Which factors are important for the implementation to establish and employ an evaluation framework for the utilization of RPA in existing and new (sub-) processes at MAN T&B SE in the department of procurement?

Author: Kristin Wedig
University of Twente
P.O. Box 217, 7500AE Enschede
The Netherlands

ABSTRACT,

The procurement department of MAN TB SE perceived the upcoming attention towards RPA - Robotic Process Automation. RPA-software systems support automating routine tasks by a software application, which are usually performed by an organization's employee. RPA-systems are commonly used to reduce the need for employees, requiring a numerous amount of time, by replacing them to execute time-consuming and repetitive tasks. This thesis identifies RPA process criteria to evaluate a criteria framework to determine the usability of RPA for processes in the procurement department efficiently. The composition of the process criteria list is done by an analysis of the current literature, as well as by interviewing RPA experts in the Volkswagen Group. The literature section further provides necessary information about the terminology of RPA, benefits, process assessment and functional areas of RPA. The comparison of the criteria in the literature with the expert interviews acknowledges, that common factors such as repetitiveness and cost/time saving are crucial for an RPA implementation framework. However, the interviews revealed missing input factors as user management/identification. The results of the literature research are further crucial as a foundation to embrace future projects regarding Robotic Process Automation for the department of procurement at MAN, for instance the mass price upload. At last, the thesis ends with the chapter conclusion and recommendation, which discusses the importance of CSR and the connection to RPA in the procurement department, briefed as a further research topic.

Graduation Committee members:
1st supervisor: Prof. Dr. Holger Schiele
2nd supervisor: Dr. Matthias de Visser

Keywords
RPA, process automation, MAN TB SE, IT, procurement, Criteria

1. PROCESS OPTIMIZATION SOFTWARE SYSTEMS: RISING ATTENTION TOWARDS RPA

1.1 Increased performance of technology-based robots in the automotive industry over the last decades

Since the 1960's, the automotive industry has been revolutionized by industrial robots. The thoughts of machines and equipment doing work automatically to fulfil, and support human-related tasks has been present for a long time. Although it took the industry and its manufactures decades to adapt the change, the importance was clear, and robots have redefined the automotive industry ever since (Comacchio & Volpato & Camuffo , 1999, p.53). After WWII in 1945, the industrial revolution began and the need for robots turned up. In the beginning, industrial robots had basic tasks to perform, which relieved humans from taking on trivial, risky and painful tasks. Nevertheless, since then, innovators have been able to increase the performance of technologically based robots (Holweg, 2008, p.14).

The optimization of production rate, based on efficient and reliable manufacturing processes, led the automotive industry to embrace robotics with promising results. A boost of employment in the automotive industry is one result of the higher production rate as well as global cost- reduction (Rüßmann & Lorenz, 2015, p.5). The result of an analysis done by Gorlach and Wessel confirms, that a highly automated manufacturing system results in a high productivity, when taking into account that "(…) the smallest number of employees produces the highest number of vehicles (…)" (Gorlach & Wessel, 2008, pp.6-7). Tremendous opportunities and new possibilities further changed consumer demands, followed by a never-ending cycle of desired novelties. Society can expect that robots will be an essential part for the future automotive industry. Hence, not only an enhancement in quality of processes within the automotive industry is given, but also the quantity will be improved (Rüßmann & Lorenz, 2015, p.10).

In the eighties, a negative correlation between the investment in IT and the resulting productivity was identified. The reason was, that the functional organization of the IT application did not change. Limited functions were supported and automated, but in contrast to high expenses, concerning the data delivery between functions and redundant data management (Weill, 1992, p.32). Nonetheless, the automotive industry has seen a significant shift with the beginning of Industry 4.0 — on account of Artificial Intelligence. Means, developing a technology where computers behave intelligently. The fundamental goal behind the implementation of Artificial Intelligence is to decrease costs, improve team efficiency, optimize processes and products and speed up development cycles (Besse, 2018, p.14).

Due to the fact that AI has an effect on several industries, which are interlinked with the automotive industry, it is important to keep up and transform business models and core processes. Nevertheless, digitalization lead to challenges for companies in process automation in order to react quickly to market changes (Auth & Czarnecki, 2018, p.114). Robotic Process Automation represents the next stage of process automation, whereby software robots take over roles and tasks of users and interact with other software systems. Process competence and control remain in the company through software robots, and outsourcing is no longer necessary. There are promising application areas for RPA in all areas of the enterprise (Auth & Czarnecki, 2018, p.122). Robotic Process Automation receives more and more attention, but specific technical and economical characteristics need to be taken into consideration to identify potential processes that fit RPA (Mindfields ,2017, pp. 9-10).

1.2 Research question and supporting sub-questions: Analysing functions and fields of RPA

Due to the novelty of the topic and the hype of RPA and its benefits, the need to implement RPA-software systems in organizations increases (Hull, R., Decker, G., Mendling, J., Reijers, H. A. & Weber, I., 2018, p.3). In future, it should be easier to determine the suitability of automation of processes by following a criteria evaluation framework. The focus lies on processes used in the automotive industry, especially in the procurement department, since the thesis is written in the team of procurement systems and processes (BSP1). The benefits of RPA implementation shall be exploited to its upmost. Hence, the research question that should be answered in this thesis is: *Which factors are important for the implementation to establish and employ an evaluation framework for the utilization of RPA in existing and new (sub-) processes at MAN T&B SE in the department of procurement?* The supporting sub- questions are as follows:

RSQ1: What is RPA?
RSQ2: What are functional areas of RPA?
RSQ3: What are benefits of RPA and how can MAN TB SE benefit from it?
RSQ4: Which criteria (technical and economical) are important for choosing a process, that should be automated through RPA?
RSQ5: What are processes and how can they be optimized?
RSQ6: What factors have to be taken into consideration when implementing RPA?
RSQ7: What are possible risk factors regarding RPA implementation?

By giving an explanation of these questions, a general understanding about the topic of RPA, as well as a basis for future projects in the procurement department dealing with the subject of RPA, should be provided.

1.3 The literature review and empirical study as the broad structure of the dissertation: RPA Criteria and a process analysis remain as fundamentals of the thesis

In a broad way, the thesis is divided into two parts. The theoretical study and the empirical study. The theoretical study includes three chapters. Chapter two describes the approach of the expert interviews and quantitative and qualitative data collection methods. Chapter three contains the literature review, including the definition of RPA, its benefits and preferred implementation sectors as well as process criteria and risk factors. The explanations are then compared to the interview's outcome. Besides the topic of RPA, the terminology of processes and business process optimization and the technological impact are clarified.

The empirical study, chapter four, comprises possible processes, which can be automated through RPA at MAN. Besides, a cost- and time analysis of the processes is made, and a description of the most efficient RPA process is exposed. The thesis ends with findings and results in chapter five, which also contain recommendations for future RPA implementation projects at

MAN and the importance of CSR and the connection to RPA in the procurement department, briefed as a further research topic.

Although the topic of RPA is hyped and literature is advanced due to the recent importance of the topic, limitations are evolving. First, as a result of the novelty of the topic, literature often does not contain a variety of information. Case studies are described but details are omitted. Secondly, writing the thesis has to be done within a limited time of 14 weeks. Nevertheless, data was conducted three months beforehand. It was only doable to brief the BSP teams one to three regarding the topic of RPA to gain knowledge about which processes could be supported by RPA. Additionally, only seven RPA experts in the VW Group were interviewed, due to the scarcity of experts.

2. METHODOLOGY & SAMPLE: CONDUCTING DATA FROM EXPERT INTERVIEWS

The expert interview is a variation of the so-called guided interview. The specific factor is the target group: Experts. The Interviewees are seen as a representative of a group, which stays in focus of the research interest. An expert interview has a structured and steering outline (Heistinger, 2007, p.6). The aim of the expert interviews is to collect criteria, which are crucial for the automation of a process of MAN via RPA to be able to compare them with the criteria listed in the literature and complete the criteria catalogue. The data collection method that is employed in this study are interviews recorded by phone to ensure the correctness of the conducted data. A qualitative investigation using interviews is seen as the primary data collection method (Miller & Burke, 2001, p.2). Besides the interview questions, the interview execution plan consists of different steps:

1) Introduction of the interviewer
2) Explanation of general topic of the study and a brief explanation (reason, derivation and goal)
3) Relay the confidentiality of interviewee's responses
4) Explanation of how the information will be used
5) Providing an estimation of the interview's length (Wilson, 2013, p.30)

It is useful to communicate the interview questions ahead of time to participants, along with a general introductory letter about the study. This is especially relevant for research topics that are abstract. Participants need time to reflect and think about their responses, but the collected data is more descriptive (Miller & Burke, 2001, p.3). Nevertheless, for this research the questions were not communicated before to prevent research, since the interview answers are compared with the literature to evaluate differences.

The interviewees will get the information that the conversation is taped for data accuracy purposes, but the interviewees' comments will be held confidential. By guaranteeing confidentiality, people are more willing to participate at the study (Wilson, 2013, p.3).

The experts are chosen based on project involvement, knowledge of processes in the procurement department, process automation experience, RPA background and technical understanding. Questions are asked in German or English, depending on the interviewee's native language.

The interview questions include open-ended questions to provide detailed answers and elaborate upon it. Additionally, a closed-end question in term of a Likert Scale will provide easy-to-score data.

The questions are created on a basis to find criteria, which are crucial for the implementation of an RPA-software system and are as follows:

1: Do you have any kind of experiences with process automation through RPA? If so, please give an example.
2: Which benefits will MAN have due to a process optimization through RPA?
3: Do you have negative experiences regarding process automation, or do you know risk factors regarding process automation?
4: Which criteria (technical and economic) are important for choosing a process that should be automated through RPA?
5: On a scale from 1-5, please rate the following criteria regarding their importance.
6: In which sector of the organization is the highest potential for a process automation through RPA? Based on which criteria do you decide?
7: Which factors have to be taken into consideration to successfully implement an RPA-software system at MAN TB SE?
8: Which factors are necessary for the acceptance of a change within MAN TB SE?

Question one is asked to categorize the experience of the interviewee and gather possible examples about process automation with software robotics. It provides a general overview of how deep the understanding of the interviewee regarding the topic of RPA is. Question two is asked to identify RPA benefits and will hence describe the expectation of the interviewee concerning the RPA–software system. The next question covers possible risk factors and negative experience of employees to compare it to the risk factors of the literature and compare the RPA hype versus the reality. The focus of the interview and the most crucial question is question four, and is asked to gather technical and economic criteria, which are important for choosing a process supported by RPA. The closed-end question (question five) will evaluate the importance of these criteria by comparing the frequency of the criteria mentioned in the literature versus the statement of the participants. Question six will compare literature and interview answers regarding potential RPA areas in the organization. The next question is asked to gather non-technical and non-economic criteria. To ensure a positive mentality of employees, while talking about change management, question eight results in arrangements that have to be taken into consideration before and during the implementation phase of RPA. By asking these questions, criteria of the literature can be compared with the criteria evaluated during the interviews. The result will show if those are similar or if criteria regarding the experts have to be added to the criteria catalogue.

2.1 Quantitative and qualitative methods: Supporting the analysis of RPA process criteria

With the help of primary collected data, which includes interviews with specialists, direct and indirect observation within the processes & systems department of MAN and the collaboration with Audi, the thesis will conceive an evaluation framework with factors that identify processes that are suitable to be automated. Besides, secondary data will support answering the research-questions. Getting an insight of the processes and systems department will mainly contributes to the success of the research, concerning the contiguous participation and knowledge

gaining within that field. Nevertheless, research is done cross-departmental to embed different perspectives.

2.1.1 Literature as a secondary data collection method

On the research of Robotic Process Automation, a sample of encyclopedic literature was conducted to determine articles of high scientific value and sustainable influence. To lean on secondary data in a methodical and transparent way is as important as gaining knowledge through primary data collection (Hochrein, 2011, p.2). The methodology used in the literature review was among other data collection methods developed with reference to the work of Hochrein:

The online library "LISA" of the University of Twente is used to get access to papers and reports. "Google Scholar", "Web of Science" and "Scopus" are included as literature databases, as well as "Researchgate". Besides, Webpages of RPA-software-providers were used to gain knowledge about technical facts and the scope of use. The selection of articles is based on relevant papers of the disciplines General Management, Engineering, IT-management, Management of Procurement and Operations and Supply Management.

The process of identifying the right articles was initiated by scanning all pre-selected papers, chosen based on key words, date, title, author and publisher. To be able to select a wider variety of articles, the table of content as well as sub-titles of articles were reviewed. Another method used was the "snowball" method. Already as relevant identified articles were analyzed by its references to select further articles that fit the topic. The year of publishing of RPA-related papers should not inferior the year of 2014 due to the prevailing topic and the fast change of IT and RPA + KI/AI.

2.1.2 Expert interviews as a primary data collection method

Due to the reason, that sources for the collection of primary data are reserved, it is difficult to gather data because of either the scarcity of population or lack of cooperation (Kabir, 2016, p.204). Following are some of the sources of primary data, which are used to collect data for this thesis.

In order to gain a better insight into the possibilities of process automation, semi-structured interviews were conducted, as described before, shown below. Depending on how the participant answers, the interviewer may ask follow-up questions to gain a more in-depth understanding. With seven employees of Volkswagen, MAN TB SE and Scania, specifically of the procurement department, the IT department and the department of finance, interviews were conducted face to face in meeting rooms or via skype for business. The average interview took about one hour, divided into the briefing of the topic and interview method as well as the actual interview with the participants. Answers were recorded by phone with consent and additional notetaking. But due to the Wifi connection, one interviewee answered questions six to eight via E-Mail. Another qualitative method to gather data is done through observation.

The next chapter explains and defines the theoretical foundation of the topic automation/process-automation and Robotic Process Automation. Besides, the differences in terms are defined and explained regarding the understanding of the thesis.

3. LITERATURE REVIEW

In the following, literature about Process optimization in regard to RPA software systems will be reviewed. Giving a basis for the analysis of MANs' processes within the procurement department and answering the RSQs is the aim. The process is then compared to the identified RPA process characteristics.

3.1 Business process optimization as a result of globalization and competition

The consecutive paragraph will answer RSQ5: *What are processes and how can they be optimized?*

The common thread is, that a process is a series of related procedures or tasks converting inputs into outputs (Akintoye et al., 2012, p.185). The result that is delivered must be of value to at least one customer, meaning a person or organization, who can initiate wishes and demands regarding the output terms. The process itself entails how the demanded result can be divided into different sub-processes and hence achieve the intended result. But, only through the interaction of all processes combined, the achievement of a specific outcome can be reached. However, that alone is not enough for a business process. The process must have some value to the business itself. Besides, the objective of the process must also align with corporate values and strategy (Münch, Armbrust, Kowalczyk & Soto, 2012, p.2).

Process optimization, process improvement or process reengineering was triggered by the increasing significance of Information Technology and the movement towards globalization. The growing volatility of the economic environment and competition amongst businesses has further facilitate the importance of process optimization (Linderman & Jones, 2013, p.335). To improve the process performance of a business is one of the main sources of competitiveness respectively the survival of businesses. To achieve a competitive advantage, businesses run large scale optimization projects, which is the ultimate goal of Business Process Optimization (BPO). This includes the selection of the right process design as well as the application of the best fitting optimization techniques (Linderman & Sanders Jones, 2013, p.339). "Procurement optimized their operations e.g., by e-procurement and electronic supplier integration, logistics further enhanced their operations in terms of ''just in time/ sequence'' (JIT/JIS)" (Horn, Schiele & Werner, 2012, p.34). After the detection of potential optimization objectives, appropriate techniques are selected and applied to the process (Schwarz & Niedermann, 2011, p.89).

3.2 Process automation to speed up the completion of process steps

3.2.1 Technology improves businesses but induces fear in employees

Task automation supports processes to execute tasks faster, with lower costs and a decreased error rate, hence, a better result. A conspicuous disadvantage resulting from process automation is the factor of cost investment. Further, human interaction can handle more variation considering tasks performance. Therefore, instead of fully automating a process, an automated support system can be best practice of a business process, like attended RPA-bots (further described under heading 3.2.2). The application of e-commerce can be seen as a technology towards the automation of business transactions and workflows (Kalakota & Whinston, 1997, p.6). Contrary, the application of new technologies has several kinds of advantages. For instance, the workflow management system (WfMS) result in less time that is spend on logistical tasks. The before mentioned application attributes to the term Integral Technology: "(…) try to elevate physical constraints in a business process by applying new technology (…)" (Reijers & Mansar, 2004, pp.302-303). Besides of improving the business by giving participants completely new possibilities, the integration of automation is adversely costly due to the purchase, development, implementation, training and

maintenance. Additionally, unknown technology often results in fear of employees, which possibly results in a reduction of business process quality (Reijers & Mansar, 2004, p.303).

Describing the difference of partly and fully automated processes, the next chapter explains the evolution of process automation and the implicated difference of attended and unattended Robotic Process Automation.

3.2.2 The evolution of Robotic Process Automation: RPA 1.0 to RPA 4.0

To gain a better understanding about the functions and structure of RPA- software systems and the correlation with Chatbots, the terminologies are explained and RSQ1 "*What is RPA*" will be answered.

Explaining the infrastructure of RPA, the bot is integrated via front-end across the IT-system, which communicates with other IT-systems via back-end. Hence, it is feasible to integrate the bot with almost any software used by an employee (Auth & Czarnecki, 2018, p.113). As reported by the Institute of Robotic Process Automation and Artificial Intelligence (IRPAAI), the founder Frank Casale states that the "RPA technology is not a part of a company's information technology infrastructure, but rather sits on top of it" (Casale, 2015, p.6). This characteristic, that distinguishes RPA from other automation technologies like Business Process Management Systems (BPMS) access these platforms through the presentation layer, hence no underlying systems programming logic is touched. Additionally, in contrast to most BPMN modeling packages, RPA solutions do not require programming skills for software interface configuration. RPA is set to work by just dragging, dropping and linking icons. Besides, RPA does not create a new application and does not store any transactional data, so there is no need of a data model or a database like BPM systems (Craig, Lacity & Willcocks, 2015, pp.6-7).

RPA robots can simply be classified into two categories: attended and unattended robots. These two automation methods are usually referred to as DPA (Desktop Process Automation) or RDA (Robotic Desktop Automation) and enterprise RPA (ERPA) robots (Amini, 2019, p.18). Attended robots operate besides a human workforce at the same local workstation. The robot supports the user in executing a specific process or process-step and acts by user events. The attended bot acts as an assistant carrying out the onerous part of a routine process and prepares necessary working steps for a human employee (Amini, 2019, p.19). Contrary, unattended bots transform the input without user interaction into an output. The bot works via predefined triggers and can automate any number of processes. Inconsistent to attended bots, unattended bots are responsible for monitoring, scheduling and providing support for work chains (Amini, 2019, p.20).

RPA has evolved over the past years. The evolution, concerning fisglobal.com, reaches from RPA 1.0 to RPA 4.0 (Appendix B). The first stage of RPA, the assisted RPA, is set up on a desktop to increase the productivity of employees, with limited scalability and automation capabilities, e.g. document completion wizards. RPA 1.0, also named as assisted RPA, has the objective to improve workers productivity, but processes can only be partially automated. RPA 2.0 means that the RPA is deployed on a server to automate processes, and it is unassisted but requires manual control of users. A downside is, that it is limited to manage system changes and screens. The process is end-to-end automated, and the bot is scalable. The third stage is called autonomous RPA. The bot is inserted in a cloud to actively automate and scale advanced processes in context with algorithms and analytics, but limited to structured data, e.g. the comparison of supplier data. Cognitive RPA, RPA 4.0 is the combination of RPA and AI. "Machine learning and natural language processing for automating tasks involving judgment, with predictive and prescriptive analytics utilizing structured and unstructured data, such as free formatted text read/write or image recognition" (fisglobal, 2018, p.2).

Typical language processing and speech recognition tools, interacting with Chatbots are for instance Apple Siri, Amazon Alexa, Microsoft Cortana and Google Assistant, categorized as the before described RPA 4.0. Commonly, Chatbots are classified into two categories: The first type of a Chatbots is, that its' function is based on rules. The second Chabot's function is based on AI. Chatbots that function on rules are limited since they are only as clever as the programmer has built them. AI based Chatbots are capable of understanding the input language and hence give the impression of being intelligent, because the Software System is based on algorithms. They can act regarding unrestricted commands but act agile as they cooperate more due to their ability to assimilate to different conditions (Hyderabad & Haldar, 2016, p.2).

3.2.3 Three main RPA provider competing on the software automation market

According to Anagnoste, the market of RPA consists of three main RPA providers. Automation Anywhere, Blue Prism and Uipath (Anagnoste, 2017, p.678). Uipath is a vendor from Romania, and witnessed a growth in terms of revenue, clients and human capital within the last years. Uipath is present now on five continents with offices close to their main clients, which offered the team to work with larger clients and add them to their portfolio, for instance: BBC, J.P. Morgan, SAP, McDonalds, Vodafone and AXA. Together with Automation Anywhere (a vendor from USA), Uipath is the star performer of the research, done by the Everest Group report (Anagnoste, 2017, p. 679). On Mach 6, 2018, the company had an estimated value of $1.1 billion. Uipath's competitor Automation Anywhere is the platform for cognitive robotic process automation, designed to automate business processes in the modern enterprise. The Automation Anywhere Bot Store from the company enables customers to scale up their digital workforce faster than before. This enhances the productivity of human workers. Automation Anywhere provides the world's best Robotic Process Automation and cognitive technology to leading healthcare, financial services, technology, manufacturing and insurance firms for over a decade (Madakam, Holmukhe & Jaiswal, 2019, p.12). Thirdly, Blue Prism is also pioneered in Robotic Process Automation software. Their intention is, that effective digital strategies require a connected enterprise, where technologies such as artificial intelligence (AI), machine learning (ML) and sentiment analysis easily integrate with business operations to deliver value (Madakam, Holmukhe & Jaiswal, 2019, p.11). Additionally, considering the purchase of a license of an RPA-Bot costs between 3000€ and 8000€ (Anagnoste, 2017, p.681).

3.3 RPA process areas: RPA-Systems are typically implemented in areas of high-volume, transactional and repetitive process activities

If an organization has the deliberations of automating a process, three perspectives have to be taken into consideration: The first perspective of the framework is the suitability, which means the degree of automation that can be achieved for a specific process.

Determination criteria are for instance the volume of transactions, the degree of digitisation, scalability requirements as well as system dependencies and constraints. By value, the second criteria, one means the financial and strategic value gained through automation of the process. Labour intensity and strategic relevance determine the merit of automation. An important fact is, that the repetitiveness of a task indicates the cost benefits. The last criteria of process assessment is the risk factor. Before a process is going to be automated, the degree of risk must be defined by associating regulatory requirements, customer experience and system stability (Kirchmer, 2012, p.3). RPA Systems are usually integrated in organizations, which have a high volume of engaged human resources, performing transactional and repetitive tasks and activities (Mindfields, 2017, p.12).

Over the past years, functional areas, which have been automated, have gone through a comprehensive workflow, process- and compliance standardisation. The introduction of RPA in these areas resulted in a more efficient re-alignment of human resources and vastly improved customer experience for internal and external customers. Appendix A shows a list of repetitive, rule-based and low-skill-tasks of areas where RPA can deliver benefits (Mindfields, 2017, p.13). Certainly, there are particular sectors in which the implementation of RPA is notably efficient. Examples are the sectors of telecommunication, healthcare, banking and financial services, utilities, travel as well as retail and mining. These areas involve a large number of human interactions (Auth & Czarnecki, 2018, p.122).

According to Lacity's and Willcocks' research, the RPA deployment at the mobile operator O2 in the UK is a successful pilot project. 15 core processes were automated, processes and process steps like order processing, SIM card exchange, activation, credit checks and complaint management. It has a huge potential for RPA success due to a transcription rate of about 400.000-500.000 per month (Craig, Lacity & Willcocks, 2015, p.8).

Another example is the implementation in the finance sector. Due to its highly standardized, structured and recurrent processes, external accounting is particularly well-suited for the use of automation through RPA technology. Controlling, on the other hand, is characterized by complex processes, unstructured data and the need for high decision-making competence as well as analytical skills. Therefore, it seems less suitable for the use of RPA (Svatopluk, Haisermann, Schabicki & Frank, 2018, p.16)

3.4 Annual cost savings as an outcome of RPA in the procurement sector

Processes with a high potential of RPA alignment are in several categories, which can be found in the procurement department. Contract management, supplier relationship and risk management, supplier onboarding and enablement, account payables, procurement performance management, tactical procurement, category management, master data management as well as spend management and visibility. (KPMG, 2018, pp.4-6). The outcome of the enhancement of the key-drivers of the procurement department are for example the raise of total annual spend cost savings from an average of 3.15% to 5.62%. One factor is the increase of the addressable spend sourced annually from an average of 39% to 56%. Further, the ROI on procurement operating costs will be five times higher. The reason is the consolidation of spending on suppliers from an average of $5,806 to nearly $1,959 (KPMG, 2018, p.7). The procurement costs decreased from an average percentage of 1.1 to 0,62% due to procurement contract compliance (average of 30%) and the number of FTE decreases from an average of 59.5 to 43.6 for $1B spend (KPMG, 2018, p.7).
Nevertheless, regarding Cold, choosing a complex process as the first RPA implementation process will most likely create delays and has been proven to be difficult as a pilot project (Cold, 2017, p.7). Hence, recommendations are to select only a part of a simple process to demonstrate the usability of technology and potential of RPA through a PoC or pilot. The pilot-project should not take long time, but simply be used to make MAN smarter about the technology and the software. As regarding tools, PwC suggests that the selection be based on the enterprise's vision, intended areas of efficiency improvement, skills of the developers, architecture requirements and possible limitations of the first PoC/ pilot (Cold, 2017, p.8). By skipping the PoC and going directly to the pilot, MAN can save time and money, which makes sense, due to the fact that other organizations have already proved that RPA works (Cold, 2017, p.8).

3.5 Process efficiency and cost reduction as benefits of RPA

A qualitative and quantitative literature review examines several benefits of RPA-software systems.

With robotics and process automation, an association of cost savings will initially come to mind. Labor intensive activities will be reduced, and project experiences show that, on average, a reduction of 30 percent net savings due to automated processes can be reached (Kaválek, 2018, p.4.). But not only is the cost reduction beneficial for organizations. RPA goes far beyond and is also able to decrease the process lead time by up to 80%. At the same time, the internal control mechanisms to prevent fraud as well as the process quality is increased. The error rate for manual work steps can be almost eliminated. At the same time, automation also enables long-term availability "24/7" – without the influence of working time laws or time zones. In addition, the robots increase the available working capacity. They balance the fluctuation of workload and assume the role of the buffer. Because of the takeover of standardized routine activities, employees have more capacity to perform cognitive tasks, hence, support human intelligence and decision-making competences (Appendix C) (Kaválek, 2018, p.4.).

Not only sector specific benefits can be identified, but also cross-sector benefits of RPA. According to a Capgemini study, an RPA software licence costs between 1/3rd to 1/5th of the price of a full-time employee (Kroll, Bujak, Darius, Enders & Esser, 2016, p.7). Lacity and Willcocks assists that one robot can proceeds structured data comparable to two to five humans (Lacity & Willcocks, 2015, p.14).

3.6 Governance-, technical- and process risk: Possible risk factor categories taking into account while implementing RPA

Since Process automation affects the core business processes and a variety of stakeholders, the implementation of an RPA takes risks with it. Regarding Indruskevics, the risks can be differentiated into three categories: governance risk, technical risk and process risk (Indruskevics, 2018, p.21). Governance risks, refers to the triple-win strategy of Lacity and Willcocks, means, organizations have to be aware, that a process change affects the customer value, employee value and shareholder value (Lacity & Willcocks, 2017, p.28). Based on their research, the worst outcome would be that automation is only seen as a tool to cut jobs instead of a supporting tool. This can impact the

reputation of the company and brings downsides like employee's reluctance and backlash in regard to implementing the change (Indruskevics, 2018, p.23). One of the most devastating risks regarding technical factors is an unexpected downtime of the internet, servers or databases. Further, with a low likelihood but high impact, force majeure must be taken into consideration. The more automated interfaces a process has, the more destabilized are the operations if a software update occurs. Besides, data privacy has to be assured due to the fact, that robots can access various systems, and each can be potentially vulnerably on data privacy (Indruskevics, 2018, pp.23-25). Risk factors concerning the process itself can be incompetent, unstructured or failed internal processes, systems and people. After testing process automation, usually constant reconfigurations are necessary. Lastly, unforeseen pop-up boxes are undocumented, but still a challenge, hence, the bot has to be reconfigured (Indruskevics, 2018, pp.25-26).

3.7 RPA process criteria: Technical and economic factors as categories to classify RPA process criteria

Referring to Fung, not all business processes are sufficient to be automated, hence defining criteria and a general architecture of a potential RPA convenient process has to be done (Fung, 2014, p.2).

The literature points out several criteria, which have to be taken into consideration when deliberating about automating a process with robotics. Concerning technical reasons, the criteria which are mentioned most are listed below. What follows is a description of steps procurement organizations can take to begin identifying and evaluating potential opportunities for RPA. The first step is to review all procurement processes to identify and shortlist the processes that will benefit from automation. The typical processes that work well for RPA automation consist of the following characteristics, which differentiate between technical and economical characteristics. For technical reasons, the process should be:

1) Rule based and repetitive (Agaton & Swedberg, 2018, p.9)
2) Access to structured data (Aguirre & Rodriguez, 2017, p.2)
3) High volume of processed data (Aguirre & Rodriguez, 2017, p.3)
4) limited change in process (Aguirre & Rodriguez, 2017, p.3)

Compared to the result of the relevance of the interviewees, the number of mentioned criteria in the literature of a sample of 20 papers is analysed. Rule based and repetitive is stated 18 times out of the sample, hence coinciding with the interview results. The access to structured data and a limited change in process is mentioned nine times. Processing a high volume of data is cited seven times and the lowest quoted technical criteria, also congruent to the interview results.

Step two includes to generate the criteria list mentioned above and based on the greatest ROI. This includes the analysis of time- and cost- investment as well as the prioritization of the potential RPA-Processes. The prioritization usually includes the impact of the RPA opportunity as well as the effort to implement the software-system. The economic factors concerning the raise of the ROI and supporting the reason to implement RPA-systems are divided into factors of impact and effort:

Impact
1) number of employees
2) time one employee is involved in task
3) costs of performed tasks
4) number of times the task is performed per year
5) improvement in error rate
6) balancing peak periods

Regarding economic factors, which are in general less stated compared to technical factors, the most mentioned factor is the number of process execution per year with eight times. The number of employees involved as well as the improvement of the error rate is cited seven times. Worthy to say is, that all interviewees said that only the combination of the number of employees with the number of executed processes per year and the time investment of one employee for the activity is relevant. Time consumption, reduction in costs and balancing peak periods are mentioned five, four and two times, respectively. Consistent with the interview results, balancing peak periods is the criteria with the lowest relevance.

Effort
1) Development and implementation cost
2) Investment in licenses and other infrastructure
3) time investment in RPA-project execution (KPMG, 2018, p.8)

After the economic analysis, step three follows. The analyzed opportunities can be allocated into an impact-effort matrix. The clusters are "quick wins" with low effort but high impact, "major projects" with high effort and high opportunities, as well as "low hanging fruit" with low effort and low impact to implement and "not worth doing", with high effort but low impact on the improvement of the process (Appendix D) (KPMG, 2018, p.9).

For the transformation opportunities, as well as for quick hits, the organization should develop a business case, estimating the economic and performance impact more detailed and analysing and developing a more specific implementation cost estimate. To select the right RPA process in the procurement department, employees should work with finance, IT and other essential departments to ensure the selection of the right RPA-process-tools and provider as well as on the approach to organizational change management (KPMG, 2018, p.14).

Often, the activities and processes that have been outsourced to low-wage countries, are processes that depict these criteria. The training effort for repetitive, highly standardized tasks is low. The volume of work can be well measured, planned and charged. Due to the difference and saving of costs, business process outsourcing has by now offered a high potential compared to processing processes in Central Europe or other high-wage regions, especially in mass processes. Automation through RPA, however, offers an even greater potential for savings than outsourcing. On the one hand, outsourced processes can be relocated, but on the other hand, outsourcing services have to compete with a lower cost against RPA. This can result in the relocation of outsourced processes (Auth & Czarnecki, 2018, p.115).

4. DESIGN PROJECT AT MAN TB SE

4.1 The highest rated process automation criteria resulting from expert interviews: Rule-based and repetitive as well as the

overall time investment to accomplish the process

By analyzing the results of the interviews, the following sub-questions are answered in regard to the experiences of the interview participants:

RSQ2: What are functional areas of RPA?

RSQ3: What are benefits of RPA and how can MAN TB SE benefit from it?
RSQ 4: Which criteria (technical and economical) are important for choosing a process that has to be automated through RPA??
RSQ6: What factors have to be taken into consideration when implementing RPA?
RSQ7: What are possible risk factors regarding RPA implementation?

4.1.1 Which criteria are important for choosing a process that has to be automated through RPA, technical and economic?

The result of the question regarding possible process criteria *"which criteria are important for choosing a process that has to be automated through RPA, technical and economic?"* is as follows: According to the experts, the process or process-steps need to be repetitive and rule based. The process volume should be high, and the system must be stable, mean limited changes within the process. Further, information that are processed must be digital within a standardized process. Besides, the error rate reduction by automating a process is one criterion. If these criteria are existing, the process is good to be automated, but also with only a few criteria it is still worth it to analyse the process further. Additionally, criteria which are not mentioned in the literature are, that the bot must have an access role as a requirement to be able to go into the needed systems. The bot also needs to work with identification IDs, to assure it is working with the right data. The systems need to be defined very detailed. An example is working with the SAP system. The bot clearly needs to know which transactions to perform in a logical and a combinatory way. Additionally, one expert claims, that employees of IT should express self-engagement in terms of further education regarding IT-tools and methods. Gaining capacity and reducing the number of employees are criteria in reference to economic factors. Contrary to the expectations, only a few interviewees mentioned the criteria of cost reduction. Nevertheless, calculating the business case, including the break-even point to show the economic benefit of RPA-bots, was stated by six participants.

4.1.2 Experts evaluating the relevance of literature-based criteria on a scale from one (low) to five (high).

One of the eight interview questions is a closed question. To answer this question, the interviewees had to rate technical and economic RPA process criteria, previously conducted from the literature, regarding their importance on a scale from one (lowest) to five (highest). The result is written down as the average score with two decimal numbers. The criteria rule based and repetitive, within the scope of technical criteria, scored an average of 4.57 points. Having access to structured data with 4.14 points and a high volume of data, 3.71 points, are less important regarding the Volkswagen experts. 3.85 points for limited changes of the process show, that the experts do not see these criteria as the most important, which is also the lowest rated criterion. The number of employees included in the process has a low average score of 3.28 and is in the scope of economic criteria. The time investment of one employee and the number of times that the process is performed per year scored 4.14 points, and 4.57 points respectively. But indeed, several experts claimed that the combination of the number of employees included in that process with the time investment of an employee and the number of process-execution-times would score a five. Cost reduction has 4 points and the reduction of the error rate 3.57. The balance of peak periods is compared to all mentioned criteria the least important concerning the statements of the MAN experts with 2.57 points. As a roundup, the most important criteria with reference to the technical impact is, that the process has to be rule based and repetitive, with its contrary and least important criteria of the limited changes of the process. In terms of economy, the number the time saving per year is the most important factor and balancing peak periods the least (Appendix E).

4.1.3 What are benefits of RPA?

To complete the list of benefits of RPA, experts were asked in the interview to comment on those. According to the experts, one benefit of RPA is the flexibility of the process automation. In case of no alternatives for programming interfaces, RPA is the right tool. Concerning this, one participant mentioned that it can be cheaper to implement an RPA-bot as well as faster, instead of programming to solve current IT related problems. Besides, customer and employee satisfaction as well as the time for valuable and cognitive tasks are mentioned benefits. Further, the bot works 24/7, hence increases productivity. The escalation of efficiency was mentioned by all seven interviewees. Additionally, only one interviewee mentioned the cost reduction as a benefit of RPA. In general, all benefits stated from the experts are named in the literature, hence one can say, that the literature and the comments of the experts regarding benefits are comprehensive.

4.1.4 What are possible risk factors regarding RPA implementation?

Interview participants commented on the hypothesis of RPA having risk factors and accordingly possible negative experiences. This also partly answers the sub-question for the analysis of further factors, which have to be taken into consideration when implementing RPA. In general, it is said that employees are afraid of new technologies due to the risk of employee reduction, also categorized into the term change management. This further refers to RPA-software systems. Besides, loosing know-how and knowledge of employees is another risk, that was mentioned by four interviewees, but is not quoted in the literature. In case the bot does not work, employees manually have to proceed with the process and revert on their knowledge. The storage and handling of sensitive data must be taken into consideration when talking about RPA risks as well. New bot releases and continuous updates are negative experiences that experts have been faced or have heard of.
Additionally, all interfaces need to be taken into account, and sometimes, very detailed intersections need to be rebuilt, that the bot can successfully be implemented. In case a process has an interface with an employee, who has to manually perform the task, a risk of a data bottleneck occurs. The literature only cites that a bot works 24/7 and increases productivity, which is right. But if an employee is involved in the middle of the automated process, the employee is the trigger for the process to go on. Hence, the second phase of the process depends on the performance of the employee. The last risk factor is the fear, that the bot accidentally falsifies a massive amount of data in case of the wrong programming beforehand. Interviewees regularly quoted that testing is an important phase of the implementation execution.

4.1.5 What are functional areas of RPA?

The next paragraph describes the statement of experts from the Volkswagen Group regarding the potential of sectors in the organization, stated as the sub-question *"What are functional areas of RPA?"*. As the literature predicates, all experts say that there is no specific area where RPA can be applied or cannot be applied. Solely, sectors where a high volume of data is produced or where many processes are rule based and repetitive or consist of many sub-processes, for example the areas of finance and human resource, are advantageous. One interviewee said, that "(…) most likely, processes as reporting, creating reports/graphs of any kind based on digital data, working with invoicing and accounting, or work tasks where you need to update things in a system based on information in another system are typical processes to automate (…)". Hence, the mentioned sectors are preferred due to the scope of possible processes that can be automated, but in general all areas of an organization can use RPA. Only one interviewee cited that RPA is beneficial for the departments close to the product production, due to a high volume of produced products. However, this is not specified in the literature.

4.1.6 What factors have to be taken into consideration when implementing RPA?

Not attributable to economic and technical reasons, all interviewees stated the term change management, going along with internal communication. Employees have the fear of losing their jobs due to the automation through RPA. Communication is important to relief employees from that fear (Craig, A., Lacity, M., Willcocks, L., 2015, p.15). Since "(…) it is rather a digital co-worker, that will help them perform their job more efficient than something that will take their job (…)", RPA is a supporting automation tool, not a digital enemy (source Interviewee Scania). It is helpful to include all relevant employees into the process automation approach from the beginning and communicate the usage of RPA and its benefits very clearly.
Occupying that method, employees are not reluctant, and the process of automating processes or sub-processes can be executed faster. In general, equal if IT-worker or the end- user, incorporated relevant employees need the right mind-set, knowing that IT will further progress, and techniques will change frequently. The hypothesis of communicating facts about RPA to reduce the employee's fear is highly remarked by both, the literature and the interviewees (Anagnoste, 2018, p.54-69). The provision of a budget and an RPA-Team, consisting of the end user, IT, the project leader and RPA specialists are mentioned by two interview participants and the support of a product owner is cited by one. In a corporation with a hierarchical management, it is also important to consider the fact, that the project has to be pushed through committees, which can result in a delay or even get cancelled.

Additionally, taking the time investment into consideration, it is important to think about the project strategy. During the observation it was stated by different employees, that RPA is just a phase and will be hyped by a limited time. The employee's position included a variety of positions up to the top management. Supposed the analysis of potential RPA processes with an immense volume in a complex organisation lasts about a year, and after that, several RPA-bots are implemented, it is a success for the RPA-project. But at that time, there might be a cheaper and faster IT solution to automate interfaces, and the project RPA was less efficient as expected due to a waste of time. This aspect was also specified by two interviewees.

First, RPA is briefed in the procurement department to introduce information to the employees. After several process ideas are collected, the suggested processes are analysed and in step four, the process, which is going to be automated, is selected. The selected process and facts will then be briefed in the "IT-Steuerkreis" committee to get approved. After that, the implementation takes place, in collaboration with the RPA provider. The testing phase follows, and the adjustments are made during step nine. The last step is the RPA project-rollout.

5.CONCLUSIONAND RECOMMENDATION

This thesis aimed to identify RPA process criteria to evaluate a criteria framework to determine processes in the procurement department efficiently. Besides, by means of the criteria list, which is seen in Appendix I, a process of the MAN procurement department is analyzed. The composition of the process criteria list is done by an analysis of current literature, as well as by interviewing RPA experts in the VW Group. Even though the number of papers referring to RPA and its process criteria is increasing, there are still criteria which are not examined at all or examined sufficient enough regarding a successful process automation through RPA within MAN.
Congruent technical criteria of the literature and the VW experts are, that the process has to be repetitive and rule based, and the bot needs to have access to structured data with a high volume and limited changes within the process. The economic criteria, which are coinciding, are the number of employees, the time an employee executes the process as well as the number of times the process is executed per year. Experts mentioned these criteria but claim that those economic factors have to be combined to consider the overall time consumption. Balancing peak periods was not mentioned by any expert, and even after indicating this factor, experts did not rate this as an important factor. Eliminating manual occurring errors as well as the factor of cost reduction are two more congruent criteria, mentioned by the literature and experts.

One of the missing criteria is the need of access requirements for the bot. Every employee has a PKI card with assigned roles for the Job. The more roles the bot needs to have, the more difficult will be the setup of the bot. Besides, all process steps must be completely digital and the process itself must be optimized before it can be automated. Moreover, the more roles a bot has the more risk is involved. The second criteria, that is insufficiently elaborated upon, is the fact that a bot also can be the reason for a data bottleneck. Further, the literature explains the cost reduction of a bot, but is not referring to the calculation of a break-even point. The literature also solely states, that the Bot implementation will lead to employee satisfaction, but not that the result of satisfaction already starts in the beginning of the project, with communicating and including all stakeholders. Besides, reducing the fear of employees regarding unemployment can be limited through early communication. The analysis shows, that the determination of a suitable process in the organization of MAN takes time but has a great potential. The main challenge is a sufficient communication of the project to all stakeholder, and the bot access requirements as a result of the complexity of the organization. Besides, RPA process suggestions had to be left out of further analysis, because the suggested processes itself must be optimized before implementing an automation tool like RPA. Simplified that means the procedure to get a specific result is currently suboptimal and must be improved regarding its execution. After the process is improved and steady, an automation tool can be implemented. Additionally, losing know-how of employees can lead to difficulties when the server breaks down and the bot cannot proceed working.

The risk of an RPA implementation is indeed limited, but factors like pop- up windows still have to be respected. Additionally, as a result of the corporation's complexity, there are many possibilities for an RPA implementation, but also the implementation time takes more time compared to a medium sized company.

IT is a fast-changing sector with new approaches to automate interfaces. RPA is a new and hyped approach. Before considering RPA as a new automation software system, the organization has to deliberated, whether the RPA implementation is worth the effort. Meant is, calculating the break-even point and including if RPA is the best system to automate the process for the upcoming years, with new technical optimization possibilities.

Including the optimization of internal processes, supplier integration is a possible option where an RPA-software robot can support the process. An improvement of the direct interface between the buyer and the supplier can have bilateral benefits. Benefits can be an increased employee satisfaction as well as an increased supplier satisfaction due to the suppliers' decision-making process, the quality of the outcome and the costs the supplier faces during an interaction (Schiele, 2012, p.1181). With reference to Schiele "Innovation is increasingly not happening in the isolated laboratory of a firm anymore but involves the supply chain including the firm's suppliers" (Schiele, 2006, p.925).

6. Acknowledgements

First of all, I would like to thank my supervisor Dr. Philipp Horn for giving the opportunity to write my thesis in the department of procurement systems and processes at MAN TB SE. Another gratitude is for my tutor Simon Wolf, who supported my journey by giving advices, and for his help, guidance and effort. His expertise and knowledge have been very valuable for me in order to finish my Bachelor studies successfully. I would also like to thank all BSP-teams, with their help, experience and enthusiasm the development of my thesis was a pleasure. Lastly, I am thanking my supervisor Prof. Dr. Holger Schiele for his valuable insights and feedback, in order to successfully complete my thesis.

7. References

Agaton, B., Swedberg, G. (2018). *Evaluating and Developing Methods to Assess Business Process Suitability for Robotic Process Automation: A Design Research Approach,* Master's Thesis in Software Engineering

Aguirre, S., Rodriguez, A. (2017). Automation of a Business Process Using Robotic Process Automation (RPA): A Case Study, *Applied Computer Sciences in Engineering,* 65-71.

Anagnoste, S. (2018). Robotic Process Automation - The Operating System for the Digital Enterprise. *Proceeding of the 11th International Conference on Business Excellence,* 12(1), 54-69.

Anagnoste, S. (2018). Robotic Process Automation – The next major revolution in terms of back office operations improvement. *Proceedings of the 11th International Conference on Business Excellence*, 676-686.

Amini, B. (2019). Robotic Process Automation: Implementation within an organization. *Technology Communication and Transport Degree Program in Software Engineering*.

Auth, G. C. (2018). *Prozessdigitalisierung durch Robotic Process Automation - Digitalisierung in Unternehmen*. Springer Fachmedien Wiesbaden, 7(7), 113-131.

Bessen, J. (2018). AI and Jobs: The Role of Demands, *NBER Working paper 24235*.

Calvi, R. G. (2012). Customer attractiveness, supplier satisfaction and preferred customer status: Introduction, definition and an overarching framework. *Industrial Marketing Management*, 41(8), 1178-1185.

Casale, F. (2015). Introduction to Robotic Process Automation - A primer, beyond pressing button: the automation of automation. *Institute for Robotic Process Automation*. https://irpaai.com/wp-content/uploads/2015/05/Robotic-Process-Automation-June2015.pdf

CF.. Akintoye, A. G. (2012). Construction Innovation and Process Improvement. *Journal of Construction Management and Economics*, 31(1), 185.

Cold, A. (2017). Successful Implementation of RPA takes time, lessons learnt by 18 of the largest Danish enterprises. *pwc Whitepaper*. https://www.pwc.dk/da/publikationer/2017/rpa-danish-market-survey-2017-uk-pwc.pdf

Craig, A. L. (2015). Robotic Process Automation at Telefónica O2. *The Outsourcing Unit Working Research Paper Series*.

Craig, A. L. (2015). The IT Function and Robotic Process Automation. *The Outsourcing Unit Working Research Paper Series*.

Dumas, M. L. (2013). Fundamentals of Business Process Management: Introduction to Business Process Management. *Springer Verlag*.

FIS. (2017). *RPA 4.0:* The New Holy Grail of Efficiency in Auto and Equipment Finance. *RPA benchmarking report*. https://www.fisglobal.com/-/media/fisglobal/files/pdf/white-paper/rpa-4-0.pdf

Fung, H. (2014). Criteria, Use Cases and Effects of Information Technology Process Automation (ITPA). Advances in Robotics and Automation, 3:124. doi:10.4172/2168-9695.1000124

Glock, C. H. (2011). Purchasing Organization and Design: A Literature Review. *Journal of Purchasing & Supply Management*, 4(2), 149-191.

Gorlach, C. W. (2008). Optimal Level of Automation in the Automotive Industry. *Engineering Letters*, 16(1), 141-149.

Hallikas, J. K. (2019). The role of Supply Management Innovativeness and Supplier Orientation in firms' sustainability performance . *Journal of Purchasing and Supply Management*.

Heistinger, A. (2007). Qualitative Interviews - Ein Leitfaden zur Vorbereitung und Durchführung inklusive einiger theoretischer Anmerkungen. Universität Innsbruck.

Holweg, M. (2008). *The evolution of competition in the automotive industry - Build To Order: The Road of the 5-Day Car.* Springer Verlag.

Horn, P. S. (2012). The ugly Twins: Failed low-wage-country sourcing projects and their expensive replacements. *Journal of Purchasing & Supply Management*, 19(1), 27-38.

Horn, P. S. (2016). Does Global Sourcing Pay off? A competitive dynamics perspective. *Journal of Purchasing & Supply Management*, 22(4), 338-350.

Hull, R. D. (2018). How do machine Learning, Robotic Process Automation, and Blockchains Affect the Human Factor in Business Process Management? *Communication of the Association for Information Systems*, 43(19), 297-320.

Hyderabad, R. H. (2016). Applying Chatbots to the Internet of Things: opportunities and Architectural Elements. *Cornell University*.

Indruškevičs, R. (2016). *Robotic Process Automation Risk Analysis in Circle K Business Centre*. Riga Business School.

Kabir, S. (2016). Methods of data collection, Basic Guidelines for Research: An Introductory Approach for All Disciplines, 201-275.

Kalakota, R. W. (1997). Electronic Commerce: A Manager's Guide, Business & Economics. *Addison-Wesley Professional*.

Kaválek, P. (2018). RPA in Finance. Deloitte - Robotic and Cognitive Process Automation. https://www2.deloitte.com/content/dam/Deloitte/hr/Documents/cfo-survey/hr_3_cfo2018_Petr%20Kavalek.pdf

Kirchmer, M. (2017). Robotic Process Automation - Pragmatic Solution or Dangerous Illusion? BPM-D Enabling the next Generation Enterprise. *BETOES Insights*.

Kpmg. (2018). Delivering Value in Procurement with Robotic Process Automation - Robotic Process Automation can bring real cost savings and process efficiencies to the procurement organization. https://advisory.kpmg.us/content/dam/kpmg-advisory/management-consulting/pdfs/2017/robotic-process-automation-in-procurement.pdf

Kroll, C. B. (2016). Robotic Process Automation - Robots conquer Business Processes on Back Office. *Capgemini Consulting*. https://www.capgemini.com/consulting-de/wp-content/uploads/sites/32/2017/08/robotic-process-automation-study.pdf

Linderman, K. S. (2014). Process Management, Innovation and Efficiency Performance - The moderating Effect of competitive Industry. *Business Process Management Journal*, 20(2), 335-358.

Madakam, S. Holmukhe, R.M., Jaiswal, D.K. (2019). The future digital work force: Robotic Process Automation (RPA), *Journal of Information Systems and Technology Management - Jistem USP*.

MAN. (2019). Strategy procurement S-Rating Prozess, Procurement Compliance. https://lso.wob.vw.vwg/one/content/media/shared_media/documents_1/markenuebergreifend_prozesse/s_rating_process/S-Rating_A-Procurement_Compliance_ENG_v1.4.pdf.

MAN. (2019). Strategy Procurement MAN rating for buyer. https://lso.wob.vw.vwg/one/content/media/corporate/corporate_docuements/one_intern/information_1/sustainability/2019_FAQ_S-Rating_for_buyers_pdf.

Mendling, J. D. (2018). How do Machine Learning, Robotic Process Automation and Blockains Affect the Human Factor in Business Process Management? *Communications of the Association for Information Systems*, 43(19), 297-320.

Miller, M. K. (2001). Phone Interviewing as a Means of Data Colletion: Lessons Learned and Practical Recommendations, *Qualitative Social Research Sozialforschung*. http://www.qualitative-research.net/fsq-texte/2-01/2-01burkemiller-e.htm. Zugegriffen: 30.07.2019

Mindfields. (2017). Robotic Process Automation: Driving the next wave of Cost Rationalization, *Robotic Process automation Report*. https://www.mindfieldsglobal.com/hubfs/Collateral/Reports/RPA%20Report%202015/Robotics%20Process%20Automation%20Report.pdf?utm_campaign=Case%20Studies&utm_medium=email&_hsenc=p2ANqtz-_ZrRM8asZUKpW9J0k32mJSS9lIdDuUEVQ3MqBkvoVu19Nc2paWt9AkeZUdJomiAIfzZjHV4ihruTvwiYjonzhytIu50g&_hsmi=61030337&utm_content=61030337&utm_source=hs_automation&hsCtaTracking=0e482e60-3ed1-478d-a4d3-c1338bb195c6%7C5828ac6f-2541-4105-9734-e02375d87ab2

Münch, J. A. (2012). *Software Process Definition and Management* (*The Fraunhofer IESE Series on Software and Systems Engineering)*, Springer Verlag.

Reijers, H. A. (2004). Best practices in Business Process Redesign: an overview and qualitative evaluation of successful redesign heuristics. *The International Journal of Management Science*, 33(4), 283-306.

Rüßmann, M. L. (2015). Industry 4.0: The Future of Productivity and Growth in Manufacturing Industries. *Boston Consulting*.

Schiele, H. (2006). How to distinguish innovative Suppliers? Identifying innovative Suppliers as new task for Purchasing. *Industrial Marketing Manager*, 35(8), 925-935.

Schiele, H. P. (2012). Megatrends 2022: Implikationen für den Einkauf. *Supply Chain Management*, 7-12.

Schwarz, H. N. (2011). Deep Business Optimization: Making Business Process Optimization Theory Work in Practice. *Journal of Business-Process and Information System Modeling*, 81, 88-102.

Svatopluk, A. H. (2018). *Robotic Process Automation (RPA) im Rechnungswesen und Controlling - Welche Chancen ergeben sich?* Controlling-Zeitschrift für erfolgsorientierte Unternehmenssteuerung, 3, 11-19.

Volpato, G. C. (2012). Automation in Automotive Industries: Recent Developmemts. *Springer Science and Business Media.*

Weill, P. (1992). The Relationship between Investment in Information Technology and Firm Performance*:* a Study of the Valve Manufactuing Sector. *Center of Information Systems Research*, 3(4), 307-400.

Wilson, C. (2013). *Interview Techniques for UX Practioners: A User-Centered Design Method*. Elsevier

7. Abbreviations

MAN TB SE	MAN Truck and Bus SE
RPA	Robotic Process Automation
IT	Information Technology
AI	Artificial Intelligence
KI	künstliche Intelligenz
ERP	Enterprise Resource Planning
BSP	Beschaffung Systeme & Prozesse
BSV	Beschaffung – Risiko- und Versorgungsmanagement
VW	Volkswagen
PoC	Proof of Concept
BPO	Business Process Optimization
BPM	Business Process Management
BPMS	Business Process Management System
BPMN	Business Process Model and Notation
WfMS	Workflow Management System
IRPA	Institute of Robotic Process Automation
DPA	Desktop Process Automation
RDA	Robotic Desktop Automation
ERPA	Enterprise Robotic Process Automation
UK	United Kingdom
SLA	Service Level Agreement
ROI	Return on Investment
FTE	Full Time Equivalent
UMB	User Management Beschaffungsantrag
LDB	Lieferantendatenbank
BDW	Beschaffungs- Datawarehouse
NTG	New Truck Generation
EKEM	Einkaufs-Einsparungsmaßnahmen
BA	Beschaffung Allgemein
BDN	Beschaffungs-Datanetwork
BEMI	Betriebsmittel

SAP	Softwareprogramm
WKB	Werkzeugbestand
AB	Auftragsbestätigung
QUKAM	Qualität Kaufteile MAN
SAQ	Self-Assessment Questionnaire
SRN	Seriennummer
RSQ	Research-Sub-Question
FIUC	Finanzen, Controlling und Recht

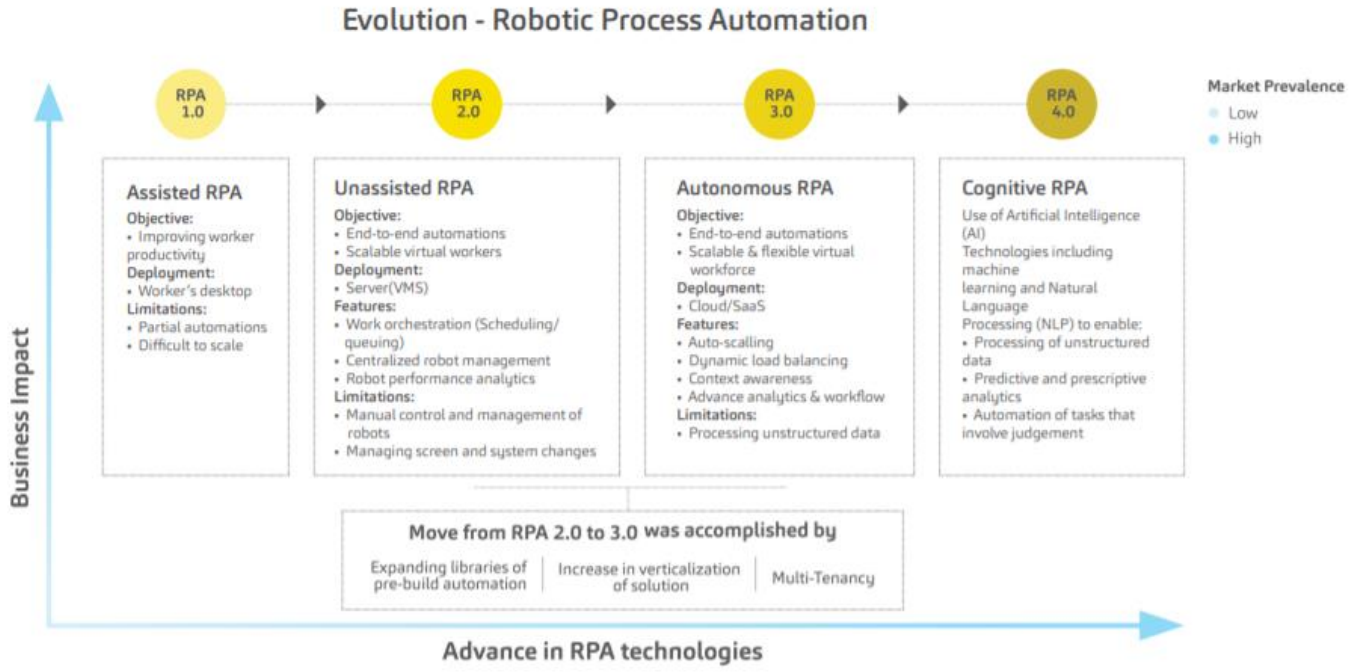
8. APPENDIX

8.2 Appendix A - Functional areas where RPA can deliver benefits today

Figure 4 – Functional areas where RPA can deliver benefits today

Source: Mindfields

8.3 Appendix B – The evolution of Robotic Process Automation, from RPA 1.0 to RPA 4.0



Everest Group. (2017, April). RPA Evolution Market Insights. Retrieved from https://www.everestgrp.com/2017-04-robotic-process-automation-rpa-evolution-market-insights-39370.html/

8.4 Appendix C – Benefits of using RPA

8.5 Appendix D - Impact-effort Matrix for RPA-processes

8.6 Appendix E – The RPA process criteria ranked from the most important to least important based on the interview results. Divided into technical and economic criteria.

Scope	Criteria	#1	#2	#3	#4	#5	#6	#7	Mean	Rank
technical	rule based &repetitive	4	4	5	5	5	5	4	4,57	1
technical	structured data	3	5	5	5	3	4	4	4,14	2
technical	limited changes in process	4	4	5	3	4	4	3	3,85	3
technical	high data volume	5	4	1	4	5	2	5	3,71	4
economical	number of times the process is performed per year	4	5	4	5	4	5	5	4,57	1
economical	time consumption per employee	3	4	3	5	4	5	5	4,14	2
economical	cost reduction	5	5	3	5	2	5	3	4	3
economical	error reduction	5	4	4	3	3	3	3	3,57	4
economical	number of employees involved in process	4	3	1	3	4	3	5	3,28	5
economical	balancing peak periods	3	3	2	2	2	3	3	2,57	6

8.7 Appendix I - RPA criteria list

# criteria	**technical or economical**	**process criteria**
1	technical	rule based and repetitive
2	technical	structured data
3	technical	high data volume
4	technical	limited change in process
5	economical	time investment (# employees * process is executed per year * time consumption per process step
6	economical	cost reduction
7	economical	improvement of error rate
8	economical	balancing peak periods
9	technical	Bot access requirements
10	technical	data bottleneck
11	technical	digital process steps and optimized process
12	economical	employee satisfaction
13	economical	Break- even point

8.8 Appendix J – Involved required systems for the bot implementation

Anforderungs-ID	**Titel und Beschreibung der Anforderungen**
1	One–Portal
2	Excel
3	SAP

Anforderungs-ID	Titel und Beschreibung der Anforderungen
4	MS Outlook
5	MP1
6	MK1

8.9 Appendix K - The automated process at MAN: A checklist to analyze the process in regard to the RPA-process-criteria

technical or economical	process criteria	criteria existing in chosen process
technical	repetitive and rule based	✓
technical	structured data	✓
technical	high data volume	✓
technical	limited change in process	✓
economical	# of employees	✓
economical	time consumption per process step	✓
economical	cost reduction	✓
economical	# process is executed per year	✓
economical	improvement of error rate	✓
economical	balancing peak periods	✓

8.10 Appendix L – Additional RPA-process-criteria resulting from expert interviews

technical or economical	process criteria	criteria existing in chosen process
technical	Bot access requirement	✓
technical	digital process steps and optimized process	✓
technical	prevent data bottleneck	✓
economical	Break-even point	✓
economical	employee satisfaction due to early communication	X

8.11 Appendix M – Interview questions for RPA experts in German and English

Erläuterung von:

Grund: Erstellung eines Kriterienkatalogs für RPA-Prozesse für die Beschaffung der MAN TB SE. Mit Hilfe von RPA einen Prozess in der Beschaffung automatisieren.

Herleitung: die Analyse der genannten RPA Kriterien.

Ziel: Ausschlaggebende Kriterien für Prozessautomatisierung durch Softwareroboter in der MAN durch die Experten erkennen und mit den Kriterien der Literatur vergleichen. Wenn Experten weitere Kriterien nennen, die Kriterien dem Katalog hinzufügen.

Frage #1

Deutsch: Sind Sie mit Prozessautomatisierung durch Software- Roboter in Berührung gekommen? Wenn ja, wo?

English: Do you have any kind of experiences with process automation through RPA? If so, give an example**.**

Frage #2

Deutsch: Welche Vorteile ergeben sich durch Prozessautomatisierung durch RPA in der MAN?

English: Which benefits will MAN have due to a process optimization through RPA?

Frage #3

Deutsch: Haben Sie negative Erfahrungen mit Prozessautomatisierungen gemacht bzw. fallen Ihnen mögliche Risikofaktoren ein?

English: Do you have negative experiences regarding process automation, or do you know risk factors regarding process automation?

Frage #4

Deutsch: Welche Kriterien sind wichtig für die Auswahl eines Prozesses, der durch RPA automatisiert werden soll, technisch und wirtschaftlich?

English: Which criteria (technical and economic) are important for choosing a process that has to be automated through RPA?

Frage #5

Deutsch: Auf einer Skala von 1-5, wie würden Sie die Kriterien der Wichtigkeit nach raten?

English: On a scale from 1-5, how would you rate the following criteria regarding their importance?

Technisch:

Kriterium des Prozesses	**Relevanz (1-5)**
Zeitintensiv	
Regelbasierend und repetitiv (wiederholend)	
Strukturierte Daten werden verarbeitet	
Hohes Datenvolumen	

Limitierte Änderungen im Prozess	

Wirtschaftlich:

Kriterium	**Relevanz (1-5)**
Anzahl der Mitarbeiter im Prozess involvierten	
Zeitinvestition des Mitarbeiters im Prozess	
Häufigkeit der Nutzung des Prozesses pro Jahr	
Kosteneinsparung durch Umstellung von manuell auf automatische Bearbeitung	
Reduzierung der Fehlerquote	
Ausgleich von Auslastungsspitzen	

Frage #6

Deutsch: In welchem Bereich des Unternehmens ist das höchste Potenzial für eine Prozessautomatisierung durch RPA? Anhand welcher Kriterien urteilen Sie?

English: In which sector of the organization is the highest potential for a process automation through RPA? Based on which criteria do you decide?

Frage #7

Deutsch: Welche Maßnahmen müssen beachtet werden, um RPA erfolgreich in der MAN implementieren zu können?

English: Which factors have to be taken into consideration to successfully implement an RPA- software system at MAN TB SE?

Frage #8

Deutsch: Welche Faktoren sind für die Ermöglichung und Akzeptanz eines Prozesswandels in der MAN nötig?

English: Which factors are necessary for the acceptance of a change within MAN TB SE?

8.12 Appendix N – Transcript of records from Interviewees

The transcriptions are excluded due to confidentiality