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ABSTRACT

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Abstract

Automation of jobs has always been a popular subject in research. The service industry has long been neglected in this matter. Due to advances in technology, jobs are increasingly becoming automatable in this economically dominant industry as well. Robotic Process Automation is a solution that enables the automation of digital processes on computers, often encountered in the service industry. The study aims to provide insight in the impact Robotic Process Automation currently has, and may have in the future, on employment in the service industry. To collect data, an exploratory qualitative research was designed. In-depth interviews with thirteen experts were conducted. It appears that currently Robotic Process Automation does not have a large impact on employment. However, it has the ability to impact the *quantity* as well as the *quality* of employment in the service industry in the future.

Key words	Automation, Services, Service Industry, Robotic Process Automation, RPA, Service Delivery Automation, Outsourcing, Job Automation, Computerization
Note	The thesis is part of the Master program: Information Technology for Enterprise Management (ITEM) jointly organized by the University of Turku and Tilburg University. The study was conducted at Accenture in Amsterdam.





ROBOTIC PROCESS AUTOMATION: AN INDUSTRY CHANGING TECHNOLOGY OR A BRIDGE BETWEEN THE OLD AND THE NEW?

Master Thesis
Information Technology for Enterprise Management (ITEM)

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Tilburg

PREFACE

The Master thesis report that lies in front of you is part of the Master program: Information Technology for Enterprise Management, or ITEM in short. This Master program is jointly organized by Tilburg University in the Netherlands and the University of Turku in Finland. It has been a very interesting and educational period, and I have enjoyed spending the time at both Universities.

I chose the subject for this Master thesis out of personal interest. I always have mixed emotions when I hear about a new job-replacing innovation on the news. It is mind blowing what can be achieved with modern day technology, which is part of the reason why I chose to study what I am studying today. However, I am also wondering where the people behind those automated jobs go. Will there still be enough jobs left in the end?

There are many people who helped in establishing this report. First of all, I would like to thank Peter Buijs from Accenture. He has been a great supervisor during the research. I also want to thank Accenture of course, for offering me the opportunity to write my thesis at a company that is packed with relevant knowledge.

Anne-Françoise Rutkowski and Eija Koskivaara, I would like to thank you both for the supervision of my thesis. But most of all, I would like to thank you for helping and supporting us during the ITEM course. That must have been a lot of work! Everything was managed perfectly.

I am also very gratefull for the experts that participated in this research. Without their knowledge and cooperation, this report would not have been this extensive.

I wish you pleasant reading,

Patrick Oosterheert

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1 INTRODUCTION

In this chapter of the report the subject under study will be introduced and the purpose of the study will be explained. First, the setting of the research project will be elucidated. Next, the problem scope of the research. What remains is an explanation of the structure, providing an overview of the contents.

1.1 Research Background

If you watch the news or read a newspaper, you have probably heard or read about an innovation that is able to execute tasks that were previously performed by humans. The subject here is automation. The first fully automated process dates back to 1785, when Oliver Evans was able to mechanize an entire process from raw grain to bagged flour without the need of human intervention (Hounshell, 1984). The next major advance in automation occured in 1961, when the first industrial robot was invented by George Devol (Nof, 1999). The robot was given the name Unimate and permiered on an assembly line in a factory of General Motors (Menzel & D'Aluisio, 2000). Unimate was able to replace a human workers' manufacturing tasks, which allowed for the complete automation of a manufacturing process. As illustrated with these leading examples, automation is often linked to employment. By making use of machines, computers or computer programs, automation enables the replacement of humans. The manufacturing industry has always been an important point of focus for automation efforts. However, due to the economic shift from the industrial revolution to the information age, automation expanded beyond its roots to include applications in sectors of the service industry (Goldberg, 2012). Fueled by the advances of information technologies, the first movement of automation in the service industry appeared and was labeled office automation (Zisman, 1978). A more recent example of automation in the service industry is called Robotic Process Automation or RPA in short. This new technology is said to be able to easily and efficiently automate digital processes. The current study investigates the technology when applied within the service industry.

1.2 Problem Indication & Scope

Automation is a popular subject of research. Mostly, the focus of these research projects is the manufacturing industry. The aim of the current research is to focus the attention more towards the service industry. A relatively new technology that is often being linked with automation in the service industry is RPA. The technology is specifically useful to automate administrative digital processes, which are widely available in companies within this industry. Since it is a relatively new technology, it has not been mentioned in research before. Therefore, the current research aims to explore: what

kind of technology Robotic Process Automation is, how it impacts employment in the service industry and if it can be considered a revolutionary technology or a ”bridging phase” between older automation solutions and automation solutions that are en route. Furthermore, the study focusses on the future impact of developments in automation on employment in the service industry.

1.3 Research Question

As stated above, this research aims to gain knowledge on a relatively new automation technology, called: Robotic Process Automation. This technology is said to be useful to automate administrative digital processes. Therefore, the choice was made to focus on its application and impact on employment within the service industry. Subsequently, the main research question reads;

> RQ: What is the current and future *impact* of *Robotic Process Automation* on *employment* within the *service industry?*

Before developing sub-questions and a research design, the main topics in this research will be further investigated in the literature review. Automation and employment are popular subjects of research, but less is known about automation in the service industry as well as Robotic Process Automation. The aim of the literature review is to list all the currently available knowledge so that appropriate sub-questions can be formulated. Therefore, the following descriptive questions about the research topics will be covered;

Automation and Employment

- *What is the impact of automation on employment?*

Automation in the Service Industry

- *How did automation develop in the service industry?*

Robotic Process Automation

- *What kind of technology is RPA?*
- *How does it work?*
- *What can be automated with RPA?*
- *How does it compare to other automation solutions?*
- *What does the RPA market look like?*
- *What are the benefits and challenges?*

When these parts of the main research question are explained in more detail, appropriate sub-questions can be developed and a research design can be constructed.

1.4 Structure

Since the literature review is used as an introduction on the subjects in the main research question, the structure of this part of the report will be explained and illustrated individually. After that, the structure of the complete report is explained to provide an overview.

1.4.1 Literature Review

In this research, the impact of RPA on the employment in the service industry is under investigation. RPA as an automation solution has not yet been mentioned in prior research, but the concept of automation is a popular subject in studies. Therefore, the literature review tries to converge from a broader point of view of automation to RPA. First, what is known about the future and current impact of automation on employment will be listed. Next, automation in the service industry will be explained in more detail. And finally, information concerning RPA is gathered to complete the literature review and the introduction of the main subjects in the study. Figure 1 illustrates the converging action of this part of the report which will be used as a guiding illustration during the literature review.



Figure 1: Structure of literature review

1.4.2 Report

The report has a standard research structure as illustrated by Figure 2. It starts with the introduction of the research project. What follows is the literature review of which the structure and purpose was already mentioned above. Next is the research methodology chapter where the research design is introduced. After that, the results of the designed research are presented. To conclude, the last chapter will contain a discussion on the research results and a conclusion and recommendations for further research. The bibliography as well as the appendices are included at the end of the report.



Figure 2: Structure of the research report

2 AUTOMATION AND EMPLOYMENT



The link between automation and employment has been a subject of discussion and research for a long time. Automation is defined in the dictionary as a way of minimizing human intervention in a process. One may therefore automatically assume that automation impacts employment negatively. Note that the *quantity* of employment is being discussed here, or in other words the number of available jobs. Countless research projects have focused on studying the link between automation and employment. The most relevant and interesting research projects and their results will be discussed next. Furthermore, expert opinions about future developments of the link between automation and employment will be listed.

2.1 Automation in Research

John Maynard Keynes predictions as an economist are frequently cited in research on automation. Keynes predicted in 1930 that technological unemployment would become a great threat. Technological unemployment basically means that humans are replaced by machines in a higher pace than new jobs are being created. His predictions have fueled a lot of discussions and research on automation and employment ever since. In his time, technological changes greatly affected productivity in mining, manufacturing, and transport (Keynes, 1963). This was mostly accomplished with mechanization. Remarkably, computerisation of jobs was not yet a subject in the matter when Keynes made his predictions.

Computerisation of jobs is referred to as job automation by means of computer-controlled equipment. This has been the subject of more recent research. In a study conducted by Frey and Osborne (2013), the susceptibility of jobs to computerisation was under investigation. They found that of the 702 included occupations, about 47 percent was at risk of being automated by computers over the next two decades. The results of a similar study conducted by the consulting firm McKinsey&Company, showed that few occupations are fully automatable by computers. Instead, they concluded that 60 percent of all occupations have at least 30% of activities that are technically automatable by computers (McKinsey&Company, 2017). The research was based on adapting currently available technology. The approach of the prior mentioned research projects was criticized by another research project on job automatability. The researchers argue that the number of jobs that are susceptible to automation is not nearly as high as the other studies predict, while the high-risk labeled occupations in these studies still contain a substantial share of activities that are hard to automate (Arntz, Gregory,

& Zierahn, 2016). As a result, the average percentage of jobs that is susceptible to automation in their study is 9%. A big difference from the other percentages.

2.2 Evidence

None of the above mentioned research projects came up with quantitative evidence of the number of jobs that are currently being replaced by automation. The reason why it is difficult to assess the exact impact of automation on jobs is that automation is often used to make humans more efficient and not necessarily to replace them. Besides that, there are also other effects that need to be taken into account when assessing the impact of automation. For example; some industries and companies may experience an increase in demand for labor when automation is used in another industry or company. In a research that targets automation in the manufacturing industry, Acemoglu & Restrepo (2017) tried to take these effects into account and in doing so, they analyzed the impact of industrial robots on the US labor market. They found evidence of a reduction of the employment to population ratio by 0,18 to 0.34 percentage points when an increase of one robot per thousand workers occured.

The highly respected academics Erik Brynjolfsson and Andrew McAfee have also investigated the link between automation and employment. They argue that technology is detroying jobs faster than it is creating new ones. The chart that shows the productivity and employment rates in the United States as seen in Figure 3 (Rotman, 2013), is argued to offer evidence of this notion. What can be seen on the chart is the sudden slowdown of job growth in 2000, whereas the productivity keeps on rising gradually from this point. By 2011 this evolved into a large gap, and this is what Brynjolfsson & McAfee call the ”Great Decoupling” (2015). Besides this change in productivity and employment the economists also see that while productivity is at a record high, the median income is falling and

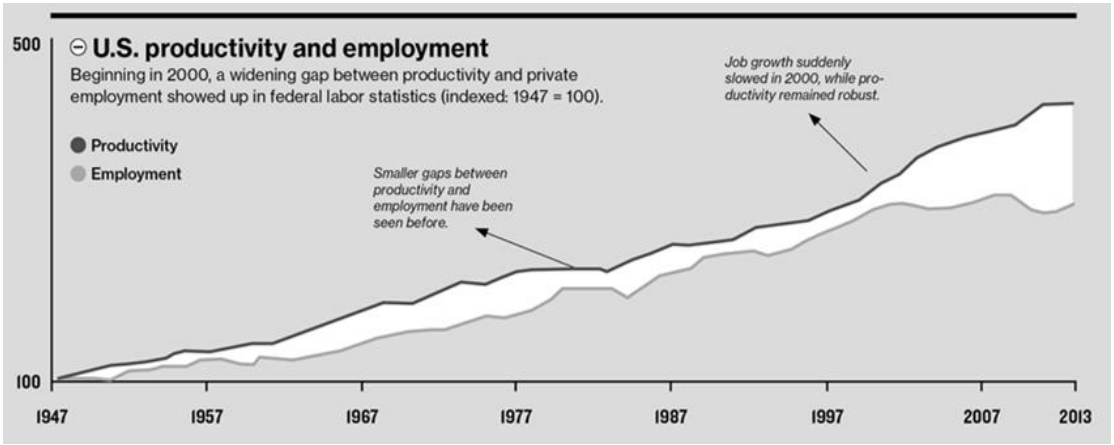


Figure 3: the Great Decoupling. Adjusted from: *”How Technology is Destroying Jobs”* by D. Rotman, June 12 2013

there are fewer jobs. Furthermore, they found that this was not only happening in the United States but on an almost similar scale in Sweden, Finland and Germany (Brynjolfsson & McAfee, 2015). The cause of these changes is in the eyes of Bynjolfsson and McAfee the fast pace of technological innovation and the fact that people and organizations can not keep up with this rapid change. Technology is in their eyes also the cause of what economist David Autor calls the hollowing out of the middle class and job polarization (2010). In his paper about the job market in the United States, Autor concluded that employment and earnings are rising for low-skill and high-skill occupations. On the contrary, job opportunities for middle-skill occupations are declining. This is argued to be caused by the advent of computer technology taking over jobs like bookkeeping and repetitive manufacturing work. Jobs that typically are middle-skill occupations.

There are however also economists that argue differently, and say that there is no conclusive evidence that new technologies are behind the loss of jobs. In a paper by Rotman for the MIT Technology Review Magazine, several experts in the field of labor were asked for their opinion. They argued that the loss of jobs can just as well be explained by other factors such as global trade related events or the financial crisis (Rotman, 2013). Furthermore, almost every workplace innovation in history aimed to substitute humans. So why is it that there are still so many jobs left after implementation of all these labor saving innovations? Autor argues this is because of an often overlooked fundamental economical reality: automation complements tasks that cannot be substituted by automation (2015). Meaning that productivity improvements due to automation in one task of the process will almost always increase the economic value and thus the manpower needed to perform the remaining tasks.

Evidently, automation has been a subject that received a lot of attention from researchers and experts. This will probably not change any time soon, since there is still no definitive evidence about its impact on employment. Nonetheless, people are already envisioning what the future impact of automation may be on employment, and the debate is just as undecided. Pew Research Center asked a myriad of 1.896 experts if they thought automation related technologies would have replaced more jobs than they would have created by 2025 (Smith & Anderson, 2014). The results are telling. 48% of the experts is pessimistic and thinks jobs will be replaced by automation, income inequality will rise and a lot of people will be technologically unemployed. The other 52% is more optimistic. Among other arguments, they refer to the industrial revolution where humanity was also able to create enough new jobs and ways to make a living.

This chapter listed what is already known and not yet evidently proven to be true about the link between automation and employment. The cited research and opinions of economists give an idea about the abundance of factors that are involved when studying the link between automation and employment.

3 AUTOMATION IN THE SERVICE INDUSTRY



The previous chapter focussed on the impact of automation on employment. The next step in the literature review converges further on the subject of automation. Automation is present in every industry. However, in this research project the focus is directed specifically to the service industry. Hence, the current chapter explains how and why automation gained interest in the service industry.

3.1 Economic Dominance of the Service Industry

The service industry is one of three industries an economy theoretically exists of. The other two are the agricultural industry and the industrial-manufacturing industry. During the last three centuries, economic dominance shifted between industries in developed countries. An important cause of this shift has been technological improvement, starting from the Industrial Revolution around 1700. For example, agriculture employed 41 percent in America in 1900. By 2000 this amount dropped to only 2 percent due to all kinds of agricultural innovations (Rotman, 2013). Likewise, employment in manufacturing dropped from 30 percent around 1945, to only 10 percent nowadays, partly because of automation technologies. Until the second half of the twentieth century, the service industry was deemed non-productive and neglected as being an important factor in the economy of a country (Giarini, 2016). Currently, the service industry is the dominant industry and employs the largest share of people in developed countries. In total, about 70 to 80 % of economic value is produced by services (Giarini, 2016). The fact that the service sector is economically dominant is in itself a possible explanation of why automation of tasks in the service industry is gaining attention. The impact of such innovations may be enormous, just like they were for the agricultural as well as the manufacturing industry.

3.2 Technological Advances

Besides the fact that the service industry was seen as a non-productive sector before, technological advancements are another explanation for the reason why automation in the service industry is something of more recent times. Nowadays, there are plenty of manufacturing plants working with a ”lights-out manufacturing” process, meaning that the whole process is automated and factories can be left working completely unattended. It is safe to say that automation in manufacturing is highly developed and in its maturing phase. The reason why automation in services is not yet at this stage is because of the nature of the tasks and the environment. In manufacturing, the whole process as well

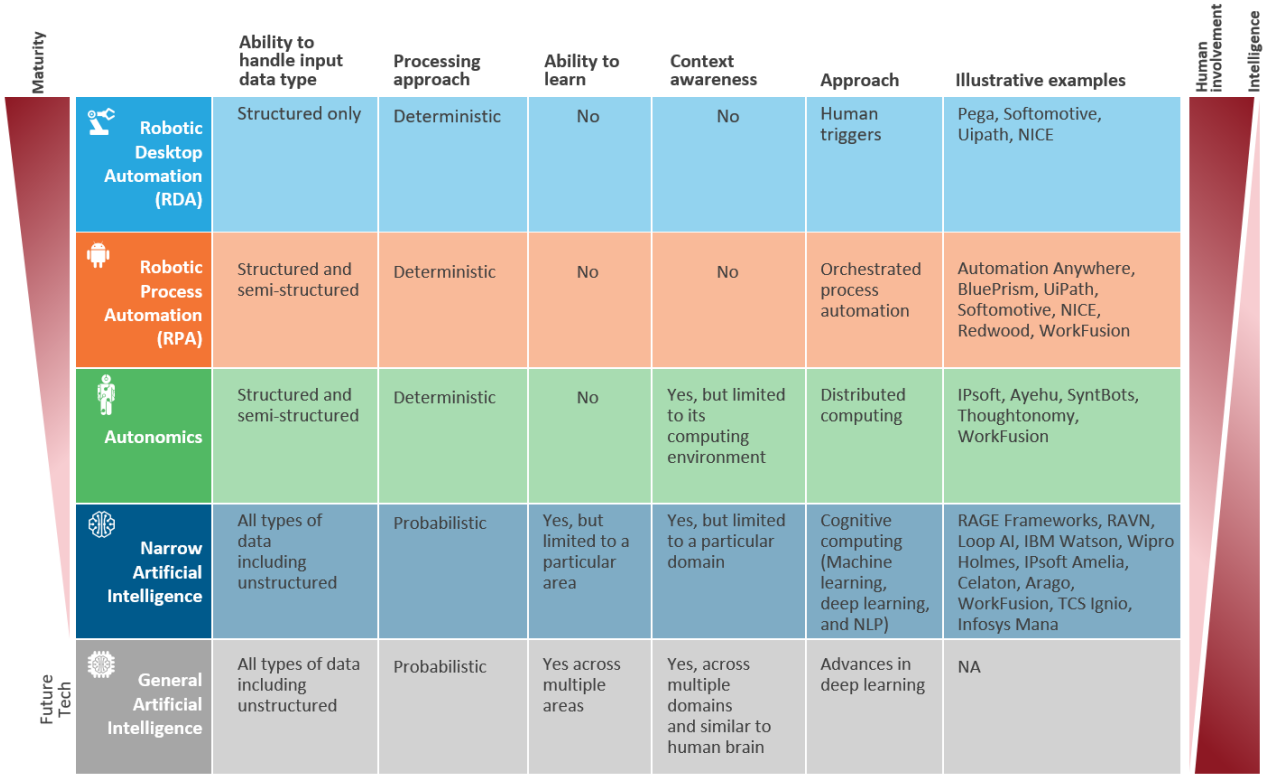
as the environment can be standardized and regulated. The lack of possible environmental regularization and the lack of flexibility of automation technology posed a major obstacle in the service industry (Autor, 2015). However, due to progress in programming and computer technologies, robotic systems are rapidly gaining the ability to handle non-standardized tasks, at an economically feasible cost (Decker , Fischer, & Ott, 2016). This is another reason why automation increasingly becomes a part of the service industry.

3.3 Robotic Process Automation in the Service Industry

This chapter explained how and why automation gained interest in the service industry. It has become a dominant factor in the present economy. 45 to 80 percent of the tasks in this particular industry is related to transforming and distributing data and information (Gölpek , 2015). A fairly recent innovation which is said to be capable of automating many of these digital tasks and processes is called Robotic Process Automation or RPA in short. To introduce the subject, a taxonomy of automation solutions in the service industry is given first.

3.3.1 Taxonomy of Automation Solutions in Services

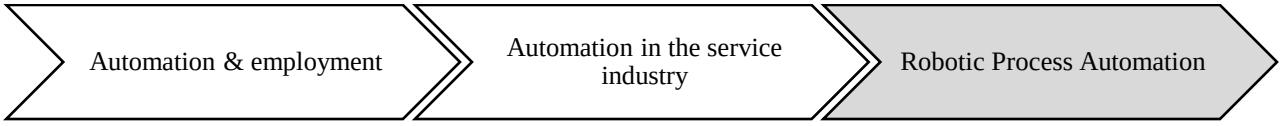
Before explaining RPA, it is helpful to know where this technology can be placed in the large spectrum of automation solutions. Nowadays, automation is everywhere from the car that you drive, to the place where you work. RPA is part of the subset of technologies that is used to automate processes. These technologies are currently surging in the global services industry. Therefore, the research and consultancy company Everest decided to categorize them as Service Delivery Automation technologies (2017). Based on this category of technologies a continuum was developed on which the different types of automation technologies are illustrated and described as seen in Figure 4 (Everest Group , 2017). The figure shows where RPA is placed in this continuum and what its characteristics are as opposed to other process automation technologies. RPA is described as a deterministic approach that can only handle unstructured and semi-structured data. The technology is not able to learn by itself and has no context awareness. According to Everest, there is still relatively much human intervention involved when the technology is applied. Newer process automation technologies like Autonomics and Narrow Artifical Intelligence are able to handle a wider variety of types of data and are gaining the ability to learn by itself, resulting in less human involvement. The next phase of the literature review will focus on explaining more about RPA.



	Ability to handle input data type	Processing approach	Ability to learn	Context awareness	Approach	Illustrative examples
Robotic Desktop Automation (RDA)	Structured only	Deterministic	No	No	Human triggers	Pega, Softomotive, Uipath, NICE
Robotic Process Automation (RPA)	Structured and semi-structured	Deterministic	No	No	Orchestrated process automation	Automation Anywhere, BluePrism, UiPath, Softomotive, NICE, Redwood, WorkFusion
Autonomics	Structured and semi-structured	Deterministic	No	Yes, but limited to its computing environment	Distributed computing	IPsoft, Ayehu, SyntBots, Thoughtonomy, WorkFusion
Narrow Artificial Intelligence	All types of data including unstructured	Probabilistic	Yes, but limited to a particular area	Yes, but limited to a particular domain	Cognitive computing (Machine learning, deep learning, and NLP)	RAGE Frameworks, RAVN, Loop AI, IBM Watson, Wipro Holmes, IPsoft Amelia, Celaton, Arago, WorkFusion, TCS Ignio, Infosys Mana
General Artificial Intelligence	All types of data including unstructured	Probabilistic	Yes across multiple areas	Yes, across multiple domains and similar to human brain	Advances in deep learning	NA

Figure 4: Service Delivery Automation Continuum. Reprinted from: *Service Delivery Automation (SDA) Continuum, Market Insights*, by Everest Group, May 9 2017. Retrieved from: http://www.everestgrp.com/2017-05-service-delivery-automation-sda-continuum-market-insights-40037.html/

4 ROBOTIC PROCESS AUTOMATION



This chapter of the literature review is dedicated to exploring the field of Robotic Process Automation, or RPA in short. The definition of the term, the technology itself, and other important aspects of RPA will be discussed. The goal is to have a deeper understanding of the subject and to explore opportunities which the study could focus on.

4.1 Definition

In January 2017, a patent has been published for the term Robotic Process Automation. The patent is owned both in the United States and in Europe by Accenture, a management consulting and professional services firm (United States of America Patent No. US9555544 B2, 2017) (Europe Patent No. EP3112965 A1, 2017). Accenture defines Robotic Process Automation in these patents as;

> *"Methods, systems and apparatus, including computer programs encoded on a computer storage medium, for automating a manual process.".*

This description only provides a general idea about what RPA entails. However, it does not explain the kind of technology that is used or what kind of manual processes can be automated. A more comprehensive description of the term comes from the Institute for Robotic Process Automation and Artificial Intelligence or IRPAA in short (2017);

> *"Robotic Process Automation is the application of technology that allows employees in a company to configure computer software or a "robot" to capture and interpret existing applications for processing a transaction, manipulating data, triggering responses and communicating with other digital systems."*

The definition by the IRPAA explains a bit more about the kind of processes or tasks that can be automated using this technology, since it addresses the processing of transactions and the manipulation of data. Furthermore, they argue that RPA can work with different digital systems, meaning that the automation effort could be able to stretch to more than one digital system. What further draws attention in the definition by the IRPAA is the quoted term robot. To clarify this, the background of robots in automation is explained in more detail first.

John T. Diebold is regarded to be a pioneer in the field of automation. He was the first to write a book about the concept of automation in factories. He described it as being both the automatic operation and the process of making things automatic (Diebold, 1952). In its present form, automation is often regarded to be a technique of operating something without the interference of human beings. In the manufacturing industry, the link between automation and robots is rather straightforward. Robots in a manufacturing setting can be seen as a tool for automation since they *enable* automation. Take for example an assembly line where human workers are replaced by robots in order to automate the whole process of manufacturing a product from start to finish. In the case of RPA, the idea is the same as in this example but the setting is different. First, there is a digital process, instead of the physical assembly line. Second, the end product of the process is not a physical product that rolls off the assembly line but a digital one that is send to another process or user. And third, the robots that enable the automation of the digital process are not physical but of a digital kind. These so-called robots are actually scripted software programs and applications (M. Grauwmans, personal communication, July 18, 2017). Since this software is supposed to replace the work of a human being, just like in the manufacturing setting, the robotic part in the term Robotic Process Automation seems to be added purely for metaphorical reasons. It expresses the fact that the automation software is mimicking and replacing a human worker. For the remainder of the report it needs to be clear that when RPA is addressed, there is no physical robot involved but rather a scripted *software* program or *application* developed to automate a digital process. The aim now is to construct a clearer picture of what RPA is, starting with an explanation of the technology behind it.

4.2 Technology

RPA is used to automate digital processes, that much is clear. The next step is getting to know what kind of technology is used to be able to automate these processes and how RPA technology evolved into what it is today. Besides that, the existence of RPA among other automation solutions will be investigated.

4.2.1 The History of RPA

At the time of conducting the study, there was no scientific research available that specifically targeted RPA. This is probably because RPA is a relatively new technology and term. Therefore, this chapter describes older, better known solutions of automating office work to try and determine the history and evolution of RPA technology. Different technologies, their solutions and their link with RPA will be explained. In the end, a timeline is used to summarize and illustrate the findings.

Office Automation

The paper written by Michael D. Zisman (1978) is the oldest that came up when searching the literature on earlier automation efforts. The subject of investigation in this paper is *office automation*. Zisman implies that in the late sixties the term office automation was used to refer to the application of computers to well structured, high volume office tasks. Later, it was used to refer to the application of computer technology, communications technology, systems science and behavioral science to the vast majority of less structured office functions which have not been amendable to traditional processing technology (Zisman, 1978). Either way, office automation is concerned with increasing the productivity and automating the work of office workers. Therefore, it clearly has a link with RPA. However, office automation is concerned with simply using computer technology instead of manual labor and paper to automate tasks. RPA goes one step further by leveraging the presently available computer technology to automate tasks and digital processes. It assumes that computer technology is all around which is of course the case for today's office workforce. Considering the above, in this study, office automation is seen as a predecessor of RPA. The advent of office automation is a result of the shift of interest from the manufacturing industry to the services industry at the end of the industrial revolution. This shift of interest began around 1950 and is often called the post-industrial revolution, the information age or the service sector revolution (Collier, 1983). The services industry started to become the dominant industry in terms of the number of available jobs and Gross National Product in America. Before this shift, organizations made little investments in office workers compared to factory workers. The capitalization per office worker ranged from 2.000 to 6.000 dollar compared to about 25.000 dollar for a factory worker (Zisman, 1978). In the manufacturing industry, the use of automation solutions enabled impressive productivity gains. Offices in the services industry did not chase automation solutions until this industry gained interest due to becoming economically dominant and cost trends surfaced. Labor costs were rising, while communication and computer technology costs were dropping significantly (Collier, 1983). Consequently, different capital versus labor decisions were made, computer technology was more frequently applied in the offices, and office automation became a strategic choice for businesses. Office automation is considered to be the first step towards RPA. The next step is considered to be screen scraping technologies, and workflow automation and management.

Screen Scraping Technologies

Screen scraping is a method of extracting data or content from a computer screen that was originally intended to be seen by a human (Merrill, 2009). The screen scraping tool extracts important data by reading the computer screen and uses and manipulates the data programmatically. The technology has evolved over the years and is most frequently used to search webpages for important data. Price comparison websites use this technology to periodically extract data about products from different e-commerce webpages to fuel their comparisons. Another example comes from search engines that use the technology to index websites. Screen Scraping technology is also being used in organizations as

a way to cope with legacy information systems. A legacy information system can be defined as an information system that significantly resists modification and evolution (Brodie & Stonebraker, 1995). It is often the back bone of an organization since it has been used to consolidate important business information since the start. These systems are expensive to maintain, run on obsolete hardware, and are difficult to integrate with other systems while they often lack clean interfaces (Bisbal, Lawless, Wu, & Grimson, 1999). A solution to this problem is called “wrapping”, which entails the surrounding of the existing data, programs, applications and interfaces with a new interface. screen scraping technology is the most widely used technology to accommodate the wrapping of a legacy system with a graphical user interface, leveraging the legacy data in a cheap and effective way (Bennett, 1995). Screen scraping is a technology that is closely related to RPA. It is also able to extract data from a computer screen and manipulate or move the data automatically. In a report by McKinsey & Company, screen scraping is mentioned as being a part of the current RPA (2016). They see it as the slow lane on a three-lane motorway. The slow lane, or screen scraping, entails a user that simply wants to collect data and put it in a document, the second lane is where specialist programmers design the robot to automate a process and the fast lane is enterprise specific automation software that is reusable and scalable (McKinsey & Company, 2016).

Workflow Automation and Management

Office automation in the 1970’s left a lot of isolated automated office tasks such as word processing and mail merging. While today’s office is incomparable to offices back then, there are still a lot of those inefficient processes. Workflow automation and management tools were developed to automate business processes by coordinating and controlling the flow of work and information between participants, making the office more efficient (Stohr & Zhao, 2001). To better understand workflow management, the basic concepts of a workflow need to be explained. In doing so, terminology developed by the Workflow Management Coalition (WfMC) is used (Hollingsworth, 1995). The coalition was established to create consistency in the use of terminology across the industry. Workflow management, as defined by the WfMC, takes care of allocating documents, information and tasks of a business process to the right participants of that business process and does this in an automated manner and according to a pre-defined set of rules (Hollingsworth, 1995). The business process in turn consists of different activities and procedures. A workflow tool is used to route the activities that need to be completed to the right participant in the business process to ultimately complete the process. This description of the workflow demonstrates the link with RPA. If you replace the participant in the business process with RPA software, you will end up with a completely automated process.

Timeline

Workflow automation, screen scraping and office automation all have a clear link with RPA and are considered to be the preceding phases leading to what is currently known as RPA. To summarize this evolution and to conclude this chapter, the timeline in Figure 5 illustrates the findings.

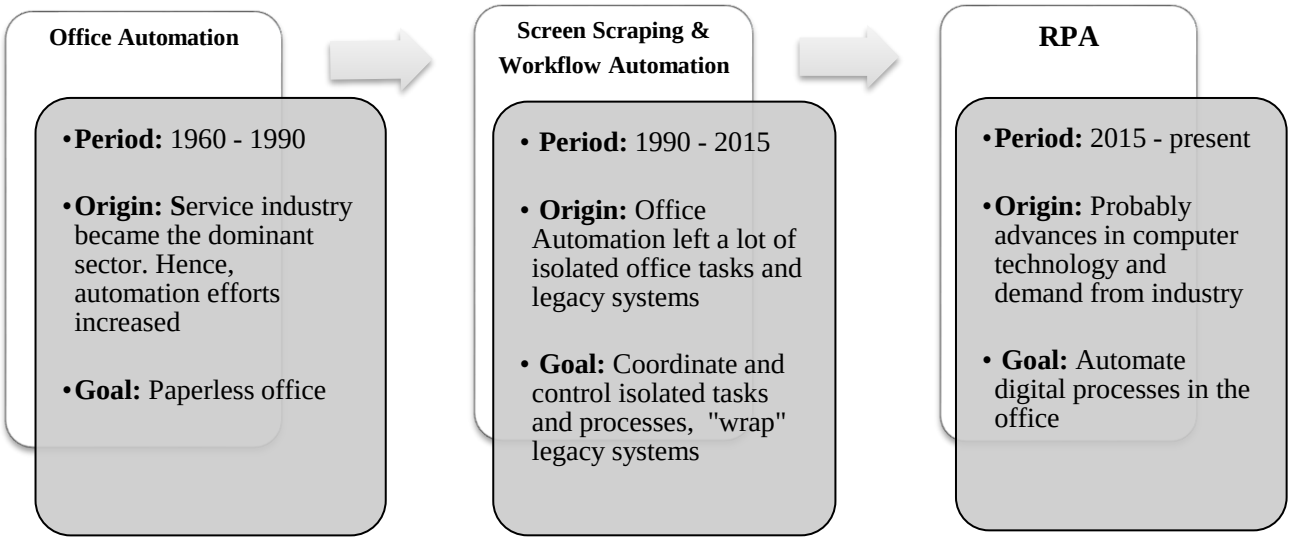


Figure 5: Timeline of the evolution of RPA. Note: dates are rough estimates

4.2.2 How RPA Functions

RPA technology is often called lightweight IT or non-invasive technology (Lacity & Willcocks, 2015). To better understand this claim, the Open System Interconnection (OSI) Reference Model will be used. The model, introduced by the International Organization of Standardization, provides a common basis for explaining and communicating about the exchange of information between systems (ISO, 1994). For this reason, the OSI-model is often used by network technicians to explain how applications work and communicate with each other (Briscoe, 2000). The OSI model comprises of seven different layers as seen in Figure 6. (Tech-Faq, n.d.). These layers are used as a structuring technique to illustrate the fact that the layers serve each other when data is sent between devices (Zimmermann, 1980). The basic idea is that each layer in the system has its own unique functions and adds value to the data transferring process of subsequent layers. Usually the process starts at the application layer. The data will pass all the layers in the stack and will be broken down in smaller chunks of data before being sent to its recipient over the network via the physical layer. On the other side of the network the recipient's device will receive the data via its own physical layer where it will be passed up the stack and pieced together again to be read and used by the application layer. The individual layers of the model will be explained from the bottom to the top, but without going too much into the technical details, since this is not necessary to explain how RPA works.

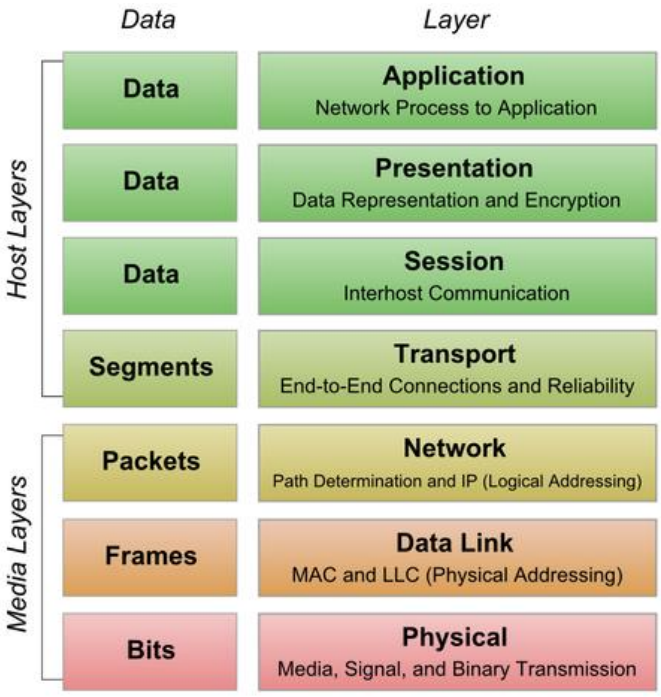


Figure 6: the Open System Interconnection reference model. Reprinted from "The OSI model," by Tech-Faq, n.d

Layer 1: Physical layer

This layer handles the data that is sent between the nodes or computers in a network. It is responsible for carrying the data, that is now still in the form of bits, across physical hardware. Essentially, this layer represents the hardware of a computer, being it the Ethernet cables, storage devices or circuit. It is responsible for transferring the data to where it needs to be.

Layer 2: Data Link layer

The data link layer enables the movement of data over the network. It is responsible for the establishment of an error-free connection between two devices. The bits that are received from the

physical layer are now transformed into so called frames. Basically, frames are bits that are arranged in an orderly manner, giving the bits meaning.

Layer 3: Network layer

The networking layer is concerned with the task of routing the packets of data to the right address. It is comparable to a normal package that gets the contact information of the addressee on it and is send with the right delivery truck. However, the router uses IP addresses, the number by which a device that is connected to a network can be identified, to route the packets of data to its destination. The network layer decides which physical path the data takes.

Layer 4: Transport layer

While the networking layer is responsible to transfer the data, the transport layer makes sure that the data is ready and in the right form to be transported. Furthermore, it needs to guarantee data delivery and make sure that errors in the data are detected and recovered. The transportation of data happens via protocols which are active in the transport layer. The best-known protocol is the Transmission Control Protocol (TCP). TCP is often used for file transferring over the internet.

Layer 5: Session layer

A session is when devices or applications on a network communicate with each other. The session layer is not responsible for transporting the messages but it is responsible for contacting the other party in the communication and establishing and terminating the connection between devices. The session layer is almost always active when the user of a computer is accessing a webpage. It communicates with the server of the webpage to determine how it should encrypt the user's data.

Layer 6: Presentation layer

The presentation layer is responsible for formatting the data in such a way that the receiving application can understand and use it. Therefore, it is able to convert protocols, translate data, interpret graphic commands and encrypt or decrypt transferred data when needed. This layer also contains the code that manages the user's interaction with the device via a so-called user interface. The layer is considered the last layer after the application layer in which the data structure and presentation can still be modified before being send into the network.

Layer 7: Application Layer

The application layer provides the communication between the networking protocols and the software that is running on the device that is connected to the network. This layer enables applications that run on a computer to interrelate with the network. All applications or programs that open what was sent or that creates what needs to be sent use this highest layer in the stack. For example, your email application uses the application layer to access the network services and it enables it to send messages via this network.

The reason why RPA is often called a non-intrusive or non-invasive technology is because it works via the presentation layer of a system. As explained above, the presentation layer is the layer through which the user of a computer also accesses the data via some sort of user interface. RPA literally replicates a human being's handlings on the device. The integration through the presentation layer of RPA software has a couple of advantages. The most important advantage is that it ensures technological independency (Forrester Research Inc. , 2011). Accessing an old system that has been developed using a relatively unknown architectural approach is not an issue since the user interface in the presentation layer already contains the formatted and understandable data of these systems. Moreover, these older and often core systems of an organization are left untouched, which protects them from any unwanted modifications. Integrating with lower layers in the OSI-model would be much more technologically challenging. This explains the notion that RPA is a relatively easy to use and simple automation technology that does not require extensive and deep technological expertise. It requires less developer and scripting knowledge than older or more comprehensive automation tools.

4.2.3 Differences in Automation Efforts

In this chapter, RPA will be compared to other automation efforts like Enterprise Resource Planning (ERP) and Business Process Management (BPM) or as it is interchangeably called; business process automation. They are purposely called automation "efforts" here since the biggest difference between them is the amount of effort or time and money that is needed. For the purpose of this comparison, an illustration of the so-called long-tail of automation will be used. The concept of the long tail in economics and business that Chris Anderson (2006) introduced, can also be used to describe the differences in automation efforts. In its original form, Anderson used the figure to illustrate the fact that when selling a large number of products with a lower demand can collectively constitute a market share that exceeds the one of the best sold product. Likewise, but in the context of IT related processes or tasks we can interpret the long tail as Figure 7 (Forrester Research Inc. , 2011) illustrates. The vertical line depicts the business value of the system or process, while the horizontal line is the number of improvements that can be made to the system or process. The line is then divided into three compartments which represent the different IT processes a company has. The *core IT* compartment has few potential improvements but they have a high value to the business and will therefore be prioritized. An example of core IT is the ERP system of an organization. An ERP system is often of ciritcal importance for the existence of an organization. Improvements to this system often receive priority above others since they potentially have a large impact on the organization. However, relatively few improvements can be mad,e and changes to an ERP system are often difficult to implement and therefore costly. Next is the *support IT* compartment. This compartment contains processes and systems that have more potential improvements to be made than the core IT, but they are being treated as less important to the business since they have less impact on the business value.

An example is the BPM effort of an organization. BPM is a comprehensive approach. It assumes that to automate and change processes, it is necessary to define all the processes within an organization after which they can be re-defined, optimized and/or automated. It therefore has a broader scope than RPA since it handles not only process automation but also: process analysis, operations management and the organization of work (van der Aalst, 2013). Finally, the operational IT compartment contains

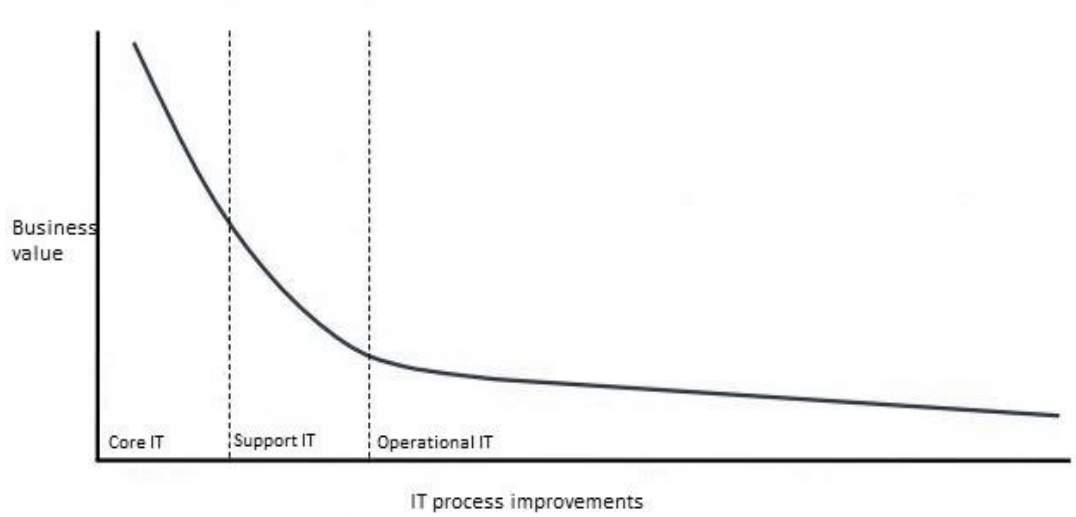


Figure 7: The long tail of automation. Adjusted from: ”The Role Of IT In Business-Driven Process Automation,” by Forrester Research Inc., 2011

the processes with the lowest value to the business, but a lot of improvements could be made. Operational IT consists of the tasks that the employees perform on their computers on a day-to-day basis. This is the area where RPA especially finds its existence. The processes may previously be deemed as not profitable to improve or automate. However, the many improvements that could be made at a relatively small cost with the help of RPA, may add up to significant business value and a big improvement in operational efficiency. This is where RPA differentiates itself from other automation efforts. With a relatively small investment in time and money the operational efficiency of a company could be improved.

4.2.4 Benefits and Limitations of RPA

A couple of important benefits of RPA have already been addressed; RPA is a non-intrusive technology and it ensures technological independency as mentioned in chapter 4.2.2. It is also a relatively quick and easily implementable technology that requires a small investment compared to other automation efforts as explained in chapter 4.2.3. However, the biggest advantage of RPA for companies is probably its ability to improve efficiency and reduce costs by automating processes. Researchers from the Outsourcing Unit started an initiative to assess the current and long-term effects of automation on organizations. The first paper that was a result of this initiative was written by Lacity, Willcocks & Craig (2015), who studied the application of RPA at the mobile communications

provider Telefonica O2. Even though the study has often been cited and the results have been lauded by others, it needs to be acknowledged that Blue Prism, a RPA software vendor, was among the sponsors of this research. In this particular case, Telefonica O2 automated 15 core processes to improve efficiency and reduce costs. The transactions of the robots represented about 35% of all back-office transactions. It was difficult to determine how many full time equivalents (FTE's) the automation saved in the end, since some of them were relocated to other service area's within the firm. Estimates were however in the hundreds. Furthermore, the three year return on investment was argued to be between 650 and 800%. These are of course interesting figures for companies.

However, there are still limitations to RPA software as to what kind of processes and tasks can be automated and whether it is economically feasible. The limitations are summarized in Figure 8.

Repetitive pre-defined steps	The process that will be automated needs to be repetitive and the process steps need to be pre-defined
No human (voice) interaction	There cannot be any human interaction in the process
Fixed in- and outputs	The triggers for the software are delivered in a pre-defined and fixed format
No cognitive decision making	No decisions based on reason or merit need to be made during the process
Significant volume	For the investment to be warranted the volume of tasks or steps in the process need to be significant.
Stable process	There cannot be any regular changes or adjustments made to the process

Figure 8: limitations of RPA

4.3 The RPA Market

The RPA marketplace consists of RPA technology vendors and RPA service providers (Le Clair, 2017). The vendors are the companies that focus mainly on developing the software to deliver automation solutions to companies, while the service providers consult and support companies that want to implement RPA. Next, the different vendors and service providers and how they work together in the marketplace are discussed as well as the financial forecasts of the global RPA market.

4.3.1 Coopetition Strategy

There are three different ways in which RPA services are delivered to clients. In some situations, RPA vendors and service providers work independently from each other. In this case, they offer their in-house developed RPA software directly to their clients. The service provider is also a RPA vendor in this situation, offering the RPA software as a part of their services. There are also two approaches in which the two parties work together closely. These approaches are characterized by a coopetition kind of strategy. Coopetition is basically a combination of competition and cooperation (Dagnino & Padula, 2002). Dagnino & Padula conceptualize in their article that organizations following a coopetition strategy work together to achieve a higher value creation as opposed to when they would have been working independently from each other (2002). This is often the case in industries where companies work together to explore new products and research. In the RPA market, this coopetition strategy exists in two different forms. First, in joint development efforts where the service provider and vendor work closely together to create tailor made solutions for a specific client or problem. And second, in a licensing approach where the service provider signs a license agreement with the software vendor. In this case, for every RPA "robot" or license that the service provider sells to its clients, he receives a compensation by the software vendor. The vendors and service providers in the RPA market will be discussed in more detail next.

4.3.2 Vendors

The independent research firm Forrester recently published a research on the different RPA vendors (Le Clair, 2017). They counted 38 different vendors of RPA software. Twelve of these vendors were included in their research after a pre-selection based on revenue, functionality, product orientation and customer interest. Next, these twelve vendors were evaluated using 28 different criteria, grouped into three different categories. The first category consisted of product offering criteria. The researchers looked at the functions that the vendors are offering and the software architecture, flexibility, governance and security. The second category focused on the vendors' vision, strategy and approach. Lastly, the market presence was evaluated according to the size of the customer installed base, revenue growth and technology partners. The vendors were than plotted in a diagram to show their position in the RPA vendor market. In the diagram as shown in Figure 9 (Le Clair,

2017), Forrester distinguishes between Leaders, Strong Performers, Contenders and Challengers. We need to emphasize that the results need only be considered as a starting point for the use by individual customers, since criteria weightings may be different per customer. Forrester suggests that the leaders in the RPA vendor market are; Automation Anywhere, Blue Prism and UiPath. The differences in offerings of the three leading vendors in the RPA vendor market will be discussed in more detail next.

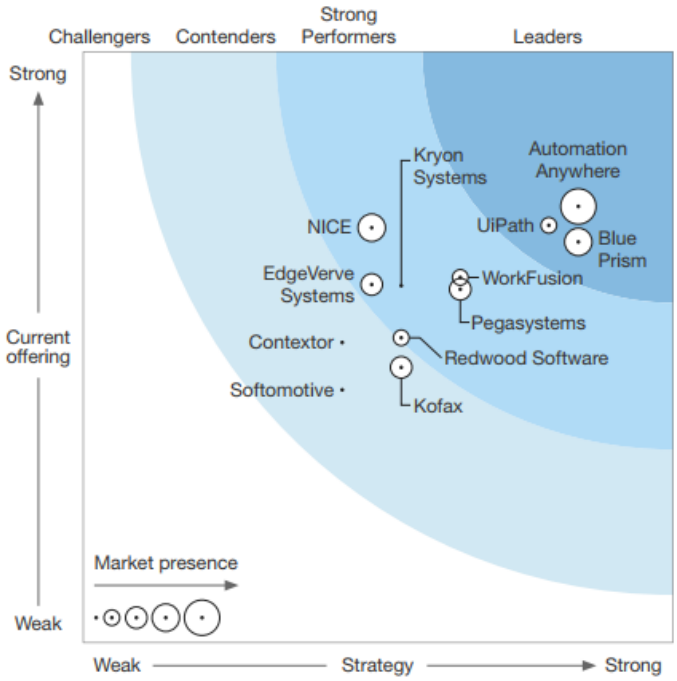


Figure 9: Classification of RPA Vendors. Reprinted from: "The Forrester Wave: Robotic Process Automation, Q1 2017: The 12 Providers That Matter Most And How They Stack Up," by Forrester, June 11 2017

RPA vendors offer three different types of solutions differing in characteristics and complexity (Le Clair, 2017). The *desktop-based solutions* require the least amount of programming and their business model is usually based on licenses. The solutions they offer are comparable to any other application software that is hosted on a desktop computer. It works as a kind of personal assistant by integrating data and applications, but often has limited capability of automating processes without any human intervention. The *enterprise-oriented solution* is often hosted on a server instead of a desktop. This enables the automation of processes that span multiple programs and systems. However, these solutions consequently require more programming and the pricing is often more complex due to charges for consulting, implementation and maintenance. Finally, there are vendors that offer a combination of these two solutions. The client can choose whether he wants to deploy RPA on a desktop or on a server within his company, depending on his requirements.

4.3.3 Service Providers

Next to software vendors the RPA market consists of more than 50 different service providers (Le Clair, 2017). These providers are Business Process Optimization (BPO) firms who deliver RPA software from the vendors to their clients as a service. Hfs research, an independent analyst firm, conducts a yearly research on the RPA service providers. Strategy, scale of deployments, added value and commercial traction are among the criteria by which the service providers are evaluated. The service provider that is evaluated as being the best in 2016 is Accenture (Fersht, 2016). Second in

line is Deloitte, which is argued to be an early mover in RPA. Third place in the ranking is for Cognizant. This company has gained a strong traction in the delivery of RPA in healthcare. Commonly, the leading service providers offer a holistic approach for automation with a broad spectrum of capabilities. Next, the top scoring service provider Accenture will be discussed in further detail. This way the role of the service provider in the RPA market will be clarified.

Accenture as a Service Provider

A client usually comes to the service provider with a request to automate certain processes. The service provider sends experts to the client who will analyze the process flows and come up with the as-is process of the client. Based on that, a to-be process is defined and the benefits of automating the processes are discussed with the client. Next, a software selection is made based on cost versus benefit analysis. The development team then starts scripting the robots to automate the agreed upon processes. The robots work from laptops or in the cloud and are monitored and updated weekly by the service provider. The service provider will therefore always be connected to the client. This is in short how a service provider delivers RPA to its clients. The information that is used here to explain the role of Accenture as a service provider was gathered during a short interview with Kannan Sehturaman, who is Vice President of Accenture in India.

4.3.4 Financials and Forecasts

According to a market research conducted by Grand View Research (2016), the global RPA market will reach a total value of 8,75 billion US dollars by 2024. In 2015 they valued the RPA market at 125,2 million. The reason of this significant growth forecast is expected to be the maturation of the technology in terms of clarity, credibility and applicability. The research also made a distinction between the adoption of RPA between sectors in the service industry in North America, which houses the largest RPA market. From these figures, we can deduce which sector is expected to adopt RPA the most. Figure 10 (Grand View Research, 2016) shows that in 2024 the research company expects that the Banking, Financial Services and Insurance (BFSI) sector and the telecom and IT sector will have the largest share of the total market. The reason for their large share in the market is expected to be the increasing pressure to reduce costs and the constantly changing technological landscape (Grand View Research, 2016). Another noticeable change in the chart is the relatively small RPA market of North America in 2016 and the apparently enormous growth it will experience in the coming years. This suggests that the RPA technology is still a maturing technology and not a lot of companies have adopted the technology yet.

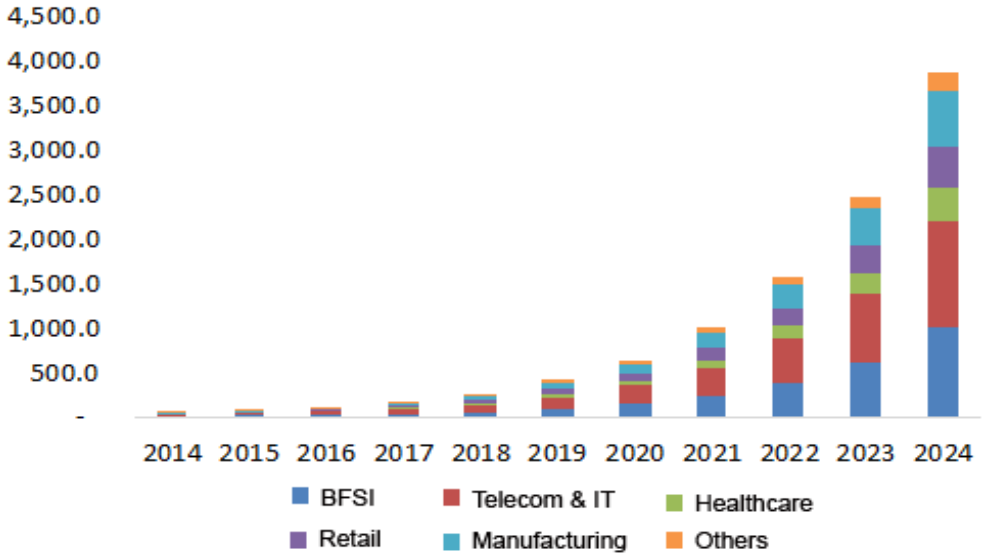


Figure 10: North American RPA market by sector, 2014 – 2024 (USD million). Reprinted from *RPA market size report 2024*, by Grand View Research, Retrieved from: http://www.grandviewresearch.com/industry-analysis/robotic-process-automation-rpa-market

Other important forecasts in the report of Grand View Research suggest that the highest growth in market share will come from small to medium sized enterprises, due to the growing need to reduce costs and improve efficiency among these companies. These companies were first resisting implementation of RPA while the programming of the technology was too complex and time-consuming. Furthermore, the researchers suggest that the healthcare industry will increasingly adopt the RPA technology while the sector copes with labor-intensive activities related to patient data and governance.

4.4 Conclusion of Literature Review

The literature review listed as much information as currently available from secondary sources on the subjects in this study. It showed that economists and researchers are still undecided about the impact of automation on employment, how automation originated and has its place in the service industry, and how RPA can automate digital processes and tasks. The information gathered in the literature review will be used to design appropriate research questions as well as a research methodology. This will be discussed in the next section of the report.

5 RESEARCH METHODOLOGY

The previous section of the report focused on finding as much information as currently available on the research topics. Firstly, this information is used to define the research problem and accompanying research questions. Secondly, an appropriate research methodology is chosen to be able to answer the research questions. And lastly, this chapter discusses the scope, sampling and relevance of the study.

5.1 Research Problem and Research Questions

The main research question of this research project, as already mentioned in Chapter 1.3, reads:

> RQ: What is the current and future *impact* of *Robotic Process Automation* on *employment* within the *service industry?*

The extensive literature review gathered more information about the topics and their relationship with each other. However, it did not yet provide any information about the current or future impact of RPA on employment. No information was available about the actual use of RPA in business cases in the service industry. Often, there is a difference between what a technology is able to do and what it is actually used for in practice. Therefore, it is interesting to study in what shape and why RPA is currently being used to know more about its *current* impact in the service industry, leading to the sub-questions:

> *SQ1: What is RPA?*
> *SQ2: What motives do companies have for choosing RPA?*

Furthermore, the impact of automation on employment is not clear yet. Therefore, it is interesting to study whether RPA is *currently* replacing human work, and to what extent:

> *SQ3: What is currently being automated with the use of RPA?*
> *SQ4: What jobs are being replaced with the use of RPA?*

When these questions are answered, the current impact of RPA is known. Comparing the current state with the technical capability of RPA provides an outlook of what the *future state* of RPA is. However, RPA technology may not be in its maturing phase yet and may still be developing. Therefore, the research also aims to study:

> *SQ5: What is the future impact of RPA on employment in the service industry?*

Lastly, there is a lot of literature on the impact of automation in general on employment. However, researchers and economists are mostly including all industries in these discussions. There is virtually no content available that specifically targets the service industry. While it is proven to be very difficult to find evidence about the link between automation and employment due to multiple extraneous factors, this research aims to provide a general outlook of developments, leading to the last sub-question:

SQ6: What is the future impact of automation on employment in the service industry?

5.2 Qualitative Exploratory Research

The research questions mostly target the use of RPA in a business setting. Currently, there is no research available that addresses any aspects of RPA in any setting. Therefore, the choice is made to develop a qualitative exploratory research design to be able to answer the research questions. This type of research design is considered to be the best choice when not much is known about the subject and the aim is to study the particular subject in-depth (Myers, 2013). During a qualitative research, the subject is studied in its natural environment, and uses the meanings of people to understand it (Denzin & Lincoln, 2000). In the current research, this translates into questioning people that are currently working with RPA and are applying it in the office, which is its "natural" environment.

5.3 Data collection: In-Depth Interviews

There are different ways to collect data for a qualitative research design. Since our research questions ask for in-depth knowledge and the subject needs to be studied in its natural environment, the best strategy to collect data is considered to be in-depth interviews. By conducting in-depth interviews with people that work with RPA, a lot of useful information can be obtained. The strength of using the in-depth interview as a method of data collection lies in the power of language. Language has the capacity to describe, explain and evaluate phenomena in an almost infinite variety of ways (Hammersley & Atkinson, 1995). An in-depth interview means having a one-to-one conversation between an interviewer and a single participant, on a single topic for an extended period (Kolb, 2008). This offers an advantage as opposed to for example the Delphi-method where participants may become prone to opinions of other participants. Most of the questions will be predetermined. These will be linked to the research questions, since the purpose of the interviews is to collect the desired data to answer those questions. The key feature of an in-depth interview according to Ritchie & Lewis, is its combination of structure and flexibility (2003). There are key topics that need to be addressed in the interview, but the order in which these topics are covered is flexible to change. This allows the researcher to explore and obtain a complete answer from the interviewee, and to respond

spontaneously to relevant issues that may be addressed during the interview. What results from this is a form of normal conversation with the biggest difference that there is a clear objective to answer the research questions. The knowledge to do so, is generated by the interaction between the interviewee and researcher. The structure of an in-depth interview has four phases according to Kolb (2008). These four phases, and thus the design of the interviews, is explained and described in more detail in the interview protocol which has been added to the appendices section of the report as appendix I. The interviews were recorded with the permission of the interviewees. These recordings were then transcribed and coded for the ease of compiling the results.

5.4 Scope and Sampling

The decision to focus on the service industry was made at the start of the research. RPA focusses on automating digital processes and tasks in offices, which makes it especially attractive for companies in the service sector where data and information processing is the raison d'etre. Determining an appropriate sample size was more difficult. A general rule for the sample size is to keep sampling as long as your knowledge and insights on the topic are expanding (Cooper & Schindler , 2014). Therefore, the researcher tried to speak with as much experts in the field of RPA as possible. In this study, someone is considered to be an expert in the social representational approach of the constructivist definition (Bogner, Littig, & Menz, 2009). Meaning that, when selecting suitable interviewees, the training, specialization and experience of the person mattered the most.

The selected interviewees in this research all have experience in working on projects regarding RPA at companies in the service sector. When selecting the interviewees, a year of working in the field was considered to be experienced. This is because RPA is a relatively new technology and therefore people who have a year of experience working with the technology are already hard to find. As mentioned in chapter 4.3.1 of the report, the implementation of RPA can be arranged via a service provider or in-house by using vendor software. Therefore, experts from a service provider as well as an expert who is working with RPA in-house were interviewed to collect data from both approaches. Furthermore, conducting the study at Accenture made it convenient to approach RPA experts within this company. However, to include different perspectives, experts form outside of Accenture were also interviewed. For the same reason, experts working on projects in different countries were also included to see if there are any differences notable.

5.5 Relevance

The Research aims to gather knowledge about how RPA is currently used, and how it impacts companies and employees now and in the future. This is relevant while no scientific material is

available that addresses RPA in its natural environment. Therefore, there is a lack of knowledge about the impact of such technology within a company and its industry. The fact that this study specifically targets companies in the service industry makes it even more interesting, since the majority of the people in developed countries are nowadays working in this industry. Automation of these jobs could therefore have a particularly large impact. The research will provide a clearer picture about the impact of automation in the service industry, and if people should start to worry about their jobs. Companies can also use the obtained knowledge to determine if RPA fits their needs as an automation solution. Finally, this exploratory research contributes to research by building theory and providing new opportunities for researchers to focus on. In the conclusions and recommendations chapter of the report, recommendations will be made to help researchers design further research on the subject of RPA, employment and automation in the service industry.

6 FINDINGS

In this chapter of the report, the data gathered from the transcribed and coded interviews is presented. First, a description of the thirteen respondents shows who participated in the in-depth interviews. This overview also makes it easy to see who said what, when a respondent is being quoted in the results. The results are divided in three parts based on the sub-questions (SQ) drawn up in chapter 5.1. as follows;

6.2 Current State of RPA

SQ1: What is RPA?
SQ2: What motives do companies have for choosing RPA?
SQ3: What is currently being automated with the use of RPA?
SQ4: What jobs are being replaced with the use of RPA?

6.3 Future State of RPA

SQ5: What is the future impact of RPA on employment in the service industry?

6.4 The Future Impact of Automation in the Service Industry

SQ6: What is the future impact of automation on employment in the service industry?

The aim is to answer the main research question by gaining knowledge about the current and future state of RPA. Whenever a sub-question is treated in the results, it will be notified in the header.

6.1 Participants

Figure 11. shows an overview of the participants in this research. Their role, industry experience and place of employment are listed. The overview makes it easier to see who said what, when a participant is quoted in the findings.

	Role	Industry Experience	Employer/Country
Respondent 1	Business Analyst Robotic Process Automation	Insurance	NN (Nationale Nederlanden)/NL
Respondent 2	Service Delivery Operations Manager	Telecom	Accenture/NL
Respondent 3	Business and Integration Architect	Various Industries	Accenture/NL
Respondent 4	Service Improvement Manager RPA Europe	Banking, Insurance, Telecom	IPsoft/NL
Respondent 5	Delivery Lead Operations	Banking, Telecom, Resources	Accenture/India
Respondent 6	Lead Automation Engineering	Various Industries	Accenture/NL
Respondent 7	Managing Director Technology Services	Banking, Telecom	Accenture/NL
Respondent 8	Robotic Process Automation Consultant	Insurance, Telecom	Accenture/NL
Respondent 9	Managing Director Operations	Communication, Media	Accenture/NL
Respondent 10	Senior Business Analyst	Banking	Accenture/NL
Respondent 11	Senior Consultant Robotics	Banking	Accenture/NL
Respondent 12	Robotic Process Automation Developer	Banking	Accenture/NL
Respondent 13	Innovation Consultant Robotics and AI	Various Industries	Accenture/NL

Figure 11: Description of the Participants

6.2 Current State of RPA (SQ1 - SQ4)

What is RPA (SQ1)

To gain knowledge about the current state of RPA in the service industry, the first step is getting to know what experts think of the technology. In the literature review the definition of RPA was adopted from secondary sources. However, experts that are currently working in the field, may have a different view of what RPA factually entails. The majority of the respondents mention the ability to mimic human workers when asked to describe what RPA is in their opinion. For instance, respondent 7 describes RPA as; "A software that mimics how humans normally interact with applications". This is reaffirmed by respondent 10, who said; "RPA is a kind of software layer on top of your existing applications, and you can let it act with these applications as humans normally would." Respondent 3 adds *how* RPA is capable of mimicking human behavior on a computer; "It is a very specific way of automating processes. It works using keyboard and mouse strokes to automate and mimic a specific process." There was however one respondent (3) who noted that exactly mimicking what a human would do is not the solution. He argued that; "What often goes wrong in applying RPA and what you may often read in commercial texts, is that it exactly mimics the human process. The mistake you can make is doing that in your process. You must think about the goal and redesign the processes. Otherwise it will not bring you any benefit." It appears that while RPA is capable of mimicking human behavior on a computer, it cannot exactly copy human behavior. The digital processes first need to be redesigned and simplified to be effectively automated by RPA.

Besides the ability to mimic human behavior, there are also many respondents that mention the ease of automating processes with RPA. Often, RPA is compared to older technologies to explain this notion. Respondent 11 argues; "We used to have enormously script driven automation applications. The last few years they have changed into applications that make it easier for business users to automate processes." Other respondents mention the amount of skills that is needed to work with RPA to illustrate the ease of use of the technology. For example, respondent 12 highlights that; "The tools that are used to develop RPA are of a much lower entry level. You do not need any coding skills, while they are mostly visual tools."

Motives to use RPA (SQ2)

The next step of studying the current state of RPA in the service industry is to figure out what the aim of using the technology is. The respondents are almost unanimous in their opinions about companies' motives. Efficiency, in terms of reducing the number of full time equivalents (FTE), is mentioned most frequently. This either occurs due to circumstances that demand a reduction of FTE, or to begin working more efficiently with the currently available workforce. Respondent 4 explains; "We have had clients who are very clear towards their personel and tell them: this is not about you but we simply need to be more efficient. And there are others who simply have to because otherwise they have to

fire people.”. Other respondents are more straight to the point and argue like respondent 6; ”At the moment, efficiency is the main incentive for companies, they want a reduction of full time equivalents.” The response by respondent 12 suggests that this has always been the priority for business; “The reduction of FTE has always been a focal point. It is often about pointless costs that can simply be saved by letting a robot do the job.” Interestingly, the study shows that RPA can increase efficiency in multiple ways. As explained in chapter 4.3.3 of the literature review, one of the ways in which RPA is offered to clients is via service providers. For example, an organization can decide to outsource its administrative processes. The service provider may use RPA to automate these administrative processes internally as well as offering their services to automate other processes for the same client. Respondent 9 explains; “We are automating our own people. Our own operations are becoming more efficient through RPA, which is step one. But we also offer our services to help clients with automating their own processes.” For service providers, the knife cuts both ways in these cases. Likewise, their clients also profit twofold: the outsourcing services can be offered at a lower price, and their own processes will become more efficient as well. Outsourcing seems to be a particularly interesting domain to apply RPA, as respondent 6 suggests; “we apply RPA a lot in our outsourcing deals, because those processes are optimized to be automated, which makes it a lot easier”.

Next to efficiency, there are other motives mentioned that mainly lead to improving the quality of processes. Respondent 6 for instance, talks about increasing the customer experience; “what I am hearing more often nowadays is the customer journey or customer experience.” Respondent 9 is thinking more about speed; “when you implement a robot, you can perform actions faster. Cost reduction does not have to be the main motive, it can also be quality. Quality of transit or speed.” Most of the respondents mentioning multiple motives to use RPA are talking about quality, next to efficiency. Quality in the form of reducing human error and delivering services faster to the clients.

A few of the respondents also mention compliancy as a motive, like respondent 7; “So its efficiency and its compliancy, because every single step in the process can be traced back and revised.” Compliancy is mainly important in the financial sector. However, the notion that RPA is used for compliancy is contradicted by a statement of respondent 11, who is working on a major RPA project in the banking industry; “Some systems can just not be automated … The national bank requires the verification of the checking of customer information, and they want evidence to show it … a data point is currently not enough evidence because it can be manipulated.” Using RPA for compliancy may therefore be a solution in other industries, but it seems not suitable in the banking industry.

Next to knowing what the aim of companies is when choosing to implement RPA, it is also interesting to know why they choose RPA among other automation solutions. Respondents view RPA as a strategic, cost, and time effective solution (R11); “The main reason for companies to choose RPA is strategic I think. Building a completely new system or functionality takes time, it can sometimes take a year or two. The companies are reasoning as follows; when using RPA for the same goal, the

payback time will be less than one year. It is clearly useful then to initiate the process." The time effectiveness was also acknowledged by respondent 12. Furthermore, he linked it to the ease of use of RPA; "The ease of use of RPA makes the time to develop a project much shorter than those of traditional software projects". Respondent 3 gave an explanation which is very similar to what is described in the literature review in chapter 4.2.2 as one of the most important benefits of RPA, being that RPA is technology independent; "The choice for RPA is also because it is technology agnostic in my opinion. When you have a process concerning multiple applications, it becomes highly complicated to use any other application than RPA."

Currently automated processes (SQ3)

The literature review described RPA as a way of automating digital processes and tasks in the office that were formerly executed by human workers. This entails a large amount of different processes and tasks. The study focused on gaining knowledge about what types of processes and tasks are being automated with RPA in the service industry. Often mentioned is the need for repetitiveness in the tasks. For instance, respondent 1 argues; "The process needs to be repetitive first of all. And it is a process that is not really cognitive, at least the stage where we are. We do not do cognitive, no human interaction in the process." The argument that human interaction cannot be part of the task or process is confirmed by respondent 5; "no human interaction, absolutely, pure one hundred percent automation". Respondent 8, who is an RPA developer explains why; "The bot has still a limited function of OCR (Optical Character Recognition), for a robot it is still quite hard to understand human hand writing. So, if the process contains human writing it is still challenging but for the rest just to click, open outlook and go to excel and then connect to SAP and after that you do some task in SAP, all of that can be automated with RPA." The respondent is already giving an example of where RPA is mainly being used for currently. Administrative tasks, found in back-office functions are especially suitable for RPA, as respondent 2 and 3 explain; (2) "RPA until now is primarily applied in back-office functions, it accounts for processing. What remains are exceptions, complex cases and customer contact." (3) "We mostly see it being applied for highly standardized processes, which are often administrative tasks." There are a lot of different processes that can be thought of as being administrative and standardized. A few examples are given by respondent 2; "It is mainly delivery processing or order processing. Besides that, it processes billing, so financial processes." Furthermore, the respondent gives an explanation why RPA is frequently being used in the financial industry; "Financial processes are especially suitable to automate with RPA because they are heavily regulated. Everything is comprised of rules." Respondent 4, who's company mainly delivers RPA for management and IT services, explains it more tangible by describing the skill levels of tasks that can be automated; "L1, L2 is where our sweet spot is". L1 and L2 refer to the level of skill needed for an engineer to solve an IT related problem at a helpdesk. L1 is equal to basic troubleshooting and L2 are technical problems.

Jobs that are being replaced by RPA (SQ4)

Besides knowing what kind of processes are currently being automated with the use of RPA, the study aimed to find out if RPA is already replacing humans in their jobs. Knowing this, may help gaining knowledge about what the impact of RPA on employment in the service industry is. The results of the study are twofold. The majority of the respondents argue that RPA is not replacing whole job functions, with the exception of some cases. Their reasoning is mostly the same as respondent 7; "I have not experienced people getting fired because of RPA implementation nowadays, except for an incidental case maybe." Many respondents do however talk about parts of a job that are being taken over by RPA. Respondent 2 explains the reason why only parts of a job are currently being automated; "Only a limited amount of people is doing strictly repetitive work without any human interaction all day. It is possible, but it is not very common. Therefore, yes. Some jobs will disappear, but in most cases it is only a part of it." Respondent 10 explains this notion, using an example; "First, an account manager is in contact with a client, then the administrative work is done by a robot and next the manager is in contact with the client again. 80% may be administrative work which we can automate for 100% percent." Whenever human interaction is involved, RPA is not suitable to automate the process.

It appears that the respondents are not worried about RPA automating a lot of jobs. They do however acknowledge that this may change soon, like respondent 8 and 11 describe; (8)" I would say not for now, not yet. In general, people are still implementing it in best practices, so there are still so many opportunities out there to automate. And it depends on the *process* of course." (11) "If you look at the processes that we are automating now with RPA, I do not think there will be an abundance of people very soon. Depends on your *approach* of course." Interestingly, these two respondents mention two contributing factors: the type of process, and the approach of implementing RPA in a project may determine if, and how many jobs can be replaced.

Contrary to what has been discussed until now, respondent 5 who is working on large international projects out of India, describes a much more striking example of automation with RPA: "Currently in my account we have one hundred people which can be automated. All the one hundred can be lead out, simple as that. Or maybe we keep only two or three just to monitor it … either they are put in some other area which is very rare, but mostly they are managed out". This example suggests that RPA may have a bigger impact in other countries. Some of the respondents are reasoning similarly. Respondent 1 for example argues; "I think we are behind in Europe, and I think in America and other markets this is already happening. We have a lot of European Union legislation, they are still saving asses, so to say." Respondent 10 also considers the following; "In practice, I do not see a lot of people getting fired. This is hard to do in the Netherlands I think. Maybe it is easier in other countries."

Another interesting topic that frequently came up in the findings, is the kind of resistance that the participants experienced at RPA implementation projects. Respondent 1 argued that resistance is

“unavoidable”. He elaborates; “Basically, my job is learning how people do their job and then try to do it with robots. You will always see resistance.” Respondent 12 does not agree and argues that it depends on the situation; “I also experienced the exact opposite where the people were asking me when the robot was finally ready. They felt happy because tasks were being automated that they really did not like to do.” Evidently, the motive why the company chooses to implement RPA causes the amount of resistance that can be expected. Therefore, change management is an important factor when implementing RPA at a project.

6.3 Future State of RPA (SQ5)

RPA is a relatively new technology and it may not be fully developed yet. Consequently, the impact that the technology currently has may become larger in the future. The aim of the study is to gain insight into the potential future impact of RPA. While there are a few respondents who argue that RPA will become smarter and capable of handling more cognitive tasks and processes, the majority sees these developments as the next stage in automation. This next stage is often called Artificial Intelligence (AI), as respondent 8 explains; “With an artificial intelligence component you can also support decision making, based on heuristics, then it gets interesting. We mention RPA and AI in the same breath, but it is the next step; RPA is automating transactions, while AI is more the automation of decision making.” Often respondents see RPA as a bridging phase, or temporary solution. For example, respondent 13 argues; “RPA is a temporary solution. It is applied to work with existing systems. If you build a totally new system from the ground up, you can design it in such a way that RPA is not needed, cause RPA really works on top off.” This suggests that RPA is being used as a temporary fix for old systems. Respondent 4 agrees; “To me, RPA is the bridge between what people do now and what machines will be doing in the future. It is a bridging phase to where we are heading. How long this phase will take? I do not know.” It appears that there is no place for RPA in the future and that it is currently used to bridge the gap between old systems and newer, fully automated systems. How long it will take before RPA becomes obsolete is hard to say, as respondent 10 argues; “If you see how many old systems are still operating in today’s organizations, I think it will take a while before other solutions than RPA are suitable.”

6.4 The Future Impact of Automation in the Service Industry (SQ6)

The literature showed that there is continuous debate about the impact of automation on employment. There is still no consensus reached whether automation leads to less jobs, more jobs, or no change in the number of jobs at all. It has proven to be very difficult to find evidence about the link due to multiple extraneous factors. The current study aimed to gather knowledge about future developments in the service industry specifically. Therefore, the respondents were asked for their expert opinion.

The majority of the respondents warn that some jobs will not be future proof. Respondent 7 convincingly states; “We can say for certain that administrative work does not have the future. Those jobs will be gone soon. Business analyst roles and a robot administrator, or robot developer; those are jobs that will originate.” Thereby, the respondent suggests that even though some jobs will disappear, new jobs will also originate. Evidently, people doing administrative work need to worry. This is also reaffirmed by respondents 6; “All repetitive work will disappear, and the impact on society will be enormous. That change is already starting to happen.” And again, by respondent 7; “If you think you can still earn a living copying data from one system to another, you have got another thing coming. You can earn a living if you understand systems well, are able to improve them, and if you like to handle exceptions.” What remains are the exceptions that cannot be automated and the interaction with customers.” Consequently, respondent 3 foresees that departments will shrink in size; “Customer service, which also handles administrative tasks. I think you will see that those teams will shrink in size because they will only handle first contact with clients. Transactional tasks will be left for the robots to handle.” Using the Netherlands as an example, the potential impact of automating all those administrative tasks can be illustrated. According to the CBS, 17% of the working population in the Netherlands has an administrative job (2015). Consequently, almost one out of every five people runs the risk of losing their job in the near future due to automation. Probably not all of these jobs are completely automatable, but it shows the potential impact. For now, people who interact with other people during their job seem to be safe. As respondent 11 explains; “The less your job is leaning towards the front office, so towards the customer, the less important and more susceptible to automation you will become.” On top of that, as automation solutions develop, jobs that tend to lean more towards the front office may even become susceptible to automation. Respondent 6, who works on projects at-scale to proof that technologies work, already sees this happening; “The second wave, as I call it, is coming. Process orchestration in which humans become central is an essential part of it. I see the step to more interaction happening everywhere already, with for example: chatbots, virtual assistants and natural language processing.” Respondent 2 confirms; “Slowly but steadily the movement towards the front office is happening. We do not talk about RPA anymore when that happens. We talk about virtual agents and chatbots, the kind of technologies that can potentially take over contact with the customer.” Clearly, the next step of automation in the service industry is focused on dealing with human interaction. One can imagine that when this happens, even more jobs in the service industry will become susceptible to automation.

7 DISCUSSION

This chapter of the report will be used to interpret the findings from the previous chapter. Furthermore, the findings will be compared with the knowledge gained in the literature review. The aim of this chapter is to explain to what extent and how the findings provide an answer to our research questions regarding the current and future state of RPA. The description of the current and future state in this chapter will aid in answering the main research question in the next chapter. Suggestions for further research will also be mentioned.

Current State of RPA

What stands out the most in the findings regarding the current state of RPA, is the discrepancy between the motive to use RPA and the actual job replacement due to RPA. The respondents were almost unanimous when asked about the most important reason for companies to implement RPA. The main objective is efficiency. Efficiency is in short; doing more with less people. The case mentioned in chapter 4.2.4. of the literature review showed that RPA enables a company to achieve this. However, when asked if the respondents have seen it happen in practice, most of them reacted negatively. RPA is currently not responsible for people losing their jobs, with some rare exceptions.

The findings mostly show that its purpose is to automate only a part of the activities of a complete job. A likely reason why it is currently only automating parts of a job is because it is not capable of automating all activities of that job. RPA is capable of automating repetitive, standardized tasks performed on a computer. However, if any human interaction is involved, the technology is not yet capable of automating that activity. A lot of administrative workers probably still have a few activities where human interaction is involved. Therefore, making it impossible to automate everything.

Another probable explanation why RPA is not replacing jobs currently, may be because of regulatory reasons. The findings showed that there is probably a difference in impact of RPA on employment between nationalities. A simple explanation is that the technology is not being used to its full potential yet in some regions. Another explanation is that it may be harder for companies in Europe to lay off people, than it is in America or Asia for example. As a solution, a company may temporarily choose to do more with the same amount of people. They can use the robots to do the extra work. As a result, lay offs will not be apparent immediately, but the hiring rate will be stagnating. To find evidence about whether this is happening and to wat extent, a quantitative research design is proposed. Comparing the productivity growth to the change in hiring rate of a company that implemented RPA, may result in quantifying the impact of RPA on employment. At the same time, these results may reveal to what extent RPA is a cause of what McAfee and Brynjolfsson describe as ”the great decoupling”, explained in chapter 2.2 of the literature review. While RPA is capable of improving

the productivity of a service firm without them having to hire new employees, it seems very likely that it is a contributing factor.

Another view on how RPA is impacting employment, comes from the fact that service providers like Accenture use the technology to automate their own processes. This enables them to deliver outsourcing services more effectively. Outsourced processes seem particularly intersting to automate since these are mostly administrative, highly repetitive processes. Automating these processes would greatly impact the employment in outsourcing countries like India. Therefore, this could also be an important explanation of the difference of impact on employment of RPA between countries. Further research should focus on the implementation of RPA on outsourced projects.

The resistance of employees on RPA projects is another intersting finding in the results. The study showed cases where a lot of resistance was encountered, but there were also cases where the employees happily cooperated. Therefore, further research on how change management affects the implementation of RPA projects will probably deliver interesting and practical insights.

Future State of RPA

Comparing the current state of RPA with what is theoretically possible, provides insight in how the impact of the technology will evolve. The findings as well as the literature showed that every administrative process in the service industry, as long as there is no human interaction involved, can be automated with RPA. Literature showed that 45 to 80% percent of all processes in this industry are related to transforming and distributing data and information (chapter 3.3). It is safe to say that the service industry is providing an adundance of opportunities for RPA. A large share of the processes will probably not be economically viable to automate with RPA yet. Taking into account that the technology is new and has not been widely implemented yet, its impact on employment in the service industry will increase.

The study also investigated if RPA technology will develop further in the future. Through developed capabilities it may have an even larger future impact. However, the findings showed that the current abilities of RPA will probably not expand further in the future. RPA is argued to be the technology that will bridge the gap between what humans do now and what machines will be doing in the future. The technology is specifically aimed to automate repetitive and standardized processes, mostly found in administrative work. Furthermore, it is often used to keep legacy systems work efficiently with newer systems. Technologies that are able to handle human interaction are seen as being different from RPA, and are often referred to as the next step. These technologies are rapidly advancing their capabilities and are already being applied in some cases.

The Future Impact of Automation in the Service Industry

This study also aims to gain insight in what the future impact of automation in general may become on employment in the service industry. Until now, mostly the impact on the *quantity* of employment has been discussed, focusing on the number of jobs. The literature review illustrated that this debate is still undecided as far as employment in general is concerned (chapter 2.2). However, when looking at the service industry specifically, it seems naive to think that there will still be the same amount of jobs in the future. The current study showed that it is already technically possible to automate every administrative process. The only hurdle now is human interaction. However, technologies that are capable of handling human interaction are already being tested and applied. This leaves the question about what kind of tasks will be left for people. Probably, these tasks will consist of handling exceptional cases, and the support and maintenance of the robots. Looking back at the taxonomy of automation solutions in the service industry presented in chapter 3.3.1, another inclining shape can be added to illustrate the number of people being automated by increasingly intelligent technology, as shown in Figure 12 (Everest Group, 2017).

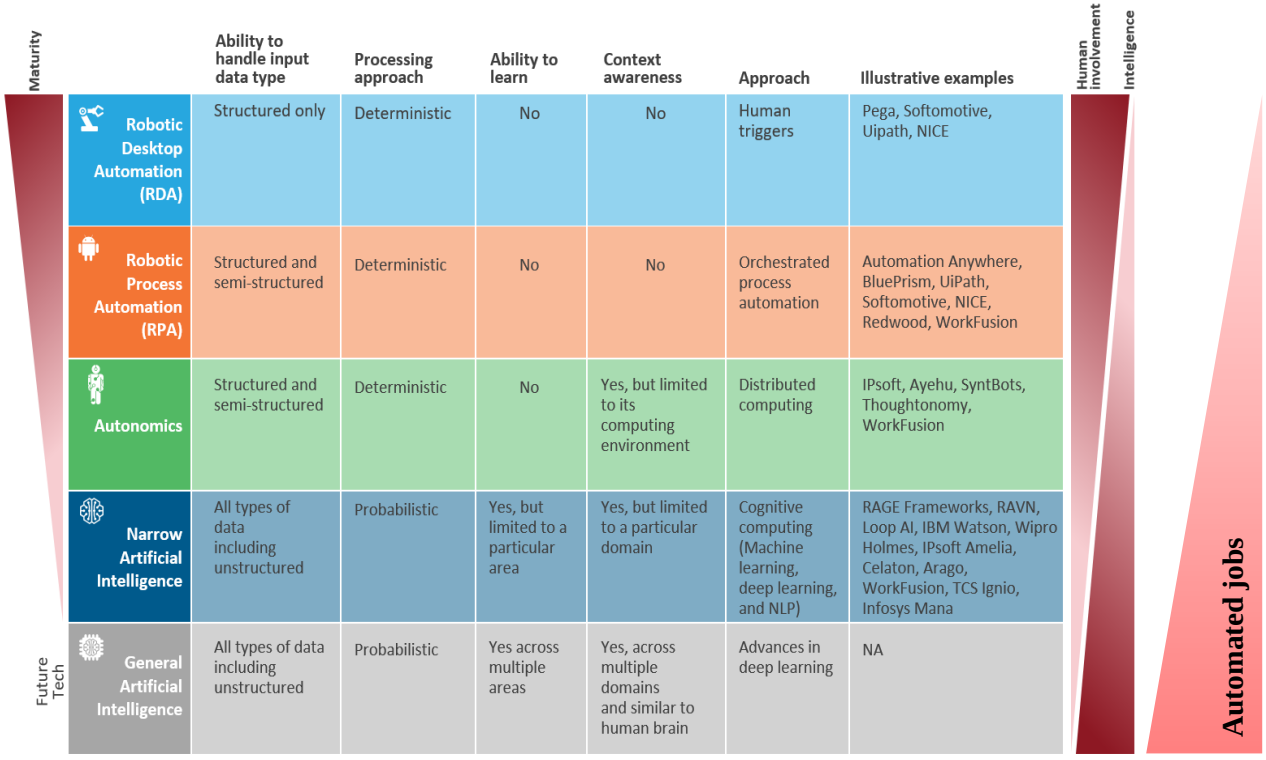


Figure 12: Service Delivery Automation Continuum. Adjusted from: *Service Delivery Automation (SDA) Continuum, Market Insights*, by Everest Group, May 9 2017. Retrieved from: http://www.everestgrp.com/2017-05-service-delivery-automation-sda-continuum-market-insights-40037.html/

Interesting findings concering the *quality* of employment were also found. The study showed that highly repetitive, administrative jobs are at a high risk of being automated in the coming years. When these jobs become automated, it would cause an even further hollowing out of the middle-class, as

described in chapter 2.2 of the literature review. This would suggest an even steeper decline in employment opportunities and earnings for middle-skill workers. Therefore, it is quite certain that automation will have a significant impact on the *quality* of employment in the service industry in the near future. More intelligent solutions, capable of handling human interaction, will also be able to automate higher-skilled jobs.

8 CONCLUSION AND LIMITATIONS

This research provides insight and detailed information about a new type of automation solution, mainly useful in the service industry. Beginning with an extensive literature review, the report introduced a widely discussed subject: the impact of automation on employment. Further converging on the subject, the service industry was introduced as a dominant and important factor in today's economy. Lastly, Robotic Process Automation (RPA) was introduced as the main subject of the study. After a literature review of the technology, the research design was developed. In-depth interviews were conducted with experts in the service industry to answer the sub-questions regarding the current and future state of RPA, and its impact on employment. Ultimately, the aim of this research is to answer the main research question:

> *What is the current and future impact of Robotic Process Automation on employment within the service industry?*

Findings from the in-depth interviews with thirteen experts, showed that the current impact of RPA on employment in the service industry is not yet apparent. Mostly, the technology is used to automate parts of job functions. Apart from a few exceptions, no jobs are being automated. The study uncovered multiple potential explanations for this finding, which provide interesting opportunities for further research.

Evidently, RPA is not used to its full potential yet. The technology is fully developed but not yet deployed industry wide. The service industry still provides an abundance of opportunities. Every administrative process can potentially be automated using RPA. Therefore, the future impact of RPA on the quantity of employment will increase. Furthermore, since RPA only handles middle-skilled administrative work, it may accelerate the hollowing out of the middle-class. Low-skill and high-skill job opportunities have been rising, while middle-skill opportunities and earnings are declining. Deploying RPA will result in even fewer job opportunities for middle-skilled workers in the service industry.

To conclude: currently, RPA does not have a significant impact on employment in the service industry. Mostly, the technology is applied to automate parts of people's jobs. However, it has the potential to greatly impact the *quantity* as well as the *quality* of employment in the future because of the large amount of administrative processes and tasks this industry entails.

The answers to all the sub-questions are summarized in chapter 8.2.

8.1 Limitations of the Research

This exploratory research provides a vast amount of information about Robotic Process Automation, which is a relatively untouched subject in current research. However, it needs to be acknowledged that an exploratory research has its limitations. Since the findings were based on a sample of thirteen, it is very difficult to generalize them. Therefore, the current research needs to be viewed as a basis for further research on the subject.

Another potentially limitating factor has been the unilateral sample. The majority of the respondents is working with the same employer, therefore their views may be biased. A more diverse view may have been obtained when experts from different companies had been interviewed. Furthermore, due to the employment at companies who are selling and implementing the technology, the views of the presondents may be overly optimistic or secretive. Therfore, a study among people who were affected in the workplace may provide other insights. Questioning them may lead to a different view of the impact that the technology has. Besides that, the majority of the respondents shared the same nationality. The one respondent working on projects from another country had some remarkable and deviant responses to some of the questions. Therefore, including more nationalities would have resulated in a more complete answer to the research question, since international differences could have an effect as well.

Lastly, RPA has been studied in the context of the service industry only. The majority of the respondents only works on projects within this industry. Therefore, the results only apply to this industry. However, the service industry is the industry with the highest potential for this kind of technology. The impact of RPA will probably be lower in other industries.

8.2 Summary of Answers to the Research Questions

Research Question	Answer
SQ1: What is RPA?	An easily usable and implementable software application, that is technology agnostic, and can replicate human behaviour on a computer after the processes are redesigned.
SQ2: What motives do companies have for using RPA?	Improving efficiency and quality of digital processes. More cost and time effective than other automation solutions.
SQ3: What is currently being automated with the use of RPA?	Standardized, repetitive tasks. Mostly administrative processes where no human interaction is involved.
SQ4: What jobs are being replaced with the use of RPA?	Only some activities are being automated, no complete job functions. There are however exceptions. It appears that the impact on employment is not yet visible due to regulatory reasons.
SQ5: What is the future impact of RPA on employment in the service industry	RPA is a bridging technology from what humans do now and what machines will be doing in the future. RPA capabilities will not develop further. However, RPA is not applied much yet. Therefore, its impact on the quantity and the quality of employment in the service industry will grow larger.
SQ6: What is the future impact of automation on employment in the service industry?	Required skill levels will shift. First repetitive work will be completely automated. Advances in Artificial Intelligence will enable even more tasks and processes to become fully automated. Less jobs will be available in the service industry.

Figure 13: Summary of Research Questions and Answers

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APPENDICES

I. Interview Protocol In-Depth Interviews

The in-depth interviews with thirteen experts working in the field of RPA will be used to answer the sub-questions and ultimately the main research question. The interviews are structured into four different phases, based on recommendations made by Kolb (2008). These phases are also described in the interview transcripts.

- *Opening phase:* the opening phase is an introduction of the interviewer and interviewee. The study is introduced to the respondent and the purpose of the interview is explained. This phase is not included in the transcripts since it is virtually the same in every interview and does not provide relevant information for the research. In the transcripts, it is marked as *intro.*
- *Questioning phase:* this phase consists of asking the pre-determined questions to the interviewee. These questions should enable the researcher to find an answer for the sub-questions.
- *Probing phase:* this phase occurs simultaneously with the questioning phase. However, probing is used to ask follow-up questions to have a more complete answer to the question. When an answer of a respondent is vague or not confirming, probing can be used.
- *Closing phase:* the interview is properly closed by thanking the respondent for his or her participation. This phase is not included in the transcripts since it is virtually the same in every interview and does not provide relevant information for the research. In the transcripts, it is marked as *closing.*

The questions asked in the interviews should help answering the sub-questions in the research. Next, the predetermined questions will be stated, with the sub-questions they are aimed to answer. Sometimes the questions were differently expressed in words during the interviews. This was due to the natural process of the conversation.

Structured Questions in the Interviews

First the sub-question is stated. Subsequently, the questions asked in the interviews are shown. Furthermore, the reason why the question is used in the interviews is explained:

SQ1: What is RPA?

Interview: What is in your opinion RPA?

Aim of asking: Knowing what the people working with the technology think of it. There may be a difference in how RPA is marketed and what it actually is.

SQ2: What motives do companies have for choosing RPA?

Interview: What kind of motives do clients have to implement RPA?

Aim of asking: Knowing why companies choose to implement this technology may also provide insight in what its current impact is.

SQ3: What is currently being automated with the use of RPA?

Interview: What kind of processes are capable of being automated with RPA?

Aim of asking: Knowing what kind of processes are currently being automated may provide insight in what its current impact is and future impact may become.

SQ4: What jobs are being replaced with the use of RPA?

Interview: Did you experience that jobs were being replaced through implementing RPA?

Aim of Asking: Experience from people working in the field may provide insight in how RPA is currently being used, and if it is used to its full potential or not. This will also explain more about the current and future impact of the technology.

SQ5: What is the future impact of RPA on employment in the service industry?

Interview: What will RPA look like in its future form? What are its capabilities?

Aim of asking: If the technology will evolve in the future it may have a larger impact in the future. People who are working with the technology will probably have a good view on these developments.

SQ6: What is the future impact of automation on employment in the service industry?

Interview: Apart from RPA: What do you think is the future impact of automation on the service industry?

Aim of asking: To come up with an overview of future developments regarding automation in the service industry.