Hochschule für
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Berlin School of Economics and Law

EVOLVING DIGITISATION:

CHANCES AND RISKS OF ROBOTIC PROCESS AUTOMATION AND ARTIFICIAL INTELLIGENCE FOR PROCESS OPTIMISATION WITHIN THE SUPPLY CHAIN

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Abstract

Industry 4.0, the vision and term once created by the German government includes companies to digitise their processes, developing them from the state of a traditional, mostly non-transparent supply chain towards a data-driven, fully connected supply chain ecosystem.

A few trends have been gaining importance in the recent years within this vision, especially in the supply chain management. Standardisation and automation of processes in the form of Robotic Process Automation (RPA) as well as the use of Artificial Intelligence (AI) are trends which many experts predict will be responsible for a massive future change of how processes are carried out and employees will work. This is often accompanied by the fear of employment loss and other possible risks.

This bachelor thesis analyses the impact of RPA and AI in supply chains and derives practical recommendations for implementing these technologies. Hence, the current expertise from the literature and various whitepapers was incorporated and evaluated in order to gain a deeper insight into the two technologies and their requirements for a successful implementation. This work also distinguishes the effects that the use of the respective technologies can have on the processes as well as the employees involved in them and their work. The results of the theoretical research were evaluated and validated by the conduction of expert interviews. Supply chain experts covering the field of potential users, suppliers and consultants provide an insight into their individual assessment of the current technological maturity of the supply chains, which chances and risks they see and what future developments they expect.

It can be said that the benefits outweigh the risks clearly and that companies should deal with the introduction of both technologies in their processes. In the long term, the digital transformation cannot be avoided and competitive advantages can only arise if it is initiated in the near future.

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List of Abbreviations

AI	Artificial Intelligence
AR	Augmented Reality
BME	Bundesverband Materialwirtschaft, Einkauf und Logistik
BPM	Business Process Management
B2B	Business-to-Business
B2C	Business-to-Customer
CPS	Cyber-Physical Systems
CRM	Customer Relationship Management
DL	Deep Learning
ERP	Enterprise-Resource-Planning
FTE	Full-Time Equivalent
IoT	Internet of Things
KPI	Key Performance Indicator
ML	Machine Learning
NLP	Natural Language Processing
OCR	Optical Character Recognition
PwC	PricewaterhouseCoopers
ROI	Return-on-Investment
RPA	Robotic Process Automation
R&D	Research and Development
SCM	Supply Chain Management
SME	Small and Medium Enterprise
SSC	Shared Services Centre
TCO	Total Cost of Ownership

1. Introduction

1.1. Challenges and importance of the topic

Process optimisation is the main objective of every supply chain manager and although the core structure of a supply chain is consistent to a great extent, the way it is being operated changes continuously. The target of a supply chain is to fulfil a customer's demand by going through different phases carried out by suppliers, manufacturers, warehouses, distributers, retailers and customers[1]. Buyers, whether B2B or B2C, are demanding to an increasing extent transparent and sustainable processes, which enable faster delivery of the products in higher quality and at a fair cost. These demands in times of globalisation with growing supply chains and concomitant growing competition exert enormous pressure on corporate management. Globalisation is nothing new, however, it is still changing how business is done. It increases competition; while in the earlier days the main competitor was the company from the nearby city, today it could be one from the other side of the world. Simultaneously, it can accelerate business performance due to new ways of solving problems, new business partners and enhanced business networks.
The ever-advancing digitisation, that many see as a future necessity for a company's success[2], is putting a lot of pressure on supply chain managers. The processes on the part of the manufacturing companies have continued to evolve significantly with the four industrial revolutions. The fourth and recent revolution, which includes cyber-physical systems aims for a transparent, automated and partly-intelligent supply network. It covers several evolving as well as new technologies affecting and shaping different parts of the supply chain and hereby, it contributes to improving processes.
Digital trends of the early 21st century such as Internet of Things (IoT) and Big Data are playing a major part of turning the vision of Industry 4.0 into reality, several technologies involved have been discussed many times and partially already implemented in different areas of organisations. For many, automation of processes is one of the main components of process optimisation and, depending on the complexity of these processes, there are different technological solutions.

Artificial Intelligence (AI), a big driver of the revolution, can be used inter alia for data management and for controlling physical machines, however, it is also the basis for many other

[1] Cf. Chopra, Sunil/ Meindl, Peter (2016): Supply Chain Management: Strategy, Planning, and Operation, In: Pearson Ed. Ltd., Harlow, 6th Ed., P. 13
[2] Cf. Bohsali, Samer/ Samad, Rawia Abdel/ et al. (2016): Preparing for the digital era: The state of digitalization in GCC businesses. Online: https://www.strategyand.pwc.com/reports/preparing-digital-era [Last accessed: 25.06.2018]

technologies and trends. For instance, drones, chatbots and simple ERP add-ons can be programmed "intelligently" and thus act independently and optimise themselves over time. The amount of data generated every day in the most diverse business processes, whether by customers, suppliers or other parties involved, is increasing rapidly every year.[3] It is impossible for humans to evaluate and manage them efficiently and effectively. As a result, a lot of information that has a decisive influence on process output is not considered. In order to master this challenge, more and more companies, whether as providers, users or consultants, are dealing with this solution of automation.

Additionally, automation of non-complex, repetitive processes through interaction with a graphical user interface in the sense of Robotic Process Automation (RPA) has also been gaining in importance for some time. In contrast to AI, the action of the virtual robot (RPA) mimicking human behaviour is based solely on predefined rules. Nevertheless, the implementation of both technologies involves several chances and risks. These do not only affect the processes themselves but also the workforce involved.

1.2. Research question and thesis structure

This thesis aims to identify and evaluate possible chances and risks associated with the implementation of RPA and AI Intelligence. It deals with the question whether a seamless launch of transformation regarding fears of business disruption can be executed and if yes, in which way.

In the following section, both technologies are defined, possible areas of application on the basis of use cases are presented, and the past development as well as current situation in Industry 4.0 are explained. It is crucial in this respect, although many people are familiar with the terms of RPA and in particular AI, there is usually no consensus on the covered functionalities and dimensions of the technologies[4] and therefore, it is necessary to create one first.

In the further part, critical aspects and requirements from the planning and implementation phases of the technologies are examined. It is done by showing which flaws are regularly committed and factors that are often not considered by the leadership and involved employees,

[3] Cf. Gantz, John/ Reinsel, David/ Rydning, John (2017): Data Age 2025: The Evolution of Data to Life-Critical. IDC White Paper. Online: https://www.seagate.com/www-content/our-story/trends/files/Seagate-WP-DataAge2025-March-2017.pdf [Last accessed: 25.06.2018]

[4] Cf. Hyken, Shep (2017): Half Of People Who Encounter Artificial Intelligence Don't Even Realize It. Online: https://www.forbes.com/sites/shephyken/2017/06/10/half-of-people-who-encounter-artificial-intelligence-dont-even-realize-it/ [Last accessed: 26.06.2018]

although they are essential for the success of the project. The effects on company processes, workflows and the workforce are examined relying on the expertise of current literature and study results.

The subsequent empirical investigation based on expert interviews will validate and supplement the previously identified chances and risks. In addition, requirements and challenges that companies should take into account and are likely to face in the digital transformation are identified. After the reader has gained an insight into the possible areas of deployment, the expert assessment provides an outline of how the current progress in German supply chains actually is and what future developments they expect.

Thus, the contribution of this work is intended to demystify the impact of growing digitisation as well as automation. It provides companies and other interested parties with an overview of the factors that need to be addressed at an early stage and what changes they should expect.

It needs to be noted that the topic is viewed from a business management perspective and therefore only limited attention is focused on the technological functionality.

1.3. Research Methodology

The research for this paper is based on two methodologies: literature-based and interview driven research. The first chapters including the *Theoretical Foundation* and *Phases and Impact of the technologies* cover theories and concepts built on theoretical knowledge gained in the literature represented and acknowledged models and perceptions. By the use of a practical approach focusing on the conduction of expert interviews these postulated theories are then validated and enhanced before a final conclusion is drawn and a recommendation for action is given.

1.3.1. Literature-based research

As stated in the introduction, the topic of this thesis focuses on relatively new technologies. The term and concept of AI has been around for many years already, however, it has not been implemented yet in most small and medium-sized enterprises (SMEs) nor many big enterprises. AI is experiencing major development jumps nowadays leading to new connected sub-technologies such as demand sensing making a traditional literature-based research difficult. Classical literature like monographs typically take years to be written due to their extensive research demand and coverage. Combining these two factors of the rapid development of AI and the tedious process of writing monographs, this leads to the current situation that they are mostly outdated or cover only a fraction of the current state-of-the-art level. Similarly, in recent years it has become more difficult to obtain meaningful hands-on examples due to escalating industrial espionage, that often results in companies with implemented technologies sharing only limited information.

Research on RPA is facing similar constrains and empirical data/ resources are rather sparse. This is mainly since it is a very new technology which has not been around for long and still does not get the attention that it might deserve.

Thus, the literature-based research in this bachelor thesis is dealing largely with journals, prestigious internet resources and use-cases publications/ whitepapers about pilot-projects and successful implementations of the new digital technologies.

Existing use cases allow a deeper insight on why, how extensive and in which functions RPA and AI have been implemented in the area of Supply Chain Management in so called lighthouse projects.

1.3.2. Interview-driven research

While use case publications do often state the results of the technology implementation which were able to be achieved in values such as cost reduction, process time reduction or profit increase, they withhold in many cases challenges, risks and discontents. This paper will rely also on an expert interview-driven research to gain inter alia insights on concerns like fear, possible hazards and what supply chain experts think about RPA and AI in general. As this methodology is relatively undefined, nevertheless, often used in empirical studies, it is essential to clarify at the beginning the term and selected concept of expert interviews. According to the Oxford Dictionary, an expert is "a person who is very knowledgeable about or skilful in a particular area"[5]. The expert interview is therefore focusing on a group of persons having specific knowledge of the research interest which is in this case the supply chain function of organisations being affected by the digitisation. The necessary knowledge is hereby measured by the job or profession of the expert one has or had in the recent past.[6] Only when there is a justified presumption that the expert has this knowledge "that one does not possess alone, but that is also not accessible to everyone in the field of interest"[7] one will become an addressee for such an interview.[8] By this research method the researcher gains theoretical and additionally practical insights which allow a broader overview of desired and actual benefits as well as disadvantages. Thus, it fulfils the objective of validating the preliminary hypothesis which is based on the literature-based sources and to give information about the research issue. The complexity hereby is caused by the generally open questions making it almost impossible to forecast experts' answers. Often, it is only with hindsight that it becomes clear to what extent the expert actually has the required knowledge and expertise. To maximise the output of gained insights, it is essential that the interview is guided and structured in the right way. Nevertheless, it should leave the necessary freedom to adapt or to go into details if it benefits the research.

[5] Oxford Dictionary: Expert. Online: https://en.oxforddictionaries.com/definition/expert [Last accessed: 13.05.2018]
[6] Cf. Liebold, Renate/ Trinczek, Rainer (2009): Experteninterview. In: Kühl, Stefan/ Strodtholz, Petra/ Taffertshofer, Andreas (Ed): Handbuch Methoden der Organisationsforschung. Wiesbaden: Verlag für Sozialwissenschaften, P. 34
[7] Meuser, Michael/ Nagel, Ulrike (1997): Das Experteninterview – Wissenssoziologische Voraussetzungen und methodische Durchführung, In: Friebertshäuser, Barbara/ Prengel, Annedore, Handbuch Qualitative Forschungsmethoden in der Erziehungswissenschaft, Weinheim-Basel, P.484 [Own translation]
[8] Cf. Liebold, Renate/ Trinczek, Rainer (2009): loc. cit. P. 34

1.3.3. Research limitations

Relying on published use cases and whitepapers is generally subject to two major issues and challenges. Firstly, it is the publication that should serve a specific purpose, namely to support the view of the author or to positively position the role of the company in focus, or negatively, if appropriate.[9] They are often seen as promotional activities taking place between an external consulting firm or other service provider and the company where the project was carried out.[10] Second, these sources have the disadvantage of limited insight into substantial information.[11] In many cases only a selected part, but not the overall view of the preparation, implementation and follow-up phase is considered, which means statements can only be made conclusively to a limited amount. This is justified in order to support the first mentioned disadvantage, one's own positioning, but also in the fact that information is considered as irrelevant, which might be relevant for others research.
Often, companies are also unwilling to provide detailed information to the public about processes and structures as they are engaged in industrial espionage or other competitive influences.[12] If detailed information is then provided by these enterprises, it is likely to be outdated, so as to minimise or even eliminate potential damage to the business because there have already been changes made.

To counteract these challenges, interviews with supply chain experts from different industries and a consultancy firm were conducted. Interviews allow first-hand information which is otherwise difficult to get if one is not directly involved in the implementation processes of the technologies. By interviewing experts, the advantage of asking for explanations and relevant questions for the thesis is gained. Although the interviewer gets access to information which would otherwise not be available for him, data might also be limited as experts could hold back information for the same reason as use case descriptions.[13] Also, often the experts do not have a

[9] Cf. Berg, Bruce/ Lune, Howard (2012): Qualitative Research Methods for the Social Sciences. London: Pearson. P. 164-165
[10] Cf. Investopedia: White Paper. Online: https://www.investopedia.com/terms/w/whitepaper.asp [Last accessed: 11.07.2018]
[11] Cf. Berg, Bruce/ Lune, Howard (2012): loc. cit.
[12] Cf. Wimmer, Bruce (2015): Business Espionage: Risks, Threats, and Countermeasures. Waltham: Butterworth Heinemann. P. 141-145
[13] Cf. Meuser, Michael/ Nagel, Ulrike (2009): Das Experteninterview: Konzeptionelle Grundlagen und methodische Anlagen. In: Jahn, Detlef/ Lauth, Hans-Joachim/ Pickel, Gert/ Pickel, Susanne (ed.): Methoden der vergleichenden Politik- und Sozialwissenschaft: Neue Entwicklungen und Anwendungen. Wiesbaden: VS Verlag für Sozialwissenschaften. P. 470-472

full overview of the discussed issues either, as there are several employees and leaders involved in transformation processes.

Moreover, it needs to be kept in mind that both RPA and AI are quickly evolving technologies. Especially AI experiences rapid technological development steps due to the broad fields of application. The rapid evolvement of AI is among other reasons caused by the growth of computer chip power which restricts the possibilities of AI since it needs extremely powerful computing capabilities.[14]

Despite Moore's Law, saying that the amount of transistors in integrated circuits doubles every two years, nowadays can be described as dead[15], computer chips still experience a continuous improvement due to reconfiguration and design changes[16] which allows AI to evolve as well. Research results and expert knowledge might therefore be up-to-date only for a relatively limited time.

[14] Cf. Hof, Robert (2013): Deep Learning. Online: https://www.technologyreview.com/s/513696/deep-learning/ [Last accessed: 11.07.2018]

[15] Cf. Spencer, Michael/ Harris, Gary/ Pagán, Jem (2018): The End of Moore's Law. In: U.S. Black Engineer & Information Technology, P. 76

[16] Cf. Simonite, Tom (2017): How AI Can Keep Accelerating After Moore's Law. Online: https://www.technologyreview.com/s/607917/how-ai-can-keep-accelerating-after-moores-law/ [Last accessed: 17.05.2018]

2. Theoretical Foundation

The objective of this chapter is to create a common understanding of theoretical aspects. On the part this includes the detailed definition of the two technologies including scope and application areas as well as the consideration of the underlying conditions resulting from the industrial revolutions and other digitisation trends. This is necessary in order to be able to build on this comprehension in the later part of this paper.

2.1. Definitions

2.1.1. Robotic Process Automation

Digital automation and thus, the foundation stone of the development towards RPA has its beginning with macros. In 1963, Timothy Hart introduced his idea of a definition of macros for LISP 1.5.[17] LISP is a programming language which has been developed and created in the end of the 1950s at the Massachusetts Institute of Technology.[18] A macro can be defined as "an automated input sequence imitating keystrokes or mouse actions. A macro is typically used to replace a repetitive series of keyboard and mouse actions […]"[19]. Macros are commonly known for its use in Microsoft Excel where it is based on the VBA-programming-language. In Excel it is used to automate repetitive tasks or functions within one or several different sheets.

Still used today, macros can be built either by recording a sequence of keyboard and mouse inputs executed by a human user or by manually writing a code.

The implementation of centralised computer systems for inventory management in the production industry in the 1960s was the first step towards an Enterprise Resource Planning (ERP) System. Also, the development of Materials Resource Planning systems (MRP) in the 1970 and the extension of it to Manufacturing Resources Planning systems (MRP II) in the 1980s,[20] paved the way. ERP systems integrate the planning and management of the overall business function from sales over HR towards Customer Relationship Management while connecting one with another. One of the most famous service providers of these systems is SAP,

[17] Cf. Hart, Timothy (1963): Macro Definitions for LISP. In: AI Memos (AIM-057)
[18] Cf. Krusenotto, Patrick (2016): Funktionale Programmierung und Metaprogrammierung. Rheinbach: Springer Vieweg. P. VII
[19] Techopedia: Macro. Online: https://www.techopedia.com/definition/3833/macro [Last accessed: 19.05.2018]
[20] Cf. Sprague, Carolyn (2013): Enterprise Resource Planning. In: Research Starters: Business (Online Edition). EBSCOhost [Last accessed: 19.05.2018]

a German-based software corporation offering different business software solutions. In the early 2000 the term ERP as a Service has been introduced. The idea of Software as a Service (SaaS) is that customers of the service provider pay for the use or a subscription with access to the application which is internet-based and platform-independent.[21]

ERP systems are often the foundation for business process automation since it combines a majority of the information within a company. A step further towards automation lies in Business Process Management (BPM) which is based on the idea of Workflow Management systems (WFM). While WFM solutions are mainly focused on simple automation of business processes, BPM combines know-how from IT management and engineering to analyse, optimise as well as automate business processes.[22] However, BPM can be seen as an approach of having a deeper look into process execution to enable process improvement. The concept of BPM includes the re-engineering of underlying processes to optimise the output and to increase the customer experience by creating a technological (software) solution. The creation of a Business Process Management application is done by software developers as it requires complex coding.[23]

Based on these concepts and relying on them, the term of RPA has been established in the beginning of the 2000s.[24]

When RPA is mentioned to a person for the very first time they often think it has something to do with a physical robotic machine which they know from assembly lines at production sites of, for instance, automobile manufactures. Nonetheless, RPA is instead a virtual robot. If implemented properly, it will act like a rule-based virtual employee executing processes the same way an FTE would do it. Therefore, RPA can be seen as a software interacting with and switching between other software applications such as ERPs, CRMs and e-mail clients by transferring information. It does this by mimicking the interactions of humans in standardised processes which always follow the same structure and rules.[25] These highly repetitive tasks being labour- and time-intensive often demand multiple manual interactions and are usually error-prone. The created value-add is compared to other cognitive challenging processes relatively low. To

[21] Cf. Gartner: Software as a Service (SaaS). Online: https://www.gartner.com/it-glossary/software-as-a-service-saas/ [Last accessed: 19.05.2018]
[22] Cf. Aalst, Will van der/ La Rosa, Marcello/ Santoro, Flávia (2016): Business Process Management. Wiesbaden: Springer Fachmedien. P. 2
[23] Cf. Forrester Consulting (2014): Building A Center Of Expertise to Support Robotic Automation. Online: http://neoops.com/wp-content/uploads/2014/03/Forrester-RA-COE.pdf [Last accessed: 19.05.2018]
[24] Cf. Ostdick, Nick (2016): The Evolution of RPA: Past, Present, and Future. UiPath. Online: https://www.uipath.com/blog/the-evolution-of-rpa-past-present-and-future [Last accessed: 19.05.2018]
[25] Cf. Lowes, Peter (2016): An Introduction to Robotic Process Automation, online: http://deloitte.wsj.com/cio/2016/03/13/an-introduction-to-robotic-process-automation/ [Last accessed: 26.04.2018]

implement an RPA-bot being able to execute these processes successfully, it is necessary to divide it into several step-by-step subprocesses. Due to the fact that RPA solutions are not "intelligent" like AI solutions but 100 per cent rule-based, it is required that no step is forgotten and planned thoroughly.

An RPA-bot is often implemented in the area of finance and accounting departments such as in the review process of high-risk accounts of banks[26], it is nowadays also used in processes like the comparison of incoming order confirmations and the actual outgoing orders. Per this example, the bot can be programmed in such a way that it fully autonomically opens the e-mail client, recognising an order confirmation has been received, opening and saving the attachment. Afterwards, it will scan the confirmation for data such as article number, description, price, delivery date, etc. and switch to SAP where it compares it to the internal data about the order. If the check does not end positively it can directly inform a responsible employee with a recommendation for action.[27] This process is usually not very demanding for a human-being which results in a low level of motivation and a higher error rate. These bots are mainly used in the middle- and back-office, however, they can also be used in the front-office.
There are several solution providers that do not require any programming skills. These tools are based on conditional logic, meaning "if A happens then B will follow", and wizards are often included which allow easy drag-and-drop features to customise the bot.[28] A deeper insight about different providers and implementation requirements will be carried out later in this paper.

[26] Cf. Institute for Robotic Process Automation (2015): Beyond pressing a button: The automation of automation, P.7
[27] Cf. Work project experience, client anonymised
[28] Cf. Lowes, Peter (2016). loc. cit.

2.1.2. Artificial Intelligence

AI is a controversial topic as experts have been discussing for years if AI will revolutionise our future or will be the greatest danger which we are facing.[29] One reason why it is a very complex issue is because there are many different conceptions on what AI really is. This is inter alia because there are also different opinions on what "intelligence" actually means.

The Oxford Dictionary defines AI as "the theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages."[30]

One of the most famous ways trying to test whether a machine is artificially intelligent or not was invented in 1950 by Alan Turing and is known nowadays as the Turing Test.[31] Turing proposed that a judge is communicating with two contestants, one of them is a human and the other one is a computer. This communication takes place via a terminal allowing the participants to exchange messages without seeing or hearing each other. The judge will then ask both contestants questions which will try to convince the judge that they are humans. If the judge cannot tell who the human is and who is not, the machine can be described as intelligent. In 2014 the University of Reading in England stated that for the very first time a computer programme passed the Turing Test.[32] However, it is controversial how meaningful this attempt actually was and whether one can interpret the test as successful.[33]

AI can be seen as the simulation of human intelligent thought processes by a computer system and processes involved include autonomous and automated understanding, planning, explanation, self-correction and execution. Besides independent decisions, hypotheses are created and the problem solving itself is done by using logical and mathematical algorithms. The way AI can influence the future of business processes is diverse. Andrew Ng, professor at Stanford University and former Vice President and Chief Scientist of Baidu, stated: "If a typical person can do a mental task with less than one second of thought, we can probably automate it using AI either now or in the near future."[34] This sentence contains what many people are worried

[29] Cf. Musk, Elon (11.03.2018): Q&A at SXSW
[30] Oxford Dictionary: Artificial Intelligence. Online: https://en.oxforddictionaries.com/definition/artificial_intelligence [Last accessed: 26.04.2018]
[31] Cf. Turing, Alan (1950): Computing Machinery and Intelligence. In: Mind, Ed. 49, P.433-460
[32] Cf. University of Reading (2014): Turing Test Success Marks Milestone In Computing History. Online: http://www.reading.ac.uk/news-and-events/releases/PR583836.aspx [Last accessed: 26.04.2018]
[33] Cf. Mann, Adam (2014): That Computer actually got an F on the Turing Test. Online: https://www.wired.com/2014/06/turing-test-not-so-fast/ [Last accessed: 08.07.2018]
[34] Ng, Andrew (2016): What Artificial Intelligence Can and Can't Do Right Now. In: Harvard Business Review

about, the possible replacement of human workforce by machines and computer systems since they might operate faster, cheaper and better, not only in physical but also in cognitive processes. The increasing acceleration of AI in enterprises is driven by the increasing level of big data, cheap storage (servers), faster processors and developing global networks.[35] These evolving factors allow AI to become more useful in different areas. Mostly relevant for businesses, one can divide AI into three different areas, which cover a large part of the functionalities of the technology: expert systems, pattern recognition and robotics.[36]

First, expert systems support the solution finding of a complex problem. Action recommendations are created based on a knowledge database and logical conclusions. An example could be the derivation of likely consequences after an incident, e.g. based on recent developments in relevant countries and connected geopolitical situations the expected demand for crude oil is automatically re-calculated.

Secondly, pattern recognition describes the ability to identify within a dataset regularities and patterns. This is highly important for sub-technologies such as Data Mining and for the interaction with humans. Besides pattern recognition in number sets, you can divide it into Natural Language Processing (NLP), which serves the automatic processing of human languages including voice- and text-based communication, and into face or image recognition which is based on optical characteristics, geometrical structures, texture and colour.

Last, AI can take over the physical interactions with machines and other systems for the execution and controlling of processes based on sensors and information processing. The system can autonomously identify an improvement potential in the production followed by the automatic realisation.

Concerning the question on how AI becomes "smart" or how it is trained, there are different methods. One frequently mentioned learning method of AI is Machine Learning (ML). The name already suggests what it is about; the system learns over the time through experience.

ML can be subdivided into four basic categories: supervised, semi-supervised, unsupervised and reinforcement machine learning.[37]

The first category describes the process of providing correct output data for several input files. During the so-called training phase, the algorithm tries to close the gap between input and output

[35] Cf. Burgess, Andrew (2018): The Executive Guide to Artificial Intelligence. London: Springer International. P.19

[36] Cf. ibid. P. 29-50

[37] Cf. Parrish, Kevin (2018): Deep learning vs. machine learning: what's the difference between the two? Online: https://www.digitaltrends.com/cool-tech/deep-learning-vs-machine-learning-explained/2/ [Last accessed: 08.05.2018]

correctly. An illustrative example for this process, supervised training, is the teaching of the system by showing it several images of cats and dogs. Each image is labelled according to what animal is on it. The system will then try to understand the pattern, colours and other characteristics which are typical for either a cat or a dog.

The semi-supervised training is very similar to this, however, only a few images are labelled while the rest are not. Using an algorithm, the system tries to bridge the gap.

Unsupervised training is more complex, the images of cats and dogs are not labelled at all and the system tries to group them in these two categories by finding similarities in each. The algorithm creates a model for a dataset that describes the structure of the data and predicts future ones.[38]

The reinforcement machine learning is similar to the former training method. In an environment unknown as in unsupervised learning, the algorithm attempts to generate an output. This is then "rewarded" or "punished", for instance, by a rating on a scale of 0-100. The system tries to achieve the best possible results and learn.

All different methods have the similarity that the system will learn, expand and improve its abilities over time. This solution can be used in the field of demand forecasting as over time it will identify an increasing amount of different complex factors having an influence on the demand and to which degree.

There is another often used buzzword besides Machine Learning: Deep Learning. Deep Learning is basically ML but on a higher complexity level.[39] Its goal is it to mimic the human brain functions which requires immense computing power and power of graphic cards, as well as access to high amounts of big data. "[…] It has more than one state of nonlinear feature transformation. One of the biggest advantages of deep learning is its ability to automatically learn feature representation at multiple levels of abstraction" allowing the system to "learn complex functions […] without many dependencies on human-crafted features."[40]

[38] Cf. ibid.
[39] Cf. ibid.
[40] Bhardwaj, Anurag/ Di, Wie/ Wie, Jianing (2018): Deep Learning Essentials. In: Packt Publishing Ltd, Birmingham. P.8

2.2. Industry Development

2.2.1. Path to Industry 4.0

Industry 4.0 is a term which has received a lot of the public's attention since 2011 when it was firstly introduced as a future project within the framework of a high-tech strategy by the German Ministry of Education and Research (BMBF)[41]. Before, three other industrial revolutions took place shaping not only how enterprises produce but also how all of us live in our everyday life. Very briefly each revolution will be explained in the following to have a common understanding of what Industry 4.0 is based on.

With the first industrial revolution taking place in Britain starting at around 1750 until the early to mid-19th century, machines based on water and steam power took over production sites and shaped the whole way of transportation.[42] Production processes which were formerly carried out by hand but now by machines were affecting especially the industry of textile manufacturing. Since it had such a major impact it is also known as *the* industrial revolution.

The second revolution was taking place between 1870 and 1914, involving mass production and the assembly line, both achieved by electricity and the division of labour. The term of mass production is often connected to one person: Henry Ford and his model T.[43] Although he was not the inventor of the assembly line he can be named as the sponsor since he implemented it into his production sites allowing cars to evolve from a highly exclusively product to one which the middle-class was able to afford. It was also the time of invention including the telephone, radio broadcasting and the washing machine.

The starting year of the third industrial revolution was 1969. In this year the first programmable controller, a computer used for industrial automation, was presented by Modicon, Inc.[44] Furthermore, the Advanced Research Projects Agency Network (ARPANET) was established, a network allowing the creation of the internet later.[45] This revolution involved the use of computers and automation for production purposes, as we can still see them nowadays.

Each of these industrial revolutions allowed a major breakthrough in product design, development and improvement. The fourth industrial revolution, Industry 4.0, will be different

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[41] Cf. Bundesministerium für Bildung und Forschung: Industrie 4.0. Online: https://www.bmbf.de/de/zukunftsprojekt-industrie-4-0-848.html [Last accessed: 26.04.2018]

[42] Cf. Deane, Phyllis (1980): The First Industrial Revolution. Cambridge: Press Syndicate of the University of Cambridge. 2nd Ed. P.72 et sqq.

[43] Cf. Mokyr, Joel (1998): The Second Industrial Revolution 1870-1914. Evanston: Northwestern University. P.1-8

[44] Cf. Jones, Clarence (1998): Programmable Logic Controllers: The Complete Guide to the Technology. Atlanta/ Philadelphia: Patrick-Turner Publishing Company. P. 18

[45] Cf. Roberts, Brian (2015): The Third Industrial Revolution: Implications for Planning Cities and Regions. Working Paper Urban Frontiers. P.2

compared to the others. It does not directly involve a totally new way of manufacturing or power generation but rather focuses on improving existing technologies by connecting them and making them more "intelligent". The keyword for this revolution is "cyber-physical systems" (CPS). By integrating digital intelligence into products, machines and plants it is meant to achieve a partly-autonomous reconfiguration and self-optimisation of production processes and conditions.[46] This is based on the concept of connecting the involved machines and products with each other, allowing a communication between them by exchanging data for instance measured by built-in sensors. Since the fourth industrial revolution is a process which is not based on a single invention the development time is longer compared to the previous revolutions. The most important technologies involved in Industry 4.0 and the digitisation will be discussed in the following chapter.

2.2.2. State-of-the-Art

According to the Oxford Dictionary, state-of-the-art means "the most recent stage in the development of a product, incorporating the newest ideas and features."[47] PricewaterhouseCoopers (PwC) identified eight technological trends which companies should learn about and consider implementing in their own business processes. These technologies are IoT, Augmented Reality, Virtual Reality, Blockchain, 3D Printing, Drones, Robots and AI.[48] These technologies will have an impact across all business aspects such as the workforce, the customer relations, strategy and operations.

Focusing on the Supply Chain Management (SCM), all of the identified technology trends can be used to improve processes and by combining technologies the level of optimisation can be further increased. In distribution IoT can be used for tracking and monitoring the status of shipped products. However, Coca-Cola had a different idea. They used IoT to create smart coolers that were equipped with sensors collecting all kind of data such as how often the door of the cooler is opened to improve strategic decisions.[49]

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[46] Cf. Bundesministerium für Bildung und Forschung: Industry 4.0 - Innovationen für die Produktion von morgen. Bielefeld: W. Bertelsmann Verlag. P.7

[47] Oxford Dictionary: State-of-the-art. Online: https://en.oxforddictionaries.com/definition/state_of_the_art [Last accessed: 26.04.2018]

[48] Cf. PwC (2017): Tech breakthroughs megatrend. Online: https://www.pwc.com/gx/en/issues/technology/tech-breakthroughs-megatrend.html [Last accessed: 27.04.2018]

[49] Cf. Moye, Jay (2018): Connected Coolers: How the 'Internet of Things' is Powering Coke's Fleet of Cold Drink Equipment. Online: https://www.coca-colacompany.com/stories/connected-coolers-how-the-internet-of-things-is-powering-coke-s-fleet-of-cold-drink-equipment [Last accessed: 27.04.2018]

While Virtual Reality (VR) can be used for warehouse or production site planning to get a better understanding on how the ready-built structures will later look like, Augmented Reality (AR) can be used to improve the actual manufacturing process by supporting employees with real-time instructions and data concerning the items they have in their eyesight. Electrical wiring in a plane does not allow any errors. Considering the amount of wires involved, the complexity of wiring plans and the difficulty of transferring a 2D-plan into the 3D-reality, this is difficult to ensure. Therefore, Boeing started testing AR in their factories allowing employees to see where exactly which cable needs to go and how the outcome has to look like in the end. Boeing stated after the first testing phase they achieved a 90% improvement of first-time quality and a 30% reduction of time spent.[50]

Blockchain is a technology that gained a lot of attention in the past year due to the fluctuation of Bitcoin, a cryptocurrency based on the blockchain technology. However, blockchain does not need to involve any currencies, instead it can be understood as a decentralised booking system. All information and values such as ownership, product details and characteristics are saved simultaneously on multiple servers. As a new value is posted and verified, the entire blockchain updates on all servers, a 'block' is added to the 'chain'. Each block contains an unchanging time stamp, a cryptographic hash and transaction data making it resistant to any modifications and therefore transparent and secure. Walmart in cooperation with IBM is working on implementing this technology to optimise food safety by replacing the error-prone way of paper documents. Thus, at any time between the farm and the end-consumer the product can be tracked and information about origin, processing and distribution is transparent.[51]

3D-Printing had experienced publicity a few years ago when first printers entered the market that were designed for private purposes and prices started to become reasonable. It can be described as a production process in which layers are glued, melted or in any other way joined together to make a 3-dimensional object from a digital model. Airbus started a pilot-project where they 3D-printed different components to cover gaps in their plane cabins which will be soon used in Finnair's Airbus 320.[52] This process does not only allow a cost reduction since parts can be individualised effortlessly, they are also lighter while maintaining their strength; another crucial factor in the aviation industry.

[50] Cf. Boeing (2018): Boeing Tests Augmented Reality In The Factory. Online: https://www.boeing.com/features/2018/01/augmented-reality-01-18.page [Last accessed: 27.04.2018]
[51] Cf. IBM (2017): Walmart, JD.com, IBM and Tsinghua University Launch a Blockchain Food Safety Alliance in China. Online: https://www-03.ibm.com/press/us/en/pressrelease/53487.wss [Last accessed: 27.04.2018]
[52] Cf. Airbus (2018): Bridging the gap with 3D printing. Online: http://www.airbus.com/newsroom/news/en/2018/04/bridging-the-gap-with-3d-printing.html [Last accessed: 01.05.2018]

Drones are often connected with the idea of transporting goods from place A to B, and while this might be a good solution to supply rural or other hard-to-access areas, drones can likewise be used for many other purposes. The unmanned flying objects are often equipped with 4 to 8 rotors and controlled by either humans via connected devices or AI. In the supply chain they can monitor and evaluate service providers or production processes. Walmart had the idea to optimise their inventory management with the technology. While the drone flies through the warehouse it takes 30 images per second.[53] By doing so, it replaces the traditional way of employees on forklifts climbing up and down while scanning codes, a process which is very time intensive and inefficient.

As briefly explained, these six technologies can have significant impacts on the supply chain of today and tomorrow if implemented successfully. However, this paper focuses on the last two of the total eight identified technologies, robots and AI. Although the term robotics describes physical robots which can be often seen on production sites in assembly lines, it also includes the non-physical RPA.

The automation of business processes that usually mean repetitive, undemanding and manual labour is compared to AI not as technological and cognitively advanced. However, it experienced an increase in attention within the last years. A European food producer implemented RPA to automate the shipment status communication with clients.[54] Traditionally, an employee had to open the customer's email requesting the status, switch to the shipment system, search and find the relevant data in the ERP system and finally send this information to the client. According to UiPath, a leading service provider of RPA solutions, this allowed an elimination of 40-60% of the manual effort required by the answering process going along with high labour costs and low employee motivation due to the repetitiveness.[55]

AI can be combined with many other technologies making them more independent from human inputs and controls, and to improve their capabilities. Possible fields of application are nearly infinite. Nevertheless, AI nowadays is still limited in its functionalities and considering how it will likely evolve within the next years and decades, the technology is only in its starting phase.[56]

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[53] Cf. Abrams, Rachel (03.06.2016): Drones Fly About Walmart Warehouses to Take Stock. In: New York Times. P. B6

[54] Cf. Deckard, Mina (2018): RPA, the Glue for Supply Chain Management. Online: https://www.uipath.com/blog/rpa-the-glue-for-supply-chain-management. [Last accessed: 01.05.2018]

[55] Cf. ibid.

[56] Cf. UBS (2016): AI's coming of age. Online: https://www.ubs.com/microsites/artificial-intelligence/en/ai-coming-age.html [Last accessed: 01.05.2018]

However, for the supply chain and its involved processes there are already use cases with significant results. One main field AI can result in a paradigm change is predictive analytics. Predicting, or also called forecasting, plays a big part in a successful SCM, it involves inter alia the prediction of changes in demand, needed supplies/ raw materials, costs and time. For years these forecasting methods have been already executed by computer systems and are improved continuously by adding AI into it. Demand Sensing is based on the concept of intelligent demand forecasting. However, this application focuses on each individual and related big data.

As customers of online retailers ask for shorter delivery times[57], the complexity of the distribution management increases but also, the question rises on how to predict what the customer is going to order before one has actually done it. Demand Sensing allows exactly this prediction of highly likely orders and thus, these products can be shipped to the nearest warehouse in advance to minimise the delivery time.[58] The system which has been implemented by Amazon, Otto, Vattenfall and other companies uses all kinds of (real-time) data such as weather, marketing ads, social media activity, paydays, order history and much more.[59]

Furthermore, AI allows the prediction of the unpredictable: maintenance. Predictive maintenance is a term to describe the technology of forecasting when exactly a machine needs to be maintained before it fails resulting in enormous downtime costs. Based on AI, IoT and big data, machines with installed sensors measuring usage, conditions, surroundings and maintenance history send relevant data to a controlling system which analyses their status and triggers a maintenance order if necessary to prevent failure.[60] As this technology is rather new, it is in many companies still in its development phase and has not reached its capabilities yet.

Since many technologies involved in shaping Industry 4.0 are still in their early stages it can be concluded that the state-of the-art has significant space to process[61] and it is not yet precisely predictable how future operational processes will look like.

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[57] Cf. Chao, Loretta (2016): Online Shoppers Want Delivery Faster, Cheaper, Survey Shows. Online: https://www.wsj.com/articles/online-shoppers-want-delivery-faster-cheaper-survey-shows-1465851072. [Last accessed: 01.05.2018]

[58] Cf. Chase, Charles W. (2013): Using Demand Sensing and Shaping to Improve Demand Forecasting. In: The Journal of Business Forecasting. Vol. 32, No. 4. P.24-32

[59] Cf. Berttram, Philipp/ Schneider, Judith/ Münch, Marc (2018): The Magic of Predicting Demand from Data. Online: https://www.strategy-business.com/article/The-Magic-of-Predicting-Demand-from-Data?gko=94906 [Last accessed: 02.05.2018]

[60] Cf. Haarman, Mark/ Mulders, Michel/ Vassiliadis, Costas (2017): Predictive Maintenance 4.0 – Predict the unpredictable. Report of PwC Netherlands and Mainnovation. P.9

[61] Cf. Brunet-Thornton, Richard/ Martinez, Felipe (2018): Analyzing the Impacts of Industry 4.0 in Modern Business Environments. Hershey: Business Science Reference. P. 260

3. Phases and Impact of the technologies

Based on the application fields defined in the previous section this part will concentrate on the literature-based view of which factors need to be considered in the planning and implementation phase of both technologies. Also, it will outline opportunities and risks going along with the launch of RPA and AI from which several implementation requirements can be derived.

3.1. Planning phase

RPA and AI offer a wide range of positive impacts on the supply chain efficiency and workforce. Nevertheless, for a successful implementation it is elementary that several requirements in the planning phase are fulfilled since not all processes are suitable for implementing new technologies yet.

In all cases it is required to define a clear target definition. Requirements concerning the execution of the process need to be specified. This step also involves an active involvement of the affected employees and department leads. A proper communication strategy for the project is important to be implemented right from the beginning. Without the early involvement of the stakeholders, a successful implementation will not be feasible. This includes not only the planning and management of the communication strategy between the planners and knowledge experts but also the affected personnel having an accurate understanding of what is going to happen. Process Automation Manager at Lufthansa Global Business Services, Dominik Jaskulski, stated that this was the biggest challenge Lufthansa was facing when implementing RPA for the first time.[62] A failure of giving a clear understanding could result in withholding important information with the intension of the process to fail. Once the employees support the change, they are needed to provide a clear process documentation including the consideration of every small step and every business exception possible. To maximise the process understanding and insights, it is useful to document the process using a flowchart presenting the workflow and different stages being passed within a process.[63] This type of process documentation is especially useful when employees are involved who do not have a deeper understanding about the process and its stages, also it supports the discussion about improvement potential. For collecting the

[62] Cf. Jaskulski, Dominik (2017): How RPA Is Impacting the Lufthansa Group. Online: http://www.iqpc.com/media/1003582/72844.pdf [Last accessed: 20.05.2018]
[63] Cf. Cambridge Dictionary: Flowchart. Online: https://dictionary.cambridge.org/de/worterbuch/englisch/flowchart [Last accessed: 20.05.2018]

required information Nesbitt writes that two different techniques can be used, the interviewing or group method.[64] He argues that interviewing is the preferred method when the process is not complex and only involves a limited number of participants while the group method should be used when the opposite is the case as it integrates different opinions.[65]

3.1.1. Robotic Process Automation

In this section an assessment framework will be developed allowing organisations to determine whether a certain process is ready for the support of or rather the autonomous execution by a robot.

Most important is that one has to keep in mind that RPA is not based on any intelligence which is comparable to human thinking but instead relies on following pre-defined rules where the robot does not deviate from, it relies on the simple logic of "if-then". The process to be automated needs to possess a certain structure which includes rules, a specific framework and governance model. If it requires human valuation, differentiates every time or relies on creativity RPA will not be able to deliver a satisfactory result. Thereby, a suitable process must already be sufficiently standardised in advance.

To make the investment in a robot worthwhile, the overall added value has to be convincing. This can usually only be the case if the process is repetitive enough. Managers must ask themselves first and determine how often a process is repeated on a daily basis. This applies especially to documentation and other simple data processing tasks generating little or no added value. However, there are two exceptions which could justify an implementation although the amount of process cycles is low. Firstly, a process having only a limited number of run-throughs daily, but requires a long processing time, could benefit from the technology due an increased amount of tasks completed per day. Secondly, it can be beneficial to rely on a robot taking over the process if an incorrect execution caused by human error could result in costly compliance countermeasures or harm the organisation's reputation.[66] Nevertheless, one can conclude that the scope of RPA lies in and the automation potential increases with repetitive and manual work (*Figure 1*).

[64] Cf. Nesbitt, Thomas (1993): Flowcharting business processes. In: Quality. Vol. 32. P. 34 et sqq.
[65] Cf. ibid.
[66] Cf. Capgemini Consulting (2016): Robotic process automation (RPA) - The next revolution of Corporate Functions. P. 12. Online: https://www.capgemini.com/consulting-fr/wp-content/uploads/sites/31/2017/08/robotic_process_automation_the_next_revolution_of_corporate_functions_0.pdf [Last accessed: 20.05.2018]

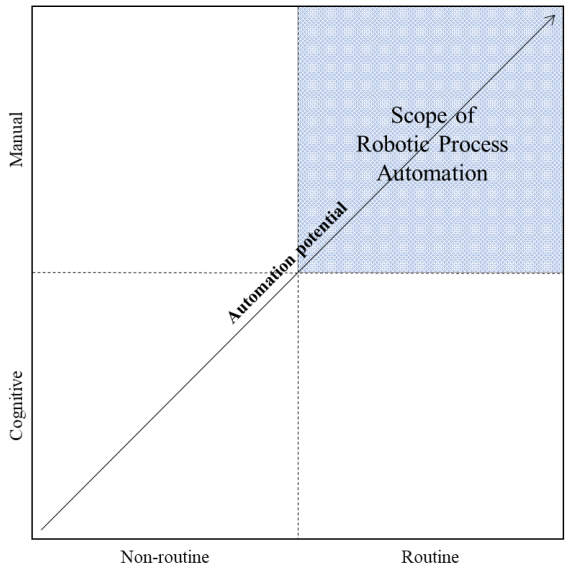

Figure 1: Automation potential of tasks (adapted from Penttinen/ Asatiani (2016))

Additionally, what type of data is going to be processed needs to be considered. Structured data is any kind of data which resides in a certain field within a file. Often these data sets are consisting of columns and rows, for instance, inventory lists saved in a MS Excel document. This type of data is relatively easy to handle and to analyse, it does not require any special sub-technology. However, unstructured data which is necessary for companies to deal with in certain processes because they give a deeper insight into customer's requirements and product characteristics or just are an integral part of the process[67], demand a more complex approach. Unstructured data such as an e-mail also plays an important role in areas like the supplier relationship management. If process automation in these areas is desired, additional technological support is required, for the robot to be able to read and manage these document types, Optical Character Recognition (OCR) would be compulsory to ensure machine readability.[68]

Furthermore, it needs to be evaluated whether the processes in mind contain many possible business exceptions. An illustrative example for this case would be the handling of financial transactions where the robot is intended to handle and process only transaction below a certain amount, 1.000€ for instance. The reason for this could be that the company management wants every transaction above 1.000€ to be checked in accordance with the principle of dual control.

[67] Cf. Vijayan, Jaikumar: Solving the Unstructured Data Challenge. Online: https://www.cio.com/article/2941015/big-data/solving-the-unstructured-data-challenge.html [Last accessed: 19.05.2018]
[68] Cf. Eikvil, Line (1993): OCR - Optical Character Recognition. Oslo: Norsk Regnesentral. P. 4-7

The robot would then be designed to follow this rule and if it comes across a transaction of 2.000€ it would recognise the exception and report it to a human employee.[69] It needs to be decided whether it is efficient to let the robot take over this transaction handling if exceptions occur regularly or if it should stay completely in human control. The smaller the number of exceptions the higher is the effectiveness of an RPA robot.

The design and implementation phase of an RPA solution is rather short due to the non-complex setup and non-invasiveness. However, prior to the decision whether a process is suitable, it needs to be considered if the applications which RPA is supposed to deal with are likely to have regular wide-ranging updates and changes.[70] If the layout, including tabs and commands of an application, changes it will result in the requirement of the adaption of the robot as it is only trained to follow specific steps. An implementation might not be recommended if underlying software changes frequently or the process itself is being adapted often since this will result in high adaption costs and longer down-time periods. Down-time of a robot will mean that an employee needs to take back over the process which could result in an even higher failure rate as before of the RPA implementation since the employee has not been carrying out the task for a while and first needs to acquaint himself again.

RPA will, as stated before, only follow pre-defined rules as a digital workforce. Thus, managers should not expect the technology to fix a broken or inefficient process. It is crucial, that the sub-process flow itself has been optimised in advance to the best level possible.[71]

In some processes it is not feasible to implement a robot for the execution of processes as there might be regulatory restrictions, either by law or by the organisations compliance principles. Internal regulations would first need to be adapted which could go along with a long processing time and intensive discussion with the works council.

To conclude, these aspects which should be considered before deciding about the implementation of RPA in a specific process can be portraited in the following assessment framework (see *Table 1*). Answering a question with a "no" does not necessarily mean that the process is not suitable for an RPA solution but rather that higher costs and complexity go along with the implementation or process adaptions in advance are recommended.

[69] Cf. Behrens, Kati (2014): Handling Errors: Can You Trust A Robot? UiPath. Online: https://www.uipath.com/blog/handling-errors-can-you-trust-a-robot [Last accessed: 20.05.2018]
[70] Cf. Capgemini Consulting (2016): loc. cit. P. 12
[71] Cf. Jalonen, Helge (2017): Assessing Robotic Process Automation Potential. Tampere University of Technology. P. 56 et seqq.

Question	Yes / No
1. Is the process rules-based and does not require human valuation?	Y / N
2. Is the process repetitive enough?	Y / N
2.1. If not, can the number of process run-throughs be increased significantly by using a robot?	Y / N
2.2. If not, can a high risk due to human error be eliminated by using a robot?	Y / N
3. Is all data readable by a machine?	Y / N
4. Can the process be executed by a robot without many business exceptions?	Y / N
5. Are the applications within the process unlikely to have significant updates?	Y / N
6. Is the process following the best workflow possible?	Y / N
7. Can the process be carried out by a robot without breaking regulations?	Y / N

Table 1: RPA - Process Assessment Framework (Own creation)

Once a process has been selected and the documentation of the process including all involved systems and applications, requirements and exceptions have been finished, the next step is to decide which RPA vendor to select.

There are different RPA solution providers offering a wide range of functionalities and cost-models. In accordance to the company's idea of the automation, the robot can be either programmed in a complex way using code or build via a visual drag and drop method looking like a flow process chart. This low-complex programming method became part of most of the big vendor's offers.[72]

Among the best-known RPA providers are Pegasystems, Bluepond, Redwood, Blue Prism, Automation Anywhere and UiPath. Pricing models differ mainly between license fees per robot per year and per executed process of the robot.[73] Besides the criteria of the pricing model and the total cost of ownership which includes not only the ongoing fees but also the setup and maintenance costs, companies need to prepare other criteria for an objective provider assessment to identify the best-fit. Due to the disruptive times companies might only plan to implement a low number of bots in the beginning. However, possible future developments should be

[72] Cf. Tripathi, Alok Mani (2018): Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool – UiPath. Birmingham: Packt Publishing Ltd. P. 17-22

[73] Cf. Business Wire (2018): Redwood Software Announces First Industry Robotic Licensing Model to Revolutionize Transparent Marketplace Pricing. Online: https://www.businesswire.com/news/home/20180322005108/en/Redwood-Software-Announces-Industry-Robotic-Licensing-Model [Last accessed: 05.05.2018]

considered before choosing a solution. While some only have a small setup-fee, others have a higher one but in case of scaling-up additional bots are a lot cheaper.[74]
The assessment criteria can also be dependent to the internal expertise within the company. The use and control complexity go along with training if necessary, only a few of the vendors offer hands-on training and material for free, others provide online material such as virtual classrooms and community forums or blogs.[75]

Furthermore, RPA bots differ in concerning factors like (data) security. It might be important for an organisation, especially if it is involved in the public service sector that the vendor is Europe-based and additionally, that the solution is not cloud-based. All providers are strong in different industries, while Redwood is strong in finance and SAP architecture, Blue Prism is strong in healthcare and telecommunication[76], and Pegasystems is well-known in the customer relationship management. UiPath, Automation Anywhere and Blue Prism are likely the most experienced providers; all three companies started with RPA in the early 2000s and have a wide range of selected partners in the consultancy area.[77] [78] [79] Moreover, Everest Group, a management consulting firm, lists all three in their 2018 assessment of RPA vendors as leaders having a very high market impact, vision and capability score.[80] Once the organisation has implemented a virtual bot workforce, it is vital to measure and analyse their performance as well as the ROI. Therefore, it should be part of the decision criteria whether a service tool includes proper dashboards to allow appropriate governance control including an easy to control graphical user interface.
In a Capgemini Consulting survey from 2016, 86 per cent of the participants (strongly) agreed that RPA can significantly reduce costs[81] and Leslie Willcocks, professor of technology, work, and globalization at the London School of Economics' Department of Management, said in an interview with McKinsey that the return on investment varied between 16 to 200 per cent in the

[74] Cf. AppliedAI (2018): Robotic Process Automation Comprehensive Guide. Whitepaper
[75] Cf. ibid.
[76] Cf. Tripathi, Alok Mani (2018): loc. cit. P. 18
[77] Cf. UiPath: Strategic Partners. Online: https://www.uipath.com/partners [Last accessed: 05.05.2018]
[78] Cf. Automation Anywhere: Our partners. Online: https://www.automationanywhere.com/partners [Last accessed: 05.05.2018]
[79] Cf. Blue Prism: Blue Prism Partner Alliances. Online: https://www.blueprism.com/partners [Last accessed: 05.05.2018]
[80] Cf. Everest Group (2018): Robotic Process Automation (RPA) – Technology Vendor Landscape with Products PEAK Matrix Assessment 2018. P. 10
[81] Cf. Capgemini Consulting (2016): Robotic Process Automation - Robots conquer business processes in back offices. P. 30

first year after implementation in sixteen case studies they undertook.[82] How high the costs are in particular depends certainly to the vendor which has been chosen and its pricing model as they differ mainly from price per executed processes and price per robot. According to The Economist, the annual costs for a robot from Blue Prism costs at most $15.000 a year.[83] However, this does not include the costs of the planning phase, the process reengineering and the change management. Adding these factors into the cost calculation, companies must calculate with total costs of $20 million for 500 implemented bots, equal to $40.000 per bot.[84] Most of all RPA vendors offer a free test-trial to allow enterprises an insight on how well the solution fits to their expectations.

3.1.2. Artificial Intelligence

While RPA handles business process exceptions by forwarding them to a human employee, AI can also process these exceptions since the technology aims to simulate human's decision making and thinking. In the planning phase of implementing AI it is crucial that expectations are set correctly from the beginning. It is a buzzword being around for years, fears and hopes have been discussed many times which leads to executive managers having wrong thoughts of what the technology actually can do today and tomorrow. One day it might be the case that it will take over major parts of business departments and bring everyone from A to B in smart, autonomous-driving cars but currently it is most efficient in data analysis and visualisation.[85] Thus, the decision-making process relying on data benefits the most out of it as it allows it to analyse enormous data sets (big data) which otherwise would not be feasible for a human-being.
Before starting the planning phase, it should be decided upon what the reason for implementing AI is. There are three different possible ways of extracting value from AI, disregarding a possible fourth reason which is based only on the purpose of marketing benefits due to the attracting of attention.[86]

[82] Cf. Willcocks, Leslie (2017): The value of robotic process automation. Online: https://www.mckinsey.com/industries/financial-services/our-insights/the-value-of-robotic-process-automation [Last accessed: 21.05.2018]
[83] Cf. The Economist (2013): Rise of the software machines. Online: https://www.economist.com/special-report/2013/01/19/rise-of-the-software-machines [Last accessed: 21.05.2018]
[84] Cf. Walker, Richard (2016): Robotic Process Automation Slashes IT Costs, Alleviates Complexity. Online: http://deloitte.wsj.com/cio/2016/07/06/robotic-process-automation-slashes-it-costs-alleviates-complexity/ [Last accessed: 21.05.2018]
[85] Cf. Burgess, Andrew (2018): loc. cit. P. 23
[86] Cf. ibid.

1. Improving/ supporting existing processes by making them more precise, efficient and faster. In the HR department of companies, a big share of the time is spent with the filtering of CVs in the recruitment process. CVs have to be checked whether they fulfil pre-defined criteria and match the expectations and requirements, a commonly used practice already.[87] In Supply Chain the procurement function can be supported by an improved demand forecasting process. AI allows not only the integration of history-based data but also of real-time data and external factors such as weather, market trends and social media posts.[88] Here AI only supports the human judgement and carried-out tasks but does not change the actual sequence of sub-processes.

2. Changing business processes and/or the business function by a transformation which influences how work was prior defined. A field of implementation can be the use of a chatbot in the indirect procurement. Purchase requisitions are usually subject to certain requirements/ prerequisites.[89] The chatbot questions the reasons for the requisition, checks the compliance by asking questions and then decides if the requisition should be forwarded to a purchaser for the actual order handling. The advantage of this change lies in the minimised costs as well as the maximised availability. Tasks are sometimes taken over automatically and close cooperation with the employees can be guaranteed. In addition, the final decision-making power and supervision remain in the hands of the staff.

3. The most intensive use of AI can be to design new products, services, or entire businesses where the technology represents its core. To refer to the example of a chatbot before, in this case it would be the offering of a whole chatbot as a service to clients for the use of promoting customer loyalty. MAGGI partnered up with Mercury.ai, an intelligent chatbot agent provider, to develop "Kim".[90] Kim, standing for Kitchen Intelligence (by) MAGGI, allows consumers to chat with the virtual agent to find the best recipe considering their personal taste, preferences, allergies and products in their fridge.

[87] Cf. Resume Genius (2014): Beat the Applicant Tracking Systems (ATS): How to Survive Résumé Reading Robots. Online: https://resumegenius.com/blog/applicant-tracking-systems-resume-keyword-help. [Last accessed: 23.05.2018]
[88] Cf. Chase, Charles W. (2013): loc. cit. P.24-32
[89] Cf. Prabhu, Pramod (24.04.2018): Guide to Big Data Procurement-How to Leverage Modern Technologies to Gain Control Over Indirect Spend. Webinar.
[90] Cf. MAGGI (2017): Hallo Kim – der MAGGI Chatbot ist da! Online: https://www.maggi.de/artikel/chatbot-kim [Last accessed: 23.05.2018]

Thus, it is important to determine in the early planning stage for what reason the enterprise wants to implement the technology as this will cause different effects on costs, change management and maybe even the business strategy itself. As seen in the examples above, unstructured data often plays a key-role in the cases since AI allows the processing of them. Structured data, especially important in the data analysis and visualisation for supporting reasons of a business functions, should not undervalued. To be chosen for a successful implementation, a process requires not only extensive data sets but also that the data quality is on a high level. As decisions will rely on them, poor master data quality would result in unsatisfying outputs and higher costs since this would have to be fixed first.[91] Due to the fact that AI solutions usually do not provide an audit trail which would allow employees to understand the exact reasons for a decision, companies have to choose a process with not only a very good data basis but one where it is acceptable that steps are not just followed the way RPA does but possibly change. The core of Machine Learning is its ability to evolve over the time with an increasing number of gone-through cases, this additionally means that it does not follow a standardised track but rather changes it the way it classifies it as correct. Thus, the process output is not certain and cannot be predicted which goes along with a risk the company has to run and need to find a solution for how it can in the end still ensure that the business cannot be harmed in any way by it.[92]

Moreover, due to the high complexity and named importance of the management and monitoring of the technology the company should have internal expertise on how the solution is built and how to handle it in case of demand for action. In many cases enterprises rely on the expertise and support of consulting firms to successfully implement and digitally transform the business function, however, after the consultants have left expertise needs to stay. Therefore, it should already be considered in the planning phase who will be responsible for keeping this know-how, how to train and empower AI-savvy employees.[93] This includes the early integration of the IT-department into the planning since systems need to have interfaces allowing a frictionless interaction between applications.

For the reason that it requires the involvement of such a large number of stakeholders and that the holistic risk cannot be totally revealed it is recommended to start off with a small pilot project bearing only a limited amount of risk before investing in a bigger change. Thus, management

[91] Cf. Burgess, Andrew (2018): loc. cit. P. 96
[92] Cf. Negahban, Nima (2018): It May Soon Be Everywhere, But AI Needs Audit Trails. Online: https://www.rtinsights.com/it-may-soon-be-everywhere-but-ai-needs-audit-trails [Last accessed: 23.05.2018]
[93] Cf. Ross, Jeanne (2017): The Fundamental Flaw in AI Implementation. Online: https://sloanreview.mit.edu/article/the-fundamental-flaw-in-ai-implementation/ [Last accessed: 23.05.2018]

should limit the amount of possible areas of deployment and rather focus on one which is the most auspicious and least risky.

3.2. Implementation phase

The implementation phase goes along with several costs which are included in the total cost of ownership (TCO). For a company it is an important model to determine whether an investment should be done or not.[94] If calculated properly the TCO provides an overview of the scale of the overall costs including not only the one-time setup costs but also the ongoing costs such as annual fees, training, management and support costs.[95]
Additionally, the costs would increase significantly if external help from a consultancy firm is requested. However, it can have vital benefits of involving advisors as often they had several RPA and AI project experiences in the past and know how to design and implement the solution in the best and frictionless matter. If the implementation phase is not executed smoothly it could result in downtime of affected process which in most cases goes along with enormous expenses or even a loss of reputation and customer dissatisfaction. Furthermore, consultants are experts on the topic of change management[96] which is crucial in the field of new digital technologies. It not only needs to be communicated in a proper manner to the staff that the work they have done for the past years is going to change but also, they need to be trained appropriately to be ready for new and different tasks. Training does not only involve seminars, often being carried out online or in schooling rooms, but also on-site support.

The implementation of RPA starting from the planning phase to the final roll-out is feasible for complex processes within a couple of months according to Accenture.[97] However, PwC published a survey with the finding that a successful implementation of RPA takes time. 18 Danish enterprises which had implemented the technology participated in the survey in 2017.[98] Three of them stated they were not using any external assistance while one of them said this decision resulted in a long delay of implementation while another reported that they noticed only

[94] Cf. Ellram, Lisa/ Siferd, Sue (1998): Total cost of ownership: A key concept in strategic cost management decisions. In: Journal of Business Logistics, Vol. 19, No. 1, P. 55-84
[95] Cf. Gartner: Total Cost of Ownership https://www.gartner.com/it-glossary/total-cost-of-ownership-tco [Last accessed: 21.05.2018]
[96] Cf. Zahn, David (2004): Quintessential Guide to Using Consultants. Amherst: HR Press, Inc. P. 34-39
[97] Cf. Neelis, Niels (2017): Robotic Process Automation: 4 Huge Benefits for Businesses. Online: https://www.accenture-insights.nl/en-us/articles/how-rpa-improves-our-performance [Last accessed: 21.05.2018]
[98] Cf. PwC (2017): Successful implementation of RPA takes time

in the middle of the process that their initial set-up strategy was not feasible. The study recommended companies to partner up with other organisations who also plan to go for a digital transformation and if one decides to seek help from advisors it should be made sure that the decision of an RPA vendor is independent to an existing partnership between them.
Regarding the change management, the survey concluded all enterprises were aware of its importance and paid attention right from the start to not let it become underestimated. Two topics should be considered as early as possible if the process should be as effective as possible:
1. "A targeted effort aimed at handling the employees is essential for success"[99]
2. "Lacking or late buy-in from executive management may slow down the implementation process"[100]
Employees might be sceptical, uncertain or even ignorant when it comes to new technologies taking over tasks and consequently, it is crucial to ensure transparency.

Implementing AI is different to what it is with RPA, alone for the broadness of the technology and as it is rather an umbrella term for several smaller technologies such as NLP and picture recognition but also the analysis of structured and unstructured data. Therefore, it is impossible to say how long it takes to implement "AI" because it depends on what exactly you are planning to implement. On the market there are many standard software solutions which cover a small field of possibilities. IBM offers the IBM Watson Visual Recognition tool[101] allowing companies to customise iOS apps to their demands by analysing and categorising pictures. Furthermore, you can do that without any knowledge about coding within days.
Concerning ERP systems and the digital transformation within companies regarding their supply chain, SAP released SAP Leonardo. It aims to support this digital transformation by being connected to the SAP Cloud Platform and offering a portfolio of dedicated solutions in the area of IoT, Blockchain, ML and big data analytics.[102] The Machine Learning field promises to "[u]nlock knowledge from structured and unstructured data […]. With the help of easy-to-use application programming interfaces (APIs), you can use the foundation to enable intelligent enterprise applications."[103] It includes, besides ready-to-use applications also the capability to develop own tools for the mentioned purposes.

[99] Ibid. P. 17
[100] Ibid.
[101] Cf. IBM: Visual Recognition. Online: https://www.ibm.com/watson/services/visual-recognition/ [Last accessed: 23.05.2018]
[102] Cf. SAP: SAP Leonardo. Online: https://www.sap.com/germany/products/leonardo.html [Last accessed: 23.05.2018]
[103] Cf. SAP: SAP Leonardo Machine Learning Foundation. Online: https://www.sap.com/uk/products/machine-learning-foundation.html [Last accessed: 23.05.2018]

The implementation of AI within an organisation can therefore happen in a short-time period, however, only if it is a standard solution. A possibility which does not exist for RPA since that would just not be feasible as each bot needs to be individualised. One can say that in many data analysis cases AI is already quite far on the development-curve. However, if a solution is requested that not only analyses big data but also uses it for optimising and controlling other business processes or for connecting with other technologies on-site such as drones or tugger trains, an individual planning-developing-implementing-process is necessary. This can take several months and longer for complex projects.[104] This approach comes with the highest flexibility and control over the characteristics and features but also means high costs as well as necessary increased effort because own data scientists and developers are required. The early integration of affected employees and ensuring of high transparency is even more important than with RPA as AI cannot only take over rules-based but also over cognitive tasks.[105]

An advisable approach of the software development is the agile software development. Agile is based on four different values which are mentioned in the Manifesto for Agile Software Development:

"*Individuals and interactions* over processes and tools
Working software over comprehensive documentation
Customer collaboration over contract negotiation
Responding to change over following a plan"[106]

This method differentiates itself from the classical waterfall method by the fact that requirements and the solution evolve during the project phase. It relies on a close cooperation and coordination between the system developer and the client based on continuous feedback loops, allowing fast adaptations if necessary.[107] This is especially important in case the process has to be changed or new influence factors come up. It is therefore associated with increased flexibility, since one is not bound by a rigid structure.

[104] Cf. Marvin, Rob (2017): 5 Steps to Adopt Artificial Intelligence in Your Business. Online: http://uk.pcmag.com/feature/87232/5-steps-to-adopt-artificial-intelligence-in-your-business [Last accessed: 23.05.2018]
[105] Cf. Wisskirchen, Gerlind et al. (2017): Artificial Intelligence and Robotics and Their Impact on the Workplace. IBA Global Employment Institute. P. 13-14
[106] Beck, Kent et al. (2001): Manifesto for Agile Software Development. Online: http://agilemanifesto.org/ [Last accessed: 21.05.2018]
[107] Cf. Götzenauer, Jürgen (2009): Agile Methoden in der Softwareentwicklung: Vergleich und Evaluierung. Norderstedt: GRIN Verlag. P. 28

Agile also differentiates itself by a specific set of roles involved in the development teams which are necessary for a successful roll-out of RPA/ AI.[108] Clearly, a process expert is needed, one is responsible for identifying and describing the process. The expert knows the characteristic features and is responsible for the knowledge sharing. The Scrum Master is the Project Manager, he should have expertise regarding the process but focus on managing the communication between all individuals from the planning phase to the final phase. The RPA or AI business analysist knows also the business requirements but additionally understands how the technologies work and what their requirements are, the role involves additionally the responsibility to identify automation potential. The developer creates the workflow and solution hand-in-hand with the solution architect who in turn connects the business analysist and the developer. Hence, a process controller is responsible for monitoring the bots proper functioning and capacity, prepares reports if required.[109]

To conclude, it can be said that several steps need to be followed on the road to a successful roll-out of both technologies. First, processes need to be selected which contain a theoretical improvement potential. These processes should then be prioritised and afterwards evaluated regarding their suitability, feasibility and complexity, for an RPA implementation the assessment framework can be used. It is unlikely that the process which has been chosen is already standardised enough and no changes have to be done, therefore, the process should be redesigned to improve the process workflow and standardisation in the best way possible. After it has been re-designed, the requirements need to be defined. This step includes a detailed step-by-step documentation covering not only the tasks to be executed but also all systems, applications and users involved, risks and regulations to be adhered. A gapless and comprehensive process documentation is the most vital step as the following development is based and entirely reliant upon it. The software solution is programmed to follow exactly the protocol and rules given, an autonomous deviation is not going to take place. Once the robot has been programmed, the second last process contains the testing or better known as the beta-phase in which possible software bugs or undesired patterns can be eliminated before the final roll-out. In the last step, the actual roll-out, it is crucial that the robot is still monitored for possible errors but also that the staff is trained and skilled enough to ensure a flawless management of and interaction with the robot.[110]

[108] Cf. Moayed, Vargha (2017): From pilot to full scale RPA deployment. P. 11
[109] Cf. ibid.
[110] Cf. ibid. P. 15

3.3. Impact

3.3.1. Impact on processes

When Seyfarth Shaw, a full service legal firm, conducted a survey in 2018 to find out how companies adapt to the changing environment due to the digitisation and asked 193 participants with leading positions "[…] which area of [their] business is most likely to be impacted by advances in robotics, including automation and AI, in the next five years?"[111] 62 per cent answered it will most likely affect business operations and processes.

Both, RPA and automation through AI, have the cost reduction and strict adherence of compliance in the core of their concepts.[112] Cost reduction can be achieved through tackling the 7+x wastes of the Lean philosophy which include motion/movement, inventory, not meeting customer requirements, transportation, waiting time, overproduction, over-processing, defects, skills/talent and energy.[113]

McKesson Corporation, a leading healthcare company listed in the Fortune 500, faced the challenge that in their procurement function 58,6 per cent of the affected employees stated they spend one to three hours a week looking for basic supplier contracts.[114] According to internal interviews this is caused by several contract repositories spread across the company, a complex legal contract screening process and an absence of efficient supporting technology. McKesson decided to implement the Discovery and Analytics Platform from Seal Software. The software solution allows collecting and aggregating all contracts in different document types such as PDFs, Images or Word files in a secure database, also, it analyses them regarding revenue opportunities, costs and legal clauses using AI. Procurement staff is therefore able to search for contracts fulfilling specific characteristics within a fraction of the time. The use case states that it forecasted a 75 per cent reduction in time of finding contracts by shortening the time to 15 to 20 minutes a week resulting in an estimated saving realisation of 80 per cent.[115]

This use case demonstrates the effectiveness of automating data analysation and handling while creating an interface between the digital and the human workforce. Processes are not only executed a lot faster but also AI allows the generation of deeper insights resulting in enhanced

[111] Seyfarth Shaw LLP (2018): 2018 Future Enterprise - Survey Results. P. 3
[112] Cf. Burgess, Andrew (2018): loc. cit. P. 78
[113] Cf. Ivanov, Dmitry/ Tsipoulanidis, Alexander/ Schönberger, Jörn (2016): Global Supply Chain and Operations Management: A Decision-Oriented Introduction to the Creation of Value. Springer International Publishing. P. 267-268
[114] Cf. Seal Software (2015): McKesson: Increasing Contract Visibility and Insight with Seal – Case Study. Online: https://www.seal-software.com/sites/default/files/Seal-Case-Study-McKesson.pdf [Last accessed: 27.05.2018]
[115] Cf. ibid.

quality outputs and risk minimisation. Especially the fast-evolving e-commerce industry is reliant on deep insights about the customer and his behaviour as well as interests. Otto, a famous German e-commerce retailer, found out that consumers are less likely to return their ordered products if they had arrived within two days after they placed the order online.[116] If the shipment takes longer than two days the likeliness of the customer seeing the product in stores for a cheaper price increases resulting in him buying it there and returning the ordered product. Additionally, consumers do not like several packages arriving on different dates and prefer one single package including all ordered products instead. Matching these two interests was a main challenge for Otto since often products are not stored in own warehouses but are shipped directly from the manufacturer to the end-consumer. The Otto Group invested in Blue Yonder[117], a start-up offering an AI-based demand forecast and replenishment solution, allowing the company to forecast which products are going to be sold within the next month with a 90 per cent accuracy and the software also automatically orders these identified items without any human support. The impact of the AI implementation was a 20 per cent reduction of surplus stock (inventory waste) and a reduction of returns by over 2 million each year (transportation waste).[118]

Looking at these case studies and findings, automation has high potentials especially in optimising procurement, inventory management and risk tackling in general as understanding existing data is a key to minimising risk. Improving the understanding of customer's needs and wants by analysing the data he creates is one of the main goals which enterprises need to achieve if they want to become and stay successful.[119] Thus, the challenge of many organisations is to analyse big data in an appropriate way like Otto did but at the same time to prevent a public firestorm of people being furious about invading their privacy. In 2012, a news headline led to a public discussion about whether Target, one of the biggest retailers of the USA, went over the top with their analyses.[120]

[116] Cf. The Economist (2017): Automatic for the people: How Germany's Otto uses artificial intelligence. Online: https://www.economist.com/business/2017/04/12/how-germanys-otto-uses-artificial-intelligence [Last accessed: 27.05.2018]
[117] Cf. Otto Group: Blue Yonder. Online: https://www.ottogroup.com/de/die-otto-group/konzernfirmen/blue-yonder.php [Last accessed: 27.05.2018]
[118] Cf. The Economist (2017): loc. cit.
[119] Cf. Camilleri, Mark (2017): Travel Marketing, Tourism Economics and the Airline Product: An Introduction to Theory and Practice. Cham: Springer International Publishing. P. 29
[120] Cf. Hill, Kashmir (2012): How Target Figured Out A Teen Girl Was Pregnant Before Her Father Did. Online: https://www.forbes.com/sites/kashmirhill/2012/02/16/how-target-figured-out-a-teen-girl-was-pregnant-before-her-father-did/#707d7a796668 [Last accessed: 27.05.2018]

A teenage girl in high school received coupons for baby items from Target according to her "pregnancy score"[121], a score which is based on her shopping behaviour in the past and connected prediction that she is very likely to be pregnant. When the father of the girl saw these coupons without yet knowing about his daughter being pregnant he became outraged, only later he found out that Target's prediction was indeed correct and apologised. However, the discussion about whether a company should be allowed to collect such personal data or not had been started and led to a PR misadventure for Target in the end.[122]

This case highlights the importance of ethical and social control functions when implementing process automation. Managers will need to focus on personal judgments which cannot be done by software solutions. The sense for a right business and project strategy involving not exclusively factors of costs and revenue but also regarding sustainability, moralities and emotions cannot be integrated in non-human systems.[123]

[121] Ibid.
[122] Cf. Duhigg, Charles (19.02.2012): Psst, You in Aisle 5. New York Times. P. MM30
[123] Cf. Kolbjørnsrud, Vegard/ Amico, Richard/ Thomas, Robert (2016): Leadership Development - How Artificial Intelligence Will Redefine Management. In: Harvard Business Review. P. 4-6

3.3.2. Impact on workforce

The impact of automation on the workforce whether it is done through "intelligent" or rules-based automation has been causing heated discussions for a long time. While many employees fear a significant reduction of jobs, their very own jobs, many experts say it will rather result in a change of how jobs are performed but not lead to mass-unemployment.[124] Considering the history of the technological revolutions briefly explained in the beginning of this paper and as well its effects on employment, the discussion about fearing unemployment is not a new one.
When William Lee, an English cleric, developed the first stocking frame knitting machine in 1589 in hope to relieve women from the hard work and presented it to Queen Elizabeth I in hope to receive a patent she told him "Thou aimest high, Master Lee. Consider thou what the invention could do to my poor subjects. It would assuredly bring to them ruin by depriving them of employment, thus making them beggars"[125]. Since automation has always been coming along with fear, what has changed, is the speed of how quick new technologies are developed and adapted by consumers.[126] Thus, despite the trend of a continuous automation in history Keynes emphasised already in 1933 that the pace of economising labour can outrun the speed on how quick new jobs are created and respectively are being adapted.[127] The challenge we face is that with an increasing speed of new technologies taking over we have to be even faster with taking adjustments on the labour market and education.[128] Beaudry et al. published in a 2013 research that the demand for skills drops while the amount of highly educated employees seeking jobs continuously increases.[129] However, there are also experts which see the potential for the workforce by implementing AI in a rather positive way.
Accenture forecasted that higher investments in the technologies will not only boost revenues but also employment. They predicted in the time between 2018 and 2022 a positive change of employment in all industries by 10 per cent, in telecommunications even an increase by 21 per

[124] Cf. Pastor, Alfredo/ Dupree, Bartolomé Mercadal (2016): Future-proofing Your Job From Robots: Technology & Employment. IESE Insight, No. 31, 4th Quarter 2016. P. 15-23
[125] Queen Elizabeth I. Cited in: Acemoglu, Daron/ Robinson, James (2012): Why nations fail: The origins of power, prosperity, and poverty. New York: Crown. 1st Ed. P. 182
[126] Cf. McGrath, Rita (2013): The Pace of Technology Adoption is Speeding Up. Online: https://hbr.org/2013/11/the-pace-of-technology-adoption-is-speeding-up [Last accessed: 24.05.2018]
[127] Cf. Keynes, John (1930). Economic Possibilities for Our Grandchildren. In Essays in Persuasion [1963], New York: W.W. Norton. P. 360–361
[128] Cf. Brynjolfsson, Erik/ McAfee, Andrew (2011): Race against the machine: How the digital revolution is accelerating innovation, driving productivity, and irreversibly transforming employment and the economy. Digital Frontier Press Lexington
[129] Cf. Beaudry, Paul/ Green, David/ Sand, Ben (2013): The great reversal in the demand for skill and cognitive tasks. Tech. Rep., NBER Working Paper No. 18901, National Bureau of Economic Research

cent (see *Appendix 1*).[130] Deloitte openly states their findings conclude that 30 per cent of today's jobs in London are at high risk of disappearing within the next two decades caused by the up rise of technology[131]. Especially facing high risks are office jobs and administrative work since these can be automated without a lot of effort. PwC is a lot more conservative with their predictions. Focusing on a shorter time frame, they state that between 2018 and 2020 only 3 per cent of jobs worldwide are at potential high risk.[132] Simultaneously, the firm claims that 45 per cent of work activities can be automated leading to savings of $2 trillion in global workforce costs.[133] To harmonise these two different perceptions, they and all other major consultancies say employers have to focus on reskilling their workers and create new job possibilities which partly goes along with the implementation of the new technologies anyway.[134]

Employees will need to obtain new skillsets due to the fact that simple and repetitive tasks will be taken over by automation technologies.[135] The development of decreasing numbers of physical workers and increasing controlling jobs can be seen in factories for years already. In order to continuously support this trend, it is required to invest in education and training.[136] As interfaces between humans and robots will increase, it will become more important to develop a sufficient analytical and technical understanding. This will also be crucial because employees "should be able to form a unit with supporting machines and algorithms"[137] which requires a basic understanding of how these technologies work according to the IBA Global Employment Institute. It will not only be the case that AI and RPA support the own work but as well it will become necessary to control the technologies and to supervise their output. Furthermore, the interfaces between human and machine/ software need to be coordinated which additionally requires more social and interdisciplinary competence.[138] As AI is effective with data analysis but not with creativity employers will change their eyesight from workers with extensive

[130] Cf. Accenture (2017): Reworking the Revolution – Future Workforce. P. 6
[131] Cf. Deloitte (2014): London Futures- Agiletown: the relentless march of technology and London's response. P.5
[132] Cf. PwC (2018): AI will impact employers before it impacts employment. Online: https://www.pwc.com/us/en/services/consulting/library/artificial-intelligence-predictions/employer-impact.html [Last accessed: 24.05.2018]
[133] Cf. PwC (2016): Organize your future with robotic process automation. P. 2
[134] Cf. ibid.
[135] Cf. Eberhard, Birgit et al. (2017): Smart work: The transformation of the labour market due to the fourth industrial revolution (I4.0). In: International Journal of Business and Economic Sciences Applied Research, Vol. 10, No. 47-66 P. 53
[136] Cf. Kuhn, Johannes (2015): Automatisierung und Arbeitslosigkeit – "Bürojobs sind stärker als andere bedroht". Online: http://www.sueddeutsche.de/digital/automatisierung-und-arbeitslosigkeit-buerojobs-sind-staerker-als-andere-bedroht-1.2368344 [Last accessed: 24.05.2018]
[137] Wisskirchen, Gerlind et al. (2017): loc. cit. P. 20
[138] Cf. Bochum, Ulrich (2015): Zukunft der Arbeit in Industrie 4.0. In: Botthof, Alfons/ Hartmann, Ernst (ed.): Gewerkschaftliche Positionen in Bezug auf ‚Industrie 4.0'. Berlin: Springer Verlag. P. 36

knowledge to workers who are able to solve problems and develop ideas in a creative way. Continuous innovations will be vital for enterprises if they strive to rise profits in fast-moving and -evolving times.

Employers will not be able to teach all the required skills especially focusing on analytics and IT themselves. The top management of the biggest enterprises and politicians are aware of this and therefore came to an agreement at the World Economic Forum 2016 that the economy needs to work closer with the government in regard to education aspects. The change will involve dealing with the question of how the world *will be* instead of how it *used to be*.[139] This includes an early focus on acquiring hard skills in the field of IT, sciences and analytics as well as soft skills such as communication, flexibility/ fast adaption, team work and assertiveness. Brynjolfsson and McAfee see the duty of teaching these skills on the part of schools and universities.[140]

According to Accenture, workers are "impatient to work with AI"[141], 45 per cent say that the technology will help them to become more efficient at work, 34 per cent state they feel already very confident in their skills to work with it and 62 per cent believe AI will have a positive impact on their job.[142]

[139] Cf. Knop, Carsten (2016): Das ist die größte Herausforderung der Digitalisierung. Online: http://www.faz.net/aktuell/wirtschaft/weltwirtschaftsforum/weltwirtschaftsforum-in-davos-das-ist-die-groesste-herausforderung-der-digitalisierung-14031777.html [Last accessed: 24.05.2018]

[140] Cf. Brynjolfsson, Erik/ McAfee, Andrew (2014): The Second Machine Age. Kulmbach: Börsenmedien. P. 225-245

[141] Accenture (2017): loc. cit. P. 9

[142] Cf. ibid.

4. Empirical study (expert interviews)

After examining the widely held perception in the literature and looking at the researched impacts of both technologies on processes and the workforce, the following part addresses the question of the thesis by incorporating practical knowledge. This is done through the methodology of conducting expert interviews as explained in the beginning. Firstly, the approach and procedure of the interviews are explained prior to evaluating and linking the interviews given in the appendix.

4.1. Approach

4.1.1. Structure

The interviews were conceptualised and structured as guided interviews. Guided interviews have the characteristic that they contain open questions allowing the participant to express their own thoughts and ideas to allow a realistic dialogue.[143] It is the task of the interviewer to begin the interview in an appropriate way by introducing himself and the topic. Also, it is one's obligation to control the development of the interview, by referring to corresponding statements of the expert or requesting explanation in cases of uncertainties. Furthermore, signals and requests of the expert which indicate a need for explanations of terms or concepts and a necessary change of procedure, e.g. after realising upcoming questions have been answered already or do not lead to a satisfying outcome, need to be interpreted correctly and answered by improvisation accordingly.[144]

Hence, it is impossible to have a standardised question catalogue for all interviews. Nevertheless, for the purpose of this paper, the interview structure and the starting point for all interviews were similar and followed the same procedure. Depending on the job position and the industry of the organisation, the key questions of the interviews were adapted if necessary.

[143] Cf. Gläser, Jochen/ Laudel, Grit (2014): Experteninterviews uns qualitative Inhaltsanalyse. Wiesbaden: Verlag für Sozialwissenschaften, 4th Ed., P. 111
[144] Cf. ibid., P. 112

The structure of the expert interviews was oriented on this order-relevant guideline:

1) General personal view on the impact and development of digitisation
2) Overview of in the organisation implemented technologies and their efficiency
3) Holistic view of RPA in the supply chain including chances, risks, requirements, challenges and affected processes
4) Holistic view of AI in the supply chain including chances, risks, requirements, challenges and affected processes
5) Personal interest in implementing these two technologies and outlook

The guideline ensures that the interview does not develop in a drastically different direction than initially planned. Moreover, it guarantees that asked questions are sorted by topics which otherwise would result in a continuous change of subjects and in the loss of the expert's attention, chain of thoughts and will of an informative dialogue. Additionally, the discussion of possible implemented technologies, which was done while looking on a present list of Industry 4.0 relevant digital technologies (including RPA, Machine Learning, AI, 3D-printing, drones, blockchain, chatbots, Data Mining, Process Mining and Webcrawler) allowed creating a shared understanding of definitions of each technology and a reflection on how digitally advanced one's own supply chain is.
Beginning the interview with simple questions about their general view and in the past implemented technologies allows the expert to have a smooth start without jumping straight into complex questions that demand full cognitive work.[145] Afterwards each question will be focused on specific issues and either RPA or AI.

4.1.2. Conduction and analysis strategy

The selection of the right interview partners is essential, as stated they initially need to be experts in the field of supply chain or technology. To decide whether a person has the potential for being an informative expert, one need to have a look on his present and past job experience, if possible his Curriculum Vitae. Access to this information can be gained in most cases by using business-oriented networking services such as LinkedIn or Xing. An expert should have several years of on-job experience in a leading position in the supply chain function, participated in different projects and at least possess basic knowledge about new digital technologies going along with

[145] Cf. ibid., P. 146 et sqq.

Industry 4.0. Thus, their knowledge level and expertise should be far above average of employees working in this area.[146] With a rising number of experts interviewed, the diversity of industries which they are currently working and have experience in should rise. This allows a broader overview of the actual situation, effects, development and a likely future of the RPA and AI technologies.

For the identification of the first experts direct contacts were considered since their willingness of participating was likely to be higher than of unknown individuals. The first contact that has been addressed with the topic of this paper was the division lead of logistics at Minimax GmbH & Co. KG. He was willing to participate for the purpose of providing insight on the topic to the best of his knowledge.

Due to the fact that the author of this paper has been working at PwC in the management consulting area focusing on strategic sourcing, the second person identified was Dr. Norbert F. Fischer, the partner leading the team and also being PwC Head of Procurement EMEA. Since clients' interests in a digital transformation including new technologies have been advancing, several projects the team had faced and proposed were containing equivalent approaches. Dr. Fischer is also participating annually in the Bundesverband Materialwirtschaft, Einkauf und Logistik (BME) symposiums that among other topics broach the issue of rising digital trends in the industry.

To gain access to the perspective and expertise from the technical point of view, Andreas Hufenstuhl, the PwC Lead of Big Data & Advanced Analytics who is also a board member of the working group 'Artificial Intelligence' at *Bitkom* was interviewed for this thesis. Hufenstuhl has managed several projects in the past which included the implementation of AI and other digital technologies.

Additionally, the Senior Supply Network Manager at Georgsmarienhütte GmbH was contacted and asked for an interview. With several years of experience in the consulting industry, as a former director leading supply chain optimisation and restructuring projects which were partly also driven by digital transformation, his expertise was a perfect fit.

To further increase the number of experts and additionally to broaden the received knowledge, the Bundesvereinigung Logistik (BVL) had been contacted, a Germany based supply chain network, to request support in the identification and contacting process. Mr. Tilman Tusk,

[146] Cf. Lackes, Richard/ Siepermann, Markus (2014): Expertenwissen. In: Gabler Wirtschaftslexikon. Springer Gabler Verlag (ed.). Online: https://wirtschaftslexikon.gabler.de/definition/expertenwissen-34831/version-184531 [Last accessed: 16.05.2018]

responsible for Business Development and Market Relations at Magazino, a company developing and manufacturing intelligent robotics for the intralogistics, agreed to share additional insights from a technology provider point of view (for overview *see Table 2*).

Expert	Organisation	Job position
Mr. Volker Knutzen	Minimax GmbH & Co. KG	Division manager logistics
Mr. Dr. Norbert F. Fischer	PricewaterhouseCoopers GmbH	▪ Partner – Strategic Sourcing ▪ Head of Procurement EMEA
Mr. Ingo Schill	Georgsmarienhütte Holding GmbH	Senior Supply Network Manager
Mr. Tilman Tunk	Magazino GmbH	Business Development/ Market Relations
Mr. Andreas Hufenstuhl	▪ PricewaterhouseCoopers GmbH ▪ Bitkom	▪ Director – Big Data & Advanced Analytics ▪ Board member – Working group Artificial Intelligence

Table 2: Overview of interview partners

Each of these identified experts were reached via email, explaining the recent research for the bachelor thesis and interest in conducting an interview with them. Furthermore, a document including the guideline questions which were going to be asked about the business function and their personal views on the future developments was added. By sending them the main questions in advance, they had the possibility to decide whether they feel comfortable enough to participate, whether questions might not go along with their business compliance and data security rules or if it would not be feasible to align it with the governance.

Moreover, the experts were able to prepare answers in beforehand and research if necessary. Hence, thought-through and structured responses were gained. However, a possible negative side-effect as a result of sending the questions in advance could be that the input which will be received might not reflect the actual personal views but rather were influenced by newly-gained knowledge. Even though this thesis is written in English, the interviews were carried out in German particularly with regard to maximise the generated output. The intention was to avoid a limitation on the wording and breadth of information of the experts. This might have been the case if interviews were conducted in the non-everyday language at work. This could also lead to an aversion to the interview which would have resulted in significantly different answers or even a cancellation.

All interviews had a length between 25 to 50 minutes each, were conducted in May and June 2018 via telephone as the interview partners were scattered around Germany and were recorded

in written form. Pitch of voice, pauses, lapsus linguae and linguistic peculiarities such as dialects and personal notes that went beyond the interview or were not intended for publication due to the subject of confidentially were omitted accordingly.

For analysing expert interviews, a single correct method does not exist.[147] Instead, there are several different options on how to proceed after all interviews have been conducted. However, most of the time the summarising content analysis is chosen.[148] As guided interviews include open questions instead of closed which can also differentiate between each interview, possible answers will vary widely. It should also be the objective of the interviewer to receive as many different knowledge insights as possible and to avoid counting how many similar responses were given. Thus, it is not feasible to conduct a quantitative analysis representing the acquisition of knowledge based on the specifically selected interview structure in advance.[149] In fact, it should be the target to cluster given answers and to extract the key points mentioned by each expert to minimise the complexity, creating a summarising output compendium. One method for the content analysis is the approach of an interpretative evaluation strategy by Meuser and Nagel which they recommend in their book about expert interviews (*Table 3*).[150]

1. Transcribing	▪ Creating a written copy of the dialog between the expert and the interviewer
2. Paraphrasing	▪ Structuring parts into individual text sections and reproducing the content in own words (restatement)
3. Sort by topics	▪ Finding keywords and headings ▪ Sorting individual text sections by topics
4. Compare	▪ Comparison of text sections between different interviews ▪ Unifying of the headers and creating of thematic categories
5. Sociological conceptualisation	▪ Comparison of categories with the own knowledge and empirical literature
6. Theoretical generalisation	▪ Including corresponding theories ▪ Individual topics are brought into theoretical context

Table 3: Expert interview analysis approach (Own creation based on Meuser/ Nagel (2009))

[147] Cf. Gadenne, Volker (2001): Wozu sind Hypothesen gut? Zum Prinzip der Offenheit in der qualitativen Sozialforschung. In: Hook, Claudia (ed.), Jahrbuch für kritische Sozialwissenschaft und Philosophie, Methodologie qualitativer Sozialforschung. 1st Ed., Münster: Kontrapunkt. P. 11-26

[148] Cf. Mayring, Philipp (2010): Qualitative Inhaltsanalyse. In: Mey, Günter/ Mruck, Katja (ed.): Handbuch Qualitative Forschung in der Psychologie. Wiesbaden: VS Verlag für Sozialwissenschaften. P. 601 et sqq.

[149] Cf. Meuser, Michael/ Nagel, Ulrike (2009): loc. cit. P. 476

[150] Cf. ibid.

The target of analysing the guided interviews following this approach is to allow comparability and identify similarities or differences between each expert's statements. Moreover, it ensures that a statement can be made about the hypotheses previously set out in the theoretical part. Thus, this systematically approach has been chosen for analysing the conducted interviews.

4.2. Analysis

4.2.1. Chances, risks and derived requirements of the implementation

The paper has identified several issues connected to implementing RPA and AI which have been controversially discussed in the past. With the growing use of AI, fears are increasingly being expressed that jobs could be cut and that machines will gradually replace humans in everyday life. Numerous studies and predictions have been conducted on this topic and come to different conclusions about the impact of automation on the workforce. However, the experts surveyed agreed on this topic. Although RPA and AI will partially replace jobs, the share is small and in return many more jobs will be created according to them. Both Hufenstuhl and Schill point out that automation is not a new topic and has always changed jobs but has never led to mass unemployment.[151] [152] Fischer predicts that new fields of work can be defined for at least 95% of all affected employees. He is aware of criticism being often voiced, which argues that many workers are not able to make such a change. However, he considers this point of view to be clearly too short-sighted since people are capable and willing to learn new things and to adapt; even if this might be tedious.[153]

Thus, some of the traditional activities will be adjusted and others will be fully automated. This will also create new fields of work. Most affected by full-automation are repetitive activities, since these are error-prone if carried out by a human and the change can also contribute to increasing employee satisfaction[154]. By taking over these activities employees have the chance to focus on more interesting fields of work. Schill describes this as "relief for all parties involved"[155] resulting in improved quality of business processes.

Particularly AI will result in the creation of many new jobs. The programming and implementation of the AI solution begins with the need for technical experts on one hand but also for process experts on the other. Those who have the process knowledge and are able to

[151] Cf. Schill, Ingo (17.05.18): Interview. Appendix 2
[152] Cf. Hufenstuhl, Andreas (13.06.18): Interview. Appendix 2
[153] Cf. Fischer, Norbert (11.05.18): Interview. Appendix 2
[154] Cf. ibid.
[155] Schill, Ingo (17.05.18): loc. cit. [Translated]

make constant adjustments to the system if the business environment so requires.[156] However, these are not the only jobs being created. Hufenstuhl refers to Amazon Alexa as an example. Alexa, linked to your Amazon account, is a constantly learning and cloud-based virtual assistant allowing one to gain easy access to online available information, control other smart home devices and place orders.[157] The expert observes that with the introduction of this service, numerous jobs were created, but none were cut. The technology results in an increased need for software developers on one part, but also for physical employees who take care of order processing and delivery, since the function of simplified ordering via virtual assistance increases sales volumes.[158] Nevertheless, he sees some professions as at least partially threatened by AI. Particularly those who require a very academic course of study are affected. The profession of medical doctor and lawyer is cited as an example. The doctor evaluates the patient's symptoms and prescribes an appropriate therapy or medication based on these symptoms. However, this activity can be taken over relatively easily by AI and additionally optimised, since a further data spectrum can be included in the analysis.[159] By contrast, those occupations in which the working environment and general conditions change daily are not threatened. Moreover, emotional jobs such as teaching, and nursing jobs would gain in importance as a human-to-human relationship is required says Hufenstuhl. With the rise of autonomous driving, Hufenstuhl predicts that the logistical department will be affected in particular. Autonomous driving refers not only to cars but also to trucks. However, this does not mean that the truck driver's job will be eliminated in the near future. Rather, the autopilot will control the main part of the route to be driven, but the last mile will be taken over by human beings. This method is comparable to the autopilot in an aircraft. The expert explains this with the fact that the number of variables increases again strongly on the final approach to the destination.[160]

The experts see the transfer of repetitive, rule-based activities to a robot (RPA) as an opportunity to increase process efficiency.[161] [162] [163] Fischer says various positive effects have been recorded in past projects. The robot does not only carry out the work continuously, but also much faster with lower resource requirements. An advantage of this maximised speed is that information and

[156] Cf. Hufenstuhl, Andreas (13.06.18): loc. cit.
[157] Cf. Amazon: Alexa kennenlernen. Online: https://www.amazon.de/b?ie=UTF8&node=12775495031 [Last accessed: 17.06.2018]
[158] Cf. Hufenstuhl, Andreas (13.06.18): loc. cit.
[159] Cf. ibid.
[160] Cf. ibid.
[161] Cf. Fischer, Norbert (11.05.18): loc. cit.
[162] Cf. Knutzen, Volker (04.05.18): Interview. Appendix 2
[163] Cf. Schill, Ingo (17.05.18): loc. cit.

material flow can be brought closer together in time.[164] Above all, however, the experts agree that process quality is being greatly optimised. In contrast to AI, RPA ensures 100 per cent compliance with predefined specifications, as there is no deviation from the process steps.
Schill sees the greatest risk of implementing RPA in the threat to process know-how in the company. Although it is required to have a specialist at the beginning who provides the robot with information on how and why the process is to be carried out and which factors have to be taken into account, this knowledge can quickly be lost. This may lead to a state in which no employee is willing anymore to make changes regarding the process flow to optimise processes because of fear.[165] Therefore, it should be the target of the organisation to maintain process experts ensuring know-how stays within the company and to keep the RPA-process transparent if necessary to adjust it. In contrast to RPA, experts see more risks in AI. Process but also technological know-how is necessary to prevent the AI from evolving in a direction that organisations want to avoid. For Knutzen, the implementation of such a technology would be out of the question if it were only carried out with the help of external consultants. In-house experts must be available.[166]

Fischer sees a greater risk that the technology will be accompanied by an increase in complexity.[167] This is because, unlike RPA, the final result is (partly) unknown and this can mean dangers. Although the purpose of AI is to achieve results which would have been hardly possible or even impossible for humans due to the analysis of such large amount of data, it is necessary to check again at the end whether the result is actually satisfactory or not. Schill shares this perception and says, "Artificial Intelligence should make decisions that I would have made with access to the same information"[168]. However, a control mechanism by a person at the end of the process which is carried out by the AI would also mean that it can only operate to a limited extent. It would only be a partial automation of the process.
However, according to Hufenstuhl, it is not possible to avoid output errors if one wishes full automation being able to unlock further potentials in terms of effectiveness and efficiency. AI often learns by making mistakes, following the logic of Trial-and-Error. The resulting challenge is that companies must be prepared to make mistakes. Only in this way can an increasingly better solution be achieved over time. It is impossible to train the AI in such a way that it acts faultlessly

[164] Cf. ibid.
[165] Cf. ibid.
[166] Cf. Knutzen, Volker (04.05.18): loc. cit.
[167] Cf. Fischer, Norbert (11.05.18): loc. cit.
[168] Schill, Ingo (17.05.18): loc. cit. [Translated]

right from the start.[169] This is because the number of variables is unknown and cannot be covered. If employees are not completely in favour of the technology implementation, the expert does not see the reason for this in them possibly seeing their job threatened or not recognising the advantages of transformation, but rather in them wanting to avoid reputational damage that can result from the output errors.[170]

Furthermore, output errors are best avoided by companies. An early implementation hereby does not take place in many cases and companies often observe digitisation cautiously from the outside. Knutzen states that the technologies must be available in an application-oriented manner and that one does not want to rely on a pilot who is susceptible to errors and thus could theoretically disrupt the supply chain. The technology must "function directly and generate added value"[171]. Consequently, Hufenstuhl clearly contradicts this attitude implying, it would not work out this way. Since digital transformation also involves a learning process which every person and every company have to go through themselves; "standing by and watching does not help much"[172]. Rather, you have to take the risk and make your own experiences, although it is a very big effort in the change process.

Even though, companies will have to accept mistakes, surely the system must have been optimally trained before putting it into operation. It is often the case that this has not been done precisely enough. According to Hufenstuhl, systems have often not been fully developed and are based on incomplete or even incorrect data. It is one of the biggest challenges but as well a requirement that the data is valid.[173] Knutzen agrees seeing one of the greatest challenges here, since it is often the master data quality posing a problem. This is because several functions within the company and external parties such as suppliers and their regulations have an influence on the quality of master data.[174]

In order to address this point, the influenced and the IT department should be involved at an early stage. This is not only necessary for the success of subsequent change management, but also for the need for precise process documentation, both for AI and RPA. The documentation of the process later executed by the robot, which is classified as important in the literature as well as the data basis, is not only confirmed by the experts but is additionally put into the focus

[169] Cf. Hufenstuhl, Andreas (13.06.18): loc. cit.
[170] Cf. ibid.
[171] Knutzen, Volker (04.05.18): loc. cit. [Translated]
[172] Hufenstuhl, Andreas (13.06.18): loc. cit. [Translated]
[173] Cf. ibid
[174] Cf. Knutzen, Volker (04.05.18): loc. cit.

of the essential precautions for a successful implementation.[175] [176] It must be defined right from the start how the technology is to be used, what effects this implementation will have and what is the starting point for the added value. Uncertainties lead to fear among the staff, which should be avoided at all costs, as the support of the staff is essential for the success of the project. Hufenstuhl points out that despite an intensive previous examination of the data and the process, errors are nevertheless hardly avoidable. The financial directive *MiFID II* is cited as an example.[177] This directive of the European Commission has been drafted for years and has therefore been examined several times by many people for possible errors. After it was given to IBM Watson for analysis, a program based on AI, they had to realise that in the end mutually contradictory contents were found.

In past projects the fact that the process was too flexible was a frequent obstacle, Fischer and Schill state. It is essential to act as precisely as possible. It is often assumed that the process concerned is already as standardised as possible, but after the transformation has started it is found that this is not the case at all.[178] [179]

Thus, first the process has to be analysed again, although one may already think one has an exact understanding of it. This is the only way to ensure limitations are known and the necessary optimisation of the process flow prior to implementation is indeed maximised. According to Schill, this is an elaborate detail work which can quickly become frustrating.[180] Sufficient time must be provided in the early planning stage. Employees who have previously executed the process will then individually become experts who will in the future have to control and manage the process executed by the machine. With RPA, the employee will also take care of exception processing. Whenever the robot encounters a case which cannot be solved by the normal rule-based procedure, the human being must intervene and take over. This exception processing will then become the focus of future work. However, this still allows an employee to be exempted from repetitive standard cases.

For RPA, it was found that repetitive non-complex processes in particular are executed and can benefit. It is difficult to make such a statement about AI. It is due to the fact that possible areas of application are much more diverse and the term "Artificial Intelligence" has no fixed definition. With the constant ongoing development of the technology, the fields of application

[175] Cf. Fischer, Norbert (11.05.18): loc. cit.
[176] Cf. Schill, Ingo (17.05.18): loc. cit.
[177] Cf. Hufenstuhl, Andreas (13.06.18): loc. cit.
[178] Cf. Fischer, Norbert (11.05.18): loc. cit.
[179] Cf. Schill, Ingo (17.05.18): loc. cit.
[180] Cf. ibid

are also growing. However, AI can already be used successfully in some areas. Supply Chain leaders need to design (demand) forecasts as accurately as possible. Knutzen speaks of his "dream [...] to know at an early stage what needs are ahead of [him]"[181]. He sees the most obvious use of the technology in data management in order to collect and evaluate information intelligently. This is already very well feasible today, so above all the route planning, demand forecasts, recognition of texts as well as objects by AI profit. The semi-autonomous use, i.e. the cooperation of man and machine, often works very well because the system generates suggestions and the human being ultimately retains the final decision-making power.[182]

As digitalisation progresses and more and more systems and supply chain participants are increasingly linked to each other, there is likewise a growing threat to data security.[183] Data abuse and white-collar crime are aspects that can be regarded as risks intensified by Industry 4.0 and thus also by implementing these technologies. However, AI can be used to combat this problem. Access anomalies can be detected at an early stage and appropriate defensive measures can be initiated, e.g. malware is being isolated. For a humanoid, such unauthorised accesses are often not easily recognisable or take at least a longer time.

Some prerequisites for a successful implementation have already been mentioned. Tunk divides them into two different categories. On the one hand, there are "technical requirements, infrastructural and procedural aspects"[184]. This includes points such as a secure and sufficient Wi-Fi connection, but moreover an effective process flow. Therefore, he validates the important components of the planning phase mentioned in the literature. This means that the process must have been optimised as best as possible in advance and that steps must be taken step by step. Full automation of all or at least a large number of processes is not a sensible approach. Rather, one should focus on the introduction in individual processes in order to expand over time. As already mentioned by Hufenstuhl and Knutzen, this category includes the aspect of correct and complete input data in order to finally be able to generate a satisfactory output.
The second category, which, according to the expert, is often not recognised as important in its significance, comprises the cultural aspect. On one hand, this includes society in general, which is more conservative in Germany than in many other countries, but also the corporate culture. Tunk recommends an active commitment to transformation, because only if one participates in

[181] Knutzen, Volker (04.05.18): loc. cit. [Translated]
[182] Cf. Hufenstuhl, Andreas (13.06.18): loc. cit.
[183] Cf. Knutzen, Volker (04.05.18): loc. cit.
[184] Tunk, Tilman (12.06.18): Interview. Appendix 2 [Translated]

the experience of digitisation one can successfully steer the transformation. However, the aim should not be to carry out the transformation for the sake of transformation. Instead, one has to stand behind the project and want to transform, not use it for marketing purposes.[185] This means one should not tackle all areas at once but must focus on certain areas with scaling potential and involve all employees within the organisation.

In conclusion, it can be said that companies must take certain precautions before embarking on such implementation. Thus, it is not only concerns of obvious necessary technical requirements and dealing with the training of employees as well as knowledge management[186], but it should be the goal to create transparency for all stakeholders at an early stage. This begins, for example, with the challenge of the term "robot" integrated in "Robotic Process Automation". Many people have the idea about this being a physical robot that is supposed to replace humans. This misconception leads to the fact that it takes some time until a certain acceptance is established.[187]

4.2.2. Maturity level of supply chains and future development

Once the opportunities, risks and prerequisites for a successful implementation of RPA and AI have been identified, the question arises as to how far these technologies have already made their way into today's supply chain. The experts from the areas of potential users, providers and consultants were asked to assess the current situation as well as to provide a future outlook.

They assessed how technologically advanced their own supply chain is, or that of the German average. The evaluation was made on a scale of 1 to 4, where 1 stands for revolutionary and 4 for conservative/traditional. It turned out that almost all experts awarded a rating of a 3. The only exception was Tunk. He rated Magazino's supply chain with a 2 and justified this with the fact that they rely on a pronounced use of 3D printing in production, use RPA and other state-of-the-art technologies and that it is necessary to be technological advanced to set a good example as a provider.[188] Their technological progress can also be explained because of Magazino being a young start-up. It is the start-ups showing how digitisation can work and setting new standards, which traditional companies are often guided by.[189]

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[185] Cf. ibid.
[186] Cf. Schill, Ingo (17.05.18): loc. cit.
[187] Cf. Fischer, Norbert (11.05.18): loc. cit.
[188] Cf. Tunk, Tilman (12.06.18): loc. cit.
[189] Cf. Evers, Jan (2017): Was Unternehmen von Start-ups lernen können. Online: https://www.wiwo.de/erfolg/management-der-zukunft/digitalisierung-was-unternehmen-von-start-ups-lernen-koennen/19333006.html [Last accessed: 21.06.2018]

Schill explains Georgsmarienhütte's fairly traditional supply chain by the fact that manufacturing and above all steel companies can only implement changes to this extent very slowly. This is since depreciation cycles of machines possibly being equipped with IoT sensors, for example, span over 20 years.[190] Digitisation in these areas often only actually takes place when it takes in the form of a greenfield project in which a production hall is completely new-built. In addition, these technologies have not yet simply arrived in the logistics sector in medium-sized companies, says Knutzen.[191] Although digitisation has been an issue for many years, when it comes to the actual digital transformation, one is often still a spectator. In this function, the introduction of AI and autonomous vehicles on the company premises has already been dealt with, but it has been concluded that implementation is not financially worthwhile at this time. The costs which would accompany the introduction and operation are still too high. At the moment, only intelligent add-ons for ERP systems are of interest, since they are already functionally more advanced and are also relatively inexpensive to purchase.[192]

The different speeds at which digital change takes place are partly dependent on the business concept and the industry. Additionally, some companies need to understand that preparations need to be done before a launch can take place. This process can be a major challenge for companies. Knutzen states it is not an easy task to identify and analyse data appropriately in order to be able to control and optimise it sustainably. Other companies would be able to do this much better.[193] Tunk agrees with this observation that some customers have always been very innovative and also have the courage and will to "promote change "[194]. However, a distinction must be made here between the individual technologies and the intended or required use. "The whole thing relies on the practicability and function of these individual digital instruments"[195]. In theory, the benefits and smooth implementation are often clearly demonstrated, but this also frequently deviates from reality.

RPA partially reaches today's limits in the area of OCR, especially when documents are received in different file formats and a not standardised structure. Technological leaps are therefore needed to help with the respective breakthrough. Nevertheless, RPA is enjoying a steadily growing interest in the technology. While at the BME symposium in November 2016 RPA was

[190] Cf. Schill, Ingo (17.05.18): loc. cit.
[191] Cf. Knutzen, Volker (04.05.18): loc. cit.
[192] Cf. ibid.
[193] Cf. ibid
[194] Tunk, Tilman (12.06.18): loc. cit. [Translated]
[195] Fischer, Norbert (11.05.18): loc. cit. [Translated]

hardly discussed, the following year it became an integral topic for conversation since it is not particularly complex and can quickly generate added value.[196]

As already mentioned at the beginning, the experts were also asked how they assess the influence of the technologies in the near future. This time the answers differed relatively clearly from each other. While Knutzen expects the influence to increase dramatically and the "real upheaval in the companies and the supply chain [...] is still imminent"[197], Schill and Tunk see digitisation as a continuous process that does not contain a major revolution but rather a step-by-step evolution. Accordingly, we are still in the early stages of this process and it will be a while before all companies will be involved.[198] [199] According to Fischer, however, this behaviour on the part of German companies is not unusual, although "the benefits are obvious"[200]. Other countries and regions, such as Silicon Valley, are more adaptable and innovative, but in return important factors would be forgotten. Although many things are already possible with AI, especially in areas of application that are stable, Hufenstuhl does not see the revolution imminent in the next few years. He sees the reason for this in people.[201] We are not yet able to adapt our processes to the technology in order to make optimum use of digitisation. Moreover, out-of-date laws and the stubbornness of each individual are counterproductive. One has to be willing to give up responsibility, even if that means making mistakes.

[196] Cf. ibid.
[197] Knutzen, Volker (04.05.18): loc. cit. [Translated]
[198] Cf. Schill, Ingo (17.05.18): loc. cit.
[199] Cf. Tunk, Tilman (12.06.18): loc. cit.
[200] Fischer, Norbert (11.05.18): loc. cit. [Translated]
[201] Cf. Hufenstuhl, Andreas (13.06.18): loc. cit.

5. Conclusion

The objective of this bachelor thesis was to examine the possible use of RPA and AI with a focus on the resulting chances and risks for the organisational supply chain and the workforce. To be able to place these two in an overall context, a general review of Industry 4.0 and the other technologies was carried out. It was observed that the progressing digitisation has arrived sporadically in the companies. Numerous technologies have been integrated into the business processes in individual cases and have been able to significantly change and improve them. Above all, big data solutions are indispensable and other technologies such as 3D printing are being used increasingly frequently[202] [203] in order to be able to act with greater independence from suppliers and to achieve cost savings. However, one often gets the impression that an implementation does not have process optimisation as its main goal, but instead it is used for marketing purposes.[204]

Concerning RPA and AI, it was determined that both technologies are aimed at advanced automation. While RPA processes are automated solely on the basis of following pre-defined rules, AI uses algorithms and mathematical models allowing a continuous learning process.

Whereas the areas of application for RPA are rather limited to repetitive, non-complex tasks, AI can cover a broader spectrum. Here, a distinction must be made as to whether semi-autonomous or fully-autonomous automation is desired or necessary.[205] The main purpose of semi-autonomous automation is to support the human workforce by compiling, optimising and analysing structured as well as unstructured data. A fully-autonomous automation takes additionally over the execution and, if necessary, independent optimisation of the process itself.

The literature research made it clear that the introduction of a new technology has to be divided into two main phases. Both the planning and the final implementation phase, which requires post-implementation management, are essential for the success of the digital transformation and include different requirements to be fulfilled.

Important requirements must be addressed right from the initial stages. For this purpose, it requires a high degree of attention to define the target scope of the assignment. It is imperative that the organisation is well aware of what the objective is. This includes not only the question of the features being ultimately included in the solution, but also which processes and employees

[202] Cf. Knutzen, Volker (04.05.18): loc. cit.
[203] Cf. Tunk, Tilman (12.06.18): loc. cit.
[204] Cf. ibid.
[205] Cf. Hufenstuhl, Andreas (13.06.18): loc. cit.

are influenced, how and when, and additionally what effects this can have on the rest of the business.[206] To achieve this, it is necessary and crucial that all affected stakeholders are involved at an early stage and are convinced of the benefits of the project. A clear and simple communication strategy allows individual actors to express their concerns and ideas. If this does not occur, it is likely that not all factors are known or that employees will try to sabotage the project by withholding information.[207] Experts share the view about incorrect or incomplete process documentation being one of the greatest challenges, as it leads to the failure of the project and thus has a direct impact on the success of the company.[208] [209] Inaccurate data analyses or incorrectly executed processes, especially those which are directly perceptible by the customer, carried out by either RPA or AI can cause lasting damage to the reputation of the business.

Not every process is suitable for the introduction of RPA or AI. RPA in particular requires certain fulfilled prerequisites and therefore, a questionnaire was developed to determine whether a process is suitable for the utilisation of it. The more questions that have to be answered negatively, the greater the risk of the implementation not running smoothly. Preparations and adjustments must be made before an introduction and thus, it is not possible to state in general in which companies and functions an implementation can take place within a short time. This must be decided on a case-by-case basis since the bottleneck is usually the planning and preparation process.

The same applies to AI, but it must be remembered that the management and control effort after the actual implementation are more complex and demanding. There is also the danger of the final result not being predictable or corresponding at all with the company's vision. In contrast to RPA, there is no simple sequence of process steps allowing 100 per cent compliance to be achieved at all times. According to the experts surveyed, the introduction of AI ironically leads to an *increase* in complexity since the final output cannot be accurately predicted and therefore compliance cannot be guaranteed.[210]

The technology requires a more pronounced understanding of IT, which must be available in the organisation and must be maintained in the long term.[211] The experts validated this point by stating that if adjustments are necessary, this must be recognised and implemented immediately.[212] Thus, internal employees must be available with a strong understanding of the

[206] Cf. Tunk, Tilman (12.06.18): loc. cit.
[207] Cf. Wisskirchen, Gerlind et al. (2017): loc. cit. P. 13-14
[208] Cf. Hufenstuhl, Andreas (13.06.18): loc. cit.
[209] Cf. Knutzen, Volker (04.05.18): loc. cit.
[210] Cf. Fischer, Norbert (11.05.18): loc. cit.
[211] Cf. Ross, Jeanne (2017): loc. cit.
[212] Cf. Hufenstuhl, Andreas (13.06.18): loc. cit.

process and corresponding technological skills. The danger is that mistakes are not only possible but also probable, because AI learns by following the trial-and-error principle. Companies must be prepared to venture these mistakes and be able to react accordingly.[213]

Even if this danger does not exist with RPA since autonomous action deviating from the given path does not take place, this carries a different risk. This is because if employees and companies rely excessively on the functioning of the robot, it can result in the fact that little attention is paid to the executed process.[214] As the outcome, any process know-how can be lost, and it is no longer possible to understand in the long term how and why a process is carried out.

Several advantages of the two technologies are obvious, such as cost reduction and quality optimisation which are caused by the reduction of the 7+x wastes of Lean Philosophy.[215] With RPA, for instance, employees are released from error-prone, repetitive tasks and can focus on other more complex tasks. AI achieves better results by including a wider range of (unstructured) data. Both technologies further allow the processes to be carried out in a fraction of the time which would be required for human execution.

The several benefits of both technologies are a constant concern for workers and regularly lead to public debate on how the labour market will change. AI's ability to take on more complex tasks is seen as a possible cause for future job losses.[216] However, this thesis has shown that fear seems to be largely unfounded. The experts and the literature expect labour will widely change and occasionally jobs will be eliminated, but in return it will create a greater amount and especially interesting work.[217] [218]

The interviews with experts have revealed that the theory still appears to be a long way from reality. Many things are already feasible today with RPA and AI, although AI in particular is still in the early stages of its evolution. Nevertheless, only a few companies are relying on digital transformation, the deployment of one or both technologies can be described as early adopters. This applies specifically to larger companies having sufficient financial resources, human capital and moreover have the possibility of coping with setbacks easier. However, start-ups in whose business model digital transformation has an important role to play are also role models.[219] Small and medium-sized enterprises are still clearly more traditionally positioned in their supply chain,

[213] Cf. ibid.
[214] Cf. Schill, Ingo (17.05.18): loc. cit.
[215] Cf. Burgess, Andrew (2018): loc. cit. P. 78
[216] Cf. Pastor, Alfredo/ Dupree, Bartolomé Mercadal (2016): loc. cit. P. 15-23
[217] Cf. Fischer, Norbert (11.05.18): loc. cit.
[218] Cf. Hufenstuhl, Andreas (13.06.18): loc. cit.
[219] Cf. Evers, Jan (2017): loc. cit.

but their degree likewise depends on the respective industry. Although, the use of RPA can offer major advantages for purchasing and warehouse management. The processes around order and payment processing as well as inventory control and linked automatic replenishment would benefit precisely due to the increased number of repetitive tasks.
Since the semi-autonomous use of AI today is more developed the advantages are particularly in the field of data management and processing, i.e. with regard to demand forecasting, in order to achieve the most accurate results possible, taking real-time data of all kinds into account.[220] Moreover, the detection of anomalies, for instance in payment transactions or other risk analysis, is another potential. In the future, the areas of logistics, i.e. autonomous vehicle operation, and of production including autonomous and smart machine control as well as maintenance (Predictive Maintenance) will greatly benefit due to the enhanced data accessibility.

The derived recommendation for companies is that they should actively consider implementing RPA and AI. First of all, suitable areas and applications must be identified within the supply chain. It is essential to grant sufficient time for this and the rest of the target-definition process. In addition, it is vital for the final success of the project that affected employees are involved as early as possible in both the planning and implementation process. The identified requirements, which include sufficient on-the-job training and comprehensive change management[221], must be adequately fulfilled. The introduction of the individual technologies initially involves certain challenges, which can involve making mistakes, especially in the case of AI. Nevertheless, fear should not outweigh it and other companies should not be left with the lead. Furthermore, the objective must not be to misuse the transformation for marketing purposes, but instead to make one's own processes more efficient and transparent in order to achieve long-term competitive advantages and strengthen one's own workforce.[222]

[220] Cf. Hufenstuhl, Andreas (13.06.18): loc. cit.
[221] Cf. Kuhn, Johannes (2015): loc. cit.
[222] Cf. Tunk, Tilman (12.06.18): loc. cit.

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Appendix

Appendix 1: Change in revenues and employment through AI implementation

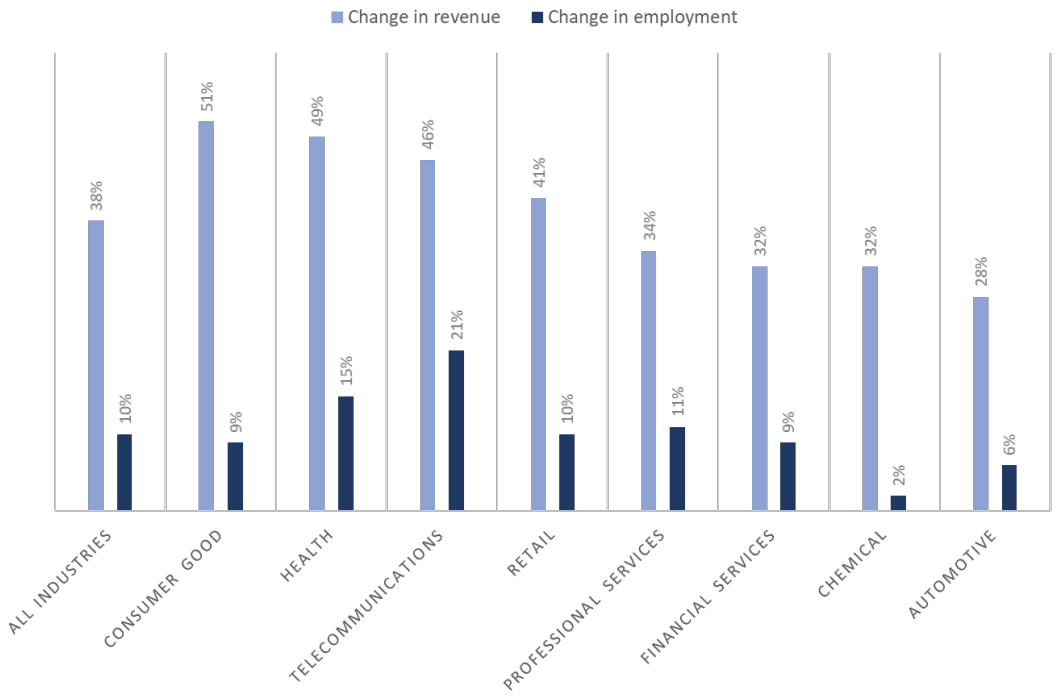

Figure 2: Change in revenues and employment through AI implementation (adapted from Accenture Future Workforce Study 2017)

Appendix 2: Transcripts of expert interviews

Expert interview #1

Date:	04/05/2018
Expert:	Mr. Volker Knutzen
Company:	Minimax GmbH & Co. KG
Industry:	Fire protection
Job position:	Division manager logistics

Herr Volker Knutzen ist Geschäftsbereichsleiter Logistik. Die Abteilung ist abgekoppelt vom strategischen Einkauf und fokussiert sich außerdem ausschließlich auf die Versorgung internen, nicht den Endkunden. Der Geschäftsbereich umfasst die Lagerversorgung, Distribution (auch an internationale Läger), Fertigungsversorgung, Versand inklusive Verpackung und Export-organisation sowie das interne Kundencenter. Durch die Anlagenbau-Branche ist eine erhöhte Komplexität festzustellen und man befasst sich daher ausschließlich mit dem Projektgeschäft.

Herr Knutzen, vielen Dank, dass Sie die Zeit für das heutige Interview gefunden haben. Ich würde mich freuen, wenn Sie zunächst etwas über sich und Ihrer Position erzählen könnten.

Ich habe in grauer Vorzeit Elektrotechnik studiert, bin dann im Bereich der Automatisierungstechnik gewesen, angestellt bei der AEG, bin dann zur Beiersdorf gewechselt und war dort in der zentralen Technik für das Thema Automatisierung zuständig. Eigene Maschinen wurden von uns programmiert, in den Betrieb genommen und gewartet. Anschließend bin ich dann zu Feldmühle, seinerseits einer der größten Papierhersteller in Deutschland, dort zuständig auch für die Automatisierungstechnik. Da ich in einem kleinen Werk gearbeitet habe, habe ich dann noch den Bereich Einkauf und Logistik übernommen und bin dann im Verlauf der weiteren Zeit immer tiefer in diesen Bereich reingerutscht. Nach vielen Jahren bin ich 2012 zur Minimax gewechselt. Hier bin ich als Geschäftsbereichsleiter Logistik tätig, ein Bereich, der ungefähr 120 Mitarbeiter umfasst.

Digitale Transformation mit dem Bezug auf das Stichwort Industrie 4.0 ist schon seit Jahren ein beliebtes Gesprächsthema, vor allem auf Messen und Veranstaltungen wie beispielsweise der Hannover Messe vergangene Woche. Wie schätzen Sie den Einfluss der Digitalisierung in der Supply Chain in den kommenden Jahren ein?

Ich glaube, dass vor allem im Bereich der Logistik in Unternehmen aus dem Mittelstand, Themen wie 4.0 und digitale Transformation noch gar nicht in der Form implementiert ist, wie man nach Außen den Anschein haben könnte. In fast allen Bereichen sind wir aktuell noch Zuschauer, betrachten die Entwicklungen und stellen fest, dass von unseren Zulieferern bestimmte Technologien in deren Produkte einfließen, aber das auch nur vereinzelt. Gewisse Sensorik existiert schon seit etlichen Jahren und wird seitdem erfolgreich eingesetzt, nur auf Veranstaltungen wie der CeMat bspw. unter neuem Namen beziehungsweise unter dem Thema Industrie 4.0 neu verkauft. Ich bin dennoch der Überzeugung, dass der Einfluss dramatisch in den nächsten Jahren zunehmen wird. Der wirkliche Umbruch in den Betrieben und der Supply Chain steht noch bevor.
Wir stehen noch vor der größten Herausforderung, vernünftige Daten der Prozesse in der Supply Chain zu identifizieren und zu analysieren, um diese nachhaltig steuern und optimieren zu können. Einige Leuchtturmprojekte wie Amazon mögen dies schon deutlich besser beherrschen, aber bei uns ist das in der entsprechenden Form noch nicht angekommen.

Im Zuge der Transformation gibt es einige Technologien, die immer wieder genannt werden. RPA, ML, AI, 3D-Druck, Drohnen, Blockchain, Chatbots, Data-, Process Mining und Webcrawler. Haben Sie eine oder mehrere Technologien aus dieser Liste implementiert?
Leider nein. Wir verwenden 3D-Druck im Bereich der Forschung und Entwicklung für die Herstellung von Prototypen, in der Supply Chain jedoch sind wir da noch deutlich traditioneller aufgestellt.

Planen Sie bzw. haben Sie bereits darüber nachgedacht RPA oder AI bei Ihnen im Unternehmen zu implementierten?
Wir haben uns bei dem Bau eines neuen Werks mit der möglichen Einführung von künstlicher Intelligenz im Bereich Fahrzeugtechnik beschäftigt, sodass diese Fahrzeuge autonom von A nach B auf dem Firmengelände fahren könnten. Wir mussten allerdings feststellen, dass solange wir uns im 1-Schicht-Betrieb bewegen, sich diese Investition nicht rechnen würde; der ROI wäre nicht gut genug.
Es gibt ja auch für die bekannten ERP-Systeme Add-Ons, die man zusätzlich einsetzen kann und hinter denen eine künstliche Intelligenz steckt. Diese Add-Ons sind für uns relevant und eine Einführung ist durchaus möglich. Allerdings befassen wir uns nicht mit künstlicher Intelligenz als eigenständiges Projekt oder dies über diese Add-Ons hinaus einzuführen.

Als wie technologisch-fortschrittlich bewerten Sie Ihre Supply Chain? Auf einer Skala von 1 bis 4, wenn 1 revolutionär und 4 konservativ bedeutet.
Ich sehe uns da zwischen 3 und 4.

Welche möglichen Vorteile und Risiken sehen Sie von Robotic Process Automation?
Es gibt mit Sicherheit immer Angst davor, dass so etwas Arbeitsplätze vernichten kann, aber üblicherweise hat sich mit neuen Technologien herausgestellt, dass sie bei rechtzeitiger Einführung nicht Arbeitsplätze abgebaut, sondern geschaffen wurden. Diese Arbeitsplätze verändern sich, aber das führt nicht dazu, dass plötzlich ein großer Anteil an Arbeitnehmern einfach ersetzt wird. Die Prozessqualität wird sicherlich steigen, denn eine Maschine bzw. ein System lässt sich stets leichter optimieren und liefert gleichmäßigere Ergebnisse als ein Mensch.

Sehen Sie die Gefahr, auch im Hinblick auf künstlicher Intelligenz, von bedrohter Datensicherheit und entstehenden Sicherheitslücken?
Das ist ein grundsätzliches Problem, unabhängig vom Einsatz von AI. Das Thema Datensicherheit, gegeben durch unsere weltweiten Netzwerke und die direkte Bindung von Lieferanten an unsere ERP-Systeme, ist immer ein großes Risiko. Mir fällt es schwer, dieses Risiko zu beurteilen, aber es ist klar, dass es weiterwachsen wird, je mehr man die Welt weiter vernetzt. Datenmissbrauch und Wirtschaftskriminalität sind da durchaus ein mögliches Problem.

Welche Prozesse könnten denn am meisten von RPA profitieren?
Bei uns wären es die Prozesse, in denen nicht körperlich gearbeitet wird, sondern eher die Prozesse im Kundencenter und die in der Disposition. Das sind in der Regel Aktivitäten, die sich häufig wiederholen, die auch maschinell erledigt, zumindest teilweise, werden könnten. Hier sehe ich definitiv Potenzial, sei es im Bereich der Beschaffung oder in der Auftragsabwicklung.

Und wie sieht das mit AI aus? Wenn also auch kognitiv komplexere Aufgaben automatisiert werden könnten.
Mein Traum wäre der Einsatz von AI, der es mir erlaubt, frühzeitig zu wissen, welche Bedarfe auf mich zukommen. Die notwendigen Daten für eine präzise Bedarfsprognose sind irgendwo sicherlich im Datennetz vorhanden, nur nicht da wo ich sie brauchen könnte. Diese intelligent zusammenzusammeln, ob es historische oder Echtzeitdaten sind, ob Unternehmensdaten oder aus Umweltfaktoren, und zu analysieren, um Prognosen zu erstellen, wäre eine große Bereicherung. Ich sehe AI noch vor allem in der Datenbewirtschaftung.

Welche Voraussetzungen beziehungsweise Anforderungen sehen Sie bei der Implementierung von RPA/ AI?

Wir bräuchten eine deutlich stärke IT-Abteilung. Solche Technologien einzuführen, ohne interne Experten im Unternehmen zu haben, halte ich für fragwürdig und riskant. Außerdem müsste so etwas anwendungsgerecht zur Verfügung stehen. Ich würde bei solchen Dingen keinen Piloten durchführen wollen, der die Lieferkette theoretisch stören könnte. Diese Technologien müssen, wenn sie eingeführt werden, direkt funktionieren und einen Mehrwert generieren.

Ich bin dennoch der festen Überzeugung, dass sich das bald ändern könnte, aktuell sehe ich uns jedoch noch nicht an diesem Punkt.

Veränderungen in diesem Ausmaß verlangen immer nach hohen Investitionen. Die Geschäftsleitung muss da komplett hinter der entsprechenden Abteilung stehen und diese entsprechend bei der Einführung unterstützen. Ein ROI ist zunächst nur theoretisch nachweisbar und man sich sieht mit reichlich Kosten konfrontiert.

Des Weiteren muss das Thema der Stammdatenqualität und -pflege angegangen werden. Im Hinblick auf den Zugriff zahlreicher verschiedener Funktionen im Unternehmen und Lieferanten, die sich nicht an Regularien halten, leidet oftmals die Stammdatenqualität von Produkten.

Sie hätten gerne also ein Automatisierungstool, dass das Stammdatenmanagement übernimmt? Auch das lässt sich mit RPA umsetzen.

Genau, das wäre definitiv ein Einsatz, den man sich vorstellen könnte. Da sehe ich einen größeren Nutzen als in Drohnen, die in Lägern die Inventur übernehmen.

Dann würde ich mich gerne abschließend für das Interview bedanken und wünsche Ihnen noch ein angenehmes Wochenende.

Danke, Ihnen auch!

Expert interview #2

Date:	11/05/2018
Expert:	Mr. Dr. Norbert F. Fischer
Company:	PricewaterhouseCoopers GmbH
Industry:	Services (Audit, Tax & Legal, Advisory)
Job position:	Partner – Strategic Sourcing

Herr Dr. Norbert Fischer ist Partner bei PwC in Frankfurt für den Bereich Management Consulting - Strategic Sourcing und außerdem Head of Procurement EMEA. Vor seiner Zeit bei PwC sowie J&M Management Consulting arbeitete Herr Dr. Fischer Global Head of Purchasing Operations bei der Deutschen Bank. Außerdem war er einige Jahre bei Capgemini als Global Head of SAP SRM und Head of SCM Service Line tätig. Er verfügt über eine mehr als 30ig-jährige Berufserfahrung im Bereich Consulting & Business.

Herr Dr. Fischer, guten Morgen und zunächst einmal vielen Dank, dass Sie Zeit für das Interview finden konnten. Ich würde mich freuen, wenn Sie zu Beginn etwas darüber erzählen könnten, wie Sie in die Beratungsbranche/ Einkauf gekommen sind.

Gerne. Ich habe bereits vor meinem Studium im Bereich Einkauf und Produktion gearbeitet, das war meine erste Erfahrung in dem Bereich. Im Studium selber habe ich Herrn Kaiser, sprich den Eigentümer der Helmut Kaiser Unternehmensberatung, kennengelernt und habe mit ihm Ideen entwickelt, wie man Markstudien im Bereich Umwelt und Umwelttechnik aufbauen kann. Das war dann mein Start in die Beratung; im Bereich Umwelttechnik waren wir damit die ersten in Deutschland, die umfassend den Markt und die Entwicklung der Umwelttechnik dargestellt haben. Diese Studie war sehr erfolgreich und so habe ich das für einige Zeit als Freelancer neben meiner Stelle als Dozent an der Uni gemacht. Mit dem Ende meiner Promotion bin ich dann in der Helmut Kaiser Unternehmensberatung eingestiegen und in die Geschäftsleitung gewechselt.

Im Vergleich zu den vergangenen Jahren, wie schätzen Sie den Einfluss der digitalen Transformation in der nahen Zukunft auf Supply Chains?

Ich denke, dass es unterschiedliche Geschwindigkeiten geben wird. Das Ganze steht und fällt mit der Praktikabilität und der Funktion dieser einzelnen digitalen Instrumente. Manche Sachen funktionieren in der Vorstellung deutlich besser als in der Realität, das ist leider immer so, aber das führt auch dazu, dass in vielen Bereichen auch mal wieder Ernüchterung entsteht. Das führt auch unteranderem dazu, dass es zwischendurch Lücken gibt, in der sich diese nicht

weiterentwickeln, weil es bis zum nächsten Schritt länger andauert. Ein Beispiel hierfür war der 3D-Druck, bei dem es eine große Euphorie gab und es dann doch eine ganze Weile wieder ganz ruhig wurde, bis eben der Punkt erreicht wurde, wo man es auch wirklich einsetzen kann. Und dieses Phänomen sieht man eigentlich bei allen Technologien, auch RPA ist an sich, im Sinne von Makros und intelligentere Makros, eine alte Technologie. Sie stößt trotzdem im Bereich von OCR an ihre Grenzen und es wird vermutlich noch eine Weile dauern bis auch da eine ausreichende digitale Unterstützung da ist, sodass komplette Prozesse digital laufen können. Diese Technologiesprünge werden dann bei den signifikanten Durchbrühen helfen. Viele Unternehmen befassen sich irgendwie mit RPA, aber den flächendeckenden Einsatz gibt es noch in relativ wenig Unternehmen. Obwohl der Nutzen klar auf der Hand liegt, tun sich die Unternehmen schwer, auf solche Lösungen zu setzen. Das ist in Deutschland allerdings nicht ungewöhnlich. In anderen Länder oder eher Regionen sieht das schon anders aus, beispielsweise Silicon Valley. Dort bleiben aber mitunter andere Dinge auf der Strecke.

Bei der Implementierung welcher Technologien haben Sie und Ihr Team persönlich im Einkauf/ der Supply Chain beraten beziehungsweise unterstützt?
Robotic Process Automation, Process Mining und Data Mining ansatzweise für den Bereich der Betrugserkennung. Für andere Technologien haben wir zwar Angebote erstellt, aber zu einem konkreten Projekt kam es nicht. RPA haben wir in einem Transportunternehmen eingesetzt für den Abgleich von Auftragsbestätigungen mit den eigenen SAP Daten. Also das Befassen mit der Frage: Stimmt die Auftragsbestätigung, die digital im Unternehmen eingeht, mit der tatsächlich von uns getätigten Bestellung, überein?

Als wie effizient bewerten Sie die RPA Technologie und wie kann man Effizienz messen?
Bei RPA sind es die Geschwindigkeit, in der die Prozesse durchlaufen werden und der Ressourcenbedarf am Ende, der für einzelne Prozessschritte notwendig ist. Und da lässt sich klar erkennen, dass RPA positive Effekte erzielen kann. Außerdem, das wurde auch in unserem Projekt klar gezeigt, ist der Punkt Prozessqualität. Das schöne ist, dass der Roboter ja nur genau das macht, was man ihm sagt. Das heißt er ist nicht kreativ, er verändert nichts, er führt die Prozesse genau so aus, wie sie geplant und vorgesehen sind; zu 100%. Bei Themen wie Auftragsbestätigungen, die man gerne mal nach hinten verschiebt, weil sie kaum Mehrwert erzeugen, ist das eine sehr gute Entlastung.

Seit wann beschäftigen Sie sich mit dem Thema RPA?

Ich messe das gerne an den BME-Symposien (Anm.: BME = Bundesverband Materialwirtschaft, Einkauf und Logistik) in Berlin. Das vergangene Mal im November 2017 war das Thema RPA in aller Munde, wurde schon als Lösung präsentiert, im Jahr zuvor war ich der einzige, mit diesem Thema und der darüber erzählt und erste Ideen mit Kunden entwickelt hatte. Ich selber habe ein halbes/ dreiviertel Jahr vorher angefangen, mich mit dem Thema RPA zu beschäftigen. Mittlerweile scheint fast jeder zu wissen, was RPA ist, doch in Deutschland tun sich viele Leute schwer mit dem Begriff „Roboter". Oftmals wird mit dem Begriff eine physische Maschine in Verbindung gebracht, das ist in dem Fall aber ganz und gar nicht gemeint und daher haben viele eine falsche Vorstellung, was dazu führt, dass es etwas dauert, bis eine gewisse Akzeptanz geschaffen wurde.

Als wie technologisch-fortschrittlich bewerten Sie die durchschnittliche deutsche Supply Chain? Auf einer Skala von 1 = revolutionär, 2 = fortschrittlich, 3 = zeitgemäß bis 4 = konservativ.

Es kommt auf den Vergleichspartner drauf an. Im Vergleich zum Silicon Valley eine 4, gegenüber dem Rest der Welt eine 3. Sicher ist jedoch, dass die durchschnittliche deutsche Supply Chain nicht fortschrittlich ist.

Welche spezifischen Vorteile und Risiken sehen Sie in der Implementierung von RPA in der Supply Chain in Bezug auf Unternehmensaspekte und Arbeitnehmer?

Ein kritischer Punkt, der jedes Mal in den Diskussionen aufkommt, ist die Angst vor Jobstreichungen. Es ist allerdings so, dass nur wenige Leute wirklich betroffen wären. So ein RPA-Einsatz erfolgt ja, vor allem zu Beginn, nicht flächendeckend. Die Anzahl der operativen, wirklich stupiden Arbeitsschritte wird mit Sicherheit in Richtung Roboter verschwinden. Arbeitsplätze werden sich verändern, aber das würde ich eher als positive Veränderung bezeichnen. Die stupide Arbeit fällt weg und die Mitarbeiter erhalten die Chance dies positiv zu nutzen und sich in andere Arbeitsfelder hineinzubegeben. Oftmals erhält man darauf die Antwort, dass die betroffenen Mitarbeiter ja nicht für was Anderes eingesetzt beziehungsweise umgeschult werden können, aber das ist zu kurzgedacht. Jeder Mensch ist bereit, neue Dinge zu lernen und das mag für Manche ein mühseliger Weg sein, aber ich glaube schon, dass wir in der Lage sind für mindestens 95% der davon betroffenen Leute, neue Arbeitsfelder zu definieren und nicht von einem radikalen Mitarbeiterabbau sprechen müssen. Das wird es sicherlich auch in einem gewissen Rahmen geben, dass man schlicht weniger Leute für einzelne Aktivitäten

benötigt, aber das ich glaube, vielmehr wird es der Fall sein, dass man die Leute in interessantere Arbeitsfelder hineinbringen kann und damit die Qualität der Arbeit deutlich steigern kann.

Sie haben jetzt schon gesagt, dass stupide und repetitive Arbeitsprozesse übernommen werden können. Welche wären das denn beispielsweise?

Letztendlich sind das klassischerweise all die Prozesse, die ich in ein Shared Services Center überführen würde und kann. Immer da wo ich durch definierte Regel Prozesse abarbeiten muss und das betrifft vor allem den Finanzbereich, wo ich Daten von A nach B bewege, Prozesse standardisiert abarbeite. Das heißt aber auch, dass da wo heute SSC sind, sprich Polen, Manila, Indien etc., mit Sicherheit extrem viele Dinge nicht mehr so passieren werden. Für Unternehmen heute macht es weniger Sinn, überhaupt in ein SSC zu gehen, sondern man eher in Richtung RPA nachdenken sollte.

Welche spezifischen Vorteile und Risiken sehen Sie in der Implementierung von AI in der Supply Chain in Bezug auf Unternehmensaspekte und Arbeitnehmer?

Hier kommt es immer drauf an, wie weit man eine künstliche Intelligenz denkt. AI heißt ja nicht, dass jede Art von menschlicher Hirnleistung auf einmal von einem Rechner erbracht werden kann. Das mag von der Rechnerkapazität vielleicht der Fall sein, aber von der Komplexität der Prozesse und der Anforderungen dessen, sind wir Menschen dann doch zum Glück noch ein bisschen voraus. Das wird sicherlich auch noch eine Weile dauern, bis Kreativleistungen von Menschen durch Rechner ersetzt werden können, hoffentlich. Das interessante an der künstlichen Intelligenz ist ja, dass es im Endeffekt eher eine Komplexitätserhöhung darstellt, das darf man dabei nicht vergessen. Bei einer RPA Lösung wird eine höchste Qualität erzielt, auf Grund der genau definierten Prozesse. Bei künstlicher Intelligenz weiß ich nicht unbedingt wie das Endergebnis aussehen wird und das ist teilweise problematisch. Ich erweitere den Anwendungsbereich, trotzdem muss ich am Ende die Lösung nochmal checken. Ein Mensch muss am Ende die Freigabe erteilen, das heißt der Prozess läuft nicht von A bis Z autonom, sondern ein Workflow wird benötigt, bei dem das Arbeitsergebnis nochmal überprüft werden muss. Insofern kann die künstliche Intelligenz Arbeit wegnehmen, ja, aber sie führt auch zu unterschiedlichen Arbeitsergebnissen. Man weiß nicht, ob das Ergebnis auch zu Stande gekommen wäre, wenn ein Mensch, mit Zugriff auf all die Daten, die Entscheidung am Ende getroffen hätte.

Welche Prozesse können denn beispielsweise von AI übernommen werden?

Ein beispielhafter Einsatz, mit dem wir uns aktuell beschäftigen, ist Semantic Folding. Ohne zu sehr ins Detail zu gehen, geht es hierbei darum, eine riesige Anzahl von Verträgen zu überprüfen, bezüglich der Compliance-Einhaltung. Ganze Textabschnitte werden dabei intelligent analysiert und bewertet, ob der Inhalt korrekt ist. Hierbei spielen auch klassische AI Funktionalitäten wie NLP eine wichtige Rolle. Also zur Bearbeitung von hohen Datenmengen, ist AI eine klare Unterstützung. Aber auch am Ende dieser Vertragsüberprüfung, muss der Mensch kontrollieren, ob das Ergebnis so zufriedenstellend ist.

Künstliche Intelligenz bietet ein breites Spektrum an möglichen Einsatzgebieten, vor allem die Unterstützung von Entscheidungsprozessen und Knowledge Management Themen. Webcrawler ziehen beispielsweise Informationen aus dem Internet, die dann von AI geclustert werden und Systematiken abgeleitet werden.

Was sind Ihrer Meinung nach die notwendigen Voraussetzungen und Anforderungen an eine erfolgreiche Implementierung beider Technologien in Unternehmen?

Es wird eine saubere Dokumentation der Prozesse benötigt und man muss wissen, wo und wie genau setze ich die Technologie genau ein, wie sind die Auswirkungen, was ist der Ansatzpunkt wo die Lösung einen Mehrwert leisten kann. Der Arbeitsflow von einer Prozessaufnahme, ob über Brownpaper, Workshops oder über Process Mining, wird als erster Schritt definitiv benötigt. Genau das ist oftmals auch das Problem dahinter, denn da entsteht teilweise die Angst vor Jobverlusten und ein resultierender Widerstand.

Wichtig ist auch die Involvierung von Fachabteilungen und der IT, deren Unterstützung wird für ein erfolgreiches Change-Management benötigt.

Welche Herausforderungen sind Ihnen bei der Implementierung von RPA begegnet, mit denen Sie im Vorhinein nicht gerechnet hätten?

Bei einem RPA-Projekt ist es so, dass der Roboter nach der Implementierung an einem gewissen Punkt wieder abgestellt wurde. Der Grund dafür ist, dass der Prozess zu flexibel gedacht war. Der Roboter war für den Auftragsbestätigungsprozess eingesetzt, die Bestätigungen wurden aber in jedem möglichen Dateityp übermittelt. Viele dieser Dokumente waren eben nicht Word oder maschinell-lesbare PDF Dateien, sondern tatsächlich Bilder. Selbst mit einer OCR-Erkennung, stößt der Roboter an seine Grenzen. Das heißt die Fehlerquote ist so hoch, dass die Nacharbeitung durch Menschen genauso viel Zeit und Kosten verursacht, wie wenn der Prozess komplett ohne RPA durchgeführt worden wäre. Man hat sich also entschieden, den Roboter

zunächst zu stoppen, um zuerst den Prozess zu optimieren. Das zeigt die eigentliche Herausforderung, das Verständnis des Prozesses und der Limitierungen beziehungsweise notwendigen Optimierungen im Vorfeld einer Implementierung. Das Unternehmen aus dem erwähnten Projekt hätte jetzt so reagieren können, dass man mittels RPA eine Antwort an die Lieferanten versendet, dass diese doch bitte eine maschinell-lesbare Auftragsbestätigung senden mögen, aber diesen Weg wollte man nicht gehen.

Expert interview #3

Date:	17/05/2018
Expert:	Mr. Ingo Schill
Company:	Georgsmarienhütte Holding GmbH
Industry:	Steel industry
Job position:	Senior Supply Network Manager

Herr Ingo Schill ist Senior Supply Network Manager bei Georgsmarienhütte Holding GmbH. Zur Hauptaufgabe gehört die strategische und taktische Weiterentwicklung des Netzwerks aus 13 bis 15 Kern-Stahlunternehmen und die Optimierung der Materialflüsse über das gesamte Netzwerk hinweg. Vor seinem Job bei Gerogsmarienhütte war Herr Schill als Director bei PwC tätig und war auch hier als Experte der Stahlindustrie gefragt. Außerdem ist Herr Schill APICS zertifizierter Production and Inventory Manager (CPIM) und Supply Chain Professional (CSCP).

Herr Schill, vielen Dank, dass Sie sich bereit erklärt haben, dieses Interview mit mir durchzuführen. Ich will sie nicht zu lange aufhalten und würde daher gerne direkt in das Interview einsteigen.
Sehr gerne.

Digitale Transformation, Stichwort Industrie 4.0 ist seit längerer Zeit in aller Munde. Wie schätzen Sie die Entwicklung, die uns in den kommenden Jahren bevorstehen wird, ein? Steht die große Technologierevolution kurz bevor?
Ich denke nicht, dass es ein Technologiesprung in dem Sinne wird, sondern vielmehr eine normale Weiterentwicklung mit wachsenden Effizienzsprüngen. Ich sehe die ganz große Revolution durch die Digitalisierung nicht bevorstehen, das mag vielleicht auch der traditionellen Stahl-Industrie verschuldet sein, aber ich denke eher, dass wir uns kontinuierlich Schritt für Schritt weiterentwickeln werden. Das wird alle Prozesse sukzessive betreffen, also von Forschung und Entwicklung bis hin zur Fertigung. Einen kompletten Wandel sehe ich erstmal nicht.

Also Sie sehen die bevorstehende Entwicklung als laufenden Fließprozess ohne extreme Sprünge?
Genau. Hintergrund ist hier, dass es beispielsweise bei uns äußerst kapitalintensiv, mit Abschreibungszyklen von 20-25 Jahren, ist. Die Maschinen sind real aber teils deutlich länger

in Betrieb und diese werden dann von heute auf morgen nicht einfach durch IoT-fähige Maschinen ersetzt. Das betrifft eigentlich alle produzierende Unternehmen mit laufenden Werken und Fertigungslinien. Bei Neubauten sieht das natürlich wieder anders aus, da sind die Sprünge dann in der Tat groß, wie beispielsweise bei Voestalpine in Österreich (*Anm.: Voestalpine plant bis 2021 das weltweit modernste Edelstahlwerk in Kapfenberg, Österreich mit einem Investitionsvolumen i.H.v. 350 Millionen Euro fertigzustellen*).

Die Stahl-Industrie ist also recht traditionell aufgestellt. Welche Technologien werden denn in der Supply Chain bei Ihnen verwendet?

Im Einsatz sind bei uns 3D-Druck und Data Mining. Außerdem verfügen wir über eine Simulationsabteilung, um bereits in der F&E Phase simulieren zu können, wie sich der Stahl verhalten wird in Bezug auf Temperaturkurven, Legierung etc. RPA und Process Mining setzen wird nicht ein.

RPA und KI, einsatzbereite Technologien oder sind diese noch nicht ausgereift genug?

Mit RPA hatte ich bei PwC damals die ersten Berührungspunkte und Projekte. Einsatzfähig ist die Technologie meines Erachtens definitiv. Künstliche Intelligenz ist immer schwierig zu verallgemeinern, weil es ein so umfassender Begriff ist. Massentauglich einsatzbereit ist sie vermutlich in den meisten Prozessen noch nicht. Das liegt meiner Meinung nach an der Komplexität der Technologie. Dennoch, die Daten-bezogene künstliche Intelligenz, also Demand Sensing, Forecasting etc. ist durchaus mittlerweile einsatzfähig. Geht es jedoch hin zu komplexen Prozesslogiken und diese durch eine KI selbstständig erkennen und abarbeiten zu lassen, wird es vermutlich noch dauern, bis das für viele Unternehmen einsatzbar ist.

Die typische deutsche Supply Chain, wie fortschrittlich ist sie auf einer Skala von 1-4?

Im Bereich der Stahlindustrie vermutlich eine 3. In der Telekommunikationsbranche und Retail sieht das natürlich schon wieder anders aus.

Sie waren ja in RPA-Projekten involviert, was sind Ihrer Meinung nach Vorteile und Risiken dieser Technologie?

Die Vorteile sind ganz klar, dass man wiederkehrende, also repetitive Aufgaben, also beispielsweise das Ausfüllen von Formularen, automatisieren kann. Das ist definitiv eine Erleichterung für alle Beteiligten und steigert die Qualität des Geschäftsprozesses. Ein anderer Vorteil liegt in der Kombination von RPA und KI zur Erkennung von verschiedenen Medien,

also Bilder, Text, PDFs, Excel, Internetdokumente etc. Eine solche Spinne ermöglicht natürlich die einfache Übertragung von dem einen Medium ins andere und löst gegebene Schnittstellen-problematiken. Außerdem ist ein riesiger Vorteil die Geschwindigkeit, in der die Prozesse durchlaufen werden. So kann sichergestellt werden, dass Informations- und Materialfluss synchron ablaufen, da der Roboter rund um die Uhr auch zur Verfügung steht.
Limitiert ist das Ganze, wenn es um die Komplexität des gesteuerten Prozesses geht. Das trifft sowohl auf RPA als auch auf KI zu, bei RPA muss der Prozess standardisiert werden können und bei KI haben wir wohl noch nicht die optimale Lösung in vielen Bereichen gefunden.
Das größte Risiko sehe ich im Prozess-Knowhow. Beispiel ist hier folgendes. Wenn ein Prozess automatisiert wird, muss es ja zunächst jemanden geben, der diesen definiert. Nachdem dieser erfolgreich definiert wurde und vom Roboter tagtäglich ausgeführt wird, dann weiß nach 2 Jahren kaum bis gar keiner mehr, was dieser Prozess genau macht. Beziehungsweise, vielleicht kriegt man das noch raus, aber nicht mehr warum er es genauso macht. Einzelne Prozessschritte können dann nicht mehr nachvollzogen werden und das Problem was dann entsteht ist, dass sich keiner mehr traut, irgendetwas daran zu ändern. Die Herausforderung liegt also darin, am Ende Personal zu haben, die in der Lage sind, dieses Knowhow zu halten, den RPA-Prozess transparent zu halten und gegebenenfalls anzupassen bzw. weiterzuentwickeln.

Oftmals wird ja von der Gefahr des großen Jobverlusts gesprochen. Teilen Sie diese Furcht oder sagen Sie, dass es das Prinzip der Automatisierung bereits seit über 100 Jahren gibt und auch der Umstieg auf die Dampflok damals nicht zur Massenarbeitslosigkeit geführt hat?

Genau sehe ich das. Ich sehe wie gesagt keine große Revolution, in der dann ab morgen alles durch-digitalisiert ist und alles komplett verändert. Es wird ein kontinuierlicher Prozess sein, der sich nicht großartig von dem unterscheiden wird, wie die Entwicklung in den letzten Jahren/ Jahrzehnten. Mit der Digitalisierung kommen natürlich neue Herausforderungen, bei denen man rausfinden muss, wie man auf Veränderungen reagieren sollte, aber das schafft wiederum Arbeitsplätze. Hier muss man richtige Notwendigkeiten in Bezug auf Knowhow, Ausbildung der Mitarbeiter für die Zukunft richtig setzt, neue Anforderungen müssen frühzeitig erkannt und angegangen werden.

Welche spezifischen Prozesse in der Supply Chain können denn beispielsweise besonders profitieren durch die beiden Technologien?

Das sind vor allem bei RPA repetitive Prozesse mit einer überschaubaren Logik. Prozesse wie Auftragsannahme, -bestätigung und Kommunikation über den Auftragsstatus mit dem Lieferanten. Das sind sicherlich sehr gute Prozessbeispiele, aber auch die Qualitätskontrolle bietet sich an. Wird ein Prüfauftrag angelegt, kann das übernommen werden und die anschließende Prüfung und Interpretation kann auch durch KI ausgeführt werden. Ein Beispiel hier ist in der Stahlindustrie, das Teilen eines Stahlkörpers, um die Struktur und farblichen Charakteristiken festzustellen. Dieser Prozess könnte automatisiert werden, in dem die KI ein Bild davon macht und dieses auswertet, anstatt eines Mitarbeiters, der diese Kontrolle mit einem Mikroskop ausführt. Das Ergebnis läuft dann wieder zurück in den Prozess und kann dann von RPA entsprechend abgespeichert und mit dem Produkt verknüpft werden.

Ein weiterer Einsatz könnte in der Überwachung von Maschinen und deren Sensoren-Daten liegen, die dann entsprechend für Wartungen genutzt werden können. In dem Bereich um Wartungsaufträge steckt auch hohes Automatisierungspotential.

Außerdem gibt es ja noch die ganzen anderen Technologien wie Drohnen, mit denen eine Verknüpfung erfolgen kann, beispielsweise auch in der Fertigung. Die Knöpfe, die quasi für den Einsatz dieser Technologien gedrückt werden müssen, können auch automatisiert werden.

Was sind denn die Anforderungen und Voraussetzungen an eine erfolgreiche Implementierung? Die klare Prozessdefinierung hatten wir bereits zuvor kurz erwähnt.

Das ist sogar die Kernvoraussetzung. Man muss sich auch der Komplexität bewusst sein. Ich hatte es bei meinem RPA-Projekt bei PwC erlebt, dass dem Kunden erst während des Projekts sukzessive bewusstgeworden ist, wie komplex der Prozess doch ist. Man war zu Beginn noch davon ausgegangen, dass es ein super Standardprozess sei, Lean und geradeaus. So war das am Ende jedoch nicht, Ausnahmen gab es dann doch einige. Es muss definiert werden, was will man wirklich erreichen und wie erfolgt das. Eine Prozesserläuterung erfolgt oftmals ja über PowerPoint. Das ist für einen Menschen leicht verständlich, wenn dann geschrieben ist „Auftrag anlegen“, für einen Roboter ist das aber durchaus ein Monsterprozess; er muss sich durch verschiedene SAP-Eingabemasken klicken, Logiken hinter jedem Eingabefeld beachten, welche Information muss er da wie einbringen. Herausforderung sind da auch vor allem unstrukturierte Daten. Wie entscheidet denn ein Mensch, dass er genau die richtige Information vor Augen hat, beispielsweise die Rechnungsnummer. Wie bringt man nun dem Roboter bei, was auf einem Zettel mit dutzenden Zahlen die Rechnungsnummer ist.

Das bedarf dann reichlich Arbeit und Prozessverständnis. Gegebenenfalls steht die Rechnungsnummer ja auch nie an der gleichen Stelle, sondern ist je nach Lieferant anders positioniert.

Genau. Das ist bei RPA wirklich Detailarbeit und das ist aufwändig, das kann am Ende auch wirklich schnell frustrierend werden. Man muss also schon bei der Planung genügend Zeit hierfür vorsehen und die betreffenden Kollegen frühzeitig miteinbeziehen.

Wie ich schon vorhin erwähnt hatte, betrifft ein anderes Thema die Fragestellung nach dem Management des Knowhows. Der Prozess muss am Ende transparent sein und das auch bleiben. Es muss durchgängig möglich sein, nachvollziehen zu können, was der Prozess genau macht. Das ist eine wichtige Aufgabe für das Change-Management. Der Sachbearbeiter, der vorher den Prozess eintippt, weiß genau was er da gemacht hat. Der muss dann dazu gebracht werden, den Prozess zu kontrollieren, den er nicht direkt sieht, also sein Fokus wird verschoben auf Kennzahlen, Stichproben und solche Sachen. Anstatt simpler repetitiven Aufgaben werden es dann eher Management-Aufgaben und das muss erstmal sichergestellt werden, dass das erfolgt.

Die Arbeit verändert sich also dahingehend, dass sie sich von der Ausführung zu der Kontrolle/ des Managements dieser entwickelt.

Ja, zumindest teilweise. Die Bearbeitung der Ausnahmen muss dann auch noch vom Menschen ausgeführt werden. Es wird dann immer noch Aufgaben geben, in denen intelligente Logik gefragt ist und das wird dann der Arbeitsschwerpunkt, also die Ausnahmebearbeitung. Am Ende führt RPA ja schließlich nur standardisierte Aufgaben aus, regelbasiert.

Da könnte dann künstliche Intelligenz eingreifen, verändert das das Bild?

Klar, KI ist, wenn man es so sehen möchte, eine Evolutionsstufe weiter. Die Ausnahmen könnten dann damit auch automatisiert werden. Am Ende muss man allerdings trotzdem sicherstellen, dass der Mensch die Kontrolle über den Prozess behält. Die Herausforderung bei der künstlichen Intelligenz ist ja, dass sie Entscheidungen trifft und da Kontrollmechanismen und Transparenz geschaffen werden müssen, um sicherzustellen, dass sich diese besagten Entscheidungen im Rahmen befinden, die ich auch so getroffen hätte. Künstliche Intelligenz soll Entscheidungen treffen, die ich mit Zugriff auf die gleichen Informationen auch so getroffen hätte.

Das Verständnis über die KI und wie diese sich stetig weiterentwickelt, mit jedem Anwendungsfall schlauer wird, muss in der Firma sein und bleiben, um zu verhindern, dass die KI sich in eine Richtung entwickelt, die ich vermeiden will. Das ist dann eine komplett andere Aufgabe, dafür braucht man Fachwissen, wie künstliche Intelligenz überhaupt funktioniert und

was die Prozessanforderungen sind, wie man zur Erfüllung dieser, die KI und deren Logik zur Prozessoptimierung anpassen kann.

Herr Schill, wir sind an das Ende dieses aufschlussreichen Interviews gelangt. Vielen Dank für all die Informationen und Ihre Einblicke.

Expert interview #4

Date:	12/06/2018
Expert:	Mr. Tilman Tunk
Company:	Magazino GmbH
Industry:	Intelligent machine manufacturing
Job position:	Business Development / Market Relations

Magazino entwickelt und produziert wahrnehmungsgesteuerte, smarte Roboter für die Intralogistik. Herr Tilman Tunk ist zuständig für den Geschäftsbereich Business Development/ Market Relations bei der Magazino GmbH. Sein Fokus liegt auf dem Erschließen und Evaluieren von neuen Märkten sowie dem Aufbau des Erstkontakts zu Kunden. Außerdem setzt Herr Tunk auf On-Site Besuche, um Prozesse und mögliche Veränderungen von diesen nachvollziehen zu können.

Herr Trunk, vielen Dank, dass Sie kurzfristig Zeit für dieses Interview finden konnten.
Selbstverständlich, sehr gerne.

Meine Arbeit hat die digitale Transformation als Thema, ein Buzzword welches schon seit längerer Zeit in aller Munde ist. Wie sehen Sie die bevorstehende Entwicklung in den kommenden Jahren? Steht die große Revolution bevor?
Sicherlich beginnt der Wandel. Die Unternehmen machen sich große Gedanken darüber, wo sich Veränderungen vollziehen werden. Viele Unternehmen müssen noch verstehen, dass da noch gewisse Hausaufgaben zu erledigen sind. Einige haben diesen Drive, andere werden manchmal erschlagen von den Vorkehrungen, die für eine Digitalisierung zu treffen sind. Es handelt sich um einen Prozess, der sich über Jahre hinweg ziehen wird und da befinden wir uns sicherlich noch in der Anfangszeit. Es gibt Unternehmen, einen haben wir auch als Kunden, die schon immer sehr innovativ waren und auch den Mut haben, Veränderungen schnell voranzutreiben. Es gibt allerdings auch andere, die sagen, dass sie noch nicht die Early Adopters sein wollen, sondern erst einmal abwarten, bis die Technologien aus den Anfängen herausgekommen ist. Das stellt natürlich eine Gefahr dar, aber so ist nun mal auch der normale Innovationszyklus.

Magazino bietet Lösungen zur Digitalisierung an. Wie technologisch-fortschrittlich bewerten Sie die eigene Supply Chain? Auf einer Skala von 1 = revolutionär bis 4 = konservativ.

Das ist zwar nicht ganz so mein Bereich, aber ich würde uns hier auf einer 2 sehen. Grund hierfür ist, dass wir noch eine sehr entwicklungslastige Organisation und dadurch sehr agil unterwegs sind. Obwohl wir schon 100 Mitarbeiter haben, was gewisse Herausforderungen hervorruft, können wir dennoch damit ganz gut umgehen. Wir haben ein recht gutes Selbstverständnis und ein Verständnis darüber, wie man schnell und zielgerichtet, eine zukunftsfähige Lösung entwickeln und auf den Markt bringen kann.

In der eigenen Produktion nutzen wir sehr viel 3D Druck, außerdem setzen wir in anderen Bereichen auf RPA. Wir verwenden State-of-the-Art Technologien und versuchen stetig, mit einem offenen Ohr und Auge an neue Technologien heranzugehen.

Sie gehen quasi als gutes Beispiel als Anbieter voran.

Ja, man muss es natürlich auch erfahren, um es erfolgreich mitlenken zu können.

Ihre mobilen Roboter setzen auf künstliche Intelligenz. Welche spezifischen Vorteile und Risiken sehen Sie bei der Implementierung von künstlicher Intelligenz? Diskussionen über einen drohenden Jobverlust und mögliche Sicherheitsrisiken werden ja häufig geführt.

Der riesen Vorteil liegt meiner Meinung nach darin, dass die künstliche Intelligenz, ja datenbasiert ist und somit quasi auch berechenbar sein kann, wenn man sie noch im Griff hat. Auf Basis dessen, basierend auf unseren Robotern, kann man dadurch Wissen und Erfahrungen viel leichter teilen als beim Menschen. Bei menschlicher Intelligenz sieht das ja ganz anders aus, die ist eben nicht so datengebunden und dadurch geht auch vieles verloren.

Auf der anderen Seite will man ja immer nur das teilen, was man auch wirklich möchte oder womit man einen Zweck verfolgt. Man darf daher nicht den Zweck aus den Augen verlieren, was mit der KI beabsichtigt wird. Wir sind sicherlich noch weit weg von dem Intelligenz-Begriff, mit dem man einen Menschen beschreiben könnte. Im Moment arbeitet man noch sehr viel Input-Output und Algorithmen dazwischen. Das wird sich aber auf Basis dessen über die Jahre weiterentwickeln und da muss man zukünftig ein Gespür für entwickeln, was passieren könnte, wenn man es nicht mehr nachvollziehen kann.

Über die Robotik hinaus, welche Prozesse können denn außerdem noch besonders von künstlicher Intelligenz profitieren?

Sicherlich im Service. Deutschland hat eine Service-Kultur, die davon profitieren könnte. Den After-Sales Bereich kann man mit künstlicher Intelligenz auch deutlich effizienter und effektiver gestalten. Hier geht es ja oft um menschliche Beziehungen bzw. um Beziehungen zwischen Organisationen im B2B-Bereich und hier kann man mit KI sicherlich noch Möglichkeiten finden, Prozesse interessanter und besser zu gestalten.

Sie hatten bereits zu Beginn von zu erledigenden Hausaufgaben gesprochen. Was sind denn Ihrer Meinung nach die notwendigen Voraussetzungen beziehungsweise Anforderungen, damit KI erfolgreich implementiert werden kann?

Das lässt sich in zwei große Kategorien unterteilen. Bei der ersten handelt es sich um technische Anforderungen, infrastrukturelle und prozessuale Aspekte, wie eine angemessene WLAN Abdeckung und ein effektiver Prozessablauf. Man kann nicht von heute auf morgen jeden einzelnen Schritt vollautomatisieren. Der Input, also korrekte und vollständige Stammdaten beispielsweise, muss stimmen, damit der Output zufriedenstellen ist.

Die zweite Kategorie, die viele noch nicht verstanden haben, umfasst den kulturellen Aspekt. Das betrifft einerseits die Gesellschaft, die ein wenig konservativer in Deutschland ist, aber auch die Unternehmenskultur. Hier reicht es nicht, dass Digitalisierung nur in den Slogan geschrieben wird. Die Menschen in der Organisation müssen mitmachen und mitdenken.

Welche unerwarteten Herausforderungen sind einem denn in vergangenen Implementierungs-Projekten begegnet?

Hier bin ich leider etwas überfragt. Dennoch ist es oft so, dass man manches als schneller lösbar eingestuft hätte und das am Ende einen bis heute noch beschäftigt. Zeitpläne müssen dann häufig überarbeitet werden.

Sie hatten am Anfang auch von den Early-Adopters gesprochen und dem Rest, der noch vom Seitenstreifen zuschaut. Inwieweit beeinflusst es denn Ihr Unternehmen, dass künstliche Intelligenz noch relativ in den Kinderschuhen steckt?

Ganz eindeutig beeinflusst es uns dahingehend, dass wir noch nicht alle Bereiche bedienen können oder wollen. Wir werden keine Geschäfte eingehen, wo wir kein Potential für danach sehen. Das hätte nur zur Folge, dass wir überall ein Fass aufmachen und am Ende zu viele offene Baustellen und Herausforderungen verzeichnen. Mögliche Skalierungspotentiale sind immer ein

wichtiger Entscheidungsfaktor. Außerdem wollen wir mit Unternehmen zusammenarbeiten, die wirklich hinter dem Projekt stehen, Lust auf die Transformation haben und sich nicht nur Digitalisierung auf die Fahne schreiben wollen.

Welche Parteien sind bei der Implementierung in der Regel involviert? Werden externe Berater von den Unternehmen hinzugezogen oder übernimmt Magazino auch hier unterstützende Tätigkeiten?
Bisher machen wir das komplett alleine.

Welcher Service wird denn über die Bereitstellung der Roboter hinweg noch angeboten?
Die Frage lässt sich ganz gut mit unserem Business Modell beantworten. Ein Roboter bei uns hat einen gewissen Hardwarepreis, damit machen wir allerdings nicht viel Profit. Unser Modell besteht dann daraus, dass wir pro Jahr pro Roboter Lizenzen vertreiben, die dann dafür sorgen, dass der Roboter hinsichtlich Maintenance gut aufgestellt ist und aber auch die Software auf dem neuesten Stand ist. Fortschritte, die wir hier oder aber auch bei Kunde X machen, können wir so auch bei Kunde Y anwenden. Das ist ja auch ein Ansatzpunkt von künstlicher Intelligenz. Die Erfahrungen, die ein Roboter bei Kunde X durchlebt, also beispielsweise ein Greifpunkt erlernen an einem gewissen Produkt, können an die Roboterflotte kundenübergreifend weitergegeben werden. Das ist der große Mehrwert, der hinter unseren Produkten steht.

Der Fokus liegt also auf der After-Sales Dienstleistung. Herr Tunk, wir sind damit bereits an das Ende des Interviews gekommen und ich bedanke mich herzlich für Ihre Zeit und die geteilten Einblicke.
Korrekt. Sehr gerne, einen schönen Abend noch.

Expert interview #5

Date:	13/06/2018
Expert:	Mr. Andreas Hufenstuhl
Company:	PricewaterhouseCoopers GmbH
Industry:	Services (Audit, Tax & Legal, Advisory)
Job position:	Director – Big Data & Advanced Analytics

Herr Andreas Hufenstuhl ist Director bei PwC in Duisburg im Bereich Consulting und Leiter des Bereichs Big Data & Advanced Analytics. Zusätzlich ist Herr Hufenstuhl im Vorstand der Arbeitsgruppe Artificial Intelligence bei *Bitkom*. Als Experte für den Einsatz von künstlicher Intelligenz fokussiert sich dieses Interview daher auch auf diese Technologie.

Herr Hufenstuhl, zunächst einmal danke, dass ich heute mit Ihnen dieses Interview führen kann. Wären Sie bitte so freundlich, zu Beginn sich und ihren beruflichen Werdegang vorzustellen.

Alles klar. Studiert habe ich Informatik und bin vor ca. 20 Jahren in die Beratung gekommen, habe verschiedene Systemhäuser durchlebt, von Oracle bis hin zu CSC Consulting und etliche weitere. In der gesamten Zeit war ich im Umfeld von Data Analytics, Datenmanagement, -planung, -simulation. Außerdem bin ich seit sechs Jahren im Bereich Big Data tätig und seit drei Jahren im Vorstand des Arbeitskreises Artificial Intelligence bei *Bitkom*. Ich konsolidiere und bearbeite dort in mehreren Firmen in Deutschland verschiedene Standpunkte zum Thema AI, wie man diese nutzen kann in den verschiedenen Industrien und die jeweiligen Reifegrad-modelle. Zum einen arbeite ich dort mit den Herstellern zusammen, also beispielsweise Microsoft und SAP, aber auch mit anderen Beratungshäusern wie Accenture und kleineren Spezialberatungen. Die Arbeit erfolgt in verschiedene Kontexten, das beginnt mit naheliegenden Themen wie autonomen Fahren und Robotics aber beinhaltet auch das spannende Thema, was wir eigentlich selbst nicht richtig greifen können, was bedeutet eigentlich „Intelligenz".

Für die menschliche Intelligenz gibt es ja auch keine klare Definition und so ist es auch vermessen zu sagen, dass man eine klare und eindeutige Definition für künstliche Intelligenz hätte. AI kann dann ja auch wieder unterteilt werden in unterstützende/ vorschlagende AI, teilautonome und vollautonome Systeme. Sprich teilautonom sind Systeme wie Flugzeuge, hier haben wir immer noch den Piloten am Steuer, wobei vollautonome Systeme beispielsweise Raketenabwehrsysteme sind.

Sie sind bereits direkt ins Thema eingestiegen und man kann bereits jetzt sagen, dass künstliche Intelligenz bereits in unserem Alltag verbreitet ist. *Digitale Transformation* ist ein Schlagwort, welches man auch besonders in der Beratungsbranche häufig zu hören bekommt. Wie sehen Sie den Einfluss in den nächsten Jahren?

Durch die hinzukommenden Technologien spricht man ja heute auch von digitalen Supply Chains, von der Bereitstellung digitaler Dienstleistungen, die immer mehr zunehmen. Es verändert aber auch wie diese konsumiert werden. Supply inkludiert ja nicht nur die Auslieferung, sondern auch den Return-Prozess, das Einsammeln der zuvor ausgelieferten Assets.

Hinzu kommen auch die automatische Planung, Distribution, autonom fahrende Gabelstapler etc. Ich glaube heutzutage ist viel digital möglich, wir Humanoiden sind nur noch nicht in der Lage unsere Prozesse entsprechend anzupassen und die Digitalisierung entsprechend zu nutzen. Der Faktor Mensch hemmt die Digitalisierung.

Das heißt, wir Menschen müssen zunächst die richtigen Vorbereitungen abschließen, bevor sich die digitale Transformation richtig entfalten kann?

Wir haben im Bereich der AI vor allem immer dann ein Problem, wenn der Mensch mit der AI interagieren muss. Wir haben viele Digitalisierungskonzepte, in denen Roboter Pakete zustellen sollen oder die Zustellung durch Drohnen. Dies wird in der Regel gestört durch Gesetzgebungen oder ein Risiko, dass man ja darüber stolpern könnte, weil der Roboter ja in unseren menschlichen Alltag eingreift. Insofern stört der unkalkulierbare Mensch im Umfeld der automatisierten Systeme oder der Mensch will Verantwortungen nicht abgeben. Sprich, technisch ist viel möglich, der Mensch will es nur noch nicht oder er verlangt direkt ein fehlerloses Handeln. Das ist aber so generell nicht möglich, die Systeme lernen ja durch Fehler.

Bei der Implementierung welcher digitaler Technologien haben Sie bereits aktiv beraten?

Ich habe Webcrawler gebaut, Telematik-Lösungen implementiert, wir haben Kontrollsysteme für autonome Hubwagen entwickelt, Lösungen für optimierte Lagerplanung eingesetzt. Das aber auch alles nicht erst seit gestern. Webcrawler habe ich bereits 2005 gebaut und von daher ist die Digitalisierung eigentlich schon ein älteres Thema. Das was heute oft als neu und revolutionär beschrieben wird, machen wir schon seit 15 Jahren und funktionieren de facto wie auch früher. Auch die Anzahl von Projekten hat sich kaum verändert.

Wo befinden wir uns den aktuell Ihrer Meinung nach im Lifecycle der künstlichen Intelligenz bzw. RPA?

Ganz am Anfang. Wir haben sicherlich die Technologie und die ist an einigen Stellen auch schon echt nicht schlecht. Ich halte nicht ganz so viel von neuronalen Netzen und Deep Learning, weil die nur bei einfachen Brettspielen gut funktionieren. Der Trainingsaufwand ist einfach riesig und das Ecosystem muss wahnsinnig stabil sein. Man muss es sehr stark nach Einsatzgebiet differenzieren, wo AI sehr gut einsatzbereit ist und wo nicht. Regulatorische/ juristische Cases haben beispielsweise ein sehr stabiles Ecosystem. Im deutschen Steuerrecht kommen jährlich ein paar Paragraphen hinzu oder werden etwas abgeändert, aber am Ende des Tages ist das Recht relativ starr und was wo in der Bilanz steht ist eigentlich auch klar definiert. In anderen Einsatzgebieten, beispielsweise dem Kundenservice, in dem neue Kundenanforderungen stetig hinzukommen und sich die Rahmenbedingung laufend verändern, ist der Ansatz der Individualisierung so groß, dass man nur sehr schwierig zum Lerneffekt für das System kommt. Entscheidend ist daher die Reproduzierbarkeit des Geschäftsprozesses. Ist diese gegeben, kann man mit AI fast alles machen, automatisch E-Mails verfassen, Texte verarbeiten etc. So stabil ist aber unser Lebensumfeld nicht. Menschen sind in der Lage einfache Veränderungen kurzfristig zu erfassen und sich zu anzupassen, AI muss da oftmals von vorne anfangen und das auch wieder nur durch Trial and Error. Das will man natürlich bei den meisten Geschäfts-prozessen nicht.

Als wie technologisch-fortschrittlich würden Sie denn die deutsche Durchschnitts-Supply-Chain bewerten? Auf einer Skala von 1 = revolutionär bis 4 = konservativ.

Ich würde uns da auf einer 3 sehen. Vieles ist möglich, die Revolution ist auch realisierbar, aber das wird in den nächsten Jahren nicht kommen.

Es ist also ein langwieriger Prozess mit sehr vielen Zuschauern, die zunächst einmal die Early Adopters beobachten und dann erst Veränderungen anstreben?

Das funktioniert aber so nicht. Das ist zu vergleichen mit der Situation, in der man zum ersten Mal ein Smartphone besitzt. Das ist ein Lernprozess, jede Person muss das für sich durchleben. Danebenstehen und Zuschauen hilft da nicht viel und so ist das auch bei der digitalen Transformation. Jeder muss da seine eigenen Erfahrungen machen und nur danebenzustehen ist keine schlaue Taktik. Alle im Prozess beteiligten Personen müssen die Veränderungen annehmen und müssen überzeugt sein. Der Aufwand des Change-Prozesses ist riesig, aber man muss es eben tun.

Welche spezifischen Vorteile und Risiken sehen Sie bei der Implementierung von RPA?
Grundsätzlich wird das ja von vielen Unternehmen genutzt, wenn es auch nur Teilprozesse in bestimmten Bereichen betrifft. Automatisierung ist ja auch kein neues Thema und so wurden schon immer Jobs wegoptimiert, das war damals so und wird sich auch nicht ändern. Was uns bevorsteht wird nicht groß anders sein, als das was wir in den vergangenen 20 Jahren auch gemacht haben. Ich bin davon überzeugt, dass die fortschreitende Automatisierung mit RPA und AI wesentlich mehr Jobs schaffen als vernichten wird. Jobs werden einfach anders gelagert sein, neue Jobs werden alte, repetitive ersetzen.

Und wie sieht das bei künstlicher Intelligenz aus?
Künstliche Intelligenz ist super bei der Routenplanung, Vorhersagen, Erkennung von Texten und Objekten usw. Unterscheiden muss man da wie gesagt, ob der Einsatz teil- oder vollautonom erfolgen soll. Da wo die künstliche Intelligenz Vorschläge generieren soll, ist der Nutzen in der Regel groß.
Das größte Risiko ist, dass man das System nicht sauber genug trainiert und man sich zu früh vollständig drauf verlässt. Das Problem liegt daher einfach oftmals darin, dass Systeme nicht zu Ende entwickelt werden oder dass die Systeme nicht mit unbekannten Situation umgehen können. Die Daten, mit denen trainiert wird, müssen stimmen.
Für Arbeitnehmer sehe ich wenig Risiken. Das Wissen, sie in den Köpfen haben, müssen sie in die Maschinen überführen und das muss stetig erfolgen beziehungsweise angepasst werden. Das viele Arbeitsplätze schaffen.

Also Voraussetzung für die erfolgreiche Implementierung ist, dass die Stammdaten stimmen und die Mitarbeiter bereit sind für einen Wandel.
Nicht nur Stammdaten, sondern jegliche Art von Daten müssen valide sein. Die Belegschaft wird in aller Regel viele Vorteile in der Transformation sehen und nicht abgeneigt sein. Wahrscheinlich zweifelt sie nur oftmals, dass es funktioniert. Die Belegschaft will auch einen Reputationsschaden vermeiden, hierin liegt aber ein Risiko der künstlichen Intelligenz, weil sie eben wie gesagt durch Fehler lernt. Ohne Fehler geht eine Vollautomatisierung von Prozessen nicht. Die Alternative ist dann, dass ein Mensch weiterhin als letzte Instanz entscheidet. So ist das in Flugzeugen und Zügen auch der Fall, verschläft der Mensch dann aber die Notwendigkeit einzugreifen, entsteht das Problem. Man muss eben experimentieren und bereit sein, Fehler zu machen.

Welche Herausforderungen sind Ihnen denn bei vergangenen Projekten begegnet?

Ich treffe eigentlich immer wieder auf die gleiche Herausforderung und zwar, dass die Annahmen, die vom Menschen getroffen wurden, teils sehr fehlerbehaftet waren. Ein Beispiel hierfür ist die Finanzrichtlinie MiFID II, eine europäische Richtlinie, die über Jahre erarbeitet wurde. MiFID II wurde dann IBM Watson gegeben, der dann wiederum festgestellt hat, dass sich in der Regulation einige Paragraphen gegenseitig ausschließen. Ein Dokument, was über Jahre von etlichen Menschen quergelesen und kontrolliert wurde, weist am Ende dennoch so schwerwiegende Fehler auf. Eine Maschine kann aber in gewissen Prozessen mit solchen fehlerbehafteten Ausgangslagen nicht umgehen. Dass die Beschreibung des Prozesses nie 100%ig fehlerfrei ist, ist für die Beteiligten auch schwierig.

Sie hatten gesagt, dass sich mehr Menschen damit befassen werden, KI zu trainieren. Wie wird sich Arbeit denn darüber hinaus verändern?

Ich glaube, die Arbeitsfelder, in denen Menschen eingesetzt werden, werden facettenreicher und abwechslungsreicher. Gerade Dinge, die nicht sehr repetitiv sind, Tätigkeiten, in denen man experimentieren kann, werden zunehmen und damit auch die individuelle Kreativität. Eintönige Aufgaben werden dagegen von der Maschine abgenommen. Das betrifft meiner Meinung nach allerdings auch sehr akademische Jobs. Studiengänge, in denen Studenten sehr viele Paragraphen auswendig lernen und verstehen müssen, aber auch das Medizin-Studium, sind langfristig bedroht. Der Mediziner verschreibt Medikamente oder Therapien basierend auf der Analyse von Symptomen, das lässt sich relativ einfach automatisieren durch eine KI.

Weniger bedroht sehe ich Jobs, in denen die Bedingungen sich jeden Tag verändern, beispielsweise durch neue Marktsegmente, Kundenanforderungen, Risiken oder auch soziale/ emotionale Aufgaben, wie die des Lehrers.

Vieles wird sich in der Logistik, im Cargo-Bereich verändern. Durch autonomes Fahren wird sich auch beispielsweise das Jobbild des LKW-Fahrers ändern. Vergleichen lässt sich das mit den Lotsen bei Containerschiffen, diese übernehmen die Steuerung auf dem letzten Abschnitt der Route im Hafenbereich. So wird die Technik das Fahren auf dem Hauptteil der Strecke übernehmen, der LKW-Fahrer steuert dann nur noch die letzte Meile, vergleichbar auch mit dem Piloten heute. Die Autobahn hat ja in der Regel zwei oder drei Spuren, geht relativ geradeaus und generell sind nicht so viele Variablen unbekannt wie es im letzten Abschnitt bei der Anfahrt an die Rampe der Fall ist. Bis die KI den gesamten Prozess übernimmt, wird es dagegen noch eine Weile dauern.

Vielen Dank für die zahlreichen Informationen. Gibt es Ihrer Meinung nach noch etwas, was ich vergessen habe zu fragen oder würden Sie noch gerne etwas ergänzen?

Ja, ich würde gerne noch ein Beispiel zum Thema Arbeitslosigkeit ergänzen. Amazon Alexa ist ja wahrscheinlich bekannt. Alexa, basierend auf AI, ist eine Supply Chain Komponente. Im Endeffekt soll der Kunde nicht im Online-Store nach dem Produkt suchen, bis er es schlussendlich findet, sondern einfach sagen können „Alexa, schick mir mal bitte eine Kiste Wasser vorbei“. Es geht also darum, dem Kunden zu ermöglichen, einfacher und schneller an seine Waren zu kommen und diese zu konsumieren. Für den Kunden wird es also dadurch optimiert, dass er nicht ein Tablet/ iPhone oder sonstiges verwenden muss, sondern dies im Vorbeigehen erledigen kann. Das erfolgt in der Hoffnung, dass der Umsatz dadurch steigt. Hat das irgendeinen Arbeitsplatz gekostet? Nein. Es hat Unmengen an Arbeitsplätzen geschaffen. Alexa musste entwickelt werden, Alexa muss regelmäßig weiterentwickelt werden, also Fehler behoben werden. Durch den erhöhten Umsatz gibt es dann auch noch mehr Bedarf an Packern und sonstigen Mitarbeitern, die diesen ermöglichen.

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I declare that I wrote this thesis independently and on my own. I clearly marked any language or ideas borrowed from other sources as not my own and documented their sources. The thesis does not contain any work that I have handed in or have had graded as a Prüfungsleistung earlier on.

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