeholders' buy-in and change management, running a Proof of Concept (PoC) and selecting a proper tool, and lastly establishing governance and a Center of Excellence (CoE), respectively. The reason for addressing RPA so profoundly is derived from the nature of the study. The idea is to raise awareness of as many aspects of the technology as possible so that the case company could obtain a comprehensive picture of the automation. The theoretical framework of RPA is illustrated in Figure 2 below.

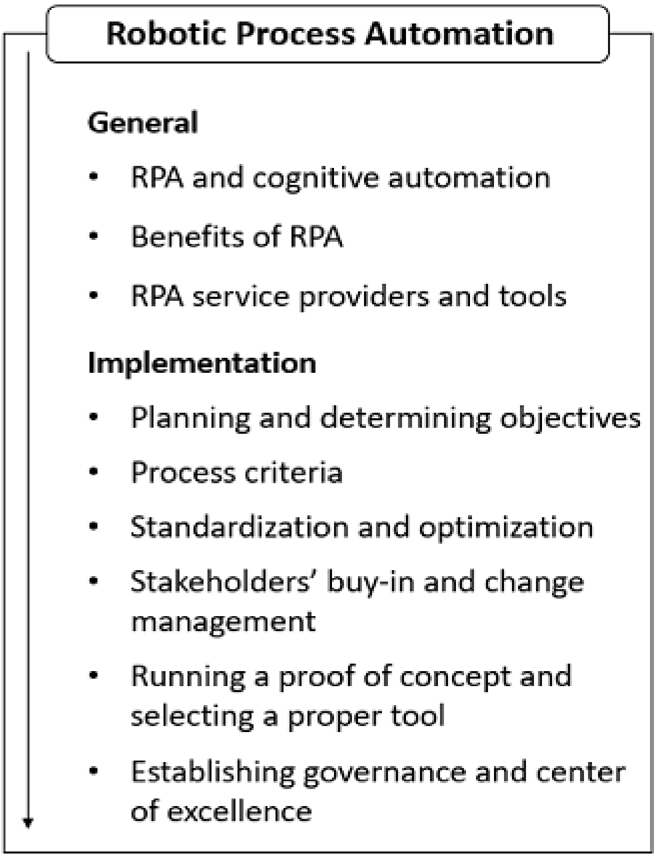

Figure 2 Theoretical framework of RPA.

Chapter 5 deals with the academical features of the study. These include research methodology, method, data collection and analysis, and validity and reliability of the empirical part. Chapter 6 presents the empirical findings and analysis. First, a brief introduction to the case company is presented after which the relation between the SCM upstream functions is depicted. Then, the existing RPA function in another business environment is introduced concerning the already automated processes, the government model and the process of identifying and deploying new automation initiatives. Next, tasks and subprocesses discovered through the interviews are analyzed one by one while some improvement suggestions are also presented. Finally, change management and employee perspectives are interpreted as well. Chapter 7 is the discussion where the empirical findings are reflected on the theoretical section. The chapter is divided into processes and change management. Finally, in chapter 8, research questions are answered, managerial and theoretical implications are addressed, and suggestions for future research are presented.

2 SUPPLY CHAIN MANAGEMENT

Supply Chain Management is the activity of managing different types of physical, financial and information flows all the way from the point of origin of raw materials to the point of consumption of final products or services. It connects material suppliers, logistics providers, manufacturers, distributors and end customers together. Consequently, these flows and different parties form a supply chain. In order for the parties in the chain to gain competitive advantage in their own field, whether it would be related to transportation, warehousing or distribution, they need to manage inbound supply and outbound distribution effectively. (Teller, Kotzab & Grant 2012, 713) Inbound supply includes all the activities that are needed to handle and optimize the material flows in the upstream, and for example, different procurement, purchasing, and sourcing activities belong to this category. Outbound distribution is the delivery of finished products to customers in the downstream or upstream (Weele 2014, 237-238). It must be noted, however, that these customers may not be end customers or consumers. A customer can also be a player in the supply chain. In addition, a finished product for some can be a component of another product for someone else. All in all, an effective supply chain arises when the parties operate effectively, consistently, cooperatively, and in a timely manner. When the cluster of operators is managed properly, a well-functioning SCM is realized.

Process-wise, for successful SCM, the integration of business processes with the ones of suppliers is important for continuously improve the performance of the players as well as the entire supply chain. Possible improvements depend on the level of integrating processes internally within the company and externally with the suppliers (Teller et al. 2012, 713). By definition, processes are structured and measured activities designed to produce a specific output with various identified inputs (Cooper, Lambert & Pagh 1997, 5). In supply chains, they are important since they generate the material, financial and information flows together. These processes can be categorized into nine areas: Customer Relationship Management related processes, Customer Service Management, demand management, order fulfillment, manufacturing flow management, procurement (Cooper et al. 1997, 5), Supplier Relationship Management, product development and commercialization, and returns management related processes (Teller et al. 2012, 714). In this study, CRM, CSM, order fulfillment, product development and commercialization, and returns management are not examined because they focus on the downstream activities towards the end customer.

2.1 SCM processes – towards subprocesses

Demand management focuses on balancing the customers' needs with the company's supply capabilities while still maintaining the optimal inventory levels. The idea is to always be able to answer to the customer requirements by the means of forecasts, which can be based on historical data, sales projections, corporate objectives or directly on the customer itself (Croxton, Dastugue, Lambert & Rogers 2001, 18). Accurate forecasting is important, and it has been researched that a correlation between improving demand management processes and more solid forecasts exists. The same research by Triple Point Technology indicates that by adopting new technologies in the area, businesses can gain 17-point average improvements in forecasting accuracy and hereby benefit a 25 % reduction on average on their inventory levels (Kamal 2013). In addition to improving forecasts, synchronizing them with procurement, production, and logistics is also vital. This way, production can be planned based on the forecasts and supply based on the production. It must be noted, however, that in order for the synchronization to work properly and efficiently, the information flows between the functions need to be smooth and impeccable. By increasing flexibility and reducing variability in demand, lead times and such by, for example, introducing postponements to production and improving customers' planning promotions, management can respond quickly to exceptional events and minimize possible surprises in the upstream. (Croxton et al. 2001, 20) When the demand is moderately constant or known and lead times abreast, supply planning has a much easier job to design purchases while keeping inventories on acceptable levels. By definition, demand management can be basically used interchangeably with Sales and Operations Planning (S&OP) (Ambrose, Matthews & Rutherford 2018, 270).

A process not directly related to procurement is manufacturing flow management. It is taken into account because it enables forecasts that are used in demand and supply planning. Operationally, it determines production pace as well as synchronizes the capacity with demand management and SRM. Strategically, it determines push and pull boundaries in accordance with customers and identifies manufacturing limitations and requirements with SRM as well as determines manufacturing capabilities with demand management. (Croxton et al. 2001, 22) The three functions are constantly working and cooperating with one another; production determines the manufacturing velocity based on demand from which procurement and SRM plan supply necessities. The cluster of interaction between the functions is demonstrated in Figure 3 below.

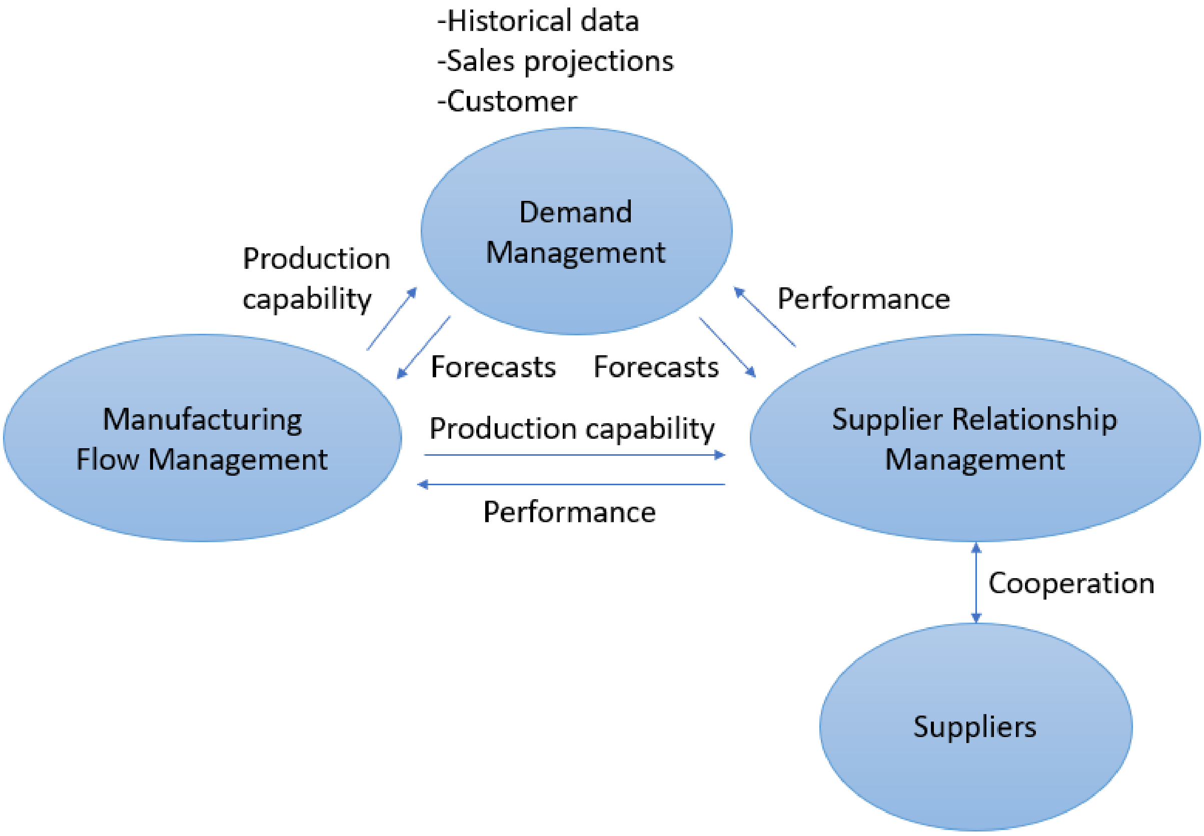

Figure 3 Internal Supply Chain Management processes.

While purchasing and sourcing constitute a part of procurement, SRM responsibilities fall to the first two. It can be defined as a business process that manages all interactions between a company and its suppliers which, for one, is an organization that supplies and sells materials or services to another party (Tseng 2014, 40). Moeller, Fassnacht, and Klose (2006, 73) define SRM as a process that engages in activities of setting up, developing, stabilizing and dissolving relationships with suppliers as well as creating and enhancing value with them. In these relationships, both parties are engaged with high commitment and in long-term. However, each supplier should agree to a Product and Service Agreement (PSA) that ultimately defines the terms of a relationship (Croxton et al. 2001, 24). Consequently, some relationships are more valued than others, and more investments are put to them.

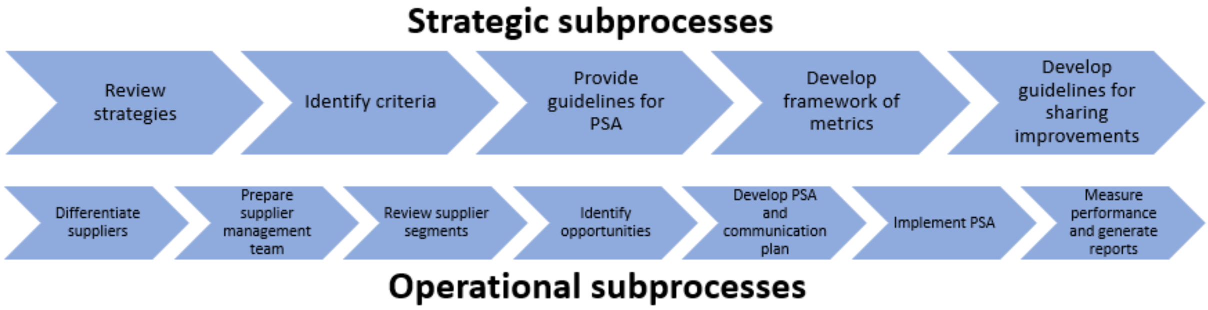

Figure 4 Supplier Relationship Management subprocesses (adapted from Croxton et al. 2001, 25).

The strategic process in SRM, visualized in Figure 4 above, provides the framework of how a company integrates with its suppliers and defines how the relations are developed and governed (Lambert & Schwieterman 2012, 340). The subprocesses include reviewing corporate, sourcing and marketing strategies to identify suitable and key supplier segments and thus, maintain appropriate relationship levels with them, identifying proper criteria for categorizing different supplier segments, providing guidelines for PSAs, developing the framework of metrics for measuring profitability and continuous improvement, and sharing possible process improvement benefits with suppliers for fruitful collaboration. *The operational process* covers developing and implementing tailored PSAs to meet the needs of the parties involved (Lambert & Schwieterman 2012, 347). The subprocesses comprise differentiating suppliers according to the mentioned criteria, preparing supplier management and segment teams, reviewing the segments for their role in the supply chain, identifying development opportunities, developing, improving and implementing PSAs for key suppliers, and measuring performance and generating supplier profitability reports. (Croxton et al. 2001, 24-26; Lambert & Schwieterman 2012, 340) All in all, SRM is all about cooperation. It should aim in win-win situations in which the processes have a huge impact. What comes to the synchronization internally with demand management, production, and other functions, and externally with suppliers, information should be shared in real time (Tseng 2014, 40). This way, positive results will be easier to achieve and operations, as well as competitiveness, could be maintained on a profitable level.

2.2 Procurement processes – sourcing and purchasing

Procurement can be seen as a part of a supply chain, and some of the SCM processes previously mentioned fall to the responsibility of procurement function units, purchasing and sourcing. One must keep in mind that all the processes in SCM are somehow linked to these units, either directly or indirectly. In any case, procurement is a vast concept and occasionally considered in various ways by different sources. Weele (2014, 5) provides a rather vague definition for procurement and states that it relates to the function of purchasing inputs used in a company's value chain. However, Tikka (2017, 22) presents a more detailed interpretation and states that procurement is a wider concept than purchasing, and can be divided into strategical, tactical and operational procurement. The first one includes planning and developing operations, while the second focuses on budgeting, forecasting, and searching, assessing and choosing suppliers. These relate to demand management and sourcing activities. Operational procurement equals purchasing and comprises routine tasks, such as ordering, invoice handling, and delivery and inventory monitoring. Consequently, purchasing, in a way, manages a company's external resources and secures their utilization in operations (Weele 2014, 3). As for sourcing, Jia, Orzes, Sartor, and Nassimbeni (2017, 840) define it as proactively integrating and coordinating common materials, designs, methods, processes, standards, specifications, and suppliers. These include some of the tactical procurement activities mentioned previously, for example searching, assessing, choosing, contracting and managing suppliers worldwide. It also creates and develops the most fitting supplier strategies for certain product categories regarding the number of suppliers, the nature of the relationship, and the contract type (Weele 2014, 10).

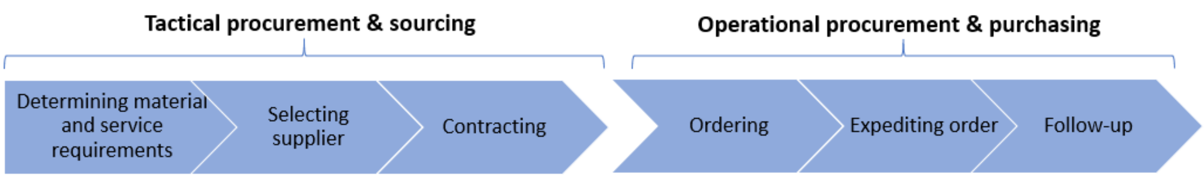

Figure 5 Procurement process model (adapted from Weele 2014, 8).

The procurement process, illustrated in Figure 5 above, begins with identifying a new need from demand management, production, maintenance or such, and determining material or service requirements in terms of quality and quantity. When it is known what needs to be purchased and how much, a proper supplier should be selected. The selection process usually follows a number of stages in which an initial group of potential suppliers is narrowed down by evaluating them on different criteria. These can include profitability, technological capability, and culture of innovation (Lambert & Schwieterman 2012, 342) as well as delivery reliability, costs and production system flexibility (Golmohammadi & Mellat-Parast 2012, 192). Boer (2017, 34-35) presents an example in which the first stage, initial screening, applies supplier reputation and the quality of response to Request for Information (RFI) as the selection criteria. The second stage, qualification, apply the quality of response to Request for Proposal (RFP) and costs as criteria. The final stage adapts trust for and from suppliers by the means of performance validations and site visits. It is important to notice that the selection process for a new vendor is also a preliminary selection process for SRM mentioned in the previous chapter as well as for supplier development activities. This, however, depends on the importance and nature of the soon-to-be purchased product or service. After the supplier has been selected, negotiations are prepared and conducted to establish an agreement and a contract (PSA) in which the buyer company engages the supplier to undertake some actions on the buyer's behalf (Broekhuis & Scholten 2018, 1190). The contract controls and regulates the relationship between the parties by describing the buyer's requirements towards the supplier and aspects such as decision-making and feedback, roles and responsibilities, payment and delivery terms, information sharing, provisions, expectations, and dispute settlements can be addressed. The scope and extent of a contract depend on the level of relationship and cooperation the parties are willing to sustain. When the agreement has been established, operations continue according to the agreed terms and standards, and ordering can be initiated.

Purchase orders are made based on purchase requisitions usually generated by the Material Requirements Planning (MRP) system which uses the production plan to evoke purchasing to buy required materials in time (Tikka 2017, 48-49). The system also assists in optimizing deliveries and inventories through ‘supply and inventory planning’, given the fact that the entered lead time parameters are accurate. This way, the buyer knows exactly when to order without burdening inventory by ordering too soon. The goal is to order the right materials for the right price, in the right quantity and quality, at the right time, from the correct vendor, and by the correct method of transportation (Tikka 2017, 30). Some of these factors are already agreed on in the bilateral contract and have been entered in the MRP system, so there is basically nothing else left to do for the buyer but to push the order button. However, it is his or her responsibility to keep the MRP parameters up-to-date, and thus the word ‘supply and inventory planning’. Once the order has been placed, the buyer should receive a confirmation for the purchase and monitor the progress of the order to ensure a punctual delivery and arrival. Finally, when the order has arrived, it is time for follow-up and evaluation. These include keeping supplier data and documents up-to-date, settling possible reclamations, auditing invoices, and rating suppliers (Weele 2014, 8).

2.3 Inbound logistics

Logistics is “the efficient transfer of goods from the source of supply through the place of manufacture to the point of consumption in a cost-effective way whilst providing an acceptable service to the customer” (Rushton, Croucher & Baker 2010, 6). It constitutes a big portion of supply chains, in which the logistic providers manage the physical flow of materials between various points in the chain. They connect material suppliers, manufacturers, distributors and end customers together by offering them different kinds of services, such as transportation, inventory and warehouse management, packaging, and security. Inbound logistics focus on the physical flow of incoming materials and their associated data or information flow in the upstream of the chain. The information flows and associated data can be triggered by different SCM processes, for example, procurement (Khabbazi, Hasan, Sulaiman, Shapi’i & Eskandari 2013, 775). Consequently, inbound logistics is majorly concerned with flows between manufacturers and their suppliers.

3 ROBOTIC PROCESS AUTOMATION

Robotic Process Automation is a rather new concept and technology that has evolved from data sciences into its own field of examination in the last decade. The reason stems from a relatively old but still a relevant question in the modern business environment: “Should something be automated or not?”. (Aalst, Bichler & Heinzl 2018, 269; Aguirre & Rodriguez 2017, 65) To be exact, the term was coined by the software company Blue Prism in 2012. It was then adopted by many other companies and by 2017, there were over 40 automation tools branded as “RPA” (Hindle, Lacity, Willcocks & Khan 2018, 4).

3.1 RPA – what is it and what is it not?

Aguirre and Rodriguez (2017, 66) characterize RPA as a high-tech reflection of a human worker that carries out structured tasks effectively and cost-efficiently. The idea is not only to make processes more efficient and flawless by automation but also to reallocate time and human resources to be utilized in more development and value-adding activities (Kroll et al. 2016, 12). The previous definition is somewhat customary and, while depicting how RPA is seen, it does not fully describe what RPA is. The Institute for Robotic Process Automation and Artificial Intelligence (IRPA AI) offers a more profound and technical definition which is described as follows: “RPA is the application of technology that allows employees in a company to configure computer software or a ‘robot’ to capture and interpret existing applications for processing a transaction, manipulating data, triggering responses and communicating with other digital systems.”

It can be remarked that the “application of technology” comprises different RPA tools and software, such as UiPath or Blue Prism. These tools operate on the user interface by mapping tasks and therefore, enable the configuration of other computer software, allowing the bot to imitate human actions in rule-based and repetitive processes (Aalst et al. 2018, 269). Waller (2018, 13) puts it simply: “RPA is used to describe the entire automation process where RPA ‘software’ with its RPA ‘tools’ is used to create and operate RPA ‘robots’.” Perceived in Figure 6 below, this virtual worker is integrated into the business’ Information Technology (IT) system via front-end, meaning that it operates the system just like a human would on the user interface. It does not interact with the system's Application Programming Interface (API) like traditional Business Process Management (BPM) systems or other back-end integrations. This allows RPA to be linked with countless of other different programs used by a human worker and it can be implemented in a matter of months. In addition, RPA enables effortless modification of automated processes and tasks. (Asatiani & Penttinen 2016, 68)

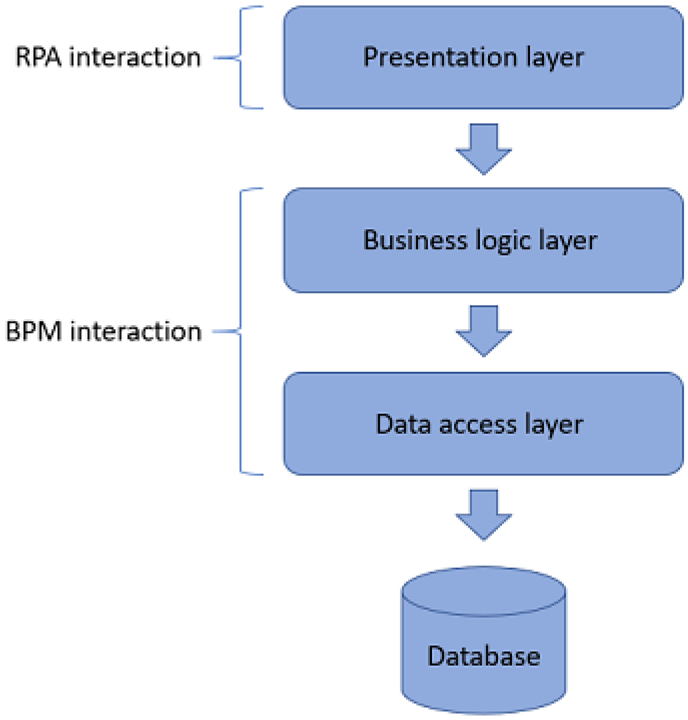

Figure 6 RPA interaction in multilayered architecture in an IT system (adapted from Willcocks, Lacity & Craig 2015, 8).

The front-end capability with existing applications, for one, differentiates RPA from other, more traditional, automation tools and solutions. The latter, with back-end integrations, usually require custom-made connections between applications in automating processes which result in more complexities in IT structure and increased maintenance costs (Beers, Heijnsdijk & Dalen 2018, 1). In addition, the front-end integration does not need specialized IT knowledge which leads to a second notable distinction; straightforward configuration. In contrast to traditional automation, RPA does not need any programming skills (Aguirre & Rodriguez 2017, 66) and can be modified by simple logical statements, process screen capture or graphical process charts by the business personnel themselves. This makes RPA extremely adaptable (Asatiani & Penttinen 2016, 68).

Table 2 RPA vs. traditional automation.

Robotic Process Automation & front-end integration		**Traditional process automation & back-end integration (scripting, programming, et cetera)**	
+ Does not require changes to existing applications	**+** Quick implementation on a small scale (<4months)	**-** Requires customization and compatibility with existing applications	**-** Relatively long implementation enterprise-wide
+ Effortless modification and usage	**-** Not able to read unstructured data	**-** Requires programming skills	**+** Able to handle any kind of data
- Not able to make selections or obtain data	**-** Does not function in two directions	**+** Able to make selections and matches	**+** Able to exchange information bidirectionally with other data sources
- If changes, a robot must be retaught	**-** Limited speed and number of data transfers	**+** Does not need a cognitive partner	**+** Able to transmit a huge quantity of data in seconds

However, RPA is not a solution for everything, and it does not fit in every situation as can be seen in Table 2 above. First of all, RPA is not able to manage unstructured data. In a general level, this kind of data is defined as information that does not have a predefined data model or is not structured in a predefined manner. The format can be any kind, and typical examples include data from social media, text files, and emails. It is estimated that about 80 % of data in companies is unstructured and the amount is growing. (Balducci & Marinova 2018, 557) Unattended, this makes RPA futile. Consequently, it needs other advanced technologies, for example, Optical Character Recognition (OCR) to extract and create structured data. For example, an email can be any length and contain all kinds of text and characters which RPA cannot interpret. OCR would identify and extract the needed data from the email for RPA to handle. Consequently, unstructured data is transformed into structured one. Another way of data manipulation is data wrangling or data cleansing, where the former is utilized in examining and preparing new data for further usage and transforming it into a more usable form (Endel & Piringer 2015, 111). Data cleansing or data cleaning, on the other hand, includes detecting, correcting and removing corrupt data records from data sets or databases (Randall, Ferrante, Boyd & Semmens 2013, 2). These data standardization methods require a deep understanding of the content in question as well as appropriate tools and technological resources. Secondly in RPA capabilities, it is not bidirectional. This means that it cannot exchange information with other data sources as inputs and outputs, for it can only follow well-defined rules. Thirdly, RPA cannot select specific data from an information cluster and then make decisions. Fourth, while RPA carries out only one transaction at a time, API supported traditional automation can execute thousands of them simultaneously. Lastly, as mentioned, RPA can only follow well-defined rules. When these rules change, the bot must be retaught. It must be monitored whether the bot makes mistakes due to the changes. (Opus 2018, 5-6) Waller (2018, 49) emphasizes this possible instability of processes and names it as one of the pitfalls for RPA.

All in all, RPA is not designed to replace traditional systems which are more comprehensive and “heavyweight” solutions. If a process or task can be carried out seamlessly and with optimally allocated resources, there is no need for new automation solutions. RPA merely complements traditional systems and is effective in smaller automation initiatives that require agility (Mindfields 2017, 13). Consequently, it should be embedded into a greater BPM framework to clarify whether it is a quick win or a long-lasting solution in the applied tasks or processes. Messiahdas (2018, 5) also mentions five factors that need to be considered when making automation decisions; availability of the source code, cost, capability and timespan of the solution, and nature of the problem. If the source code or API is not available, costs and timespan are clarified and acceptable, the functionalities are achievable, and the nature of the problem is suitable, then RPA might just be the answer.

3.2 RPA vs. cognitive and intelligent automation

As mentioned, RPA handles structured and well-defined tasks and learns by doing and observing human example. However, this requires the tasks to be standardized and non-variable. It cannot think rationally or make cognitive decisions. If a task has any deviation from the initially taught logic, RPA simply stops operating since it has encountered something new and unexpected. Cognitive or intelligent automation, on the other hand, utilizes AI technologies to extend the range of actions and processes executed by RPA. It aims to mimic human behavior regarding, for example, perceiving patterns, judging, reasoning, analyzing and predicting outcomes (Russo, Napolitano & Spiller 2016, 1) and exploits a vast amount and a large variety of data (Lacity & Willcocks 2016, 13). The typical activities associated with the two technologies are stated in Table 3 below.

Table 3 RPA and cognitive technologies' capabilities (adapted from Dorr, Kumar & Morrison 2018, 6).

RPA technologies and transactional work	Cognitive technologies and knowledge work
Data entry	Analyzing data
Moving files	Pattern recognition
Updating files	Predictive analysis
External data downloading	Probabilistic inference
Monitoring for events	Building a logical model
Checking and comparing data	Deductive reasoning
Collating and coding data	Self-learning and inductive reasoning
Memorization	Making decisions and recommendations
Numeracy, basic calculations	
Formatting data and reports	
Orchestration	

An example of an RPA automated operational process using the left side capabilities in Table 3 above can be seen in Figure 7 below. For example, checking an email for new mails is “monitoring for events”, while verifying whether there is a valid file attached is “checking data”. Entering the data is simply “data entry”.

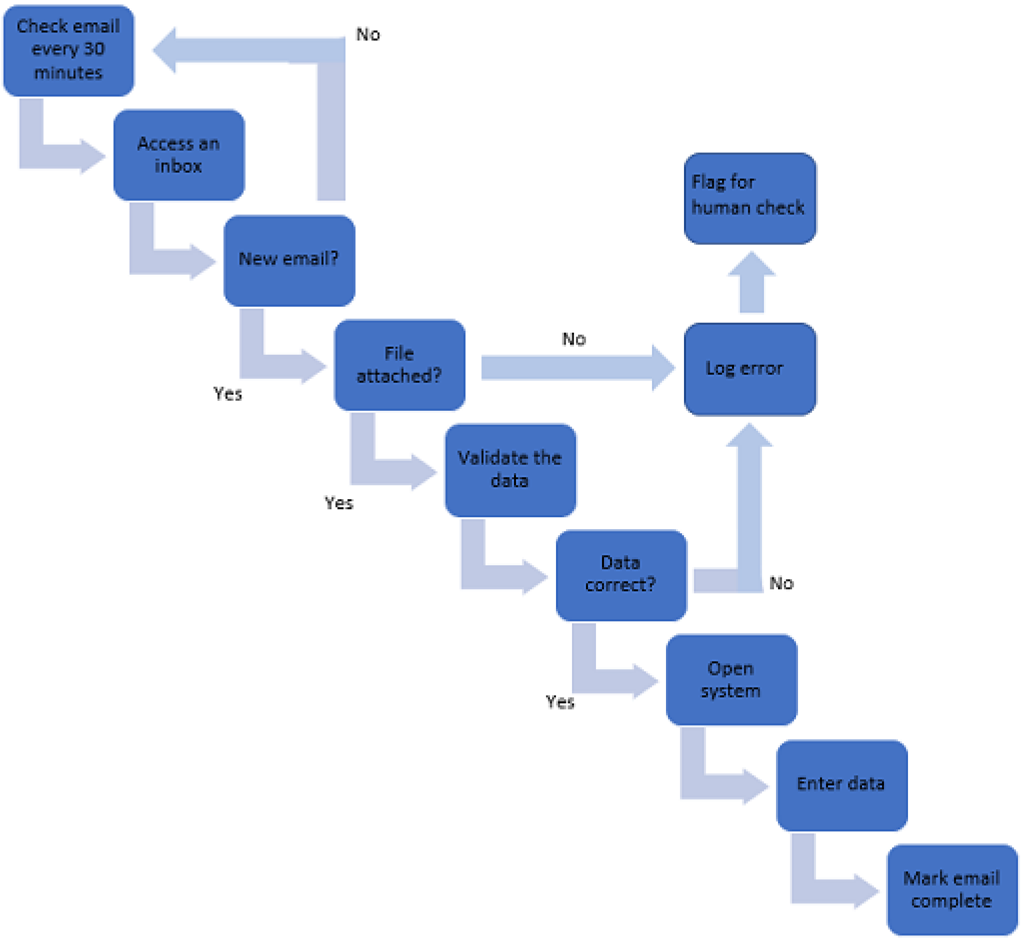

Figure 7 An example of RPA automated process.

Currently, RPA capabilities are limited to these kinds of processes and if-then logic activities. However, according to Waller (2018, 54), the RPA market will attain almost 3 billion US$ by 2021. For comparison, the market was worth a little over 250 million US$ in 2016. This imparts the quick and vast development of RPA. With AI and other cognitive technologies, RPA would be able to handle more complex as well as less defined and non-standardized tasks. The potential for this is seen by technology experts who think that eventually, RPA will be able to think by and for itself and execute more and more value-adding initiatives (Kroll et al. 2016, 12). Willcocks et al. (2015, 4) mention that cognitive tools move the focus from structured data to unstructured one. This way, they extend RPA by handling more complex data to automate processes.

3.3 The advantages of RPA

RPA is seen as the next wave in digital transformation. Companies are increasingly interested in adopting this intelligent technology and many have also gained significant benefits already by its implementation. This considerable level of adoption and market growth are due to several reasons. Firstly, the list of potential cases for which RPA could be used is growing. (Kroll et al. 2016, 11; Mindfields 2017, 5) As mentioned, RPA aims to take control of repetitive and non-value adding tasks. However, since it is an evolving technology, it will be assimilating increasingly complex and non-standardized tasks and incorporate advanced analytical and predictive capabilities as well. In addition, in some years, later on, RPA will be AI-based and self-learning. (Mindfields 2017, 7-8) The second reason is the realization of quicker and targeted benefits (Kroll et al. 2016, 11). This means that the actual benefits are delivered, rather promptly, according to the set goals for RPA implementation. The goals can include profit, budget, schedule and other requirements.

The third reason for the growth of RPA indicates that it does not require any considerable upfront investments. This is partly due to the fourth reason which states that RPA has only minimal impact on the business' existing IT infrastructure. (Kroll et al. 2016, 11) Aalst et al. (2018, 271) call this an outside-in approach, in which the underlying systems remain unchanged during and after the implementation of the new automation. The deployment takes very little time compared to some other Enterprise Application Integrations (EAIs) and does not necessarily require businesses to make changes to their existing strategic processes. RPA can be integrated with almost any software used by a human worker, regardless of other implemented technological systems. Furthermore, the bots are easily modifiable and do not require any coding skills whatsoever to allow for smooth and flexible functionality. (Asatiani & Penttinen 2016, 68; Kroll et al. 2016, 10-11) Aguirre and Rodriguez (2017, 66) describe the operation of RPA to include only “dragging, dropping and linking icons”. All in all, RPA does not require heavy investments; simple integrations, quick deployment, and easy modifiability.

Kroll et al. (2016, 11) classify the possibility of developing internal capacity as the fifth reason. Since RPA deals with structured and conventional tasks, there is more time for human workers to concentrate on more value-adding activities that develop the business’ internal capacity. This means that the operations should be business led; to proactively recognize, what is necessary for the business and what can be done to achieve targets. At the same time, they can focus more on training and self-improvement activities. The sixth reason for the growth is RPA’s flexibility to adapt to a changing business environment (Kroll et al. 2016, 11). As previously stated by Aalst et al. (2018, 271), the implementation of RPA does not require adjustments to the existing infrastructure or operations. When the business environment changes, RPA is able to adjust to this change in a rather adaptable manner.

Mindfields (2017, 2; 34) emphasizes additional factors that affect increasingly to the adoption of RPA, also from the service providers’ point of view. Increasing operational and overhead costs as well as rises in wage rates in offshoring facilities attract businesses towards new solutions. RPA forces companies to rethink the utilization of resources and adds to the competition. In addition, the automation allows for better deal coverage. It can secure new deals which previously were not achievable. The drivers for implementation as well as outcomes and benefits of RPA are shown in Figure 8 below.

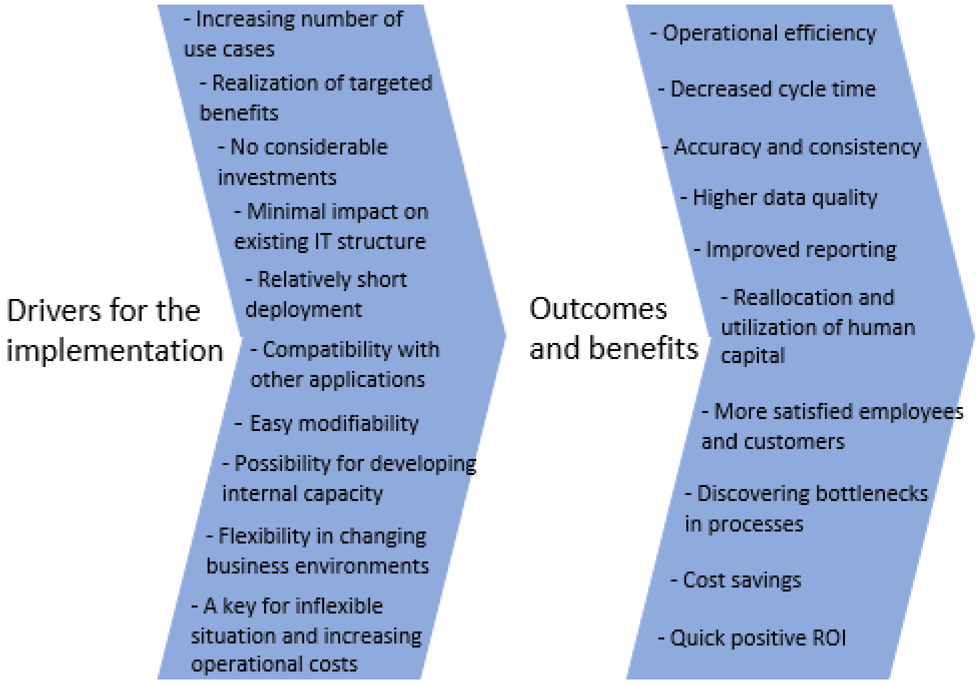

Figure 8 Drivers, outcomes and benefits of RPA.

Once a company has decided to adopt RPA and implementation is completed carefully, there are many benefits perceived; one of them being operational efficiency. RPA bots work significantly faster (five times faster at best) than a human worker and around the clock, therefore reducing cycle time. If configured correctly, it is not prone to errors and can perform the same tasks repeatedly with full consistency, accuracy, and compliance. (Kaelble 2018, 10; Mindfields 2017, 39) This leads to higher data quality and improved reporting (Rozario, Moffitt & Vasarhelyi 2018, 9). Another aspect affecting operational efficiency is the change in business practices. Since RPA handles repetitive processes, procedures and activities for growth and development emerge. (Kaelble 2018, 57) Human capital can be reallocated and utilized in more innovative, value-adding, customer tending, and relationship boosting activities. This requires creativity and decision-making from employees which develop their cognitive skills (Kroll et al. 2016, 7). They are continuously more satisfied with their work while operations comply with lean principles. In addition to the employee point of view, RPA eases gathering and analyzing data, resulting in a more detailed and predictive understanding of various issues and possible undiscovered bottlenecks in the processes. (IRPA AI; Mindfields 2017, 35)

Cost savings is another major benefit resulting from RPA. According to the IRPA AI and Kroll et al. (2016, 12), RPA bot can cost 70-80 % less than a human worker. This is achieved through increased operational efficiency; decreasing cycle time and errors and utilizing resources more effectively offer companies a payback period of about one year (Mindfields 2017, 37; Wright, Witherick & Gordeeva 2018, 11). Of course, these numbers depend on the industry the business operates in and on the functions the examined processes belong to, but still indicate the positive effects of RPA. In addition, the mentioned benefits quickly yield a positive ROI (Kaelble 2018, 11; 56). In Table 4 below, some real-life case examples of RPA results are illustrated.

Table 4 Value added in some case companies (adapted from Willcocks et al. 2015, 18).

<table>
<tr><th>Case company</th><th>Number of automated processes</th><th>Number of RPA transactions/month</th><th>ROI</th><th>Benefits</th></tr>
<tr><td>Telefónica O2</td><td>15 core processes</td><td>400 000 – 500 000</td><td>650 – 800 % in three years</td><td rowspan="3">- Faster delivery
- Better service quality
- Higher compliance
- Higher scalability
- Strategic enablement
- Employee reallocation</td></tr>
<tr><td>Utility company X</td><td>35 % of back-office processes</td><td>1 000 000</td><td>200 % in a year</td></tr>
<tr><td>Xchanging</td><td>14 core processes</td><td>120 000</td><td>30 % / process</td></tr>
</table>

While RPA might eliminate some jobs and positions, it would certainly create new ones as well. Titles such as automation analyst, operator, architect, specialist, developer, solution engineer, and consultant are wanted, and the demand is increasingly rising (Kaelble 2018, 60). Wright et al. (2018, 3) investigated that automation technology caused about 800,000 job losses between 2001 and 2015 in the UK, yet created about 3,5 million new, more demanding and higher paid, positions. The job landscape in the field of automation will surely change and most likely for the better. People who were previously working on the vanishing positions could be reassigned to the new roles, preventing job loss or sending them abroad (Asatiani & Penttinen 2016, 68).

All in all, RPA can be seen as sort of a proactive risk management tool. By increasing operational efficiency and cost savings, a business can mitigate risks related to various functions and can achieve opportunities that might have not been previously apparent or available. The risks could include loss of customer satisfaction and proactivity, rising labor rates, staff attrition, and miscommunication. Customer satisfaction and proactive thinking can be enhanced, and staff attrition diminished by focusing on value-adding activities. Instead of outsourcing mundane tasks abroad, they should be automated. Less managerial resources and investments would be needed, labor costs could be reduced, and miscommunication evaded (Asatiani & Penttinen 2016, 68; Waller 2018, 47).

3.4 RPA service providers and tools

The amount of RPA service and tool providers have increased in the last few years and will continue to rise (Aalst et al. 2018, 269). The reason stems from surging demand. Company buyers are becoming increasingly more aware and open-minded to new vendors that can provide value at a lower cost. Since automation solutions can offer this value, RPA service providers have begun to bid against each other, resulting in improved operations and solutions through competition. (Mindfields 2017, 23) According to Clair (2018, 2), new distinguishable solutions between vendors include more efficient analytics, deployment, scale and governance in RPA, but also attended automation as well as improved security aspects. Vendors make investments in their existing and future capabilities, such as training modules, auto-scaling systems, computer visions, and self-healing systems. Through competition, partnerships arise as well. They allow for more effective marketing and support for various RPA products. (Burnett, Modi, Sharma & Munjal 2018, 7) As the technology continues to evolve, however, partners might become competitors and competitors might become partners (Mindfields 2017, 23).

According to Gartner (2018), the yearly increase of over 50 % in RPA software spending has led it to reach the Peak of Inflated Expectations in the Gartner Hype

Cycle. The article also states that by the end of 2022, 85 % of large enterprises have adopted some form of RPA, driven by the increasing awareness, the decrease in average RPA prices, and the expectations of better overall business results. However, as Everest Group's research indicates, Small and Medium-sized Enterprises (SMEs) hold the major proportion of the global robotic automation market. While these enterprises maintain the top positions, large enterprises are not far behind (Burnett et al. 2018, 6). In any case, the market itself will attain almost 3 billion US$ by 2021. For comparison, the market was worth a little over 250 million US$ in 2016 (Waller 2018, 54).

The basis for the current RPA capabilities and toolsets has been created mostly by a small group of specialist software suppliers. Many traditional IT companies have recognized the market gap originated from the massive demand and begun to license tools from the original specialists. Some have developed their own tools, and some have become resellers of third-party automation tools. (Mindfields 2017, 23) As the market evolves, new business models emerge. Asatiani and Penttinen (2016, 71) present four possible models for RPA: license reseller, value-added consultant, Software as a Service (SaaS) provider, and RPA-enabled outsourcing partner. As the name indicates, *license reseller* sells licenses for RPA solutions and tools which can include standard process libraries. These solutions basically start from square one for the client; nothing has been configured or optimized in advance. It is the client's responsibility to choose the correct and most suitable tool. *The value-added consultant* can sell licenses as well, but more importantly, offers consultation and support for RPA implementation and use. Compared to the previous model, there is more room for differentiation. *SaaS provider* offers RPA as a service on the contrary to licensing. This means that the technology is already optimized and configured, to a degree, to the client's needs when the transaction takes place. *RPA-enabled outsourcing partner* offers RPA solutions to its client's outsourced processes which are previously redesigned to fit automation. To supplement, Mindfields (2017, 25) depicts four different vendor types for RPA. It must be noted, however, that the feature scale of each vendor can be vast and complicated, and therefore it is impossible to draw a distinct line between one another. The first type includes independent RPA specialists, such as Blue Prism, Automation Anywhere, UiPath, and IPsoft. As their core competencies, these providers concentrate on developing proprietary RPA tools but also other solutions, such as big data analytics. Their supply includes consultation, implementation, and training as well. The second is service providers that offer only their own tools and capabilities, for example, WNS Global. Unlike in the previous type, these vendors do not choose to partner as they have the confidence and maturity to develop their own RPA platforms. Their confidence derives from highly skilled staff, process excellence capabilities, and wide-ranging portfolio of large client companies. The third type involves parties that partner with RPA specialists to build and increase their automation capabilities. These providers, such as Tech Mahindra, are especially accomplished in BPM and Business Process Outsourcing (BPO) domains. Linked with RPA, they can offer customized and optimized service for their clients' business processes. The fourth and the most common group consists of providers that offer their own RPA tools but also partner with RPA specialists. Here belong companies like Cognizant, IBM, HP, and Genpact. Cognizant, inter alia, offers their own RPA tool along with CRM and Business Intelligence (BI) functionality (Aalst et al. 2018, 269). In addition to the already mentioned vendor types, there are number of different consulting companies in the RPA environment. They offer advisory and training regarding implementation, change management, governance, and other RPA connected areas (Mindfields 2017, 28).

4 RPA CONSIDERATIONS AND CHALLENGES

Since RPA does not need any considerable investments or significant changes to existing IT infrastructure and strategic processes, it can be implemented in a matter of months (Kroll et al. 2016, 10; Waller 2018, 42). However, there are a lot of aspects and risks to consider before deploying RPA and a number of things must be addressed for a successful implementation. According to Hindle et al. (2018, 6), about 30-50 % of RPA projects fail due to targeting wrong processes, neglecting process optimization and existing IT infrastructure, and focusing solely on benefits, among other things (Dutta, Gillard & Kaczmarskyj 2016, 6-7). It is important to obtain stakeholders' buy-in, include people from several functions with whom to evaluate the possible benefits and impacts of RPA, assess and prioritize processes, and examine vendor aspects. For the implementation itself, flexible agile methods rather than traditional linear waterfall approaches are recommended (Kroll et al. 2016, 22). This way, more resilience and development opportunities are allowed, and with an established CoE, the best practices of top-down and bottom-up approaches are available.

There is no explicit way to start the RPA implementation process. Some companies start with a process and task identification (Srivastav, Singh, Gadiyar & Anand 2016, 2), some determine objectives and potential benefits at first, and some consider the transformation aspects (Rombough & Barkin 2017, 2). If proper planning is neglected, it could result in a failure in the implementation. Hindle et al. (2018, 7) call this a launch or project risk which includes unrealistic project estimates and focusing solely on the possible benefits, disregarding the baseline of processes.

4.1 Planning RPA and determining objectives

The identification of business goals is important since it creates the baseline for decision-making (Waller 2018, 70). Mindfields (2017, 42) discloses several factors to be considered, such as targets and objectives of RPA, process identification, stakeholder impact, and risk assessment, possible interdependencies between processes, establishing automation teams, implementation schedule, and governance framework. While envisioning RPA, it is already good to have people included from different functions. To succeed, both knowledge of IT and the business itself where automation is about to be implemented is required. (Kaelble 2018, 19) The expectations for RPA and its influence are not always clearly defined, so comprehensive discussions with up- and downstream business units can mitigate concerns and encourage engagement (Nelson 2017, 2-3). Not planning on an early stage is one of the top issues in failed RPA implementations (Dutta et al. 2016, 4). This can involve failed realizations, increased system failures, poor accuracy levels, and frequent support requests from IT. To ensure all the needs and recognize possible issues, Mindfields (2017, 41) suggests developing a Target Operating Model (TOM). This would cover aspects related to, for example, issue management, reporting, and government.

One of the first things to consider in planning is how a new technology will affect the current organizational structure. According to Beers et al. (2018, 2), the balancing elements (people, tasks, technology, and structure) of choices that perform organizational processes are usually configured to heavyweight IT solutions. These comprise traditional system integrations. RPA belongs to lightweight solutions which, in other words, means that it destabilizes the original structure by directly cooperating with IT and connecting business knowledge with IT knowledge. Traditionally, business and IT have had their own distinct boundaries. This transformation might generate disapproval from both sides, so new alignment solutions and proactive discussions would dispel possible conflicts (Nelson 2017, 3). The responsibilities are shared so both sides should work together. Dutta et al. (2016, 7) and Waller (2018, 49) emphasize that forgetting about the IT infrastructure is one of the top pitfalls in RPA projects. The fact of how RPA would impact also the stability of current IT operations is usually defaulted.

Another aspect that must be considered already in the planning phase pertains change. Since RPA takes over assignments and jobs, it requires considerations of old and new roles, skills and capabilities of employees (Nelson 2017, 3). For example, it must be acknowledged whether an employee that was carrying out now an automated activity can have a new role as an, for example, automation operator and require training. In addition, it must be taken into account of how RPA alters interaction and information flows between different stakeholders (Rombough & Barkin 2017, 4) because change might have undesirable effects. Employees could see bots as competitors which may create tensions between workers and management. This could, in turn, result in a decrease in morale. Consequently, it is very important to plan and communicate these factors well in advance. (Asatiani & Penttinen 2016, 68) A well-performing digital workforce should be designed, deployed, and integrated into the human workforce. Wright et al. (2018, 20) say that this wellness and assimilation would depend on choices regarding, for example, the amount of unattended and attended bots, and the extent of process re-engineering. One of the top problems in RPA implementations is that the integration is neglected, and the bots are always left unattended to handle entire processes (Dutta et al. 2016, 7).

4.2 Process criteria for RPA

Aguirre and Rodriguez (2017, 65) mention that RPA is mostly utilized in back-office functions, particularly in accounting and human resources, but also in procurement and sourcing. Utilized processes can include invoice processing, order and billing management, payroll administration, and claims management. Regarding front-office functions, customer service and sales have the most RPA utilized processes, which can include query management and billing support. (Kroll et al. 2016, 7; 19; Mindfields 2017, 13) All of those processes have the same things in common; they are repetitive, rule-based, and causing manual rework (Waller 2018, 71). Kaelble (2018, 6) highlights that a typical back-office employee can spend as much as 80 % of the time to perform these kinds of activities. They are exhausting and take time from employees who could focus more on strategic and value-adding activities that can only be carried out by humans. It must be noted that it does not matter whether a process or task is in back or front-office, as long as the RPA process requirements are met, and the potential implementation would be reasonable. However, most of the customer value-adding and exceptional activities are fulfilled in the front-office, so it is not necessarily reasonable to tamper with those activities that are already providing value and cannot be standardized. This could be the reason why Aguirre and Rodriguez (2017, 65) say that research shows no indication of the benefits of RPA in front-office functions. However, as mentioned, those benefits exist, just not on the same scale as in back-office functions.

The typical criteria that work well for RPA include the following:

- High volume activities that are repetitive and carried out frequently.
- High-value activities with low volume (provided cost of automation < cost of penalty).
- Data-intensive activities that draw information from various systems or applications.
- Rule-based and well-defined activities that can be broken down into explicit steps.
- Activities that are prone to human errors and cause manual rework.
- Activities that require searching, collating and updating information.
- Activities that do not require interpretation skills and have no strategic fit.
- Activities that are standardized or have very few exceptions.
- Activities that are problematic to transfer offshore.
- Activities which cost structure is known and the ROI of RPA can be calculated. (Aguirre & Rodriguez 2017, 67; Asatiani & Penttinen 2016, 69; Borbe et al. 2018, 8; Fung 2014, 2; Mindfields 2017, 13; Rombough & Barkin 2017, 3)

If the criteria above are fulfilled, each step of a process or task is clear, and all its consequences can be considered, the process is most possibly suitable for RPA. This type of process is less risky for the company. For example, to be automated processes have to be rule-based and well-defined because, with the current technology, bots still need precise instructions to successfully complete tasks (Rozario et al. 2018, 3). If a task is not well-defined, the bot could assimilate it the wrong way which could result in possibly catastrophic situations. In addition, the literature addressing business process improvements suggests that RPA leads to improved processes when the steps are, in fact, rule-based and standardized (Mindfields 2017, 13; Rozario et al. 2018, 3). Major exceptions to the designed workflow will result in an immediate intervention by the process supervisor (Kroll et al. 2016, 31). Therefore, very few exceptions are allowed, and processes already automated should have as little human intervention as possible. In Figure 9 below, a graph is shown to illustrate RPA candidate processes.

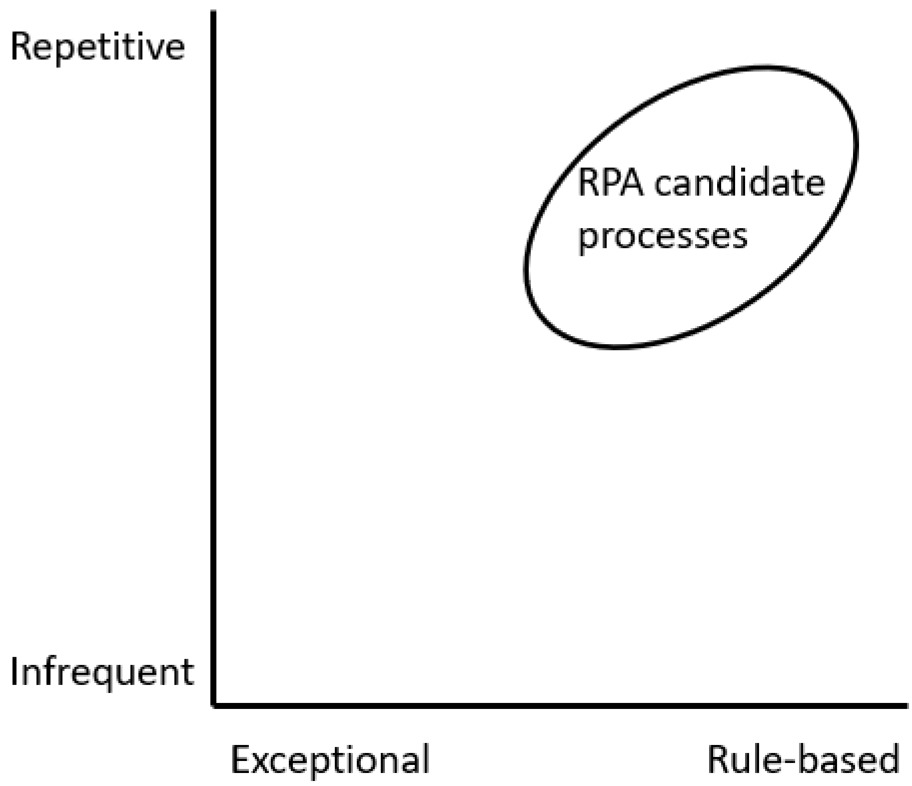

Figure 9 Process potentiality for RPA.

It must be noted, however, that not all the criteria necessarily have to be filled. For instance, not all to be automated activities are prone to human errors, cause manual rework nor require searching and collating information. Activities that are problematic to transfer offshore could be transferred as well as automated abroad. The criteria above are not completely carved in stone. Furthermore, it is a different question of whether a company wants or is capable to automate a suitable process or task at all. Kroll et al. (2016, 15) emphasize the alignment between RPA and a company's IT strategy. The former should not be necessarily initiated if IT can fix problems at the source. All implications, short- and long-term must be taken into account.

Finally, as already mentioned, RPA is an evolving technology. As it evolves, the number of criteria decreases, and it will be able to work in cognitive areas and handle more and more complex tasks. These tasks have aspects of decision-making and non-standardization. Kaelble (2018, 46) calls this cognitive decisioning or decisioning automation which includes advanced analytical capabilities, self-learning and AI (Mindfields 2017, 8). While these technologies are entering the markets, most companies are still, however, concentrated on rule-based RPA solutions (Kroll et al. 2016, 11).

4.3 Prioritization, standardization, and optimization of processes

To be automated processes and tasks should follow the criteria mentioned in the previous chapter. Aiming to automate too complex processes is one of the most common mistakes in RPA implementation (Dutta et al. 2016, 6). Companies should start with simple processes first, and then when the learning curve increases, proceed to more complex ones (Fung 2014, 8). However, the criteria are not carved in stone and there are likely some other considerations as well. For example, a process that seems suitable might be too risky for automation or add too little value. That is why potential processes should be assessed and prioritized by their value gain and risk degree as well. These should also be reflected in the company's strategic objectives (Srivastav et al. 2016, 3). Value can be measured by cost benefits and strategic relevance, and risk by, for example, system stability. For the potential processes, a transformation roadmap should be developed based on each task's individual requirements. This roadmap would also contain a strategic framework which the tasks should be suited for. (Kroll et al. 2016, 40) The prioritization could also consider the impact and effort factors. The impact factors include aspects of how RPA would benefit the company, for example, measured by the number of resources that can be reallocated more effectively. The effort to implement factors cover investments and costs. (Borbe et al. 2018, 8-9) The prioritization could be done by benchmarking the current performance of processes with distinguished peer performances in order to set an appropriate baseline for RPA (Rombough & Barkin 2017, 3). This way, the processes that have the most leeway for possible benefits could be identified.

Process standardization is one of the most important factors of process criteria and Wright et al. (2018, 14) say it has been the most challenging aspect in RPA implementation in 2017. According to Rahimi, Møller, and Hvam (2016, 1215), process standardization is "the activity of defining and agreeing on a finite and manageable set of rules and standards for conducting business processes". The idea is to reduce the variability of a process and execute it the same way every single time. Capgemini's survey has revealed that the usage of automation in a process is directly correlated to the degree of standardization in that particular process (Kroll et al. 2016, 7). Accordingly, the standardization degree is a good indicator of how far a process can be automated. If a process is not standardized and it has some variability, the bot cannot handle it correctly and due to possible contextual changes, it can start executing incorrect decisions which could lead to harmful situations (Aalst et al. 2018, 271). As Wright et al. (2018, 14) put it: “Process complexity drives robot complexity”. It increases operating costs as well as business disruptions. The effect of process standardization is demonstrated in Figure 10 below.

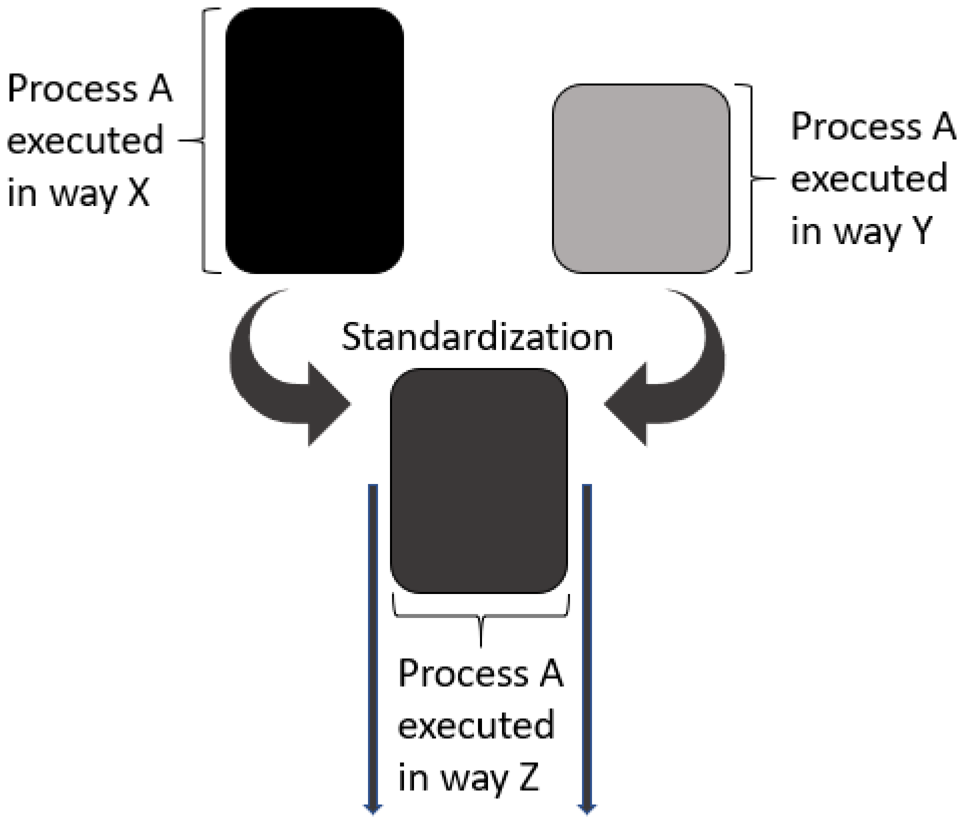

Figure 10 The effect of process standardization.

To make the most of RPA, processes should also be optimized beforehand. According to Kroll et al. (2016, 8), it is believed that RPA serves as an instrument and enabler of process optimization. It does optimize by automating the current state of a process. However, by optimizing a process before the involvement of automation, RPA would then optimize an already optimized process. This would improve process outcomes, decrease costs and cycle times even more, and eliminate waste and unnecessary steps (Mindfields 2017, 43). The goal should not be improving a process by automation; the goal should be just automating a process (Brain & Davenport 2018). Some companies in the Capgemini's survey optimize processes during or after the implementation (Kroll et al. 2016, 35-36). This is caused by minor corrections but also by quick-win solutions for optimization. RPA helps with small process steps and sends notifications about exceptions and loops to process supervisors. This way, little by little, work routines are defined and processes automated. The effect of process optimization is visualized in Figure 11 below.

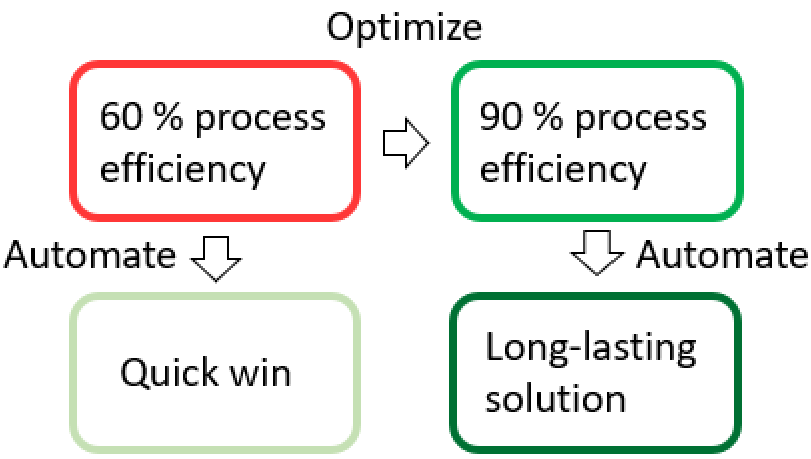

Figure 11 The effect of process optimization.

Some companies focus on the long-term benefits by optimizing processes beforehand, while others go after the quick wins. Either way, measuring the outcomes provides data and builds momentum for change. Even though there is no straight answer whether the optimization should be done before or after the automation (Nelson 2017, 4), Dutta et al. (2016, 6) point out that not optimizing at all or automating too much is one of the most common reasons why RPA projects fail. Companies try to eliminate human contribution in a process which results in too much automation effort and eventually additional costs. In addition, they do not have the effort to optimize the existing processes to enable RPA to work as much as possible. Automation and optimization should work hand in hand, preventing automating too much (Nelson 2017, 4).

4.4 Stakeholders' buy-in and change management

Hindle et al. (2018, 7) as well as Wright et al. (2018, 14) name stakeholder buy-in, especially from IT department, management and directly impacted employees, as one of the most, if not the most, important aspects when implementing RPA. Not acknowledging stakeholders and not communicating with them in a sustained manner usually results in failure. IT's vital involvement is needed regarding hosting, security, scalability, and connectivity of RPA solutions as well as deploying and maintaining servers (Beers et al. 2018, 2; Kroll et al. 2016, 24). Its engagement ensures stable implementation and improved service delivery (Nelson 2017, 3). In order to attain the full confidence and commitment from IT, a continuous alignment between the function and the business should be established. This means that IT should be involved at an early stage of implementation and that it should be able to accept the technology by being demonstrated how RPA adds value by extending the process portfolio and unburdening IT. (Beers et al. 2018, 4)

Management support and sponsorship is also essential. It can remove organizational barriers, provided there is resistance, and accelerate scaling (Wright et al. 2018, 12). Following evoking awareness in the organization, the business should get the acceptance and support for the technology from top management. Particularly C-Suite level sponsorship would indicate RPA's value to the organization. In addition, being able to create both top-down and bottom-up demand in the organization would increase the value of RPA and point out more automation potential. (Beers et al. 2018, 4-5)

As mentioned, RPA has a huge impact on employees. Bots are part of a living organization in which some jobs are taken over by automation, but at the same time, new positions will emerge. Thus, human workforce needs to be prepared and its acceptance should be gained for the technology by effective change management which plays a key role in a successful RPA implementation (Kroll et al. 2016, 24). For the change management to be effective, companies should identify the needs for successfully reskilling workforce (Geyr 2015, 1) and engage employees in the implementation of the bots. This way, they would be more satisfied with their new positions and would want to spread awareness even further (Wright et al. 2018, 16). Clear and proactive communication of objectives and employee impact dispels fears and creates an open culture which helps employees to adapt to change more rapidly (Geyr 2015, 1; Waller 2018, 41). Just by looking at automation as a tactical tool to cut costs and missing the value from stakeholders together with poor communication and not managing operational dynamics really limit RPA potential. As such, stakeholder buy-in and support and employee impact are reported as the top challenges after standardization in RPA implementation. (Hindle et al. 2018, 6-7; Wright et al. 2018, 14)

4.5 Running a Proof of Concept and selecting a proper tool

Before implementing RPA in a full scale, it is good to perform some pilots to test processes, learn more about the automation in terms of requirements and the technical compatibility to the existing IT structure, and demonstrate the overall value RPA would bring. These pilots form the PoC for which it is essential to include the same stakeholders who are associated with the actual implementation in order to obtain as truthful results as possible. (Waller 2018, 70) From the employee point of view, it is important to distinguish and understand the potentiality in processes, while involving IT is for understanding the complexity of automation at an early stage. Rombough and Barkin (2017, 4) suggest this is also the point where it is good to view different RPA vendors and service providers and select the most appropriate tool or software. Finally, it is important for companies to perceive this piloting phase as evidence of value-boosting RPA, rather than just seeing it works. Hankiewicz (2018) calls this a Proof of Value (PoV) which rather proves that there really is a real business case for RPA that delivers desirable and planned improvements. This requires planning, object scoping, suitable process identification, change management, and stakeholder buy-in in advance. Hindle et al. (2018, 7) warn that moving robots from the test phase into operations too quickly and without proper verification or operating model can cause them to stop working or carry out tasks incorrectly.

For the vendor and tool selection, it is important to consider aspects such as validity, reliability, fixed as well as variable costs (Rozario et al. 2018, 7-8), product maturity, functionality, ease of use, and scalability (Waller 2018, 72). For example, regarding scalability, the robots should be enabled to be scaled in accordance with the frequency and fluctuations of processes. As with reliability and functionality, the tool should include a feature which depicts the bots' executed actions during a specific time period in a particular process run. This helps in monitoring and improving the operations, but also in reversing incorrectly made steps. (Srivastav et al. 2016, 6) In addition, the tool's technology should be compatible with the underlying IT standards and infrastructure. Should the IT system undergo changes, it is vital for the tool to handle them. Some tools also might have integration issues with different platforms. (Srivastav et al. 2016, 6; Waller 2018, 72) Hindle et al. (2018, 6) highlight the importance and difficulty of tool selection. Since RPA is in the middle of a "hype" and the technology is relatively new to many businesses, the chances to choose a wrong and unsuitable tool(s) are somewhat considerable. The assessment of the tools' capabilities may turn out to be very difficult.

Additionally, it is important to notice that the RPA service provider can be different than the one that provides the actual software or tool. Therefore, the service provider's credentials should be checked as well. The considered factors can include financial and organizational stability and experience in the RPA markets (Srivastav et al. 2016, 6). Again, Hindle et al. (2018, 6) editorialize this by saying that choosing the wrong service provider or not choosing one at all can generate excessive costs and untapped value. Finally, ownership structures should be considered as well. Questions like who owns the software, who maintains the tool(s) on a continuous basis, and what obligations belong to each party in ensuring smooth and reliable operations, should be assessed (Mindfields 2017, 48).

4.6 Establishing governance and a Center of Excellence

In order to ensure that RPA is implemented properly and working correctly, a sufficient governance mechanism should be established. This would provide a foundation for effective change management and allow for continuous improvement initiatives for automation (Nelson 2017, 4). This governance would be called a Center of Excellence. It is defined as an organizational unit for a specific business area that comprises a set of capabilities that has been explicitly selected and joined as a source for value creation and continuous improvement to be disseminated in the entire organization (Frost, Birkinshaw & Ensign 2002, 997). It is a unit for automation that comprises both business as well as IT knowledge not only to ensure smooth operations but also to reduce tensions between the two functions. Its aim is to create value on an ongoing basis for the whole organization and continuously improve business processes. In addition, it tends to reduce the possible negative effects of automation, for example, job losses, errors caused by process changes, and crumbling of traditional organizational structure. Some of its daily assignments can include queuing tasks, collecting process data for new automation initiatives, monitoring process, and bot operability as well as system's overall stability and functionality, and reallocating robotic resources. This would allow reliability and visibility of the entire RPA system (Kaelble 2018, 11-12).

A profitable collaboration between the players within the center is essential. It is also important to assemble a team that has people from specific areas and expertise of the subject. Kaelble (2018, 37-38) names some important roles which include the CoE leader, technical lead, automation analysts, tester, developer, connectivity engineer, and administrator. They are responsible for coordinating the activities and resources, monitoring the quality of output, prioritizing potential cases and analyzing their challenges and value, testing and executing end-to-end solutions, managing IT integration, and maintaining ongoing automation solutions, respectively. Additionally, Srivastav et al. (2016, 8) highlight the importance of including the vendor or service provider to the team. They have the required technical capability, implementation experience, and functional know-how to ensure successful automation.

A CoE can be organized basically in two different ways; as a centralized or decentralized model. In *a centralized model*, the entire automation team is located in the same organizational unit (Kaelble 2018, 38) from which all the functionalities for the entire organization are driven and distributed (Vist Ekren 2018). It provides competence and manages the capabilities required to deliver RPA successfully. The benefits of this model include economies of scale and more effective usage of knowledge and enforcement of processes (Biggins 2018). However, when supervision and control are somewhere else than where a process itself is carried out, problems may arise concerning confusion and miscommunication. In *a decentralized model*, the CoE functionalities are designated to separate individual business units across the organization. They drive their own operations and have their own capabilities to maintain automation initiatives. However, as there is not a joint platform, the costs tend to be higher and process maturity more varied. The solutions are also more difficult to scale and connect with IT department. (Vist Ekren 2018) However, both models have their pros and cons and no single solution can be provided for every situation.

Once some bots are up and running, even in the test phase, continuous improvement is a vital aspect in RPA. It can be seen as an explicit set of principles and activities to create ongoing, systematic and cumulative improvements in operating procedures and systems (Lillrank, Shani & Lindberg 2001, 43). Regarding RPA, these principles and activities should be flexible and agile to ensure resilience, responsiveness, and effectiveness in digital as well as in human workforce (Kroll et al. 2016, 22; Wright et al. 2018, 22). An agile approach or method means that improvement steps taken are revisited to analyze emerged problems even further and find a correct solution. By registering each bots' inputs, outputs, timings and rules, documentation, and troubleshooting of dataflows is enabled (Waller 2018, 52). This process documentation should fill the gap between the newly programmed human knowledge and bot knowledge, caused by the disappearance of personal process expertise (Clair 2018, 3). Inevitably, some of the human process knowledge disappears once computed into the bot.

TOM has governance as one of the critical aspects in the first place, but it is essential for the CoE to maintain operations according to TOM. It is a model that clarifies and states the roadmap for change derived from business goals and company strategy and includes factor models such as sourcing, process, governance, performance metrics, skills and capabilities, and technology (Dutta, Choudhury & Ray 2017, 13). It creates an opportunity for the company to maximize business value by utilizing the virtual workforce and other resources while controlling costs and mitigating risks (Mindfields 2017, 48). This can be done by stating and underlining what aspects need to be considered in advance; ownership structures, change management, roles and responsibilities, Key Performance Indicators (KPIs), performance management, virtual workforce management, and governance. KPIs are important in monitoring process performances. However, it is important to note that the indicators and standards for bots should not be similar to those of the human workers. Consequently, new standards for quality measurements should be assessed. (Srivastav et al. 2016, 11) By continuously monitoring the KPIs, reporting performance progress to management according to baseline and goals, and recognizing improvement areas, they ensure that automation is utilized and realized into benefits that support the overall business objectives (Waller 2018, 75). According to Dutta et al. (2016, 4), neglecting responsibilities is one of the most common issues in failed RPA projects. Staff should be trained to operate the robots and continuously enhance processes.

5 RESEARCH DESIGN AND METHODOLOGY

In this chapter, the research design and methodology, as well as other research aspects, are assessed and covered. By explaining the research terminology from broader concepts to more narrowed ones, it helps the reader to comprehend the definitions and their relations with each other. More importantly, a profound explanation of the concepts helps in justifying the chosen methodologies and methods for this research.

A research design is a general plan in designing how the research questions will be answered. It contains distinct objectives derived from the questions, specifies the sources from which data will be gathered and the means of how the data will be collected and analyzed, and addresses possible validity and reliability related aspects regarding, for example, the accessibility to data. (Saunders, Lewis & Thornhill 2016, 163-164) A research methodology, on the other hand, constitutes the entire journey of how to find the answers to the research questions (Kumar 2011, 36). Consequently, these concepts can be used interchangeably. One of the main things concerning the methodology is to decide what kind of research is conducted, empirical which comprises quantitative and qualitative aspects or conceptual which does not involve conducting any practical experiments. The justification for choosing a proper method should be based on the nature of the research questions and the objectives and should indicate consistency across the entire research (Saunders et al. 2016, 165). For this thesis, empirical research was chosen and more precisely, a mixed methodology of both quantitative and qualitative aspects.

While quantitative research focuses on numeric data and numbers, a qualitative one concentrates on non-numeric data, such as words, images or videos. According to Kumar (2011, 36; 38), the two differ from each other regarding data collection methods, data analysis procedures, and the manner of communicating the findings. In qualitative research, data is collected through interviews, case studies and participant observations, analyzed by, for example, data categorizations, and reported verbally. In quantitative research, on the other hand, data is collected through measurements, such as correlation and regression analysis, mean, mode and median assessments, analyzed through comparisons and statistical reasoning, and reported through statistical analyses. In addition, the sample size tends to be larger in quantitative research. However, according to Saunders et al. (2016, 165), elements of both aspects are usually utilized which makes the differentiation problematic. For example, this thesis adopts a mixed methodology since interviews are applied in which many questions are open-ended (qualitative), but some answers are also to be ticked in their appropriate boxes (quantitative).

5.1 Research method and strategy

A research method is seen as a separate concept than a research methodology. A method, or strategy, should be able to address the plan of how the research will be conducted. It seizes deeper than the methodology and deals with aspects such as study participants, techniques and procedures. Consequently, it is “the methodological link between the researcher’s philosophy and the subsequent choice of methods to collect and analyze data”. (Saunders et al. 2016, 57; 177) Examples of a research strategy are an experiment, documentary research, a case study, a narrative inquiry or a survey. A case study was selected for this thesis.

In a case study, the selected “case” becomes the basis of a comprehensive, holistic and in-depth examination of the aspects the researcher wants to know more about. A case can be, for instance, an individual person, a group of people, an organization, an event or a change process. (Kumar 2011, 123) In this case, the examined business environment is the case for the study. In order to define a case study, a key factor is to determine the boundaries (Flyvbjerg 2011, 301). These are addressed in chapter 1.3 as limitations. According to Grinnell (1981, 302), this method is a very flexible and open-ended technique for collecting and analyzing data which, in fact, suits this thesis very well. It is very useful for examining an area where one wants to have a comprehensive understanding of. When selecting a case, the idea is not to choose a random sample, but rather a sample that provides the researcher as much information as possible in order to obtain that comprehensive understanding of the examined area. (Kumar 2011, 123) This is related to the fact that only certain and specific people are interviewed for this case. In addition, Saunders et al. (2016, 185) remark that in order to fully understand the effects of a situation and implications for action as well as the dynamics of the studied phenomenon, a case study should adopt a mixed methods approach. This reflects the application of both qualitative and quantitative practices.

5.2 Data collection process

Primary data was collected through several single as well as pair interviews in order to obtain as comprehensive view of the case as possible. The positive side of this method and the reason it was chosen is that it is extremely flexible and able to obtain any form between a highly disciplined and fixed and a rather loose structure (Kumar 2011, 339). This suits this thesis very well since the interview questions used are not all qualitative like or open-ended, yet they provide answers that can really build up the case. In addition, the interviews included not only asking questions but also describing and clarifying the subject and even a little bit of steering towards more explicit responses as well. This was due to the fact that RPA was not so familiar or well-known concept for most of the interviewees and because the potential processes needed to be seized into more scoped and narrowed subprocesses. Saunders et al. (2016, 391; 394) call this kind of interview as a semi-structured or a qualitative research interview. It is the most beneficial approach in obtaining data when there are a large number of complex, open-ended and logic varying questions to be answered. The method contains a list of themes and some key questions of which scope, use, and order might vary depending on the session and its flow. Additional and more precise questions may be required in order to examine answers or a topic more closely. Furthermore, due to the nature of the interview and the questions, the data will be captured by note taking, and the discussion will be opened, furthered and closed by some extra comments. In this case, the themes included RPA process criteria in relation to discovered SCM subprocesses as well as the aspect of change management. Key questions were always about the process criteria, and the scope, use, and order varied in almost every interview, depending on the nature of the responses and whether or not there was a comprehensive answer to some of the criteria sections. Some criteria were too difficult to assess in a subprocess and consequently, some questions were excessively challenging to answer to and were left blank. Notes were made and discussions furthered, always depending on the answers. The interview layout and questions are stated in Appendix 1.

The questions were sent to the interviewees well before the session itself in order to give them an opportunity to get familiarized of the subject. The business functions and persons for which the interviews were held were chosen in a way so that a viable in-depth analysis, from the perspective of procurement, was made possible. These functions were logistics, demand management and planning, sourcing, and purchasing. An interview of logistics included two logistic service engineers, and demand management and planning a value chain specialist, a team leader of planning and inventory management, and an S&OP process owner. Sourcing included three different sessions for category and sourcing managers in mechanics, electronics, and electrical teams. Each team interview involved a category manager as well as a sourcing manager in New Product Development (NPD). Regarding purchasing, four different sessions were held. The first one concerned a global supply planner, based in Estonia. The second session was held for a supply planner and a project buyer. The third one involved two development specialists in purchasing, and the fourth a purchasing specialist in shared services. The interview summary can be seen in Table 5 below.

Table 5 Interview summary.

Business function	Interviewees	Interview type	Duration	Date
Logistics	2x logistic service engineers	Contact	1,5h	10.4.
Demand management & planning	Value chain specialist, team leader, S&OP process owner	Contact	2h	11.4.
Sourcing (mechanics)	Category manager, sourcing manager	Contact	1h	18.4.
Sourcing (electronics)	Category manager, sourcing manager	Contact	1,5h	12.4.
Sourcing (electrical)	Category manager,	Contact	1h	23.4.

	sourcing manager			
Purchasing	Global supply planner	Skype	1h	9.4.
Purchasing	Supply planner, project buyer	Contact	1,5h	15.4.
Purchasing (development)	2x development specialists	Contact	1,5h	17.4.
Purchasing (shared services)	Purchasing specialist	Skype	1h	25.4.

Some of these small group interviews made open discussion possible, especially regarding change management. The discussion sort of fed itself, allowing participants to reveal data that provided important insights. In addition to primary data, secondary data was acquired to support the empirical part of the study from case company documents, websites and personnel that was not specifically interviewed.

5.3 Data analysis

This thesis follows an inductive approach to analyzing data. It means that new decisive implications are built up by focusing on the collected data, not using existing theories to shape the research process or aspects of the data analysis like in a deductive approach. The former approach is described to have a clearly defined theoretical framework and an emerging theory from the process of data collection, analysis and interpretation. (Saunders et al. 2016, 569-570) The phases of processing data are depicted in Figure 12 below.

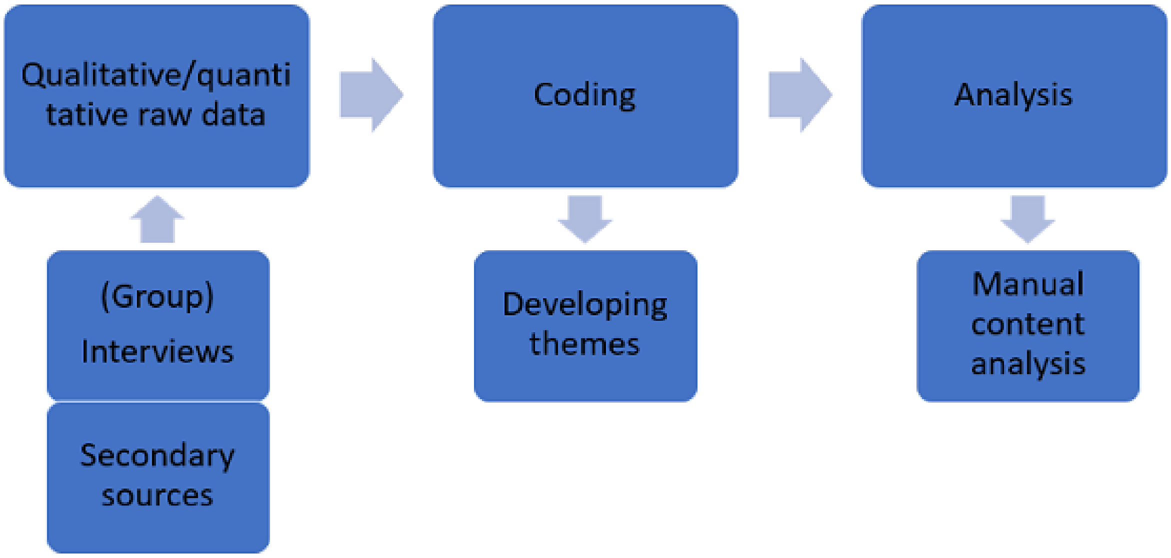

Figure 12 Phases in data processing (adapted from Kumar 2011, 227).

After data collection, coding and developing themes are in place. As mentioned in the previous chapter, the beforehand defined themes include RPA process criteria in relation to the discovered SCM subprocesses as well as the aspect of change management. From these, manual content analysis is derived. It is a helpful method to analyze data, both quantitative and qualitative, from semi-structured interviews (Saunders et al. 2016, 610). The analysis includes assessing the business environment's RPA suitability at a general level. This means that the addressed automation criteria in subchapter 4.2 are reflected to subprocesses and tasks discovered through the interviews. By general level, it is meant that not a single subprocess is examined any deeper than it is necessary in order to find areas of potentiality for automation. The potential subprocesses were discovered by reflecting interviewees' tasks to the process criteria which include the following:

- Repetitive and frequent.
- Rule-based and well-defined.
- Interpretation free.
- Few of exceptions.
- Using only digital information.
- Packed with structured data.

These are the most important criteria since they are basically compulsory for RPA to be able to execute anything at all. Other criteria and aspects include:

- Causing manual rework.
- Depended on by other processes (a bottleneck).
- Human intervention prone.
- Used applications and software (reflects complexity).
- The level of standardization.
- The level of optimization.
- The number of employees currently dealing with the process.

The standardization and optimization aspects are quantitative like in the interviews, meaning that there are a few options to choose from (low/medium/high level). The reason is that these aspects can be altered to be more suitable for automation. For example, an existing low level of standardization in a process is not an obstacle per se because it can be increased and improved prior to an automation initiative. On the other hand, a clear obstacle is when a process is not repetitive or rule-based. Repetitiveness cannot really be altered and if a process is not based on rules, the bot cannot execute it efficiently or at all. Finally, in addition to potential processes, change management aspects are analyzed as well. They address the business environment's RPA suitability from the perspective of employees and specify how they would feel about new automation solutions in their imminent surroundings.

5.4 Validity and reliability

The *validity* of a research refers to the appropriateness of the adopted methods, the accuracy of the analysis of the results, and generalizability of the findings (Saunders et al. 2016, 202). Methods and procedures are appropriate when they help to answer the research questions. Consequently, validity can be defined as the degree to which the researcher has measured what he has originally set out to measure (Smith 1991, 106). *Reliability*, on the other hand, is the degree of accuracy and precision in the results derived from a research instrument (Kumar 2011, 169). In this case, the research instrument is a semi-structured interview. Additionally, it can be said that a study is reliable when the same findings are achieved by another study by repeating the exact same research design like in the original study

(Saunders et al. 2016, 202). According to Kumar (2011, 169), reliability cannot ever be fully accurate since there are multiple uncontrollable factors affecting it; the wording of questions, the physical setting of instruments, the mood of interviewees and interviewer, and the nature of the interaction. In addition, Saunders et al. (2016, 203) mention participant error and bias and those of the researcher as threats to reliability. Errors can include misinterpreted questions or answers, and biases providing purposively positive and false answers or letting subjective views get in the way of responses. Also defects in the research problem, as well as possible limitations, affect the validity and reliability of a research (Kumar 2011, 68).

Validity and reliability are usually regarded as technically unsuitable for qualitative research. Kumar (2011, 171) defends this argument by asking how an instrument can be consistent and measure what is expected when semi-structured interview questions are neither fixed nor structured. This is why in qualitative research the two concepts are compensated by credibility, transferability, dependability, and confirmability (Guba & Lincoln 1994, 114). According to Trochim and Donnelly (2007, 149), *credibility* means that the results of a qualitative research are credible and believable from the perspective of the participants. It can be increased by using more clarifying and specified questions, probing meanings, and examining answers from different angles (Saunders et al. 2016, 400). The higher the credibility, the higher the validity. As mentioned earlier, applied semi-structured interviews in this case included describing and clarifying the subject, and the discussions were furthered and closed by some extra comments. These increase both the credibility and validity of this thesis. *Transferability* is the degree to which the results can be generalized or transferred to other contexts (Trochim & Donnelly 2007, 149). This is hard to obtain in a case study where semi-structured interviews are used. A rather small sample size limits the generalizability (Saunders et al. 2016, 205) and thus, hinders validity in this case. However, this case reflects particular participants in a particular setting at a particular time. This causes it not to be necessarily replicated at all. *Dependability* relates to the fact whether the same results would be obtained if the same case is re-observed (Trochim & Donnelly 2007, 149). Due to the flexible nature of semi-structured interviews and not keeping detailed records, dependability is not fully formed. However, if one inquires suitable processes for automation again from the same participants, the answers would be quite the same in this case. *Confirmability* is the degree to which the results could be confirmed or verified by others (Trochim & Donnelly 2007, 149). According to Kumar (2011, 172), this is only possible if the original and the following research follow the process identically.

All in all, the adopted methods in this case are appropriate since they help to answer the research questions. The findings cannot truly be generalized due to the fact that this case reflects particular participants in a particular setting at a particular time. In addition, the wording of questions in semi-structured interviews, the nature of the interaction, the mood of the interviewer and participants as well as their possible errors and biases affect the reliability of this case. The questions or answers could have been misinterpreted, and since the interviewer has worked in the same positions as some of the participants, subjective views may have been affecting the answers. Additionally, some sessions were held at the end of the day so it might have been a participant mood factor to reliability. Also, some existing tasks in the environment that did not become apparent in the interviews may have been unintentionally disregarded due to misunderstanding the concept and topic as a whole.

6 EMPIRICAL FINDINGS

In this chapter, the collected primary and secondary data are reviewed. First, a brief introduction to the case company is presented after which the relation between the SCM upstream functions is depicted to provide the reader with an understanding of their collaboration in practice. Then, the existing RPA function in another business environment is introduced concerning the already automated processes, the government model and the process of identifying and deploying new automation initiatives. Next, tasks and subprocesses discovered through the interviews are analyzed one by one while some improvement suggestions are presented as well. The analysis itself is based on the theoretical RPA process criteria to which the discovered tasks and subprocesses are reflected. Over 20 of them were originally identified from which about half have a real potential for RPA after some standardizing and optimizing endeavors. Furthermore, some other solutions but RPA were recognized to be applicable to a few of the discovered practices. In any case, the most, as well as the least, suitable tasks and subprocesses are represented in two different charts to allow comparisons of why some are more suited for RPA than others. Finally, change management and employee perspectives are interpreted as well.

6.1 Introduction to the case company

The case company of this study is a major multinational corporation which operates in over 100 countries, and in the areas of electrical equipment, power, automation, and robotics. Its roots stretch all the way back to the 19th century's Sweden and Switzerland. At its current state, the company has been operating since 1988 with more than 145,000 employees working worldwide of which a little over 5,000 in Finland. Remarkably, the corporation has been included in the list of Fortune Global 500 for 24 years straight. Regarding this study, the mandator is a business unit and a part of one of the divisions of the entire corporation.

6.2 Collaboration between the SCM upstream functions in the case company

The sourcing department leads and executes the sourcing and category strategies as well as the supplier portfolio and category management in the related business environment. Theoretically, these are strategical procurement activities. It also handles SRM activities, such as supplier development, ratings, meetings, and negotiations of which the latest can be included in tactical procurement. The department also participates actively in quality management matters as well as in the integration between SCM and Research and Development (R&D). These are only some of the operations the sourcing department is responsible for, either in leading, executing or consulting the activities. It works closely with purchasing in every aspect of which one of the primary responsibilities is operational procurement, including activities such as availability, forecasting, planning, inventory management and purchasing itself. Leading and executing certain KPIs belong to the purchasing department as well. Logistics consults purchasing activities and takes care of transportation arrangements, factory logistics as well as pallet and packaging circulations, among others. Demand management (S&OP team) and manufacturing flow management come along in the inventory management process in which a material plan is established. In accordance with the plan, forecasts and MRP actualize in SAP. This leads to input data for purchasing to look after the correct parameters of each material, but it also affects the purchasing process itself. It must be noted that the previous relations between the upstream functions are simplified to protect classified information but still depicted to show the joint correlation.

6.3 Existing RPA function in shared services

There is not RPA in place in the business environment this thesis is targeted at and limited on nor is there any processes automated with the technology for the actual mandator of this paper. A shared services outsourcing partner and BPO provider, however, has already implemented RPA along with other Business Process Automation (BPA) software to automate some of the case company’s processes in functions like finance and procurement and logistics. In finance, these processes include, for example, processing supplier invoices that cross the auto-match period in the eFlow application, managing fixed assets master data, pre-checking invoices, and collating KPI data on orders, revenues, margins, and cash flows on a monthly basis. In procurement and logistics, one automated process concerns checking for open purchase requisitions, grouping them by vendor and then creating a purchase order. Another one relates to a missing good receipt where the bot extracts invoices, defines their category and sends a notification to the original error requester. Easily noticeable, almost every automated task and subprocess are associated with the finance function.

The RPA function in question is a centralized operating model for which every business unit and person in the entire corporation can suggest automation initiatives. The suggestions usually come from someone that currently carries out the task and knows its requirements and features. The process itself of identifying and deploying initiatives starts by answering questions about the data type of inputs, if-then logic, and outputs of the task. If the input data is structured, if-then logic realized and outputs clearly defined in the suggested task, the initiator can move to the second phase of the process. Here, the initiator manifests the opportunity to the geographically closest automation product owners that list, prioritize and select the most feasible initiatives that have been manifested. The prioritization requires analysis as well as working with relevant stakeholders to align the initiatives with global demand inside the corporation. In the next phase of the process, the product owner determines the Process Design Document (PDD) depicting AS-IS (current) and TO-BE (future) task descriptions for the selected initiatives, provides these to the development team, and agrees on which initiatives can be delivered within a set time frame. After this, the most suitable and agreed initiatives are chosen. However, if task descriptions in PDD phase indicate any destabilization or non-standardization in a task, the product owner must bring the matter to a quality team or to a domain expert to standardize the task in question. This does not mean, however, that tasks needing stabilization solutions are to be discarded. It only means that possible standardizations or optimizations have to be addressed prior automation. Should the automation project need any technical support, the product owner should raise the issue and work with IT or service providers to accommodate the needs. If stabilization, standardization or technological support is not needed, the most suitable and agreed initiatives are finally implemented through the development team to a bot.

Product owners are the center in the bot lifecycle process. They are in charge of the analysis and prioritization of automation initiatives and serve as the interface between the initiatives, bot owners, development team and other resources. Bot owners, on the other hand, handle the bots in use and are accountable for all the actions their bots make. If a task needs change or a target system in which a bot operates an update, its owner should address the matter with a product owner in order to plan changes in that particular environment to prevent any problems.

6.4 Discovered potential tasks and subprocesses in the interviews

Two of the potential processes for automation could be *a materials lead time check for suppliers* and *the insertion of the correct parameters to SAP ERP software*. Currently, the lead time in about every fifth purchase order is misleading or incorrect, at least in the electronics category. This leads to a reliability check for vendors which takes about six human hours per month, the insertion included. However, if all the acquired and procured materials are considered in the mechanics and electrical categories as well, the time required equals approximately 160 hours of human work every month. The two related tasks themselves are rule-based and well-defined and require no interpretation, judgment or creativity whatsoever. Of course, ensuring and confirming the updated lead times before adding them to SAP is required in order to avoid errors and possible too high differences between the old and the new parameters. This requires some interpretation by a human employee which can be a cause for manual rework. The two tasks are not bottlenecks for other subprocesses but themselves. However, they affect functions and operations such as purchasing and hence, production as well. It is extremely important for the lead times to be correct in order to prevent late deliveries, production stops and confusion in the mentioned functions. When it comes to standardization, both processes are quite straightforward and unambiguous for automation. It still needs to be ensured that the lead time inquiry list for suppliers is a standardized Excel -file and that the instructions for filling it are explicit. The values the vendors add to the cells should be equivalent to each other, meaning that the definition of lead time is unequivocal and expressed in a similar manner every single time, for example in days. If variation exists, RPA cannot handle the data correctly and false data may be inserted to SAP. Optimization, on the other hand, has not so much room in these particular processes. Of course, the inquiries could be sent to all suppliers in a centralized manner from one address so that the responses arrive in the very same address and email box. In addition, suppliers could send the files without a separate inquiry. These relate heavily to standardization as well. Currently, 2-3 human employees are carrying out these activities while a bot could possibly do the job much more conveniently on behalf of every supplier responsible employee. The two tasks and human confirmation process are depicted in Figure 13 below.

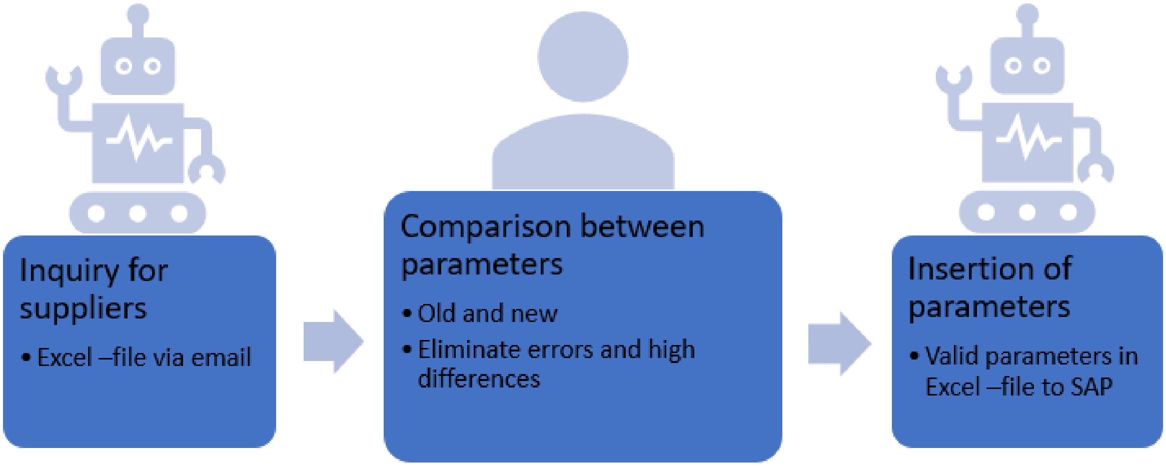

Figure 13 The tasks of lead time check and parameter insertion.

Depending on the RPA software and its ability to handle some unstructured data, these tasks should be able to be automated. The most important criteria are fulfilled; rule-based without requiring any interpretations. Also, the lead time updates could be assessed even more often and for more materials to make SAP parameters more dynamic. This would not only increase the flexibility of operations and decrease confusion regarding lead times and deliveries but also increase the repetitiveness of the task for the bot to handle. Concerning standardization and optimization, some adjustments are needed before automation. If there are changes in lead times during an examination period, which in this case can be a two week or a month, suppliers could automatically send updated parameters to a specific email address. The changes are assessed by a human employee, after which the bot inserts the parameters to SAP. More frequent changes and dynamic lead times enable more accurate deliveries and flexible operations. In addition to the mentioned parameter, lot size changes could also be assessed.

When it comes to the Request for Quotation (RFQ) -process, RPA, with the help of other advanced technologies, could *compare the received data to pre-defined minimum values and prioritize the most suitable quotations* for further human analysis. The quotation data could include prices, lead times, delivery terms, and so forth. Currently, depending on the responsible person, reviewing quotations and choosing the most suitable ones takes up to two hours every single day. The process is mainly well-defined, with some exceptions. There is a standardized RFQ -form for the suppliers to fill, but not all follow the instructions. For example, prices might be informed as per piece or as per 100 pieces, or they can be of different currency. These factors hinder the RPA capability enormously. The form or template should be fixed, meaning that it should only accept certain values. After it has been filled correctly, it is sent to a specific email address where the bot receives it and starts working. Again, with some unstructured data, RPA needs other advanced technologies in reading the quotations according to the criteria after which it can make the prioritization itself. In time, instead of using the email, the new automation solutions could work together and obtain the required data from a template in Power BI, for there is already an ongoing project for it. The subprocess is depicted in Figure 14 below.

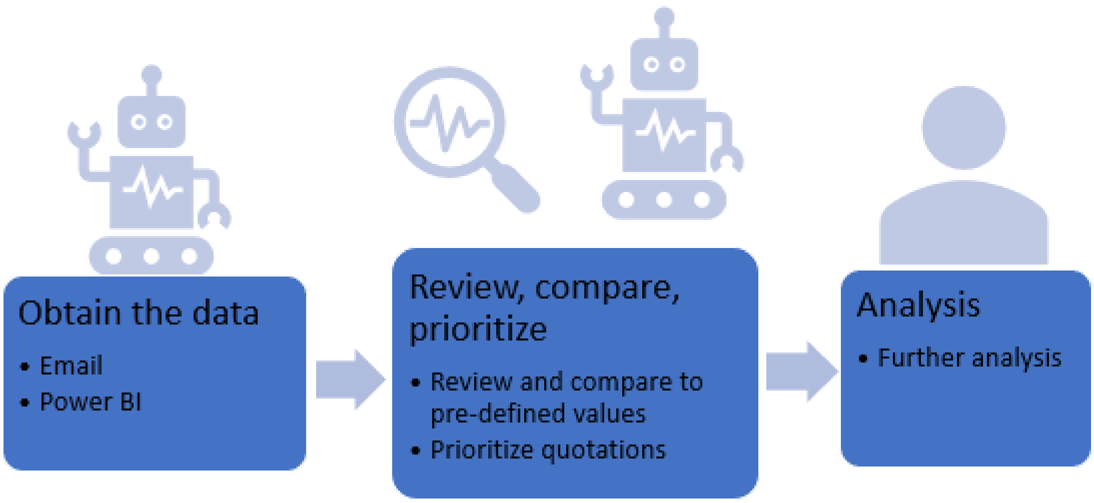

Figure 14 The tasks of comparing and prioritizing quotations.

Forwarding Engineering Change Notices (ECNs) to their respective suppliers is a potential task for RPA, at least when it comes to its repetitiveness. The notice itself concerns design changes for a product in any stage during its lifecycle. Approximately ten ECNs reach purchasers or supply planners daily, each containing anything between 1-30 material lines. Currently, checking each line's supplier, buffer stock level and the number of open orders, and forwarding the required change notice information to the respective suppliers take about one minute. Thus, the entire subprocess takes about 75 minutes per day on average. It is also well-defined; checking material buffer stock levels and the number of open orders are separate, yet compulsory, tasks that must be addressed as well, but require human interpretation. In this case, the bot would be responsible for checking each material line's respective supplier and forwarding the necessary information to them. Nonetheless, this would still mitigate the responsible human employee's workload, even though buffers and open orders had to be checked manually. If they existed, separate guidance for suppliers would be provided regarding the required actions. The process is depicted in Figure 15 below.

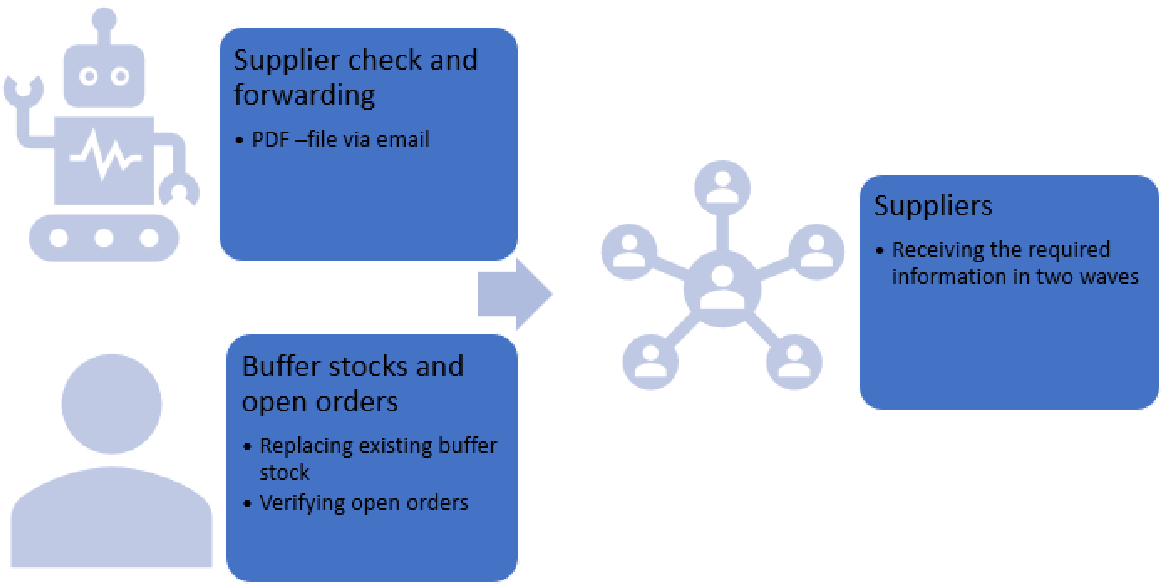

Figure 15 The tasks of checking and forwarding ECNs.

The base for checking the correct suppliers can be found in SAP or in a separate maintained file where source lists, as well as supplier contact information, are stored. With other advanced technologies, the bot recognizes the material code in the ECN itself and checks the base file for the correct supplier. Forwarding the information, as well as receiving ECNs from designers in the first place, should be performed with a common specified email address just for this purpose. This way, all the files are stored in a shared place where it is easy to maintain and check them. Some room for optimization and standardization still exists; in each category, only one person should be responsible for the process so that two or more would not send the same files over and over again. Since this subprocess is a major bottleneck, human supervision is required for the bot, especially in the beginning.

RPA could also *create a report of factors that affect and change* the material end prices that are used in purchases. These factors could be alterations in raw material prices or machine hour rates, among others. The generation of the report requires the bot to compare the old and new prices of each material in an Excel -file and then highlight the differences and reasons for them. Again, some advanced technologies that can read unstructured data are needed. For example, OCR executes the comparison, highlights the differences and reasons for them, from which RPA creates the report for further human analysis. Checking the differences is carried out once in a quartal and requires as much as 40 hours of manual labor. Of course, this load is shared with some other sourcing or category managers, but still, not all of them do this. The tasks are described in Figure 16 below.

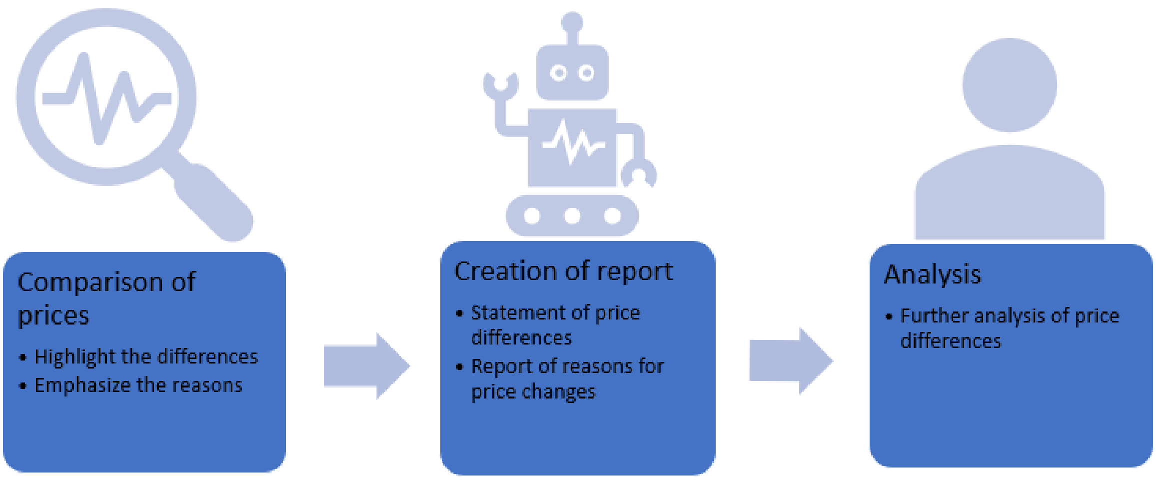

Figure 16 The tasks of comparing prices and creating a report.

However, the differences can be anywhere in masses of data, so complexity exists. In addition, there is room for optimization and standardization before automation. For example, a master file or files should be created to link the data so that the processing would be smoother. Also, the current files containing the information are not uniform. All things considered and with some enhancing work, this subprocess could work well for RPA.

Late Open Order (LOO) inquiries require some 5-10 human employees to check the recent late open orders and send inquiries to suppliers on a daily basis. The amount can vary anywhere between 15-30 emails per day per person, where writing and sending one email can take up to 5 minutes. Hence, in the worst-case scenario, these activities can even take two and a half hours per day. Checking the late open orders can require interpretation because some of them may not be that urgent and do not need inquiries right away, and some of the new materials can cause false alerts in urgency levels. In addition, some late open orders have already been inquired and replied to. Consequently, a human employee must decide which orders are to be inquired via email. There should be a standardized layout for an inquiry so that it does not have to be rewritten every single time. Only some variable factors vary on the layout, such as the name of the supplier, the purchase order number in question, and the required delivery date. The subprocess is depicted in Figure 17 below.

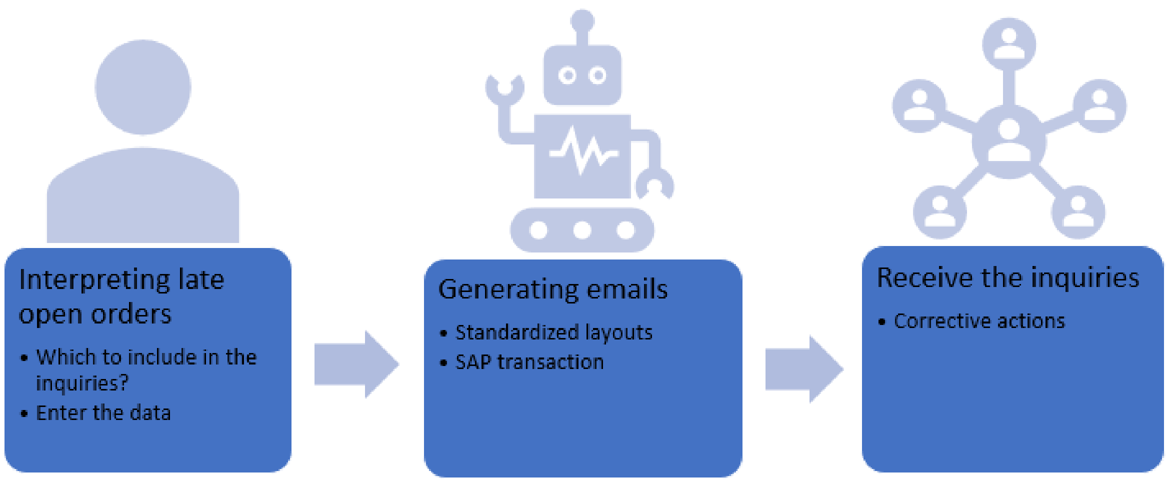

Figure 17 The tasks of interpreting late open orders and generating emails.

In addition to RPA handling the inquiries, another solution is that an SAP transaction is created to automate late open order inquiries. Here, behind a few clicks, SAP would automatically generate a reminder email for late open orders.

Requiring two to four hours of manual work, about 12-24 *Manual Special Orders (MSOs) are prepared and sent* to suppliers every week. Here, production sends an action plan to the purchasing department for ordering special colored materials. The action plan or instructions should include a standardized form that encompasses the material itself, quantity, color, production plant, sales order, and if possible, the supplier. Based on this information, the purchase order is made. In the purchaser's manual, there are explicit guidelines on how to carry out the order. Consequently, the only aspect that has room for standardization are the instructions themselves coming from the production. RPA cannot execute the orders itself, but it could acquire the incoming instructions from a specific email address and save them to a certain database from which Winshuttle, in turn, executes the orders according to set timing. Another solution could be that the most purchased items with every special color have their own material code, hence consumption and so forth. Therefore, special orders would be ordered just as normal purchases without the need for manual work of filling the order template with various different factors.

RPA could *create a report of certain materials* that have had some problems arriving on time in the near past. This report would be a continuous improvement proposal for further human employee root cause analysis. On the report, materials could be prioritized based on, for example, their frequency (how many times the same material has been delivered late?), level of criticality (what kind of harm the late delivery of certain material has caused?) and vendor repetitiveness (how many times a certain vendor appears on the list?). Based on these, it is easier for a human employee to see whether a certain material combined with other factors recurs on the list and analyze the reasons further. This task is currently carried out casually only, and no instructions whatsoever exist. However, it should be done at least weekly to eliminate the most occurring cases and late deliveries. Thousands of materials wait for reporting and analysis, so RPA would act as sort of a "fire extinguisher". Again, for data recognition, some other advanced technologies are needed to create a report based on the information in SharePoint. At the moment, Power BI is linked to the material follow-up list regarding shortage cases. This, however, does not show a prioritized list of the most recurring materials. In addition, more criteria and variations should be added so that a more comprehensive and complete report can be established. All in all, this is a potential case for RPA.

Stock comparison requires comparing material quantities between two applications, SAP and the stock application of the one third-party logistics service provider. The idea is to point out possible errors and incoherencies between the two stock levels. Currently, this is not carried out full-time, so RPA would be utilized here as sort of a “fire extinguisher”. It is estimated that a human employee would carry out this activity full-time for nearly two months until all the incoherencies are checked and analyzed. The comparison itself is well-defined and rule-based, after which the possible differences are interpreted and analyzed by a human employee. However, there is already a Power BI report project in progress to which RPA could be possibly linked. The bot could execute the material stock comparisons from certain files which are then entered to Power BI reports. Before this, RPA would need assistance from other advanced technologies to handle unstructured data. In this case, the data concerns material codes and quantities which are extracted from their source and then handed as a “transcript” to structured data for the bot for comparison. Another solution could be data wrangling or cleansing, where the original or “raw” data is basically transformed and mapped into a more appropriate format for RPA. All in all, a rather complex task for automation but still possible.

Adding new type codes and frame sizes to SAP Business Warehouse module is another task suggested for RPA. Currently, it is carried out once a month, requiring approximately two hours of manual labor. However, this should be done once a week in order to keep the most updated data in readiness. The type code and frame size information are available, for example, in the SAP Materials Management module, among others. The tricky thing is that the base data can be inaccurate, and the most exact data cannot be found in just one place. Since the data is scattered and the steps for gathering it not explicit or well-defined, the task is currently not suitable for RPA. One solution could be that the required data is entered into a centralized and maintained file in the first place, from which the bot runs it to the Business Warehouse.

On Time Delivery (OTD) -corrections take only about one hour per week per person depending on the supplier, but it is a tedious and manual task that does not bring any added value. Here, the supplier sends a file weekly where its material orders' actual delivery dates are stated. The job is to change inaccurate delivery dates in the respective purchase orders in SAP so that at the beginning of each month, KPI reporting shows the factual situation of late deliveries. Currently, the entire process needs some optimization before automation solutions can be introduced. The problems are sort of bypassed and employees have adjusted themselves to the current situation. For example, now these weekly files are received via email as well as via SharePoint, and the templates differ. One standardized template should be created where the actual dates are transferred to, and then from which the dates are transferred to SAP. In order for a long-lasting solution, a process should be fully optimized prior automation.

As RPA can monitor events, it could *alert new won opportunities* to local database from Salesforce's cloud-based system. Checking new opportunities is done once a month and taking about four hours per instance, though it should be done more often in order for some of the opportunities to not "expire". It is a standardized task when a certain trade quantity is exceeded; those can be directly utilized while non-exceeding trades require interpretation by a human worker. It is also a bottleneck for it is required in determining material and factory capacity. Too optimistic figures cause the capacity to increase excessively while more pessimistic figures result in an opposite reaction. However, while this could work well for RPA, Salesforce can already be connected to Power BI and obtain data, and vice versa. Accordingly, RPA does not bring added value here.

In Table 6 below, tasks and subprocesses that have the most potential are listed and prioritized according to repetitiveness as well as their overall readiness and maturity degree for RPA. Combined average frequency depicts the repetitiveness of a task when all the employees currently carrying it out in the same business environment are considered. This also includes employees who, in accordance with their responsibilities, should be carrying it out but are not. If daily variation exists, an average quantity is calculated. The column is stated as hours required per day/week/month or amount of repetitions per day/week. Complexity imparts the fact of whether a task is well-defined and rule-based. It considers the required interpretation, possible exceptions and number of used applications in a task as well. In this case, if a task is rule-based, it requires no interpretation and has a limited number of exceptions. Upfront standardization and optimization tell if a task requires some fixing or enhancing before an automation initiative and is depicted in the column as a level of low, medium or high. For example, if it's a high level, a great standardization or optimization work is required. It also depicts a certain automation maturity of a subprocess. If the level is high, it is currently less mature for automation than the ones where the level is low. The type of data used in a task is either unstructured (U) or structured (S). This leads to possible other required solutions and advanced technologies alongside RPA. Existing solutions simply tell if there are currently any other solutions applied in a task that make RPA futile. Lastly, a task is currently in motion or not. Some tasks below are modified, new and derived from the existing tasks. This refers to the fact that RPA can discover possible bottlenecks in processes and reveal new possibilities.

Table 6 Discovered potential processes for automation.

Subprocess	Combined average frequency	Complexity	Upfront standardization & optimization	Type of data	Other solutions required	Existing solutions	A current process
Check + insert lead times	6h/month. 160h/month if all materials	Rule-based, <5 apps	Medium	U	Winshuttle	None	Only for electronics
Check + forward ECNs	2,5h/day or 150reps/day	Rule-based, <5 apps	Medium	U	Advanced technologies, data wrangling	None	Yes
Prepare + send MSOs	3h/week or 18reps/week	Rule-based, <5 apps	Medium	U	Winshuttle	None	Yes
Inquire LOOs	75h/week or 900reps/week	Rule-based, <5 apps	Medium	U	SAP transaction	None	Yes
Create a price change report	170h/month	Rule-based, <5 apps	High	U	Advanced technologies, data wrangling	None	No

Correct OTDs	13h/week or 500reps/week	Rule-based, <5 apps	High	U	Advanced technologies, data wrangling	None	Yes
Insert type codes & frame sizes	6h/month	Rule-based, <5 apps	High	U	Advanced technologies, data wrangling	None	Yes
Compare + prioritize quotations	130h/month	Rule-based, <5 apps	Medium	U	Advanced technologies, data wrangling	Project ongoing	Yes
Alert won opportunities	4h/month	Rule-based, <5 apps	Low	U	Advanced technologies, data wrangling	Power BI	Yes
Compare stock levels	-	Rule-based, <5 apps	Medium	U	Advanced technologies, data wrangling	Project ongoing	Casual
Create a material report	-	Rule-based, <5 apps	High	U	Advanced technologies, data wrangling	Power BI	No

6.5 Discovered unsuitable tasks and subprocesses for RPA

Some other tasks became apparent in the interviews as well but are not suitable for RPA at all, even with some upfront fixing. One of them is *a stock level check when making purchase orders* and *the decision of whether to choose a sea or air delivery* when land transport is not an option. As can be noticed, decision-making is required in choosing a proper delivery method which RPA cannot handle. In addition, the process is fairly complex and has multiple exceptions. Not only does it require decision-making, but also checking the consumption of the material in question and its relation to safety stock as well as the stock situation in other plants. Of course, this can be divided into two subprocesses; check the stock and make the decision. However, even if the stock level is low, some other aspects may still support sea delivery. Because there are so many factors to consider, the processes are not suitable for automation. Even if they were, it could lead to excessive amounts of wrong delivery methods; urgent materials by sea and non-urgent by air.

Buffer stock update to Hermes SAP integration is a task too complex for RPA. The problem is not that there are many steps in the process, but rather that the update is done based on the consumption of a material, among other factors. This requires interpretation and analysis. Another factor that speaks against automation is the infrequency of the task; it is carried out once per month and takes about four hours. Finally, Hermes itself needs to be upgraded first before new solutions are introduced. This is something that is still good to have in human control.

The next task involves an eFlow invoice software. The bot would *check a possible match error* regarding an invoice number and coding data between a purchase order in SAP and its corresponding invoice in eFlow. If no errors are found, the bot would forward the invoice straightly to the responsible sourcing manager. The problem is that currently a non-responsible human employee is required to do the forwarding manually, taking up to three hours per week concerning 10-15 invoices. In this case, however, optimization strongly objects the need for automation. Invoices could be sent to the correct responsible person in the first place without needing a bot in the middle to do that. In addition, eFlow is a complicated software requiring some improvements in itself before new solutions are to be introduced. Processes that are related to invoicing are also major bottlenecks; small mistakes can cause huge problems in the supplier side as well.

Handling and combining data in and between different Excel -files and then *creating a readable inventory report* to Power BI came up in the interviews. The data would consist of variable data (material quantity, consumption, et cetera) as well as attribute data (material name, et cetera). Currently, the data collation requires approximately four hours of manual labor every month and is not in an easily readable format. The task is a relatively well-defined and rule-based combination of data. It is a small bottleneck since the report is needed at the end of every month for decision-making activities. However, the potentiality for Power BI readability already exists. There is an Extract, Transform, Load (ETL) -tool for reporting that obtains some of the required data and enters that into a specific server which, in turn, is connected to Power BI. Consequently, the answer is already there, not just utilized at a full scale.

In the following task, RPA would be instructed to *collate information and data from a few Excel –reports into several master Excel –files*. The raw data concerns sister factory forecasts and the idea is to combine the information for Helsinki production planning. Currently, the data is gathered manually once per month which requires about eight hours of work. The bot would need to be selective in collating since the data needed is only a fraction of the data available and should focus only on Helsinki production. Also, possible changes in sister factory forecasts are possible, so rework is required. While the reports can be standardized, some exceptions exist, and the complexity of these reports is great. In addition, data is scattered in more than one place. Consequently, RPA is not the primary solution here. Some rules could be created for the email to save incoming reports automatically to a SharePoint -file. In addition, yet to be introduced, a global S&OP SharePoint -site should be created to increase information sharing and flexibility regarding these matters.

Another task that came up for automation is *comparing the set quota percent for a material to the actually ordered proportion* of that material. For example, if a material's quota is 80 % for supplier A and 20 % for supplier B, do these percents match the proportion that is actually ordered from those suppliers. There can be multiple factors that cause the numbers to differentiate, and the problem is that suppliers complain about not receiving enough orders. However, since this is not a "continuous" task and only would be carried out once a month or even less frequently, RPA is not the solution here. Also, acquiring the data for the comparison would be somewhat complex. One answer to the problem could be Power BI which would run the numbers, for example, once a month and show all the differences as a list. Corrective actions from a human employee would then be implemented.

Some other unsuitable tasks include *the transfer of price updates from Power BI to SAP.* It already has a mass tool in place and is also not so time-consuming process since it takes about two to three hours per month to execute the transfers. *Prioritizing the most sold materials* into a costing run requires some problem-solving skills and interpretation. Furthermore, this is a futile job for RPA because the costing run can be scheduled to be executed at nighttime. Consequently, prioritizing the materials is not particularly cost-effective. There are clear instructions for *setting a material ready for purchases*, so the process itself is well-defined. However, the information required can be found in various places, and some sections in SAP where to put this information require interpretation. In addition, there is a mass tool currently underway that automatically adds the information to SAP. *Adding a new supplier to an integrative supplier collaboration -site* is not a regular process, and the duration can vary between thirty minutes to two hours per week. The problem is that the data needed for this can be found in various places, and exceptions exist. There are so many factors affecting a smooth supplier insertion that RPA is not the solution here. Another task concerned *maintaining the Component Contract File* (CCF) in SAP since it requires one hour a day of human actions. The problem is that anything can be entered into the file and there is no uniformity whatsoever. The basic idea is that RPA would maintain the file and create instructions in the background so only certain values would be accepted. There is a lot of room for improvement here but RPA, however, is not the solution nor it even could be. This is basically just the development of SAP. All the unsuitable subprocesses for RPA are listed in Table 7 below.

Table 7 Discovered unsuitable processes for automation.

Subprocess	Combined average frequency	Complexity	Upfront standardization & optimization	Type of data	Other solutions required	Existing solutions
Check stock level + decide delivery method	-	Interpretation & complexity	-	U	Human	None
Update buffer stocks	4h/month	Interpretation & complexity	High	U	Development of Hermes	None
Check invoice errors	3h/week or 10reps/week	Interpretation & complexity	High	U	Development of eFlow	None
Combine data + create an inventory report	4h/month	Rule-based, <5 apps	Medium	U	-	ETL -tool
Collate data	8h/month	Complexity	High	U	S&OP SharePoint	None

Compare quotas to orders	-	Complexity	-	U	Power BI	None
Transfer price updates	2h/month	Rule-based, <5 apps	-	U	-	Mass tool
Prioritize materials for costing run	-	Interpretation & complexity	-	U	Night timing	None
Set materials ready for purchases	-	Rule-based, <5 apps	-	U	-	Mass tool underway
Add suppliers to website	1h/week	Interpretation & complexity	-	U	Human	None
Maintain CCF	-	Interpretation & complexity	High	U	Development of SAP	None

6.6 Change management and employee aspects

Regarding change management and compliance towards automation and new solutions, the overall view is very tolerant and favorable. Most of the interviewees prefer doing less mundane tasks and more value-adding activities that require creativity. This is not something that should be taken for granted, however. Some people consider everyday tasks to be essential for them to be up-to-date about things.

> *"Still carrying out certain manual processes can keep an employee up-to-date and maintain professionalism."*

Of course, maintaining professionalism is important. It is still important even though a robot begins to execute a certain task. If an error occurs, there needs to be a "back-up" who can find the cause of the error quickly and restore the situation as it was before the adversity. At all times, it must be known what a bot is doing. In addition, a robot does not contain tacit knowledge. If the original employee leaves the company, this knowledge disappears. There is no one training the preferable ways and means of doing something. This is why it is important to maintain professionalism and not reasonable to leave everything for robots. Lastly, carrying out manual tasks can bring a certain rhythm to a job and create a feeling that everything is under control.

When asking the interviewees whether they could work alongside or administrate a robot, or adopt new automation related positions, it did not raise any adversarial feelings but rather some minor concerns. No one was wary per se about automation taking over some tasks or possibly an entire position in the future, but some worries came up regarding a thinkable increased amount of work.

"A possible increased amount of work due to automation can be harmful."

Bots need to be taught the initial logic according to which they operate. In addition, at least at the beginning of an automation journey, they need constant supervision. This reduces the chances for errors and allows an instantaneous reaction to them. Hence, corrective actions can be executed when the cause is known from the start. However, in the worst-case scenario, the work required for all this regarding a task can actually exceed the workload of an employee of that very same task prior to automation. Some things would still have to be checked by a human after a bot to ensure that there is nothing amiss. Also, one of the worries that came up in the interviews concerns incorrect and false base data. A bot does not recognize or care about that so the consequences can be severe. Of course, it must be ensured that base data is correct and standardized but regarding an excessive amount of work, it is important to distribute new assignments evenly and reasonably. When employees and bots get "better" in what they do, operations run smoother and the need for supervision and human work decreases.

There were no concerns as to automating any individual process and its possible negative impact on, for example, material availability or stock levels. However, some general worries regarded RPA's modifiability, reliability, governance, and training. Scalability and modifiability are some of the major advantages companies rely on when choosing to adopt and implement RPA. The fact is that the tool is modified according to the needs and requirements of the company, not the other way around. The automation benefits emerge when other existing systems cannot communicate with each other properly. However, depending on the RPA software, there are certain limits and constraints, one of them being unstructured data. Also, as mentioned several times already, it is good to make some adjustments to processes and activities to a degree which RPA can make the most out of automation. When it comes to reliability, information security must be assessed.

“The authorization of the bots needs to be on the right level.”

Access to data networks and justifications of system permissions as well as admissions for robots are common challenges that need to be determined right from the beginning. Each bot has its own accounts or usernames to which a designated human employee should be allowed to get access. Should there be some mishaps in the systems, corrective actions can immediately be taken IT-wise. Furthermore, if there are any changes in applications, for example, updates for SAP or Microsoft products in which a bot operates, it needs to be informed because it compromises the initially taught logic. Overall, the authorization of a bot should not exceed its domain and needs to be addressed to avoid any possible negative scenario.

RPA governance and training are also aspects that cause some concerns. An extra layer in between the business and IT alleviates and dispels possible traditional silos. Whether a CoE is centralized or decentralized and involving people from different functions, communication is essential. This enables functional cooperation which, in turn, allows for agile ways of working. While RPA might mix some roles in business and IT, the former is responsible for process knowledge, while the latter manages servers, security, connectivity, and technical aspects, among others. Momentarily, these responsibilities may increase the workload of each related person. However, CoE’s purpose is to ensure a smooth implementation and administration of new solutions. In the long run, if handled correctly, benefits exceed downsides. Finally, in order to be able to work alongside RPA and be a beneficial part of CoE, it requires some training. RPA is a fairly new concept and unknown to many people so evoking awareness and holding training sessions should be in place. These kinds of issues take a considerable portion of total RPA expenses. Likewise, recruiting competent automation personnel might prove to be difficult.

“The future is here, and simple things must be done by robots.”

“RPA justifies what a person is originally hired to do.”

Despite some concerns, the overall view for automation is very tolerant and favorable, as mentioned. Every single interviewee felt good when asked if they would assign some of their current tasks for the responsibility of a robot. Some respondents were also very eager to start testing new different solutions in their business environment.

7 DISCUSSION

One of the reasons for starting to write about this topic is the research gap. As mentioned, there are relatively little research and academic work regarding RPA, especially in the field of SCM. This makes the comparison of similarities and differences between theoretical and empirical findings somewhat difficult. Still, this is a good opportunity to provide new and fresh findings concerning suitable and potential processes that fit RPA in the field of SCM. Of course, the criteria, as well as the features, attributes and other aspects of the technology, are the same despite the researched field. Consequently, the comparisons and reflections are aimed between them and the discovered issues. It must be noted, however, that RPA is a rapidly evolving technology as mentioned already, so the requirements change, and the current ones are not carved in stone. A process that might not suit RPA today might just work well in a couple of months. This development must be kept in mind when reading this thesis as well. In addition, being a case study, the findings cannot be generalized which means that the reflection cannot be derived from earlier studies.

7.1 Process discoveries' reflection on the criteria

There were more or less potential tasks and subprocesses discovered for automation in the business environment. This mentions automation instead of RPA because the data collection method and analysis of the study actually enabled other solutions or development initiatives to be applied or investigated further as well. For example, Winshuttle is an existing solution in the business environment that already carries out certain tasks. Rather than deploying RPA itself in some subprocesses, the former technology can actually be a more reasonable solution. Another example is purely developing certain existing used applications instead of utilizing RPA. These include the development of SAP and eFlow, among others. As mentioned, RPA is not a solution for everything. If a distance can easily be covered with a bike, there is no need for a car. Furthermore, as IRPA AI and Mindfields (2017, 35) emphasize, RPA eases gathering and analyzing data, resulting in a more detailed and predictive understanding of various issues and possible undiscovered bottlenecks in processes. In this case, however, certain issues, bottlenecks, and development opportunities were already discovered just by analyzing potential automation initiatives, before even deploying RPA itself. In addition, the interviews allowed discovering subprocesses that are not currently carried out as often as they should be or at all because they are exhausting and dull or because there is simply not enough time. This is another point where RPA allows determining bottlenecks and issues not only in processes but also in more comprehensive procedures and operations.

The previous facts introduce optimization. Kroll et al. (2016, 8) mention that RPA serves as an instrument and enabler of process optimization which can be executed before, during or after the implementation. Optimization beforehand is exactly what has happened in this case. By analyzing RPA potentiality, optimization opportunities in processes have emerged, like the ones mentioned in the previous paragraph. Mindfields (2017, 43) emphasizes the fact that by automating an already optimized process, it would improve outcomes, decrease costs and cycle times even more, and eliminate waste and unnecessary steps. In addition, Brain and Davenport (2018) point out that the goal should not be improving a process by automation, but just to automate a process. This is the idea behind why to assess the optimization levels in subprocesses in the interviews and in the analysis. Some companies focus on the long-term benefits by optimizing processes beforehand, while others go after quick wins by optimizing them during or after the automation. There, RPA helps with small process steps and sends notifications about exceptions and loops to process supervisors. This way, little by little, work routines are defined and processes automated. Even though there is no straight answer whether the optimization should be done before, during or after the implementation (Nelson 2017, 4), it should still be one of the primary focus areas. As Dutta et al. (2016, 6) point out, not optimizing at all or automating too much is one of the most common reasons why RPA projects fail. A well-executed optimization work might even make RPA unnecessary as can be observed in the previous paragraph.

In this case, along with optimization, standardization is also used in measuring the maturity levels of tasks and subprocesses because they can actually be influenced. One can optimize and standardize processes to a certain point, but not really make them more frequent or otherwise more suitable for automation. As can be noted in

Table 6, all of them need some level of optimization and standardization activities prior automation of which the latter is one of the most important factors of process criteria. Both are also used as prioritization factors; as Aalst et al. (2018, 271) mention, if a process is not standardized and it has some variability, a bot cannot handle it correctly and due to possible contextual changes, it can start executing incorrect decisions which could lead to harmful situations. Also, in addition to process standardization, another aspect here is data standardization. By organizing and correcting data from various sources into a more compact entirety and to a more usable form, bots can handle it correctly and more easily. Capgemini's survey mentioned that the usage of automation in a process is directly correlated to the degree of standardization in that particular process (Kroll et al. 2016, 7). Accordingly, the standardization degree is a good indicator of how far a process can be automated.

Data standardization originates, to some extent, from the used data type in tasks and subprocesses which, in turn, leads to other required solutions alongside RPA. As reviewed, RPA cannot, at the moment at least, read unstructured data (Opus 2018, 5). Since all of the discovered potential tasks and subprocesses utilize some sort of unstructured data, RPA would need other advanced technologies to operate with. However, as mentioned, RPA is an evolving technology and will be assimilating increasingly complex and non-standardized tasks and incorporate advanced analytical and predictive capabilities as well (Mindfields 2017, 8). Consequently, somewhere in the near future, RPA could handle unstructured data in complex processes. It must be noted that these features also depend on the capabilities of different RPA vendors and service providers. According to Clair (2018, 2), distinguishable solutions between vendors include more efficient analytics, deployment, scale and governance in RPA, but also attended automation as well as improved security aspects.

Process complexity relates closely to process standardization because due to some standardization activities, complexity can actually be decreased to a certain point. According to Kroll et al. (2016, 31), it can be defined in two ways; either complexity depicts a dynamic nature of cause and effect in processes that require interpretation, or that it involves many interconnected explicit steps and several variables. According to the former definition, complexity hinders a task’s suitability for automation because of the interpretation factor. On the other hand, the latter description approves complexity. Even though it represents many phases, it still possesses order. Consequently, complexity can impart whether a task requires interpretation, has exceptions and is well-defined and rule-based. It also communicates just how many applications a task utilizes or steps it requires. For the potential tasks and subprocesses discovered, interpretation is not required. However, if a process entirety has a phase that requires interpretation, it has been split into separate subprocesses. For example, for late open orders, human interpretation is first needed in choosing the orders that need information after which a bot sends the inquiries to suppliers regarding these orders. As mentioned, activities that do not require interpretation skills and have no strategic fit suit RPA very well (Aguirre & Rodriguez 2017, 67). The reason stems from the fact that RPA cannot think rationally or make cognitive decisions. If a task has any deviation from the initially taught logic, RPA simply stops operating since it has encountered something new and unexpected. This is one of the reasons why standardization is important; exceptions must be kept at a minimum. Major exceptions to the designed workflow result in an immediate intervention by a process supervisor (Kroll et al. 2016, 31) which can actually hinder and slow operations down. In the analysis, if a task has some exceptions, they have been considered in the standardization as well as in the complexity aspects. At best, standardization can sort of eliminate exceptions by straight forwarding and simplifying different phases in processes. When it comes to the empirical findings, all the potential tasks and subprocesses in their entirety are somewhat well-defined and rule-based. Regarding the used applications and the number of steps which reflect complexity as well, not one of the potential discoveries has that many of them to disturb automation. This, in fact, also relates to the latter definition of process complexity by Kroll et al. (2016, 31). All in all, the complexity aspect is extremely important and that is why it has been taken so profoundly into account in this case. As Wright et al. (2018, 14) put it: “Process complexity drives robot complexity”. It increases operating costs as well as business disruptions.

When it comes to the frequency and repetitiveness of the discovered tasks and subprocesses, some are listed in the potential list in Table 6 even though the combined average frequency could be higher. Examples include preparing and sending manual special orders to suppliers as well as inserting type codes and frame sizes to SAP. This is not only because other factors of those subprocesses support automation, but also because the repetitiveness of a task is not everything. For example, a task might be carried out quite infrequently, but is so hideous or takes a lot of time to execute that it would actually suit the philosophy of automation. Consequently, ROI and added value are more important indicators. This is theoretically pointed out by Fung (2014, 2), who mentions that high-value activities with low volume are suitable, provided that the cost of automation is lower than the cost of errors due to no automation. Nevertheless, most of the suitable tasks and subprocesses discovered are rather repetitive and frequent.

The prioritization for the most suitable tasks and subprocesses in Table 6 is performed in accordance with combined average frequency, process maturity (standardization and optimization level) as well as the existing process solutions because the other analyzed factors do not vary between the potential tasks and subprocesses and thus, do not affect the prioritization. In addition, since this is solely assessing the business environment’s suitability by charting suitable processes, risk factors, value gain, ROI and possible other more comprehensive factors are not considered, as already mentioned in subchapter 1.1. As Srivastav et al. (2016, 3) mention, potential processes should be assessed and prioritized not only according to the criteria but also by their value gain and risk degree after which they should be reflected to the company’s strategic objectives. Even thoroughly, a transformation roadmap should be developed based on each process’ individual requirements which would also contain a strategic framework for which the processes should be suited (Kroll et al. 2016, 40). The prioritization could also consider the impact and effort factors. The impact factors include aspects of how RPA would benefit the company, for example, measured by the number of resources that can be reallocated more effectively. The effort to implement factors cover investments and costs. (Borbe et al. 2018, 8-9) These are covered in subchapter 8.3 suggestions for future research.

7.2 Governance and change management

Governance aspects are reflected because they provide some base knowledge about the already existing RPA relations in the case company. As mentioned, there is an RPA function in shared services that does not belong to the targeted business unit or environment. However, it is introduced because the discovered tasks and subprocesses of the examined environment can be suggested for this BPO provider. One of the RPA models that Asatiani and Penttinen (2016, 71) present is the RPA-enabled outsourcing partner to which the case company model can be categorized. It is a centralized model which means that the entire automation team is located in the same organizational unit (Kaelble 2018, 38) and from which all the functionalities for the entire organization are driven and distributed (Vist Ekren 2018). However, this does not mean that there cannot be any other models or solutions existing elsewhere. All automated processes in the examined business unit are actually in decentralized control. It must be noted, however, that these initiatives do not necessarily concern RPA. Nevertheless, that brings the benefits from both centralized and decentralized models. It is called a hybrid model where the CoE has centralized operations and delivery support, while the separate business units have their own capabilities for automation (Vist Ekren 2018). These benefits include effortless enforcement of processes, policies, and standards as well as economies of scale while the supervision and control are still at the source. Each business unit can proceed independently and feel a stronger sense of ownership over different automation initiatives (Biggins 2018).

Proper continuous improvement initiatives are set in the centralized CoE, and each bot is registered and documented (PDD). This is validated theoretically since Kroll et al. (2016, 22) and Wright et al. (2018, 22) emphasize flexible and agile continuous improvement initiatives in a CoE to enable resilience, responsiveness, and effectiveness in digital as well as in the human workforce. In addition, by registering each bots' inputs, outputs, timings and rules, documentation, and troubleshooting of dataflows is enabled (Waller 2018, 52). This should fill the potential gap between bot knowledge and freshly originated human knowledge, caused by the disappearance of previous process expertise (Clair 2018, 3). Consequently, empirical employee worries regarding the loss of tacit knowledge as well as establishing an effective CoE is dispelled. However, if the decentralized model in the business unit is to deploy RPA and be expanded, these matters along with IT aspects must be re-examined.

By including the change management perspective in this thesis, a part of the overall RPA readiness and suitability of the business environment is covered because it happens to be a major part in the success of the deployment. Hindle et al. (2018, 7) as well as Wright et al. (2018, 14) name directly impacted employees' buy-in as a very important aspect in implementing RPA because it simply has a huge impact on them. Bots are part of a living organization in which some jobs are taken over by automation, but at the same time, additional positions emerge. Processes are adjusted, altered and optimized for automation supplemented by supervision and control which might, at least temporarily, increase the workload of some employees. Accordingly, human workforce needs to be prepared, especially if RPA is to be deployed in the decentralized business unit.

An increased amount of work is one of the concerns that came up in the interviews along with training aspects, possible bot errors, false base data, and RPA scalability as well as reliability. These are, in fact, often covered in RPA literature as well. The first two are covered by efficient governance as well as by identifying the needs for successfully reskilling workforce (Geyr 2015, 1). Clear and proactive communication of objectives and employee impact dispels fears and creates an open culture which helps employees to adapt to changes more rapidly (Geyr 2015, 1; Waller 2018, 41).

If a bot is configured correctly, it is not prone to errors and can perform the same tasks repeatedly with full consistency, accuracy, and compliance (Kaelble 2018, 10; Mindfields 2017, 39). It has to be ensured, however, that the configuration is done correctly and according to instructions. In addition, if there are any changes or updates, et cetera, in the used applications, they must be addressed and added to the initially taught logic. It must be monitored whether the bot makes mistakes due to the changes (Opus 2018, 5-6). Even if the bot itself does not make mistakes, false base data can cause major problems. The bot does not know whether the data it uses is correct or incorrect, so the validity has to be ensured.

When it comes to scalability, RPA itself is highly scalable. As mentioned, an RPA tool is modified according to the needs and requirements of the company, not the other way around. Nevertheless, the chosen tool and software still play an extremely important part here. The bots should be enabled to be scaled in accordance with the frequency and fluctuations of processes (Srivastav et al. 2016, 6). This is not something that every tool and software are capable of doing. As with reliability, the tool should include a feature which depicts the bot’s executed actions during a specific time period in a particular process run. This helps in monitoring and improving the operations, but also in reversing incorrectly made steps (Srivastav et al. 2016, 6). Finally, some respondents were very eager to start testing new different solutions in their business environment and adopt new roles. This should be ensured since it prevents job loss, among other things (Asatiani & Penttinen 2016, 68).

8 CONCLUSIONS

This thesis has examined RPA generally in a rather comprehensive manner, and the overall focus has been on the SCM upstream functions. The components include demand management, manufacturing flow management, SRM, logistics as well as sourcing and purchasing that together constitute procurement in this case. The aim was to assess the business environment's suitability for RPA in which the business environment consists of the SCM upstream functions of the business unit in question as well as its personnel. First, the research questions are answered after which some managerial and theoretical implications are presented. Finally, future research suggestions are addressed.

8.1 Answering the research questions

Before the main research question, the supporting sub-questions are answered:

SQ1: What are the potential benefits derived from RPA?

This question includes the theoretical perks as well as some actual real-life benefits of RPA. The former includes operational efficiency, decreased cycle time, accuracy and consistency of processes, higher data quality, improved reporting, more efficient allocation of human capital and hence, more satisfied employees, bottleneck discoveries, cost savings, and quick positive ROI ratios. Some actual detected benefits in real-life cases include multiplied ROI within just a few years, faster delivery, better service quality, higher compliance and scalability, strategic enablement, and employee reallocation. Of course, the benefits and their degree depend on the successfulness of the implementation as well as on the industry a company operates in. However, the numerous advantages sort of states RPA's potentiality.

The second sub-question was the following:

SQ2: What are the general process criteria for RPA?

The typical activities that fit the automation include high volume activities that are repetitive and carried out frequently, high-value activities with low volume, provided that the cost of automation is smaller than the cost of no automation, data-intensive activities that draw information from various systems or applications, rule-based and well-defined activities that can be broken down into explicit steps, activities that are prone to human errors and cause manual rework, activities that require searching, collating and updating information, activities that do not require interpretation skills and have no strategic fit, activities that are standardized or have very few exceptions, activities that are problematic to transfer offshore, and activities which cost structure is known and ROI can be calculated. Of course, not all of these are carved in stone or have to apply at the same time. For example, if a process can be automated without any major problems and the ROI is tempting, the frequency or proneness to errors of that very process do not really matter. The criteria are also subject to change and the process potentiality depends on the business environment and policies, among other things, of the company.

Based on the answers to the first two sub-questions, it is a preliminary ‘go’ for RPA. The benefits are persuasive, and the criteria seem to be appropriate considering the state of the business environment in question. Consequently, the third sub-question was the following:

SQ3: How the discovered subprocesses reflect on the criteria?

Table 6 shows that there are eleven tasks and subprocesses that more or less suit RPA. On the other hand, Table 7 indicates that the same number of processes do not fit the automation. Consequently, 50 % of all the discovered tasks and subprocesses somehow fit RPA and its criteria. Nevertheless, a few of them fit the criteria but have existing solutions in place (for example, compare + prioritize quotations), and all of them require, to some extent, upfront optimization and standardization work. In addition, the type of data used in the processes forces to apply some other advanced solutions and technologies together with RPA.

Along with SQ3, the fourth sub-question defines the business environment’s readiness and suitability for RPA. It was stated as follows:

SQ4: How does the case company’s employee aspect affect the initialization?

The affected employees’ overall view is very compliant, tolerant and favorable towards automation and new solutions. There were no worries regarding any individual process, and most of the other concerns relate to aspects that are dispelled in the theoretical and empirical sections of this study. Of course, views like being able to be up-to-date of things and maintain professionalism free of automation are important and must be taken into account in the possible deployment.

The previous sub-questions help to answer the main research question:

MQ1: What is the business environment's overall suitability for RPA?

Based on the SQ3 and 4, the upstream functions are somewhat suitable for RPA, especially employee-wise. There are no objections or barriers to automation. However, personnel opinions, expectations, and possible wishes must still be taken into account before actions are taken, and awareness needs to be raised so that nothing comes as a surprise for anyone. Process-wise, the basis is there. Manual, repetitive and rule-based tasks and subprocesses are found, but not a satisfactory amount. It could be a result of already well-maintained operations, existing automation solutions in processes or misunderstanding the capabilities and role of RPA in the interviews. In hampering the suitability, also unstructured data hinders the application. By applying data standardization methods or other technologies alongside RPA, costs go up considerably and the original idea behind the automation of saving expenses fades, in a way. Therefore, calculating the added value and ROI and then determining the profitability of automation is very important, as stated in subchapter 8.3.

All in all, the business environment's more comprehensive readiness is not at a sufficient level for RPA, at least not currently. Lots of work is required regarding standardization and optimization activities, among the data inconveniences, before automation can be utilized on a wider scale. Furthermore, an efficient process standardization and optimization can even make RPA unnecessary. The two activities enhance processes already themselves, thus preventing automating too much or at all, as stated in subchapter 4.3. This is why it is extremely important to make some corrections to the discovered tasks and subprocesses before possible automation initiatives. Due to the stated remarks, it is a 'no go' for RPA.

8.2 Managerial and theoretical implications

Even though there exists an RPA governance in shared services, it is not in the same business environment as the focus of this study per se. However, one solution is that personnel would suggest automation initiatives for that centralized RPA team and assist in the possible deployment of bots. As mentioned, the suitability of the upstream functions could be better, and the more comprehensive readiness of the business environment is not in a sufficient level at the moment for the business unit to start utilizing RPA itself. On a more positive note, however, new tasks that are not necessarily carried out full-time or at all as well as other development objects were discovered. For example, checking and inserting lead times to SAP is not executed in every category team, and the creation of a price change report does not utilize automation. Other development objects arisen for which pure RPA is not the best solution include a wider utilization of Winshuttle, Power BI and SharePoint as well as a further development of applications such as SAP Hermes and eFlow. In addition to the previous managerial implications, by arising awareness, employees are more conscious of new technologies and start thinking outside the box of how automation could make their job easier and more enjoyable. Finally, this study evokes discussions of what can be done next.

Being a case study, this thesis does not bring much for theoretical implications. The findings cannot truly be generalized due to the fact that this case reflects particular participants in a particular setting at a particular time. However, since there is very little academic work related to RPA, this thesis brings added value and practical examples to the scholarly perspective. Processes that are new and quite suitable for automation, as well as unfit processes, are presented. Change management's role is emphasized as well because as Hindle et al. (2018, 7) and Wright et al. (2018, 14) state, directly impacted employees are one of the most, if not the most, important aspects in implementing RPA. Change should not be viewed as a bad thing.

"The world hates change, yet it is the only thing that has brought progress." -Charles F. Kettering

8.3 Suggestions for future research

As mentioned, the business case in this study did not include explicit process documentation or value assessment reports. They were disregarded because mapping every suitable process and calculating their ROI would have been too in-depth in assessing process suitability and business environment readiness. However, as for future research, process documentation and ROI calculations of the most suitable tasks and subprocesses could be executed for an even thorough analysis. In addition, risk, impact and effort factors of individual discovered processes could be determined and reflected to the company's strategic objectives to gain a view of automation's effects on a more comprehensive scale.

This study was conducted from the perspective of the case company and thus, supplier and customer point of views were excluded. The limitation also concerned CRM, CSM, order fulfillment, product development, and commercialization, and returns management functions in SCM. For future research, these functions could also be assessed for RPA. For example, CRM and CSM are front-office functions where RPA is not yet utilized at the same scale as in back-office functions. This brings forth a rather new challenge. When it comes to the supplier point of view, joint processes could be automated. For instance, Borbe et al. (2018, 6) name Master Data Management (MDM) as an area where RPA could assist in checking and correcting incorrect supplier information. The processes could become joint when the supplier has automation solutions for change of data that the customer company requires. RPA in the supplier side could forward the changed information to the RPA bot in the customer side for receiving and correcting the data automatically to its proper destination. The automatic interaction between the two bots in two different companies could be continuous for the data to be always correct. This actually arose in the interviews; some discovered tasks and subprocesses included inquiring something from suppliers and then entering the data to SAP but was limited to a parameter such as lead time. Consequently, future research could concern about automating both master data forwarding as well as receiving jointly on a wider scale. This could include, for example, the parameter of the country of origin.

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APPENDICES

Appendix 1 - Interview structure

Background information:

- Name?
- Position and area of responsibility?
- Experience in the current position?
- SCM processes you are currently involved with? [Display the process flowchart and model]
- Familiarity with RPA?

Questions related to RPA:

- Are any of the subprocesses and tasks you are carrying out repetitive or frequent? If so, how frequent?
- Are these repetitive subprocesses and tasks:
    - Rule-based and well-defined? Are the steps explicit?
    - Interpretation free? Do they require judgment, thinking or creativity?
    - Few in exceptions?
    - Having room for standardization or optimization? [Low/medium/high]
    - Causing manual rework?
    - Requiring other than digital information?
    - Bottlenecks? Do other subprocesses depend on them?
    - Prone to human intervention?
    - Having any KPIs measuring them?
    - Employing many human workers? How many?
    - Using many applications? Which applications?

Questions related to change management:

- How would you feel if a robot did some of the work you did previously?
- Do you prefer doing less mundane tasks and more value-adding activities that require creativity?

- Could you work alongside a robot and administrate it, or adopt other positions related to automation?
- Do you have any worries regarding any specific individual process or automation in general?