Computer Science & Economics (BSc)

The Acceptance of Robotic Process Automation Software Explained by the Technology Acceptance Model

Twumi Weterings
Student number: s1710648

Supervisors:
T.D. Offerman MSc & P. van Leeuwen MSc

BACHELOR THESIS

Leiden Institute of Advanced Computer Science (LIACS)
www.liacs.leidenuniv.nl

01/08/2020

Abstract

More and more organizations are using Robotic Process Automation Software to boost and optimize their business processes. Automation used to be part of the IT department, but RPA is supposed to make it a multidisciplinary tool. It seems that there is a discrepancy between the expectations of the software in theory and practice. To benefit from the advantages of RPA, the workplace must have a clear picture of the software. In this study, we use the Technology Acceptance Model to map the different parts of adopting a new technology, in this case, RPA software. We found, in line with existing literature and following the found structural relations, that it is essential for users to understand the usefulness of the software. Subsequently, it is also possible to positively influence the acceptance of RPA if the user creates a habit of working with the software.

Based on the results we discuss how different TAM constructs influence the behaviour of users towards the implementation of RPA. Next, we provide a practical recommendation for implementation within organizations, based on our discussion of the results with RPA experts in practice. In our research we find that it is possible to explain the acceptance of RPA via the TAM. Using our results and previous TAM research, we find RPA implementation primarily requires users to be well informed about RPA usefulness. Next to usefulness, the ease of using RPA software influences the attitude towards working with RPA software. As not all hypothesis show to be significant, this topic requires more research on both specific constructs, e.g. perceived ease of use, and a more complete model that can provide a generalized overview on RPA acceptance. Finally, we provide a comprehensive potential research agenda for future RPA and TAM related research, split up in four different directions.

Acknowledgements

I would like to thank various people for their help during this thesis; Jean-Louis Colen for the practical RPA insights during my internship at Vattenfall NV; Desmin Dekker, Joost van Wendel, Marcus Groeneveld and all others for their help and advice in finding respondents; Hugo Karelse for consulting me on this thesis; and my friends Tijn Borm en Alexander Broux for providing me with a quiet place to study and work. Finally, I wish to thank my thesis supervisors, Tyron Offerman and Paul van Leeuwen for their advice and guidance in this thesis.

Contents

Chapter 1

Introduction

Digitalization has made its way into both the business sector as well as the academic world and creates the opportunity for the BISE community (Business & Information Systems Engineering) to research many different technologies and tools [1]. Companies are continuously looking into new tools they can use to improve their market position. Most of these tools have much potential and can improve business processes, which results in better customer experience, product quality, or improved agility. Robotic Process Automation (RPA) is one of these tools that can improve a business. It is a set of tools that automates tasks done on any computer system in a human way [2]. Many companies are leveraging RPA as a way to improve their processes [3]. Some of the advantages RPA offers include easy integration with other systems, fast return on investment and implementation, and reducing costs and full-time equivalent (FTE's). RPA shows great opportunities but only when implemented properly.

1.1 Problem Statement

O'Connor et al. previously noticed that the right way of implementing new tools needs the organization to understand and manage people's attitude and behavior towards change [4]. Blackler & Brown even explain that next to technological difficulty, it is especially important to focus on involving different users and groups in the process [5]. In their research, they include involvement, acceptability and expertise of key individuals, and groups as aspects of change.
Observing the challenges RPA presents businesses with, the acceptance of RPA is a general obstacle. It has been noted that the employee's understanding of RPA could lead to a different pace of acceptance [2]. For example, the relation between the usefulness of RPA and user acceptance and how this is measured [6]. Most studies mention pre-implementation research or describe directly measurable effects like cost-savings or higher productivity. But insight is also needed on other effects [7]. For example, a specific explanation of how employees respond after RPA implementation [1] or insights from different fields of study besides neighboring disciplines [6].

To summarize the above, there is a lack of information about the key aspects of people's behavior towards RPA, especially during or after implementation. The above describes best the problem we try to solve in this thesis.

We observe a discrepancy within the use of RPA in theory and in practice. On the one hand, it should be a tool that is easy to implement and use, showing quick results and a fast return on investment [8]. But on the other hand, it is complicated to understand how to implement, develop and work with RPA without general IT knowledge. More information is needed to show why. In literature there is little mentioned about the challenge of implementing RPA opposed to other technologies. Nevertheless, general discussions and other sources often show the implementation of RPA to be difficult, mostly due to reduced acceptance [9, 10, 11]. As described in consultancy, implementing RPA needs to focus on "...a holistic change management approach that is focused on closely aligning people, processes and structure." [11] As it is not scientifically confirmed but suggested by practice, in this thesis we assume an 'expected reduced acceptance' of RPA.
Legris et al. notice that most of the studies use the Technology Acceptance Model (TAM) to review system development applications or back-end automation software [12]. TAM is a frequently used model to map people's behavior towards a new technology into different aspects of change, often called constructs. This behavioral model was proposed by Davis in 1986 in order to help predicting system use [13]. Later this model was revised to show relations between different constructs that influence technology acceptance. We suggest that the mentioned discrepancy can be explained by the TAM.

1.2 Research questions

This thesis uses the following research question to achieve the research goal:

"To what extent can the expected reduced acceptance of RPA be explained by the TAM?"

To answer the main question, three secondary questions need to be answered:

- *"To what extent can the expected reduced acceptance of RPA be explained by a difference in perceived usefulness (PU)?"*
- *"To what extent can the expected reduced acceptance of RPA be explained by a difference in perceived ease of use (PEOU)?"*
- *"Is there a difference between the significance of perceived usefulness and perceived ease of use regarding the TAM and RPA?"*

1.3 Thesis Outline

Examining the diverse collection of determinants that influence the adoption of a new IT-tool, we observe a difference in acceptance if the determinants vary. If the above is correct and RPA differs from other software when studied via the TAM, investigating the difference between RPA and other IT software with regard to a user's perceiving should provide insight on this contrast and why it is difficult to implement RPA. This means the research can be split up into two parts. First, we have to determine the user's behavior towards RPA software. This is achieved by a Structural Equation Modelling analysis that shows the different relations between the important aspects of adopting a new technology. Secondly, with the results, we can provide a better perspective on how different TAM constructs affect people's intention to use the software.

In chapter two relevant background literature on RPA is described and an overview of the current problems in RPA literature is shown. Along with information about the Technology Acceptance Model, the statistical technique Structural Equation Modelling is briefly explained. In the third chapter, the methodology is presented, including the specification of our proposed model. Chapter four includes the results of this study, which are discussed in chapter five, along the lines of our hypotheses. Finally, the research questions are answered in chapter six, which also includes future research suggestions.

Chapter 2

Literature Background

The principle of automation has been around since Henry Ford introduced his assembly line in 1913. It started a time of technological advances, resulting in many different forms of automation [14]. Although it is an ongoing debate, these forms of automation can be seen as the predecessors of RPA. According to UiPath, a big RPA company, the three main predecessors are screen scraping software, workflow automation, and management tools [15].
If RPA originated from these three tools, this is also the start of relevant research on RPA. Finally, Sirisuriya states that the so-called 'macros' are also early stage RPA tools, which means it could also be called a predecessor [16]. More background information about these predecessors is found in Appendix A.

2.1 Robotic Process Automation

While based on its similar predecessors, RPA differs because it is built including multiple other technologies. RPA brings together machine learning and AI components, but also makes use of natural language processing(NLP) and optical character recognition(OCR). Robotic Process Automation is an upcoming automation tool. It has many different definitions.

The definitions show that RPA functions next to the existing software, previously controlled by a human user. The autonomous software uses business rules and clearly defined steps to provide the same or even better results than a human employee. It replaces human tasks via an 'outside-in' manner. This is different from the 'inside-out' approach used to improve information systems [2]. The tools mentioned are mostly realized in the form of automation software. RPA is used in the business area of a company and it, therefore, makes sense that it is intuitive and visual. UiPath, Blue Prism PLC, Automation Anywhere and Redwood Software (all major market leaders in RPA) use a visual programming language, much like for example BPMN software. Lacity & Willcocks also explain that despite the term 'robotic', there are no actual mechanical robots. The term is still accurate as it uses virtual workspaces (often on a server or a cloud) to handle a process [17].
In this thesis we use the definition of Lacity & Willcocks since they are most frequently cited in articles about RPA: RPA is the "...automation of service tasks that were previously performed by humans. For business processes, the term RPA most commonly refers to configuring software

to do the work previously done by people, such as transferring data from multiple input sources like email and spreadsheets to systems of record like enterprise resource planning (ERP) and customer relationship management (CRM) systems." [17] Appendix B provides a full overview of the definitions used in literature.

Another useful view on RPA can be found in computer science. Here, so-called agents are regarded simply as systems that process information, from which they then produce an output [18]. These systems are often implemented as software agents, and referred to as "a program that calculates a result from user input". The above means that RPA software can also be looked at as an agent.
According to Luck, McBurney & Preist, agents are "...autonomous, problem-solving computational entities capable of effective operation in dynamic and open environments" [19]. This definition has two useful parts, the first being the environments in which they function. Sometimes agents are combined, interacting with other agents (this can also be a human agent). The agents are often deployed in environments in which they interact, and maybe cooperate, with other agents (including both people and software) that have possibly conflicting aims. Such environments are known as multiagent systems [19].
Also, this part shows agents are supposed to function in dynamic and open environments. The agent has to be agile enough to function in a changing environment. As stated before, RPA is built on top of existing systems or software. According to Yan, Maamar and Shen, an optimal agent should even be able to react to the environment by adjusting itself to changes, forming a new flow or activity, exactly like RPA does [20].
The other part of the above definition states agents should be able to solve problems autonomously. This, in a way, has multiple similarities to cognitive systems or even artificial intelligence. Since AI is seen as "[the automation of] activities that we associate with human thinking, activities such as decision-making, problem-solving, learning...", this could be why the field of AI is often mentioned alongside RPA (or even as a predecessor or successor) [21].

2.1.1 RPA Software Advantages

Most of the companies that implement automation, in general, will see multiple improvements [22]. This can be decreased delivery times, lower costs improving service quality, and increased compliance. To make automation feasible, only cases that occur very often are handled with an automation tool. Other cases might need more human interaction, resulting in a more complex process. This means that cases that occur often but are just too expensive are still handled manually and therefore more time consuming than the automated processes. RPA provides a solution to the challenge above since it lets the agents (robots) handle the human interaction part. Although not all other processes fall in this category, a big percentage of the cases can be solved by RPA.
Apart from the advantages mentioned before, RPA has a lot of other benefits. According to a case study, these include better customer service, reduced business operating costs (as much as 200 percent cost reduction compared to the human executed process), and employee workload (300 robots, managed by two people, could do the work of 600 people) [23]. Finally, a mentionable benefit is the freedom RPA gives current employees to switch from monotonous, tiresome work to more challenging tasks the robots can't do.

2.2 Current RPA Problems: an Overview

Another topic that is voluminously talked about is implementing RPA, concerning the company's infrastructure. For example the uniformity [22], security, compliance and economical risks evaluated when a infrastructure is built [22, 24]. Another potential research area could be the difference between top-down or bottom-up implementation.

After RPA is implemented, studies raise questions about another subject, the effects and results of RPA. Starting with the characteristics a process should have to make RPA the most suitable tool for improving the process [2], onto the tool's importance in the effectivity of a company's strategy or other company values [17]. This also raises the question about the optimal ratio, business-tool or IT-tool, for RPA to produce the best results. Legris et al. notice that most of the studies use the Technology Acceptance Model (TAM) to review the implementation of system development applications or back-end automation software, while there is little research on business process software [12]. In addition, another implementation challenge occurs. Even when RPA is accepted by employees, it often shows to be difficult to find the right processes to automate, especially if those processes are multi-perspective or complex. Literature suggests combining process mining and RPA to support this challenge [25]. However, in their study, Leno et al. conclude that more in-dept research is needed.

Even if RPA research provides companies with enough knowledge and guidelines to implement the tool, to show the results and to benefit from the advantages, another problem arises. If we look at large companies, e.g. organizations setting up a RPA Centre of Excellence, many questions and challenges arise [9]. Most of these can be solved by reading case studies, scientific papers or posing these questions to experienced experts in the field. There is another challenge that is more difficult to solve. Even though the RPA software continuously improves, making the possibility to combine RPA with other technology endless, it seems to be difficult for the business-oriented employees to gain a precise understanding of RPA and the things that can be achieved with it. In an article by Mendling et al. (2018) an explanation is provided: "...technologies such as machine learning, RPA, and blockchain are complex and difficult to understand, which might explain low perceived behavioral control." [26] On the other hand, people often do trust in human experts. This shows why it is difficult to implement RPA even though it is definitely ready to be implemented according to literature.
Following the statement by Mendling et al., it is also important to notice that RPA is often proposed as tool to accelerate digitization and the use of digital enablers (e.g. AI, machine learning, blockchain, etc.). Siderska elaborated on this by providing a full overview of possible RPA integration with other technologies [27]. This leads to the following problem: As the use of RPA accelerates, organizations need a way to standardize and scale their RPA processes. And even though easy scaling is one of the suggested advantages of RPA, in practice this proves to be a difficult part of RPA deployment [28].

2.3 Explaining Behaviour on Technological Change

Management often follows a strategy focused on improving the productivity of information systems. This results in the need for research on user satisfaction of computer systems, as this might influence the efficiency and effectivity of data output [29].
This research resulted in several factors that influence the use of technology, mainly regarding information systems. Later on, around the mid-nineties, this list of factors was the foundation in developing new models that could predict the use of IS, for example, the use of computer-aided software engineering (CASE) was reviewed using the Technology Acceptance Model (TAM) [30].

2.3.1 Technology Acceptance Model (TAM)

The model, suggested by Fred D. Davis in 1986, states that of the many factors that affect system use, the most important are perceived usefulness and perceived ease of use. User acceptance is commonly measured as 'user satisfaction' or 'system use', as these are regarded as representatives or prerequisites. Also, perceived usefulness is regarded as an important measure of technology acceptance [13, 31, 32].

Some human factors appear when looking at the determinants of perceived ease of use, which can be grouped into control beliefs, intrinsic motivation, and emotion [33, 34], while other research uses habit as a factor. According to Venkatesh, the determinants "...are primarily individual differences variables and general beliefs about computers and computer use." [35]
Also, there are various factors included in the TAM that affect an information system's user satisfaction [12]. Since user reception is difficult to measure, due to it's complex and multi-faceted nature, more systematical research is needed on different mechanisms that drive user acceptance. Especially looking into alternative theoretical models. In other words, RPA should be compared to other automation solutions [36]. Current research describes some occasions where RPA was compared to more heavyweight IT [17, 37], but these do not mention the difference using a behavioral model. Hubona & Blanton evaluate different system design features regarding the TAM [38]. It shows multiple variables of the TAM but focuses on system characteristics, which the model regards as external variables. The paper's hypotheses all involve the user interface of the system. Other works also suggest the interface of the system influences user performance (which affects the ease of use) [39, 40, 41, 42]. This shows the importance and impact of user interfaces on the implementation of a new system.

A case study about the TAM in healthcare shows the relevance of one other element, the perceived behavioral control (PBC) [43], also defined as "...perceptions of existing infrastructure, internal and external resource constraints, or skills, resources, and opportunities necessary to use the system."
Honing in on the TAM and the PBC, other case studies show the value of other factors that influence the perceived ease of use, perceived usefulness and attitude [44, 45]. Examples of these factors include the available resources, user's general interests, social influences, trust and security, and a user's understanding of the tool (how easy is it to learn the tool). The above problems all show the importance of different constructs when using new tools, software, or technology.

2.3.2 Structural Equation Modelling

Structural equation modeling (SEM) is described as a collection of statistical techniques to examine relations between dependent (endogenous) and independent (exogenous) variables, both continuous or discrete [46]. In other words, SEM can be used when analyzing the relation between a single measure *(e.g. Behavioral Intention to use a system)* and multiple other variables *(other TAM constructs)*. SEM is especially useful when comparing the covariance matrix of a model to the actual covariance matrix population [46]. It is also used for testing hypotheses that compare different models, that are subsets of one another, mainly regarding the model's parameters. In short, SEM examines competing theories, using specific statistical methods. That makes it particularly interesting to this thesis since we use the SEM in a similar way to find the difference between the influence of PU and PEOU. To ensure the validity and accuracy of the analysis, previous works suggest a few assumptions [47]. First, the data should be multivariate normally distributed and assuming a linear relationship between the dependent and independent constructs. Next, the data should not contain heavy outliers and be on an interval scale. A clear cause and effect relation needs to be present between the dependent and independent constructs. Finally, the sample size needs to be large enough since it influences the confidence level and margin of error.

Chapter 3

Methodology

To assess the acceptance of RPA a (simplified) Technology acceptance model was applied [48]. The TAM was used to determine the effect of perceived usefulness (PU) on the acceptance of Robotic Process Automation, compared to the effect of the perceived ease of use (PEOU). To test the effect of perceived usefulness on the predicted future use of the technology Davis uses a factor analysis [13]. Factor analysis focuses mainly on reducing multiple separate items into only a few dimensions, reducing the number of variables in a model. Together with multiple regression analysis, factor analysis forms a multivariate statistical analysis technique called Structural Equation Modelling [47]. Simply put, a SEM analysis consists of a factor analysis (testing the measurements) and a structural model test (testing the model's relations). This means the study is organized as follows. First, the audience, research method, data collection and measurements are identified and put into perspective using various statements. Next, the final steps of the study are mentioned; the hypotheses and suggested model.

3.1 Survey: Psychometric Test

To measure the impact of TAM constructs, most studies use a survey to show which parts in a proposed relational model are most noticeable. This is done using a Likert scale survey, with several statements for each construct. Psychometric tests are commonly used in research to measure mental capabilities and behavior. A Likert scale is used as one of these tests as a psychometric scale, often used in research with questionnaires. The range of the Likert scale shows how strongly a respondent agrees or disagrees with the questionnaire item [49]. Analyzing multiple of these items results in a pattern that has scaled properties (a function can be formulated), making it possible to apply mathematical operations on the data. Literature both suggests a five-point scale and a seven-point scale. This study will use a five-point Likert scale because it is less confusing to subjects, which also increases response rate and quality [50]. The first part of the survey focuses on collecting demographic attributes. These attributes will provide a way to check how the sample is represented. It will also grant the opportunity to filter or check for the correct audience stated before. The survey and used statements can be found in Appendix C.1, which are based on the constructs in Appendix C.2.

3.2 Data Collection

The target population, including sampling size, depends very much on the goal of our research. Since the goal of this study is to find any irregularity in perceived usefulness for a specific technology (RPA), we base our decision on preceding works similar to this thesis. The first suggestion is a group of students. According to Legris, students work in a simplified environment that is not exposed to all factors usually affecting the TAM [12]. Even though this provides advantages Legris claims this is out-weighed by research in a business environment.
Another commonly used subject group consists of mostly non-IT employees using the system. A good way to classify their level of IT can be done via Rockart & Flannery's classification of end users [51]. It is widely accepted and used by MIS researchers [52]. By classifying the subjects we can indicate a level of RPA sophistication in the studied organization. Similarly to the group of managers, a frequently used group researching the TAM consists of experienced programmers [30]. The results are then often compared between different groups. Focusing on the effect of perceived usefulness on the predicted future acceptance means the group of managers, C-level and salespersons is most valuable for this research. Since identifying and contacting only this group resulted in a lack of subjects, the group of programmers was also added to the audience. The questions used in forming a demographic profile are shown in Appendix D.1.

Previous TAM research show a very large range of sample sizes [53, 54, 55, 38], making it difficult to find a valid size. The number of subjects, also known as the sample size, greatly influences the confidence level and margin of error [56]. Working with a mostly homogeneous group of subjects, the sample size should be increased until data saturation is reached. Since it can not be predicted when this is, the study uses the proposed sampling size of Saunders of at least 30 subjects [57].

Also stated in Saunders, using non-probability sampling is unavoidable, since the sampling frame is unknown [57]. Saunders, therefore, provides researchers with multiple sampling techniques. In this thesis, the researcher uses snowball sampling. This technique helps in acquiring enough subjects, so the sampling size will meet its requirements. First, contact is made with several cases in the population. Then, these cases are asked to identify further cases, these cases are then approached as well. The snowball effect is stopped when the sampling size is large enough. The survey is created and distributed using Easion X. This survey-software is provided by Leiden University and is therefor the logical choice. Both the factor analysis and the structural model test were done using IBM SPSS Statistics 26 and AMOS.

3.3 Factor Analysis

The SEM analysis starts with an exploratory factor analysis (EFA). As in Yong, et al.: "EFA tries to uncover complex patterns by exploring the data set and testing predictions." [58] In other words, this analysis calculates correlations between the different items to find which items are the best candidates for a simplification of the data set. Usually, three tests are used to examine the items. First, a correlation matrix that shows if any insignificant relations exist. Next, the determinant indicates the level of possible multicollinearity, which prevents EFA. Finally, a sampling adequacy test is done to check if the data is suitable for confirmatory factor analysis (CFA), which is the next step in SEM [58, 59].

Using the results from the EFA, a CFA was conducted. The CFA shows how to go from a measurement model to a structural model and if this is an acceptable fit, in this study, by extracting five factors; respectively BI, PU, PEOU, H, and SQ. The CFA then uses the factor loadings of EFA in a path analysis. The path analysis models relations between the different variables, often realized as hypotheses [60]. This means it is possible to explain the relations between constructs, using the model´s path coefficients. Finally, defining a structural model and running the factor analysis results in a visual representation of the relations mentioned before. This provides more insight, but even provides the researcher with data to compare two relations, which is especially useful in this study, e.g. for answering the secondary research questions.

3.4 Model Specification

SEM requires the type of model to be specified. In this thesis, the used model is the Technology Acceptance Model (TAM). It is a structural model, as it shows us relations between the different constructs. The TAM is a broadly researched model and has more than one version. In this thesis, we use a simplified model of the extended TAM used by Rafique, et al., shown in Appendix E.1. The model is based on the Venkatesh & Bala extended TAM3 model, shown in Appendix E.2. The simplified model used by Rafique, et al. consists of seven relations between the constructs, shown in Table 3.1 as hypotheses. The relevant explanation of the constructs can be found in Appendix F. Based on the five constructs and seven relations this study proposes the research model in Figure 3.1.

Table 3.1: Hypothesis and their description

Hypothesis	**Description of relation**
H1a	Having a habit of using RPA software has a positive significant effect on the perceived usefulness of RPA software.
H1b	Having a habit of using RPA software has a positive significant effect on the perceived ease of use of RPA software.
H2a	The system quality of RPA software has a positive significant effect on the perceived usefulness of RPA software.
H2b	The system quality of RPA software has a positive significant effect on the perceived ease of use of RPA software.
H3	The perceived ease of use of RPA software has a positive significant effect on the perceived usefulness of RPA software.
H4	The perceived usefulness of RPA software has a positive significant effect on the behavioral intention of using RPA software.
H5	The perceived ease of use of RPA software has a positive significant effect on the behavioral intention of using RPA software.

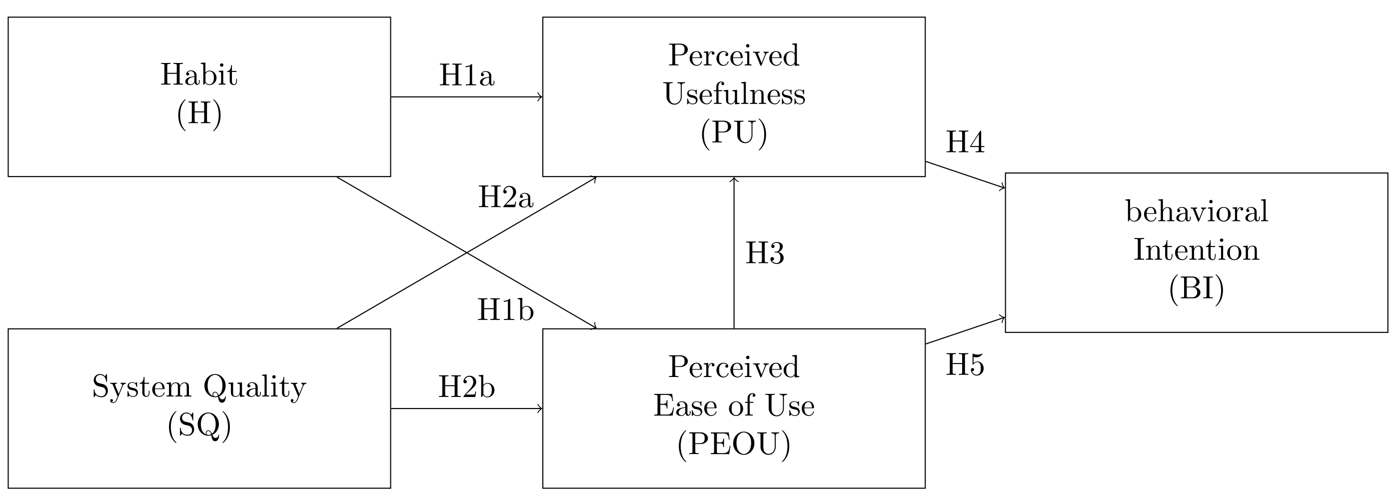


Figure 3.1: Proposed model based on the simplified model by Rafique, et al. [48]

Chapter 4

Results

A total of 30 respondents answered the survey. In this chapter a demographic profile is specified, to map the distribution of our respondents. Next, the results from both factor analyses are shown and based on fitness indices our model is re-specified.

4.1 Missing Values

In our dataset, some missing items were found, two age-items and two construct-items were missing. Since SEM uses a different approach than classical statistical analysis, handling these missing values based on substantial argumentation is crucial to the study integrity. In SEM, 'fixing' missing data by data imputation can lead to bias and imperfect hypotheses tests [61]. To make sure we follow a statistical guideline, we chose to act per the practical guidelines of Newman [61]. Following his guidelines for missing data treatments, the two options were to use the maximum likelihood (ML) algorithm or to use a listwise deletion approach. In SPSS, the only missing data options are 'exclude cases listwise', 'exclude cases pairwise' and 'replace with mean'. According to Newman, as long as the missing items are random listwise exclusion is unbiased, the only disadvantage being a smaller sample size. Since SPSS does not provide a direct option for the ML approach, the cases were excluded listwise. This is in line with common practice and also with our approach in AMOS, which only works for datasets without missing values.

4.2 Demographic Profile

The demographic profile can be seen in Table 4.1. 86,7% of the respondents were male and 13,3% were female. Their age was between 18 and 58, with an average of 36. The distribution of experience was as follows, 26,7% had less than 6 months of experience; 20,0% had between 6-12 months of experience; 16,7% had between 1-2 years of experience and 36,7% had more than 2 years of experience. The results infer that the majority of respondents have a developer role regarding RPA and function as a normal employee within their organization.

Table 4.1: Demographic Profile

Gender	Frequency	Percent (%)	
Male	26	86,7	
Female	4	13,3	
Other	0	0	
Total	30	100	
Experience			
<6 months	8	26,7	
6-12 months	6	20	
1-2 years	5	16,7	
>2 years	11	36,7	
Total	30	100	
Role (organization)			
Intern	2	6,7	
Employee	17	56,7	
Middel Management	5	16,7	
C-Level	2	6,7	
Other	4	13,3	
Total	30	100	
Role (RPA)			
User	6	20	
Developer	19	63,3	
Owner	5	16,7	
Total	30	100	
Age*	**Between (range)**	**Average**	**Median**
	18-58 (40)	35,75	32

$*$ Age contains 2 missing values, resulting in $n = 28$.

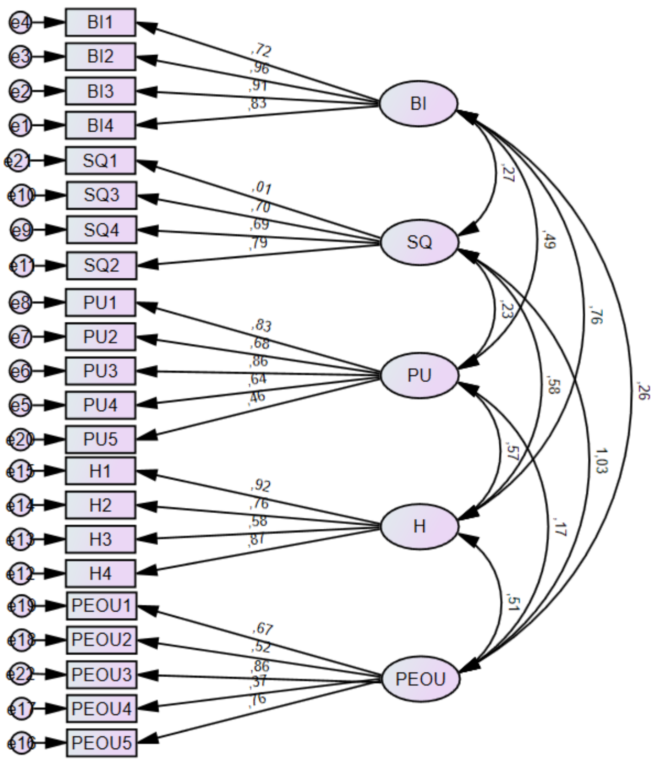
4.3 Exploratory Factor Analysis

To start the use of SEM, an exploratory factor analysis (EFA) was done. Using Rietveld and Yong, et al., three tests were conducted [58, 62]. First, the correlation matrix was inspected, since correlations under $0,3$ since these do not show a significant relationship (Appendix G.1). The determinant of the correlation matrix was greater than 0, which should indicate the absence of perfect multicollinearity. A test for sampling adequacy, Kaiser-Meyer-Olkin (KMO) was performed, resulting in $KMO = 0,562$ and Bartlett's Test of Sphericity resulted in $P = 0,0000$.

To find a model with a good fit, the following rule was used: "A model that is a good fit will have less than 50% of the non-redundant residuals with absolute values that are greater than 0,05..." [58]. Since our model has 25% of the non-redundant residuals greater than 0,05, our model is a good fit.

4.4 Confirmatory Factor Analysis and Model Re-specification

After the EFA, a confirmatory factor analysis (CFA) is done. The model is built from the pattern matrix in Appendix G.2. The CFA model and it's regression weights are shown in Figure 4.1. The analysis consisted of multiple indexes to test the model fitness, particularly the Chi-square(X^2) test, the Comparative Fit Index (CFI), and the Root Mean Square Error of Approximation (RMSEA). According to Gerbring & Anderson, the primary index to use is the CFI [63]. Our CFA showed a CFI of $0,548$; which is below the threshold ($CFI >= 0,90$). The RMSEA showed was $0,211$; which is above the recommended $RMSEA < 0,08$. Finally, $X^2 = 438,223$, but more importantly $X^2/df = 2,202$, also known as CMIN/DF in AMOS.
These recommendations have become a rule of thumb for factor analysis and a rationale for model re-specification. The reason and explanation behind the low factor loadings can be found below.



			Estimate
BI4	<---	BI	,835
BI3	<---	BI	,915
BI2	<---	BI	,960
BI1	<---	BI	,717
PU4	<---	PU	,642
PU3	<---	PU	,864
PU2	<---	PU	,676
PU1	<---	PU	,832
SQ4	<---	SQ	,689
SQ3	<---	SQ	,698
H4	<---	H	,868
H3	<---	H	,580
H2	<---	H	,763
H1	<---	H	,924
PEOU5	<---	PEOU	,760
PEOU4	<---	PEOU	,371
PEOU2	<---	PEOU	,524
PEOU1	<---	PEOU	,672
PU5	<---	PU	,456
SQ1	<---	SQ	,014
SQ2	<---	SQ	,793
PEOU3	<---	PEOU	,859

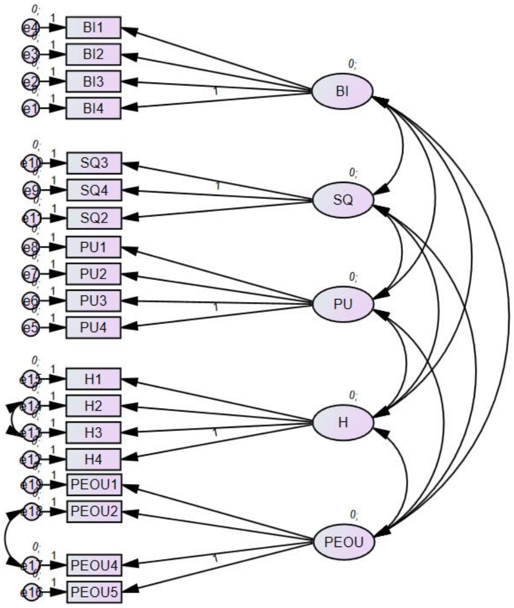
Figure 4.1: CFA model and Standardized Regression Weights

The EFA is meant to check if the data can be reduced by finding common factors using correlation [64]. The correlation matrix showed that the items belonging to the same construct were correlated, while there was little correlation to items of other constructs. This means if several factors can be identified, a pattern can be found to also support the use of constructs. Yong, et al. (2013)'s KMO threshold ($KMO > 0,5$) was met, but other literature indicates this means it is barely acceptable [65]. We should take into consideration that the data should be revised or the sample size could be too small to indicate a valid pattern in the data set. But since Bartlett's Test threshold was met, the data was declared suitable for factor analysis.

Examining the table of eigenvalues and the scree plot it is possible to extract the relevant factors [59]. The factor analysis was done according to Kaiser Criterion ($eigenvalue > 1$), to find the best cut-off [59, 66]. This results in six extracted factors, where the first factors provide a better substitute then the latter. The six factors are in line with the fact that five constructs are chosen in this study, considering the sixth factor being barely above the threshold, also visible in the scree plot (Appendix D.2).
Unfortunately, literature does not show an unambiguous threshold for factor loadings, the majority of the factor loadings were above the commonly used $0,5$ mark. Even though the loadings were seemingly high enough, using the model fitness indexes and using the recommended values in Hair et al. (2010), the data was unlikely to fit the model, even though the values in the EFA did declare the data suitable for factor analysis. Also, the factor loadings of PU5, SQ1, H3, PEOU2, and PEOU4 fell below or barely above Hair et al. (2010)'s recommendation of $0,5$. Some of the items show high loadings for more than one factor, indicating statements in our survey might not only measure the construct for which they were meant, but also another construct. This makes it difficult to use that item for finding our regression weights.

4.4.1 Model respecification

When the model is a poor fit, Hair et al. (2010) and Byrne (2010) state it is common to respecify your model by purification of items. Since literature lacks clear guidelines for model respecification, this study follows Hair and Byrne as they state it is important to show all factor results, so further research can be done if necessary [64, 67, 68].
Looking at the modification indicators provided in AMOS and keeping the $0,6$ cut-off for factor loadings in mind, multiple items were removed or rearranged. SQ1 did not have any high correlation to other SQ items and it was the only factor that loaded into the sixth factor. This might be the explanation for the low factor loading of $0,01$. PU5 was also removed because its factor loading was very low, but more importantly, it shows a very low correlation with the other PU items and high correlation with other items like Habit and Behavioural Intention. The way it is formulated is very different from the other items, which might explain why it does not fit well with the other PU items. The same is true for PEOU3. Where all PEOU items focus on how easy it is to use RPA, PEOU3 focusses on understandable and clarity. Even though these seem similar, they are formulated differently. The preceding, but also because PEOU3 is the only item in PEOU that has a correlation below the earlier mentioned threshold of $0,3$.
Some of the endogenous parameters showed a high covariance, so in agreement with Byrne (2010) the covariance was drawn between those of the same construct to increase the model fit [67, 68]. To summarize; Items SQ1, PU5, and PEOU3 were removed and covariance was drawn between (e17, e18) and (e13, e14). This resulted in a revised model shown in Figure 4.2.



			Estimate
BI4	<---	BI	,826
BI3	<---	BI	,903
BI2	<---	BI	,973
BI1	<---	BI	,712
PU4	<---	PU	,611
PU3	<---	PU	,891
PU2	<---	PU	,651
PU1	<---	PU	,846
SQ4	<---	SQ	,631
SQ3	<---	SQ	,709
H4	<---	H	,855
H3	<---	H	,515
H2	<---	H	,717
H1	<---	H	,955
PEOU5	<---	PEOU	,691
PEOU4	<---	PEOU	,366
PEOU2	<---	PEOU	,646
PEOU1	<---	PEOU	,806
SQ2	<---	SQ	,818

Figure 4.2: Respecified CFA model and Standardized Regression Weights

Another CFA was RUN, resulting in the following indexes. A CFI of $0,642$; which is below the threshold ($CFI >= 0,90$). An RMSEA of $0,201$; which is above the recommended $RMSEA < 0,08$. Finally, $X^2 = 292,177$, the $X^2/df = 2,087$. Using the new results, it still means the model fit does not meet the standards for CFA. The fit however did increase. To see if the results could still be relevant, a discriminant validity test was done. The covariance between the different constructs should be less than the covariance within the individual constructs. Table 4.2 shows the results of this check. Apart from PEOU, the other constructs seem to fit the criteria. This is why it was decided to continue with the SEM analysis, building the Latent Variable Structural Model (SM) in Figure 4.3.

Table 4.2: Validity test results

	CR	**AVE**	**MSV**	**MaxR(H)**	**BI**	**PU**	**SQ**	**H**	**PEOU**
BI	0,917	0,738	0,593	0,962	**0,859**				
PU	0,842	0,577	0,231	0,885	0,415	**0,759**			
SQ	0,765	0,523	0,791	0,787	0,259	0,258	**0,723**		
H	0,854	0,606	0,593	0,936	0,770**	0,481†	0,588*	**0,778**	
PEOU	0,731	0,42	0,791	0,784	0,336	0,125	0,889*	0,644*	**0,648**

Significance of correlations: $*p < 0,050$; $**p < 0,010$; $***p < 0,001$

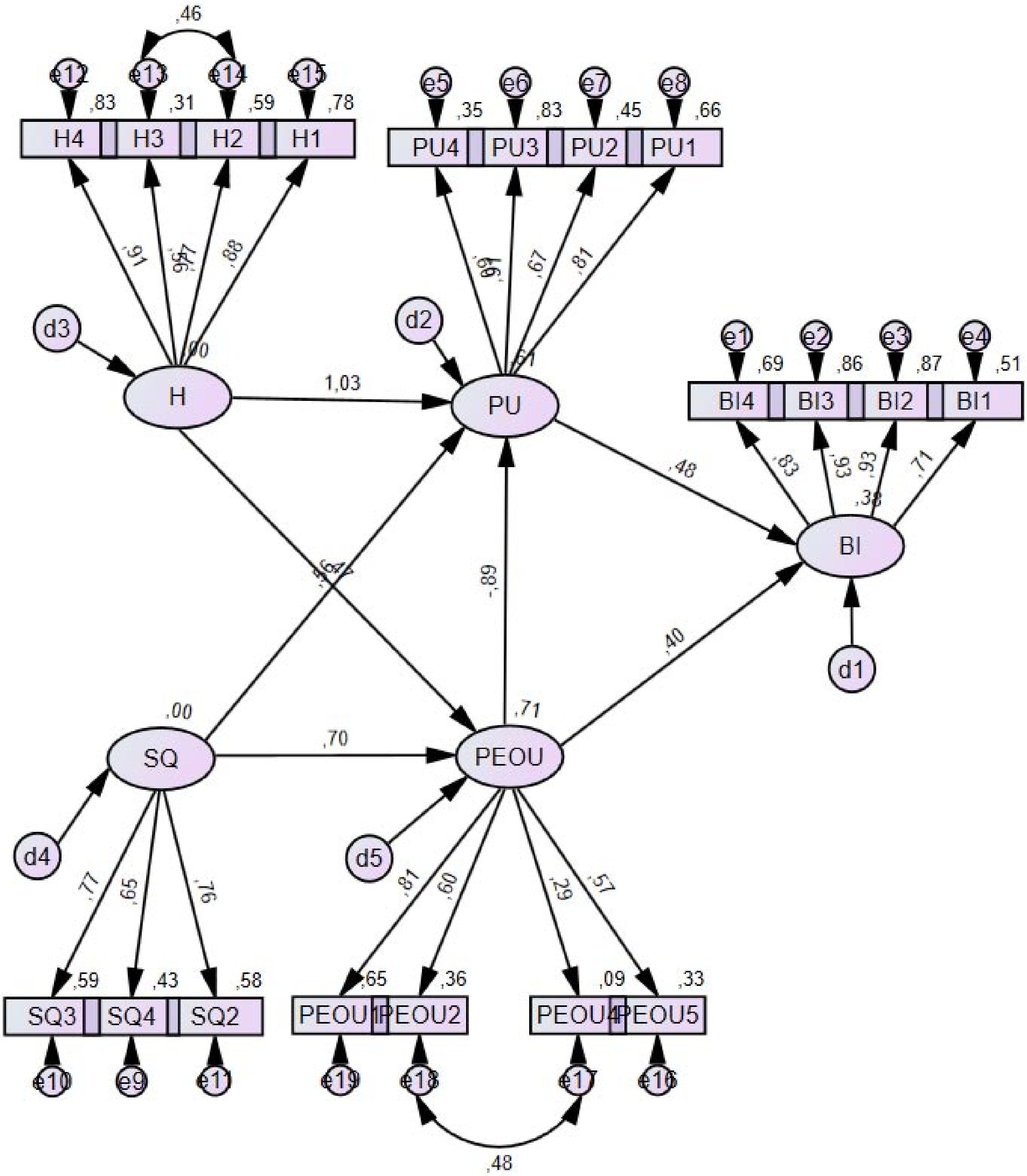


Figure 4.3: Structural model with relations based on hypotheses

Just like the CFA model, the SM can be validated using fitness indexes. The SM showed a CFI of .613; an RMSEA of .207; $X^2 = 307,796$ and the $X^2/df = 2,152$.
Using the standardized path coefficients(β) it is possible to test our hypotheses. An overview of the hypotheses, their β, SE, and the P-value can be found in Table 4.3.

Table 4.3: Hypotheses and their values

Hypothesis	β	**SE**	**t-value**	**P-value**	**Suggestion**
H1a: H ->PU	1,029	0,225	2,12	0,034	Reject
H1b: H ->PEOU	0,469	0,159	2,095	0,036	Accept
H2a: SQ ->PU	0,556	0,417	0,932	0,351	Reject
H2b: SQ ->PEOU	0,699	0,345	2,166	0,03	Accept
H3: PEOU ->PU	-0,889	0,493	-1,18	0,238	Reject
H4: PU ->BI	0,476	0,346	2,103	0,035	Accept
H5: PEOU ->BI	0,397	0,222	1,787	0,074	Reject

Chapter 5

Discussion

First, it is important to notice that both our CFA and SM did not meet the fitness requirements. In detail, this means that multiple indicators (fitness indices) show that the model cannot reproduce the correlation within our dataset. Our model is therefore not fit for confirmatory analysis, but it can still be for exploratory analysis since our EFA showed promise. Another important note is that even though the fitness indices did not meet their threshold, it still showed the model fits in some way. The indices we calculated were far from one, which would indicate no fit at all. This is why in our discussion we decided that even though our model fitness was not met, it was worth discussing the relation between constructs individually.

5.1 Explaining TAM Construct Relations

In this section, we interpret the results from the previous chapter by comparing the found path coefficients with previous studies, specifically Rafique, et al., Hubert, and Venkatesh. We end each relation with a short conclusion.

H1a: Habit → Perceived Usefulness

Even though we found a significant P-value for this relation, the path coefficient showed a value above 1. A regression coefficient can be above one, but this means it is a case of multicollinearity, which often leads to large standard error and difficult interpretation [69]. Since this is not in line with our SEM model, we have to reject this hypothesis. In literature however we find that Hubert et al. recorded $\beta = 0,32$; $t = 5,122$ and $P < 0,05$ [70]. Rafique et al. and Venkatesh found similar values [48, 71]. In short, even though our model suggests multiple predictors for this relation, it is similar to a relation described by previous studies. From our point of view, this means an organization can accelerate the acceptance of technology by assisting its employees in working with that technology. This way, they will better understand the usefulness of the tool. However, we cannot generalize this to the point of RPA software, but we suggest more research could lead to a better understanding of this effect.

H1b: H $\rightarrow$ PEOU

The regression coefficient of this relation is in line with literature (Hubert: $\beta = 0,13$; $t = 2,601$; $P < 0,05$. Rafique, et al.: $\beta = 0,501$; $t = 8,863$; $P < 0,05$) [70, 48]. The P-value indicates this result is significant and using our initial definition of H and PEOU we can say the following. This hypothesis is supported, meaning a difference in automatically performing RPA software behavior has a direct significant influence on the level of effort of using RPA software. This would mean that users of RPA experience working with RPA as easier, due to a habit of working with the tool.
We do however have to note that the PEOU construct did not pass the validity test, indicating a very low average variance extracted (AVE). This does not mean this relation is automatically insignificant because it is the influence of habit on PEOU and not the other way around. It is however important to mention this as we also recommend further research on this construct.

H2a: SQ $\rightarrow$ PU

The hypotheses H2a and H2b are based on the research by Rafique, et al. which where they found $\beta = 0,480$; $t = 7,456$ and $P < 0,05$ [48]. This indicates there is a positive effect of system quality on the use of the technology they investigated. Furthermore, they state their findings are in line with prior research by Jeong [72]. Looking at our results a β of $0,556$ was found with a P-value above the threshold, making it an insignificant finding and incorrect to assume a positive significant relation between good assistance and accessibility of RPA software systems and the perceived usefulness. Yet, that does not mean the system quality is not important to RPA users. Future researchers might consider using a more in-depth type of research, e.g. interviews, to examine the preferences and desired features regarding this construct. This would not only provide practical improvements, but also insight on the specific elements of SQ that are most required.

H2b: SQ $\rightarrow$ PEOU

Similar to hypothesis H2a, this relation is based on Rafique, et al. and Jeong. Again Rafique, et al. found substantial evidence to accept this hypothesis ($\beta = 0,491$; $t = 5,576$ and $P < 0,05$). Our results indicate the same evidence ($\beta = 0,699$ and $P < 0,05$). This means we presume access to an easily usable RPA system has a positive effect on the perceived ease of working with RPA software. Similar to H2a, the relation between these constructs are not only useful in practice to organizations and RPA suppliers, but also to future studies. If RPA users are provided with accessible and suitable RPA software and systems, they are more likely to work with RPA without difficulty. Nevertheless, we again have to note that the PEOU construct did not pass the validity test, which provides an opportunity for future TAM research focused on relations in which the dependent variable did not pass the validity tests and how to interpret this better.

H3: PEOU $\rightarrow$ PU

First of all, the PEOU construct did not pass the validity test discussed in the previous chapter. This means that our result is not accurate enough to test our hypotheses regarding PEOU's influence on other constructs. Next to this, we see a P-value above our threshold of $0,05$ which also indicates there is no evidence this hypothesis holds. This is not in line with Hubert's findings of $\beta = 0,13$; $t = 2,601$; $P < 0,05$ and Rafique, et al.'s similar findings, indicating PEOU should positively influence the perceived usefulness of RPA software users [70, 48]. Meaning according to previous work users that find it easy to work with RPA software are more likely to understand its usefulness.

H4: PU $\rightarrow$ BI

This relation is often mentioned in literature, showing its importance in TAM research. In Hubert et al. (2017) they found $\beta = 0,23$; $t = 2,715$; $P < 0,05$ and concluded: "Furthermore, the effects of usefulness (H2a)... on behavioral intention are also in line with TAMs (Davis et al., 1989)." [70] Rafique et al. find $\beta = 0,344$; $t = 5,349$; P $<$ 0.05 [48]. They however address that even though PU has a significant positive influence on BI, PEOU has an even stronger impact on the use. This is not only in their own research but also in previous similar studies. Our results are in line with previous research ($\beta = 0,476$ and $P < 0,05$), but based on the above we recommend further research on this outcome.

H5: PEOU $\rightarrow$ BI

This relation can not be used in this study any further as explained in a similar situation at hypothesis 3. Albeit the foundings of Hubert and Rafique, et al., which found a positive significant influence of PEOU on the actual behavioral intention of RPA software use [70, 48]. The literature above suggests that if users understand the RPA software and can comfortably work with it, their intention to work with the software should increase.

5.2 Recommendation for RPA Software Use in Practice

In this section, we provide a better perspective on what the conclusions of the relations in the previous section mean in the context of our study and RPA specifically. The described practical problem in this thesis shows it is often difficult for beginner RPA users to adopt the new automation tool. In theory and also while talking to RPA experts it is supposed to be a tool that is easy to learn, implement, and use. Accepting hypotheses H1b, H2b, and H4, this study shows that for RPA users it is beneficial to understand the usefulness of the tool, as this positively influences the intention to use it. To improve the impression of the usefulness of RPA, one could make sure the system and software of RPA are easily accessible and provide the user with easy to use tools. Another way to boost the perceived usefulness is by creating a habit of working with the software, as performing more tasks automatically shows a positive influence on the PU.

Reflecting on these recommendations with RPA managers and consultants in practice, we found that informing users of RPA is not always simple. Managers often have too much on their hands, are focused on output based directions and do not always have an IT background. Hence, we suggest showing users how a robot works, e.g. via a live demonstration or video, where it is clear what makes the robot better at a task than a human. Instead of only showing results like saving hours, the demonstration should follow and explain the workflow of the robot, step by step. Next, the managers can be convinced by actual cost-savings and other output.

5.3 Related Work

Examining the outcome of the structural model and technologies close to RPA, e.g predecessors such as AI, machine learning or macros, we find it is difficult to compare the measurable results, due to the design and nature of SEM. It is, however, possible to compare the outcome with the conclusions of previous studies. A study by Sohn et al. shows the TAM is used in many fields of study, for example artificial intelligence, mail systems or smartwatches [73]. In these studies, we notice the perceived usefulness is often the factor that positively influences the use of a technology, while less studies mention the perceived ease of use, or only mention PEOU as a predictor of the PU [74, 75, 76]. This is in line with our research, is supported by the respecive path coefficients of PU on BI and PEOU on BI, and explains why in practice we find a need for an improved impression of usefulness of RPA.

5.4 Research Agenda

During our research, we also found other relevant future research opportunities. The options can be split up in three directions; the acceptance and implementation of RPA, the effects, and results of RPA and the influence of system quality and characteristics of RPA regarding the TAM. After analyzing our results, another direction was added, future RPA TAM research. An overview of the proposed questions and the sources on which these questions are based can be found in Appendix H.

To start with, we found literature suggesting more research is needed on the implementation and acceptance of RPA. According to Moffitt et al., it is important for users of technology, to know it is reliable, otherwise, this might affect the acceptance of the tool. For it to be evaluated and studied, it needs to be measured properly [6]. Another challenge Moffitt et al. mentions is about standardization and data conversion between different systems. This leads us to believe there are more challenges regarding the company‘s infrastructure when implementing RPA and we found more studies requesting research on this topic [2, 22, 24]. An example of these challenges is a question found in practice; "What is the difference between implementing RPA top-down and bottom-up?".

Following the raised question about measuring RPA reliability, we found that this problem can be generalized. More research is needed regarding the effects and results of RPA. An example of proposed future research on this topic is more insight into the characteristics of suitable RPA processes [2]. Next, RPA results often mention cost-savings and higher productivity. Willcocks et al. therefore asks the question whether or not there are other results, e.g. the effectivity of RPA [7, 17]. In practice, we even come across experts who ask themselves if RPA could be a temporary solution, but in this study, we were unable to find literature about this topic. However, literature does show different opinions on where to implement RPA, in business, or as an IT-tool, which is why we also suggest further research on this topic [22, 24].

System quality is a construct that is mentioned in a portion of the RPA studies. As suggested at the discussion of hypothesis H2a, more in-depth research is needed on this construct as it consists of more than just one factor. Both Legris et al. and Davis support this request, as they note that it is often difficult to measure SQ rigorously [12, 13]. Also even though user attitude towards computers are complex, theoretical models are extended, leading to more opportunities to observe these reactions.

Throughout discussions, more future research was added to the research agenda. The study shows if users understand the usefulness of RPA software, they are more likely to use the tool [77]. However, the hypothesis regarding the perceived ease of use could not be validated. Previous studies show a clear relation between both PU and PEOU. We suggest it is possible to improve the acceptance of RPA by providing a better view of the relation between these constructs. In line with the above, PEOU possibly showed a multicollinear relation, which the used SEM can not handle. This is why we suggest more research on this construct, preferably in a simpler model and with a big enough sample size. Finally, we think it is important to have different angles on the TAM, focusing on different types of technology. This is because we think current TAM research barely uses anything other than mobile applications, simple search applications, or online learning technologies [78, 79, 70, 80].

Chapter 6

Conclusion

While literature shows it is clear that RPA adds a lot of value to an organization, it seems to be difficult to get everybody on board with the implementation. Using a SEM analysis and the TAM, we found a positive significant effect between some of the examined constructs, which means it is possible to improve the acceptance of RPA by focusing on these items during the implementation. Even though not all validity tests and model fit tests proved to be significant. We can still conclude that the proposed model and its constructs show a possible better understanding of how to adopt a new technology, namely RPA software. We notice that previous studies show how important understanding the constructs behind technological change or the introduction of a new technological tool is. Returning to the original research questions of this study, the rest of this conclusion's focus is on RPA software specifically.

6.1 Explanation of the Expected Reduced Acceptance of RPA

Based on the results of the structural equation modeling analysis, we conclude that the reduced acceptance can partially be explained by TAM. This thesis also provides future researchers with a research agenda, based on both literature and this study. The specific constructs this thesis chose to assist in the explanation by TAM were habit, system quality, perceived usefulness, and perceived ease of use. The H and SQ construct both show their positive influence on the PEOU and PU respectively. The PU construct can be used to improve the behavioral intention of RPA and therefore the acceptance of RPA, answering the first of the secondary questions: *"To what extent can the expected reduced acceptance of RPA be explained by a difference in perceived usefulness (PU)?"* This means the acceptance of RPA is influenced by how users of the software experience its usefulness. During a further discussion with RPA experts and by comparing the results of our study with previous literature, we conclude that informing both current and future users of RPA of its possibilities and usefulness should help in the acceptance of the tool.

Another secondary question of this research is *"To what extent can the expected reduced acceptance of RPA be explained by a difference in perceived ease of use (PEOU)?"* We found a positive path coefficient between PEOU and BI, which indicates at least some influence of the difficulty of RPA and it's actual use. In practice we found that RPA users often have too little experience to develop their own RPA program. This means they use a program that is written for them, without fully understanding how it is written. We think this could lead to a more limited attitude towards working with the software. The effect is however smaller than the effect of PU. While the inability of the PEOU validity test limits an exact answer, the results provide the opportunity to further examine the PEOU construct, especially it's relation to BI and PU, but also concerning its possible multicollinear nature. Another question we pass on to future studies is the influence and difference between the effect of PU and PEOU on acceptance of technology.
In short, it is possible to enhance the acceptance of RPA software by providing a satisfactory system that is easily accessible, by helping RPA users creating a habit of working with the software and finally by verifying the users know the usefulness of RPA software. The final secondary question; *"Is there a difference between the significance of perceived usefulness and perceived ease of use regarding the TAM and RPA?"*; could not be fully answered in this study. We do, however, suggest that when comparing PU and PEOU of RPA on the intention to use RPA, there is a noteworthy difference. PU seems to have a stronger relation with BI, which matches with previous literature. The stronger relation indicates that providing users of RPA with insight of RPA, helping them understand why RPA is useful, it will boost the attitude towards RPA. Still, we previously mentioned the inaccuracy of the PEOU construct, which is why we propose future research researches the PEOU correctly, so it can be properly compared to the PU.
Concluding, this research aimed to find out to what extent the acceptance of RPA software could be explained by using statistical analysis researching TAM construct relations:

> *"To what extent can the expected reduced acceptance of RPA be explained by the TAM?"*

The acceptance of RPA can be explained by the TAM, but it is important to notice that the used TAM is a behavioral model, committed to display the human part of technology implementation, specified as the behavioral intention (BI). This study can therefore not provide insight in other obstacles found when implementing RPA, like infrastructure, security issues or process identification. In this study we identify four factors that influence the behavioral intention to use RPA. To start with, we expect the user‘s level of BI can be explained by informing users of the possibilities of RPA and helping them understand the usefulness. Besides knowing the advantages of RPA, we feel providing users with the correct resources helps them in learning the tool, or even finding it easier to use. If the factors above are not present, the user´s intention to use RPA decreases, creating a reduced acceptance of RPA. In short, using factors that show the influence of how people behave towards RPA, it is possible to explain why there is a reduced acceptance of RPA.
The above is based on results from a group of respondents that already work with RPA. The research question is concerned with finding an explanation for reduced acceptance. This explanation should also include a part that focuses on predicting future use of RPA. As explained by Venkatesh and Davis, the moment on which PEOU and PU are measured does not drastically change the outcome or significance of their relation towards intention to use the technology [81].

This means it is not only important to inform and help users of RPA understand the potential and usefulness, but also to keep the users up to date after implementation. But the above can not be generalized and more moments have to be investigated in future research. More construct research is needed, using a larger sample size. Especially the perceived ease of use needs to be examined to have a full overview of all relations in the proposed model. That way, not only individual relations can be explained, but a more generalized outline can be sketched. This way, the discrepancy between RPA software acceptance in practice and theory can be explained and even cleared up. RPA practitioners will be able to benefit from all advantages RPA has to offer. In science, clearing up this discrepancy will not only assist in future research but will also provide documentation on how to resolve similar situations.

6.2 Limitations

As mentioned before, the CFA and SM both failed the fitness test, this could be since the multicollinearity is too high. Meaning the proposed model can not reproduce the correlation between the constructs by simply calculating them individually. Furthermore, the used sample size did just meet the threshold of 30. Other literature shows that the importance of a big enough sample size and even state the more constructs are tested, the bigger the sample size should be. Next to sample size, the group of respondents should preferably consist of one category of RPA users, e.g. only developers or only process owners, to ensure the validity of the study. In future research, it is therefore important to correctly identify the sample before the respondents are contacted. This way, it hopefully is less difficult to find a big enough sample size and the results can be viewed more generalized.

6.3 Future Research

Another contribution of this paper is our future research agenda presented in 5.3 and Appendix H. We propose four different directions; the acceptance and implementation of RPA, the effects, and results of RPA; the influence of system quality and characteristics of RPA regarding the TAM and future RPA TAM research. All items are based on previous literature, studies, or the results in this thesis. It will give future researchers a good overview of the current condition of RPA research.

Bibliography

[1] C. Legner, T. Eymann, T. Hess, C. Matt, T. Böhmann, P. Drews, A. Mädche, N. Urbach, and F. Ahlemann. Digitalization: Opportunity and challenge for the Business and Information Systems Engineering Community. *Business & Information Systems Engineering*, 59(4):301–308, Aug. 2017.

[2] Wil M. P. van der Aalst, M. Bichler, and A. Heinzl. Robotic Process Automation. *Business & Information Systems Engineering*, 60(4):269–272, Aug. 2018.

[3] GVR. Robotic Process Automation (RPA) market worth 3.11 billion by 2025, Oct 2018.

[4] Edward J O'Connor, Charles K Parsons, Robert C Liden, and David M Herold. Implementing new technology: Management issues and opportunities. *The Journal of High Technology Management Research*, 1(1):69–89, 1990.

[5] Frank Blackler and Colin Brown. Evaluation and the impact of information technologies on people in organizations. *Human Relations*, 38(3):213–231, 1985.

[6] Kevin C Moffitt, Andrea M Rozario, and Miklos A Vasarhelyi. Robotic process automation for auditing. *Journal of Emerging Technologies in Accounting*, 15(1):1–10, 2018.

[7] Leslie Willcocks, Mary Lacity, and Andrew Craig. Robotic process automation: strategic transformation lever for global business services? *Journal of Information Technology Teaching Cases*, 7(1):17–28, 2017.

[8] Aleksandre Asatiani and Esko Penttinen. Turning robotic process automation into commercial success–case opuscapita. *Journal of Information Technology Teaching Cases*, 6(2):67–74, 2016.

[9] C. Tornbohm. Market guide for robotic process automation software. *Gartner*, 2017.

[10] Why is rpa so difficult?: Roboyo blog, Dec 2019.

[11] Dec 2018.

[12] Paul Legris, John Ingham, and Pierre Collerette. Why do people use information technology? a critical review of the technology acceptance model. *Information & management*, 40(3):191–204, 2003.

[13] Fred D Davis. Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS quarterly*, pages 319–340, 1989.

[14] P. Groover. *Fundamentals of modern manufacturing: materials processes, and systems*. John Wiley & Sons, 2007.

[15] N. Ostdick. RPA's forefathers, Jul. 2016.

[16] S.C.M de S. Sirisuriya. A comparative study on web scraping. In *KDU*, pages 135–140. 8th International Research Conference, Nov. 2015.

[17] M. Lacity, L. Willcocks, and A. Craig. Robotic process automation at Telefonica O2, 2015.

[18] W. Ertel. *Introduction to artificial intelligence*. Springer, 2018.

[19] M. Luck, P. McBurney, and C. Preist. *Agent technology: enabling next generation computing (a roadmap for agent based computing)*. AgentLink, 2003.

[20] Y. Yan, Z. Maamar, and W. Shen. Integration of workflow and agent technology for business process management. In *Proceedings of the Sixth International Conference on Computer Supported Cooperative Work in Design (IEEE Cat. No. 01EX472)*, pages 420–426. IEEE, 2001.

[21] R. Bellman. *An introduction to artificial intelligence: Can computers think?* Thomson Course Technology, 1978.

[22] M. Lacity, L. P. Willcocks, and A. Craig. Robotic Process Automation: Mature capabilities in the energy sector. LSE Research Online Documents on Economics 64520, London School of Economics and Political Science, LSE Library, Oct. 2015.

[23] Mary Lacity, Leslie P Willcocks, and Andrew Craig. Robotic process automation: mature capabilities in the energy sector. 2015.

[24] G. Barnett. Robotic Process Automation: Adding to the process transformation toolkit, 2015.

[25] Volodymyr Leno, M Dumas, FM Maggi, and M La Rosa. Multi-perspective process model discovery for robotic process automation. In *CEUR Workshop Proceedings*, volume 2114, pages 37–45, 2018.

[26] Jan Mendling, Gero Decker, Richard Hull, Hajo A Reijers, and Ingo Weber. How do machine learning, robotic process automation, and blockchains affect the human factor in business process management? *Communications of the Association for Information Systems*, 43(1):19, 2018.

[27] J. Siderska. Robotic process automation-a driver of digital transformation? 2020.

[28] Henri Poussa. Challenges of scaling robotic process automation. 2020.

[29] James E Bailey and Sammy W Pearson. Development of a tool for measuring and analyzing computer user satisfaction. *Management science*, 29(5):530–545, 1983.

[30] Patrick YK Chau. An empirical investigation on factors affecting the acceptance of case by systems developers. *Information & Management*, 30(6):269–280, 1996.

[31] Blake Ives, Margrethe Olson, and Jack Joseph Baroudi. The measurement of user information satisfaction. *Information Systems Working Papers Series, Vol*, 1983.

[32] Moshe Zviran, Nava Pliskin, and Ron Levin. Measuring user satisfaction and perceived usefulness in the erp context. *Journal of computer information systems*, 45(3):43–52, 2005.

[33] Viswanath Venkatesh. Determinants of perceived ease of use: Integrating control, intrinsic motivation, and emotion into the technology acceptance model. *Information Systems Research*, 11(4):342–365, 2000.

[34] Viswanath Venkatesh and Fred D Davis. A model of the antecedents of perceived ease of use: Development and test. *Decision sciences*, 27(3):451–481, 1996.

[35] Viswanath Venkatesh and Hillol Bala. Technology acceptance model 3 and a research agenda on interventions. *Decision sciences*, 39(2):273–315, 2008.

[36] Markus Renner. Software robot-based automation of financial administration's processes. *LUTPub LUT University*, 2019.

[37] Esko Penttinen, Henje Kasslin, and Aleksandre Asatiani. How to choose between robotic process automation and back-end system automation? In *European Conference on Information Systems 2018*, 2018.

[38] Geoffrey S Hubona and James E Blanton. Evaluating system design features. *International Journal of Human-Computer Studies*, 44(1):93–118, 1996.

[39] Izak Benbasat and Albert S Dexter. An investigation of the effectiveness of color and graphical information presentation under varying time constraints. *MIS quarterly*, pages 59–83, 1986.

[40] William E Pracht and James F Courtney. The effects of an interactive graphics-based dss to support problem structuring. *Decision Sciences*, 19(3):598–621, 1988.

[41] Joseph KH Tan and Izak Benbasat. Processing of graphical information: A decomposition taxonomy to match data extraction tasks and graphical representations. *Information Systems Research*, pages 416–439, 1990.

[42] Iris Vessey and Dennis Galletta. Cognitive fit: An empirical study of information acquisition. *Information systems research*, 2(1):63–84, 1991.

[43] Richard J Holden and Ben-Tzion Karsh. The technology acceptance model: its past and its future in health care. *Journal of biomedical informatics*, 43(1):159–172, 2010.

[44] Mohamed Aboelmaged and Tarek R Gebba. Mobile banking adoption: an examination of technology acceptance model and theory of planned behavior. *International Journal of Business Research and Development*, 2(1), 2013.

[45] Shumaila Y Yousafzai, Gordon R Foxall, and John G Pallister. Explaining internet banking behavior: theory of reasoned action, theory of planned behavior, or technology acceptance model? *Journal of applied social psychology*, 40(5):1172–1202, 2010.

[46] Jodie B Ullman and Peter M Bentler. Structural equation modeling. *Handbook of psychology*, pages 607–634, 2003.

[47] Statistics Solutions. Structural equation modeling.

[48] Hamaad Rafique, Alaa Omran Almagrabi, Azra Shamim, Fozia Anwar, and Ali Kashif Bashir. Investigating the acceptance of mobile library applications with an extended technology acceptance model (tam). *Computers & Education*, 145:103732, 2020.

[49] Ankur Barua et al. Methods for decision-making in survey questionnaires based on likert scale. *Journal of Asian Scientific Research*, 3(1):35–38, 2013.

[50] Emin Babakus and W Glynn Mangold. Adapting the servqual scale to hospital services: an empirical investigation. *Health services research*, 26(6):767, 1992.

[51] John F Rockart and Lauren S Flannery. The management of end user computing. *Communications of the ACM*, 26(10):776–784, 1983.

[52] Chittibabu Govindarajulu. An instrument to classify end-users based on the user cube. In *IS2002: Informing Science + IT Education Conference Procedings and Schedule*. Drexel University, 2002.

[53] Sung Youl Park et al. An analysis of the technology acceptance model in understanding university students' behavioral intention to use e-learning. *Educational technology & society*, 12(3):150–162, 2009.

[54] Jen-Her Wu and Shu-Ching Wang. What drives mobile commerce?: An empirical evaluation of the revised technology acceptance model. *Information & management*, 42(5):719–729, 2005.

[55] Gina C Green, Alan R Hevner, and Rosann Webb Collins. The impacts of quality and productivity perceptions on the use of software process improvement innovations. *Information and Software Technology*, 47(8):543–553, 2005.

[56] JWKJW Kotrlik and CCHCC Higgins. Organizational research: Determining appropriate sample size in survey research appropriate sample size in survey research. *Information technology, learning, and performance journal*, 19(1):43, 2001.

[57] Mark NK Saunders. *Research methods for business students, 5/e.* Pearson Education India, 2011.

[58] An Gie Yong, Sean Pearce, et al. A beginner's guide to factor analysis: Focusing on exploratory factor analysis. *Tutorials in quantitative methods for psychology*, 9(2):79–94, 2013.

[59] Andy Field. Discovering statistics using spss, thrid edition, 2009.

[60] Matthew W Gallagher and Timothy A Brown. Introduction to confirmatory factor analysis and structural equation modeling. In *Handbook of quantitative methods for educational research*, pages 287–314. Brill Sense, 2013.

[61] Daniel A Newman. Missing data: Five practical guidelines. *Organizational Research Methods*, 17(4):372–411, 2014.

[62] Toni Rietveld and Roeland Van Hout. Statistical techniques for the study of language behaviour. *Berlijn: Mouton de Gruyter*, 1993.

[63] David W Gerbing and James C Anderson. Monte carlo evaluations of goodness of fit indices for structural equation models. *Sociological Methods & Research*, 21(2):132–160, 1992.

[64] Megan Norris and Luc Lecavalier. Evaluating the use of exploratory factor analysis in developmental disability psychological research. *Journal of autism and developmental disorders*, 40(1):8–20, 2010.

[65] Henry F Kaiser. An index of factorial simplicity. *Psychometrika*, 39(1):31–36, 1974.

[66] Henry F Kaiser. The application of electronic computers to factor analysis. *Educational and psychological measurement*, 20(1):141–151, 1960.

[67] Joseph F Hair, William C Black, Barry J Babin, Rolph E Anderson, Ronald L Tatham, et al. *Multivariate data analysis*, volume 5. Prentice hall Upper Saddle River, NJ, 1998.

[68] Barbara M Byrne. *Structural equation modeling with Mplus: Basic concepts, applications, and programming*. routledge, 2013.

[69] David A. Kenny. Multiple regression, Dec 2015.

[70] Marco Hubert, Markus Blut, Christian Brock, Christof Backhaus, and Tim Eberhardt. Acceptance of smartphone-based mobile shopping: Mobile benefits, customer characteristics, perceived risks, and the impact of application context. *Psychology & Marketing*, 34(2):175–194, 2017.

[71] Viswanath Venkatesh, James YL Thong, and Xin Xu. Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. *MIS quarterly*, pages 157–178, 2012.

[72] Hanho Jeong. An investigation of user perceptions and behavioral intentions towards the e-library. *Library Collections, Acquisitions, and Technical Services*, 35(2-3):45–60, 2011.

[73] Kwonsang Sohn and Ohbyung Kwon. Technology acceptance theories and factors influencing artificial intelligence-based intelligent products. *Telematics and Informatics*, 47:101324, 2020.

[74] Girish H Subramanian. A replication of perceived usefulness and perceived ease of use measurement. *Decision sciences*, 25(5-6):863–874, 1994.

[75] Elena Karahanna and Detmar W Straub. The psychological origins of perceived usefulness and ease-of-use. *Information & management*, 35(4):237–250, 1999.

[76] Dennis A Adams, R Ryan Nelson, and Peter A Todd. Perceived usefulness, ease of use, and usage of information technology: A replication. *MIS quarterly*, pages 227–247, 1992.

[77] T. Weterings. The acceptance of robotic process automation software explained by the technology acceptance model, Aug 2020.

[78] Yang Zhao, Shengli Deng, and Ruoxin Zhou. Understanding mobile library apps continuance usage in china: a theoretical framework and empirical study. *Libri*, 65(3):161–173, 2015.

[79] Xianjin Zha, Jinchao Zhang, and Yalan Yan. Comparing digital libraries in the web and mobile contexts from the perspective of the digital divide. *Journal of Librarianship and Information Science*, 47(4):330–340, 2015.

[80] Asad Khan and Saima Qutab. Understanding research students' behavioural intention in the adoption of digital libraries. *Library Review*, 2016.

[81] Viswanath Venkatesh and Fred D Davis. A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management science*, 46(2):186–204, 2000.

[82] M. Alberth and M. Mattern. Understanding robotic process automation (RPA). *Automation*, pages 54–61, 2017.

[83] D. Georgakopoulos, M. Hornick, and A. Sheth. An overview of workflow management: From process modelling to workflow automation infrastructure. *Distributed and parallel Databases*, 3(2):119–153, 1995.

[84] E.A. Stohr and J.L. Zhao. Workflow automation: Overview and research issues. *Information Systems Frontiers*, 3(3):281–296, 2001.

[85] D. Weise and R. Crew. Programmable syntax macros, 1993.

[86] W.D. Clinger and J. Rees. Macros That Work. In *POPL*, volume 91, pages 155–162, 1991.

[87] Microsoft. Create or run a macro - word, 2019.

[88] IRPAAI. Definition and Benefits, 2019.

[89] T. Allweyer. Robotic Process Automation – Neue perspektiven fur die prozessautomatisierung, 2016.

[90] Thomas Barton, Christian Müller, and Christian Seel. Mobile anwendungen in unternehmen. *Konzepte und betriebliche Einsatzszenarien, Wiesbaden*, 2016.

[91] IEEE guide for terms and concepts in intelligent process automation, Sep. 2017.

[92] S. Aguirre and A. Rodriguez. Automation of a business process using robotic process automation (RPA): A case study. In *Workshop on Engineering Applications*, pages 65–71. Springer, 2017.

[93] Mark L Gillenson, Daniel L Sherrell, et al. Enticing online consumers: an extended technology acceptance perspective. *Information & management*, 39(8):705–719, 2002.

[94] Viswanath Venkatesh, Michael G Morris, Gordon B Davis, and Fred D Davis. User acceptance of information technology: Toward a unified view. *MIS quarterly*, pages 425–478, 2003.

[95] Timothy Teo, Chwee Beng Lee, Ching Sing Chai, and Su Luan Wong. Assessing the intention to use technology among pre-service teachers in singapore and malaysia: A multigroup invariance analysis of the technology acceptance model (tam). *Computers & Education*, 53(3):1000–1009, 2009.

[96] Chao-Min Chiu, Chao-Sheng Chiu, and Hae-Ching Chang. Examining the integrated influence of fairness and quality on learners' satisfaction and web-based learning continuance intention. *Information systems journal*, 17(3):271–287, 2007.

[97] Suzanne Rivard, Guylaine Poirier, Louis Raymond, and François Bergeron. Development of a measure to assess the quality of user-developed applications. *ACM SIGMIS Database: the DATABASE for Advances in Information Systems*, 28(3):44–58, 1997.

[98] Moez Limayem, Sabine Gabriele Hirt, and Christy MK Cheung. How habit limits the predictive power of intention: The case of information systems continuance. *MIS quarterly*, pages 705–737, 2007.

Appendices

Appendix A: RPA predecessors

Since there is little previous TAM research on RPA, the results of this thesis are eventually compared to similar TAM studies that focus on the technologies below. Also, understanding the RPA predecessors could help with what RPA is and how to define the term.

Appedix A.1: Screen Scraping Software

Screen Scraping, also known as Web Scraping, Web Data Extraction, Web Harvesting, or Web Data Scraping, is explained by Sirisuriya (2015) as: "...the technique which people can extract data from multiple websites to a single spreadsheet or database so that it becomes easy to analyze or even visualize the data" [16].

According to Alberth and Mattern (2017) "The early incarnations of today's RPA were mainly screen scraping solutions...". They then explain that later RPA evolved to rule-based automation machines that work across multiple systems and organizational boundaries [82]. And more recently the RPA tool tries using machine-learning approaches to find new solutions to improve processes that normally require human actions.

Appendix A.2: Workflow Automation and Management Tools

One of the Workflow management (WFM) systems in the nineties focused on transferring data without having to replicate all information piece by piece [2]. A research gap took form, because the systems were not able to do all tasks, but mainly management tasks.
Workflow Management (WFM) focusses on reengineering business and information processes [83]. It consists of two main tasks. It describes important actions (or skills) regarding the control and coordination of a process. Secondly, WFM helps to adjust processes when business or information systems need change.
One of the first Workflow Automation case studies arose to research the processing of insurance claims [84]. After this more and more Workflow Management Systems (WFMS) or similar technologies were developed.
According to Stohr and Zhao, "It is apparent that workflow automation is both a technical and managerial subject. Difficult challenges abound in both areas." They find that the technical implementation of the WFMS is more popular amongst researchers than the managerial and human challenges and even state there is an urgent need for more research in these fields.

Another paper confirms this need [83]. They show research on WFM is fragmented across disciplines and the lack of interdisciplinary research hinders understanding the tool from different perspectives. They also provide a good example: "...database researchers view workflows as information processes and do not consider the human aspects of the business process implementation. ...CSCW researchers ignore the role and importance of information systems."
This citation shows that even before RPA, there might have already been a shortage of knowledge about the more human constructs of technology acceptance.

Appendix A.3: Macros

As stated before, one could argue that Macros are also an early form of RPA tools. Weise and Crew (1993) explain that macros belong to one of the oldest programming languages described as: "...a meta-programming construct that transforms programs into programs" [85]. They provide more abstract uses, other languages lack. Further explained, it functions as a source-to-source program transformation using a high-level pattern language, useful to enhance syntax and abbreviate common programming idioms [86]. In other words, the term macro functions as a placeholder for other coding languages, making it often easier to interpret and reuse. This is however not the only definition of Macros in computer language, because Microsoft also uses the term Macros as "...a series of commands and instructions that you group together as a single command to accomplish a task automatically" [87]. A user can record or write a macro and then run it, which is similar but more primitive to RPA automation.
Regardless of the definition, it shows macros are a relevant predecessor of RPA software.

Appendix B: Definitions of Robotic Process Automation

During this study we found there is not one singular definition of RPA, instead we found the many similar definitions. Table 1 below provides an overview of the different sources and descriptions of RPA in previous literature.

Table 1: Appedix B.1: RPA definitions and sources

Source	**Definition**
(IRPAAI, 2019)	"Robotic process automation (RPA) is the application of technology that allows employees in a company to configure computer software or a "robot" to capture and interpret existing applications for processing a transaction, manipulating data, triggering responses and communicating with other digital systems" [88].
(Barnett, 2015)	"Robotic process automation describes the use of technology to automate tasks that are traditionally done by a human being. The technology itself mimics an end user by simulating user actions such as navigating within an application or entering data into forms according to a set of rules" [24].
(Lacity, 2015)	"Although the term "Robotic Process Automation" connotes visions of physical robots wandering around offices performing human tasks, the term really means automation of service tasks that were previously performed by humans" [17].
(Allweyer, 2016)	"...as software robots here take over activities previously carried out by employees unchanged and using the same user interfaces" [89].
(Barton, 2016)	"Robotic Process Automation (RPA) introduces a new approach to process automation. So-called software robots take over activities that were previously handled by employees. They learn manual activities and execute them automatically" [90].
(IEEE, 2017)	"A preconfigured software instance that uses business rules and predefined activity choreography to complete the autonomous execution of a combination of processes, activities, transactions, and tasks in one or more unrelated software systems to deliver a result or service with human exception management" [91].
(Tornbohm, 2017)	"Robotic process automation (RPA) tools perform "if, then, else" statements on structured data, typically using a combination of user interface (UI) interactions, or by connecting to APIs to drive client servers, mainframes or HTML code. An RPA tool operates by mapping a process in the RPA tool language for the software "robot" to follow, with run-time allocated to execute the script by a control dashboard" [9].
(Aguirre, 2017)	"RPA can automate rules-based processes that involve routine tasks, structured data and deterministic outcomes, for example, transferring data from multiple input sources like email and spreadsheets to systems like ERP and CRM systems" [92].

Appendix C: TAM Constructs and Items

This study uses a Likert scale survey to find the behavior of RPA users. The statements used in the survey are described in Table 2, along with their respective source and abbreviation.

Table 2: Appendix C.1: TAM statements used in the survey

Construct	**Abbr**	**Statements/Items**
Perceived Usefulness	PU1	Using RPA software in my job improves my performance.
[13, 76]	PU2	Using RPA software in my job increases my productivity.
	PU3	Using RPA software in my job enhances my effectiveness.
	PU4	Using RPA software makes it easier to carry out my job.
	PU5	I find RPA software to be useful in my job.
Perceived Ease of Use	PEOU1	I find it easy to get RPA software to do what I want it to do.
[13, 76]	PEOU2	I find RPA software to be easy to use.
	PEOU3	Interaction with RPA software is clear and understandable.
	PEOU4	Learning to use RPA software is easy for me.
	PEOU5	It is easy to become skillful at using RPA software.
Behavioural Intention	BI1	I intend to use RPA software, assuming I have access to it.
[93, 94, 95]	BI2	I intend to use RPA software in the next <n>months.
	BI3	I plan to use RPA software often.
	BI4	Assuming I have access to it, I will use RPA software again in the near future.
Habit	H1	The use of RPA software has become a habit for me.
[71, 48]	H2	I am addicted to using RPA software.
	H3	I must use RPA software.
	H4	The use of RPA software has become natural to me.
System Quality	SQ1	I would find it easy to get access to RPA software.
[72, 96, 97]	SQ2	RPA software is accessible when I need it.
	SQ3	The layout and design of the RPA software is user friendly.
	SQ4	I feel comfortable using the functions and services that are provided by RPA software.

Table 4: Appendix C.2: Common items and statements for TAM constructs

Construct	Abbr	Statements/Items
PU [13, 76]	PU1	Using RPA software in my job improves my performance.
	PU2	Using RPA software in my job increases my productivity.
	PU3	Using RPA software in my job enhances my effectiveness.
	PU4	Using RPA software makes it easier to carry out my job.
	PU5	I find RPA software to be useful in my job.
PEOU [13, 76]	PEOU1	I find it easy to get RPA software to do what I want it to do.
	PEOU2	I find RPA software to be easy to use.
	PEOU3	Interaction with RPA software is clear and understandable.
	PEOU4	Learning to use RPA software is easy for me.
	PEOU5	It is easy to become skillful at using RPA software.
BI [93, 94, 95]	BI1	I intend to use RPA software, assuming I have access to it.
	BI2	I intend to use RPA software in the next <n>months.
	BI3	I plan to use RPA software often.
	BI4	Assuming I have access to it, I will use RPA software again in the near future.
SE		*I could do my job using RPA software...*
	SE1	... if there was no one around to tell me what to do as I go.
	SE2	... if I had just the built-in manual for assistance.
	SE3	... if someone showed me how to do it first.
	SE4	... if I had used similar software before this one to do the same job.
SN	SN1	People who influence my behavior think I should use RPA software.
	SN2	People who are important to me think I should use RPA software.
	SN3	The C-level management of my organisation supports the use of RPA software.
	SN4	In general, my organisation supports the use of RPA software.
PE		*I feel using RPA software is...*
	PE1	Enjoyable – Disgusting
	PE2	Exciting – Dull
	PE3	Pleasant – Unpleasant
	PE4	Interesting – Boring

Table 6: Common items and statements for TAM constructs (Continued)

Construct	Abbr	Statements/Items
PEC	PEC1	I have control over using RPA software.
	PEC2	I have the resources neccessary to use RPA software.
	PEC3	Assuming I have the resources, opportunities and knowledge it takes to use RPA software, I have no difficulty using RPA software.
	PEC4	RPA software is compatible with other systems and software I use.
IMG	IMG1	People in my organization who use RPA software have more prestige than those who do not.
	IMG2	People in my organization who use RPA software have a high profile.
	IMG3	Using RPA is a status symbol in my organization.
REL	REL1	In my job, using RPA software is important.
	REL2	In my job, using RPA software is relevant.
	REL3	The use of RPA software is pertinent to my job-related tasks.
OUT	OUT1	The quality of the output I get from the RPA software is high.
	OUT2	I have no problem with the quality of RPA software's output.
	OUT3	I rate the results I book with RPA software to be excellent.
RES	RES1	I have no difficulty telling others about the results of RPA software.
	RES2	I believe I could communicate to others the consequences of using RPA software.
	RES3	The results of using RPA software are apparent to me.
	RES4	I would have difficulty explaining why using RPA software may or may not be beneficial.
USE	USE1	On average, how much time do you spend using RPA software each day?

Appendix D

Table 8: Appendix D.1: Demographic survey attributes, questions and options

Attribute	**Question**	**Type**	**Options**
Gender	"Please specify your gender:"	Multiple-choice	Male Female Prefer not to answer/Other
Age	"Please specify your age:"	Open	Restriction: <16 and >100
Experience	"How many years of RPA-experience do you have?"	Multiple-choice	Under 6 Months 6-11 Months 1-2 Years Above 2 Years
Position	"What is your current role/position within your organisation?"	Multiple-choice	Intern/Trainee Lower Management/Superior/Employee Middle Management C-level/Executive level Other Position
RPA-Role	"What is your current role when working with RPA software?"	Multiple-choice	User/Customer Developer Owner

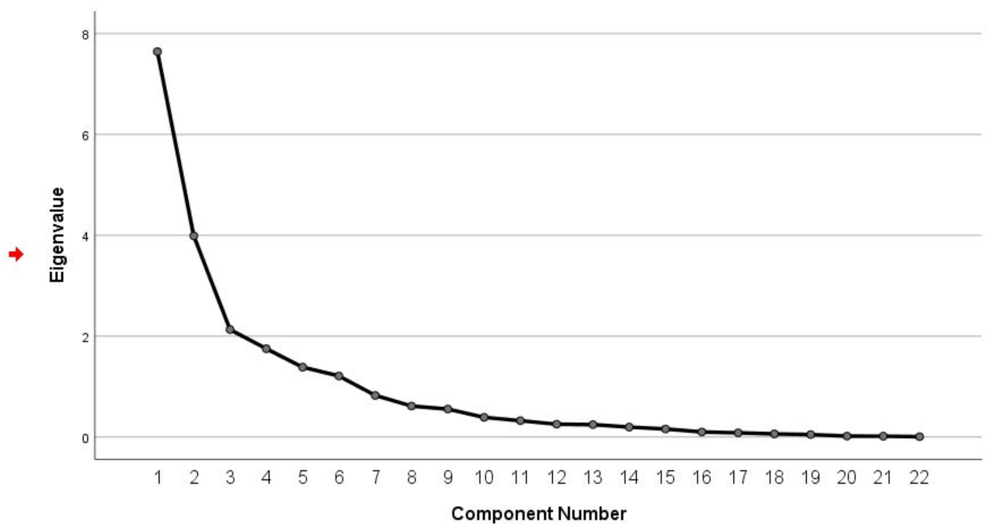


Figure 1: Appendix D.2: Scree plot displaying 6 possible factors

Appendix E: TAM Based Models

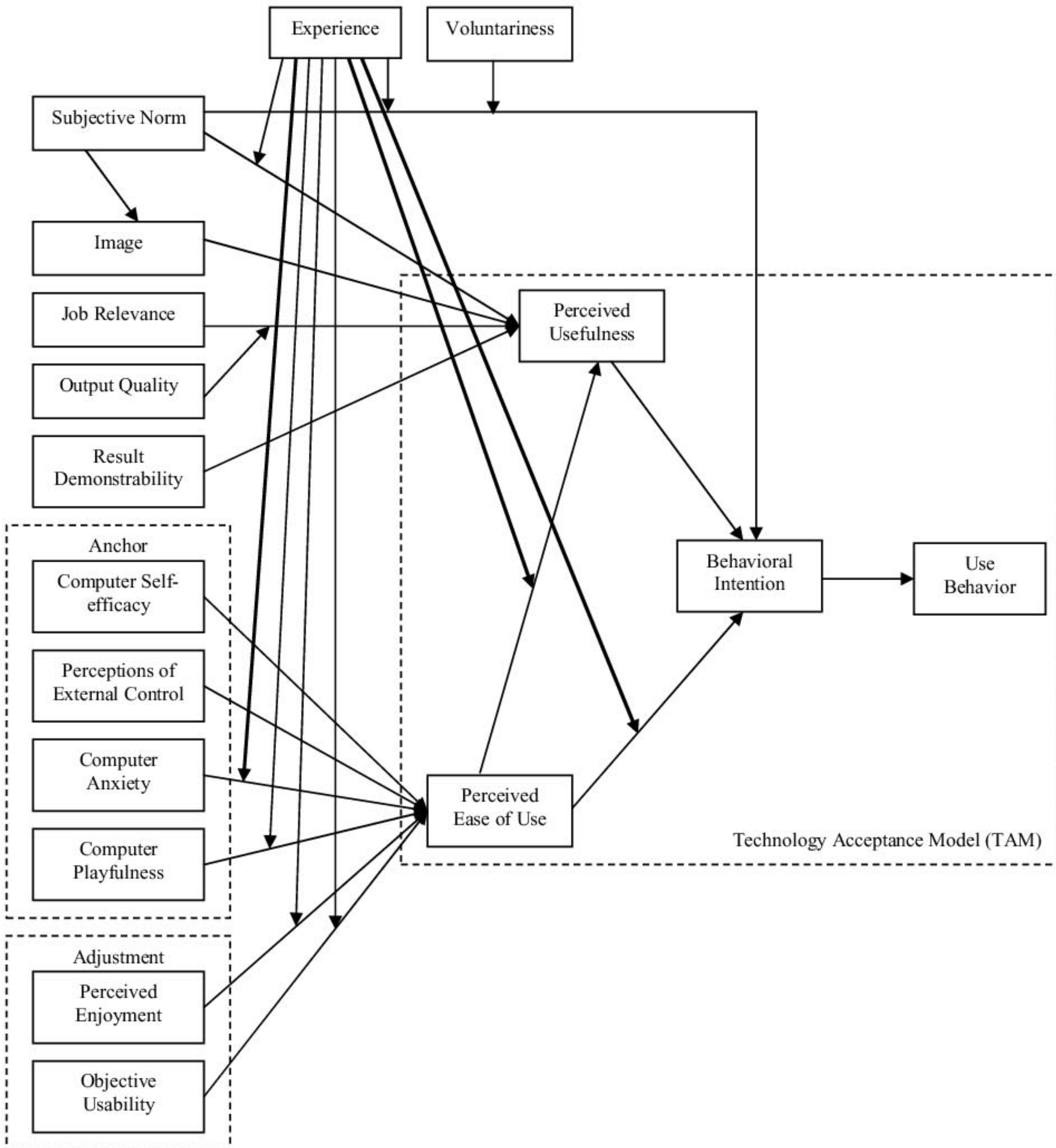


Figure 2: Appendix E.2: Technology acceptance model 3 (TAM3)

Appendix F: Further explaination of the used constructs

As seen in the simplified model by Rafique, et al. (2020), this research studies five relevant TAM constructs.

Dependent Variable

Behavioural Intention (BI)

A variable based on the likelihood the user wants to use Robotic Process Automation [93]. This variable represents the actual use of RPA software.

Independent Variables

Perceived Usefulness (PU)

The perceived usefulness is a variable that indicates to which level people favor the use of the application, as far as they believe it will help them perform their job [13]. Here we use the definition stated by Davis (1989): "The degree to which a person believes that using a particular system would enhance his or her job performance."

Perceived Ease of Use (PEOU)

For this variable we also use the definition stated by Davis (1989): "The degree to which a person believes that using a particular system would be free of effort." The definition is based on the meaning of the word 'ease', which implicates the "freedom from difficulty or great effort."
Research shows that PU and PEOU both influence the actual use via BI [54]. This is also in agreement with the work of both Venkatesh and Davis. Meaning the three constructs above are relevant for this study.

System Quality (SQ)

The fourth construct is System Quality, described by Jeong (2011) as " 'users' level of getting assistance from an information system". SQ shows the users perception of easiness, accessibility and acceptance of the system [80]. Also, the system quality impacts the acceptance of technology in developed states and it should be included to measure the effect on the behavioural intention [48].

Habit (H)

The last construct is Habit, defined as: "the extent to which people tend to perform behaviors automatically because of learning" [98, 71]. The relevance of habit as a construct is not only described by Limayem and Venkatesh, but also by Benbasat and Barki (2007) who say it is an often overlooked addition to TAM and likewise by Bagozzi (2007).

Appendix G: Correlation Matrix

The correlation matrix below was generated by SPSS as part of the CFA in this study. It shows the correlation between each item used in the survey and indicates if its value is above the threshold. Items are grouped with their own construct. These items should correlate more to each other than to items of different constructs.

Table 9: Correlation Matrix

	PU1	**PU2**	**PU3**	**PU4**	**PU5**	**PEOU1**	**PEOU2**	**PEOU3**	**PEOU4**	**PEOU5**
PU1	1,000	0,523	0,761	0,597	0,292	0,207	-0,061	0,288	0,063	0,194
PU2	0,523	1,000	0,563	0,481	0,365	0,020	0,202	-0,016	-0,136	0,002
PU3	0,761	0,563	1,000	0,488	0,317	0,073	-0,026	0,200	-0,256	-0,022
PU4	0,597	0,481	0,488	1,000	0,405	0,202	0,094	0,000	0,070	0,029
PU5	0,292	0,365	0,317	0,405	1,000	0,248	-0,009	-0,069	-0,145	-0,061
PEOU1	0,207	0,020	0,073	0,202	0,248	1,000	0,558	0,514	0,311	0,503
PEOU2	-0,061	0,202	-0,026	0,094	-0,009	0,558	1,000	0,360	0,555	0,489
PEOU3	0,288	-0,016	0,200	0,000	-0,069	0,514	0,360	1,000	0,244	0,654
PEOU4	0,063	-0,136	-0,256	0,070	-0,145	0,311	0,555	0,244	1,000	0,465
PEOU5	0,194	0,002	-0,022	0,029	-0,061	0,503	0,489	0,654	0,465	1,000
SQ1	-0,040	0,174	0,073	-0,119	0,181	-0,136	-0,181	0,038	-0,118	-0,215
SQ2	0,194	0,092	0,269	0,191	-0,070	0,578	0,473	0,704	0,203	0,599
SQ3	0,242	-0,013	0,056	0,000	0,116	0,516	0,263	0,622	0,311	0,549
SQ4	0,188	-0,126	0,131	-0,065	-0,068	0,344	0,182	0,714	0,166	0,513
H1	0,276	0,389	0,366	0,157	0,434	0,600	0,428	0,459	-0,042	0,324
H2	0,423	0,466	0,617	0,308	0,320	0,332	0,276	0,309	-0,168	0,080
H3	0,526	0,084	0,586	0,345	0,086	0,479	0,167	0,480	0,065	0,188
H4	0,339	0,555	0,492	0,250	0,546	0,519	0,325	0,188	-0,044	0,063
BI1	0,359	0,218	0,315	0,499	0,586	0,245	0,057	0,233	0,019	0,133
BI2	0,193	0,343	0,370	0,218	0,736	0,305	0,188	0,164	-0,175	0,048
BI3	0,323	0,388	0,449	0,378	0,700	0,503	0,395	0,362	-0,081	0,299
BI4	0,233	0,355	0,324	0,475	0,818	0,177	0,167	-0,044	-0,122	-0,106

Table 10: Correlation Matrix (Continued)

	SQ1	**SQ2**	**SQ3**	**SQ4**	**H1**	**H2**	**H3**	**H4**	**BI1**	**BI2**	**BI3**	**BI4**
PU1	-0,040	0,194	0,242	0,188	0,276	0,423	0,526	0,339	0,359	0,193	0,323	0,233
PU2	0,174	0,092	-0,013	-0,126	0,389	0,466	0,084	0,555	0,218	0,343	0,388	0,355
PU3	0,073	0,269	0,056	0,131	0,366	0,617	0,586	0,492	0,315	0,370	0,449	0,324
PU4	-0,119	0,191	0,000	-0,065	0,157	0,308	0,345	0,250	0,499	0,218	0,378	0,475
PU5	0,181	-0,070	0,116	-0,068	0,434	0,320	0,086	0,546	0,586	0,736	0,700	0,818
PEOU1	-0,136	0,578	0,516	0,344	0,600	0,332	0,479	0,519	0,245	0,305	0,503	0,177
PEOU2	-0,181	0,473	0,263	0,182	0,428	0,276	0,167	0,325	0,057	0,188	0,395	0,167
PEOU3	0,038	0,704	0,622	0,714	0,459	0,309	0,480	0,188	0,233	0,164	0,362	-0,044
PEOU4	-0,118	0,203	0,311	0,166	-0,042	-0,168	0,065	-0,044	0,019	-0,175	-0,081	-0,122
PEOU5	-0,215	0,599	0,549	0,513	0,324	0,080	0,188	0,063	0,133	0,048	0,299	-0,106
SQ1	1,000	0,046	0,326	0,197	0,069	0,033	0,025	0,292	-0,205	-0,010	-0,088	-0,079
SQ2	0,046	1,000	0,540	0,481	0,505	0,364	0,434	0,293	0,115	0,155	0,432	0,005
SQ3	0,326	0,540	1,000	0,600	0,386	0,058	0,340	0,277	0,136	0,188	0,258	0,012
SQ4	0,197	0,481	0,600	1,000	0,440	0,270	0,554	0,185	0,211	0,175	0,273	-0,173
H1	0,069	0,505	0,386	0,440	1,000	0,674	0,465	0,813	0,408	0,735	0,766	0,382
H2	0,033	0,364	0,058	0,270	0,674	1,000	0,672	0,685	0,237	0,472	0,590	0,351
H3	0,025	0,434	0,340	0,554	0,465	0,672	1,000	0,492	0,262	0,208	0,338	0,069
H4	0,292	0,293	0,277	0,185	0,813	0,685	0,492	1,000	0,279	0,678	0,650	0,420
BI1	-0,205	0,115	0,136	0,211	0,408	0,237	0,262	0,279	1,000	0,695	0,621	0,717
BI2	-0,010	0,155	0,188	0,175	0,735	0,472	0,208	0,678	0,695	1,000	0,871	0,802
BI3	-0,088	0,432	0,258	0,273	0,766	0,590	0,338	0,650	0,621	0,871	1,000	0,772
BI4	-0,079	0,005	0,012	-0,173	0,382	0,351	0,069	0,420	0,717	0,802	0,772	1,000

Appendix H: Future Research

During this study we also found other noticeable questions or problems outside the scope of this thesis. The table below provides a full overview, including a possible question and their source.

Table 11: Future Research Agenda based on previous research and this study

General Question	**Used question or citation in literature**	**Ref.**
The acceptance and implementation of RPA		
To what extend does people's fear of the reliability of RPA affect the acceptance or effectivity of the technology tool?	*"Reliability of RPA tools: How should RPA tools be evaluated?"*	[6]
To what extend does people's understanding of RPA software lead to a faster/slower user acceptance?	*"How can RPA agents and people seamlessly work together?"*	[2]
What is the difference between implementing RPA top-down and bottom-up?		
What challenges arise when implementing RPA, regarding the company's infrastructure, both in IT as in Business?	*"How to control RPA agents and avoid security, compliance, and economic risks?"*	[2]
	"When looking at RPA platforms, we look for attributes that make it easy to deploy the technology, manage the process of creating automations, and manage these automations effectively once they are in production."	[24]
	"The RPA "infrastructure" comprised servers with different power, memory, and operating systems which caused disparate performance and complicated management oversight. Once RPA was elevated to a strategic level, a uniform infrastructure was built."	[22]
	"Are data conversion, or standardization, primary challenges?"	[6]
The effects and results of RPA		
When is RPA or AI useful to improve a process?	*"What characteristics make processes suitable to be supported by RPA?"*	[2]
Does RPA produce better results when implemented as a business-tool or as an IT-tool?	*"The corollary to this is that where the business adopts RPA, the IT function should also be engaged as early as possible in the process, because process automation is a team effort."*	[24]
	"In most customer cases we have studied, the reasons for excluding IT at the onset were (1) the RPA program was seen as a business operations program since RPA required process and subject matter expertise, not IT programming skills, and (2) fears that IT would beleaguer the adoption with bureaucracy."	[22]
What are the effects after RPA is implemented at a company?	*"At this stage, should it be just about cost savings and higher productivity?"*	[7]
In what way does the use of RPA influence the effectivity of a company's strategy, processes or other values?	*"The degree of business value inherent in the process is worth considering in situations where significantly increasing the speed or accuracy with which a process is executed can yield outsized benefits to the business, for example in terms of enhancing speed to market, product quality, customer satisfaction, regulatory compliance, etc."*	[17]
An explanation is missing on how employees respond after implementing RPA at a company.	*"In research, we need to accept that digitalization requires more interdisciplinary research, which not only includes our neighboring disciplines computer science and business administration, but increasingly fields like psychology, sociology, engineering, or even philosophy."*	[1]
	"However, in current available white papers, vendors and proponents of RPA do not address the factor of robots replacing human workers. Instead, they tout the benefits of allocating mundane, repetitive tasks to software agents, which frees up human workers to perform tasks that require creativity, complex decision making, and emotional insight."	[6]
Is RPA a temporary solution?		
Influence of System Quality and Characteristics of RPA regarding TAM		
How does the System Quality antecedents influence perceived usefulness?	*"Since most of the studies do not measure system use, what TAM actually measures is the variance in self reported use. ... Not only is it difficult to measure rigorously, but it also involves problems."*	[12]
	"Appendix A. Factors affecting information system satisfaction"	[12]
	"User reactions to computers are complex and multi faceted. But if the field continues to systematically investigate fundamental mechanisms driving user behavior, cultivating better and better measures and critically examining alternative theoretical models, sustainable progress is within search."	[13]
Is there a difference in system characteristics between software functioning on top of existing software, like RPA, and normal software?	*"We also notice that most studies examined the introduction of office automation software or systems development applications. We think that research would benefit from examining the introduction of business process applications."*	[12]
Future RPA TAM Research		
How does the perceived ease of use (PEOU) of RPA software influence the perceived usefulness (PU) of RPA software?	*Our study found a significant positive effect of PU on Behavioural Interntion, but it could not say anything about the effect of PEOU. Previous studies show a clear relation between the both and also indicate that PEOU might even have a bigger impact than PU. Answering this questions not only helps improving the adoptation of RPA, but also provides more verification on the relation between PU and PEOU.*	[77]
To what extent can the expected reduced acceptance of RPA be explained by a difference in perceived usefulness (PU)?	*The PEOU is a crucial construct in many TAM studies. In this study, PEOU showed a possible multicollinear relation due to which it was not possible to answer this subquestion. We suggest to increase the sample size and use less constructs to focus on the role of PEOU in the acceptance of RPA.*	[77]
How does the acceptance of different types of technology vary when viewed through the TAM?	*During the fase writing the background on RPA, we found many case studies and TAM research that focused on mobile applications, simple search applications or online learning technologies, while little studies focused on more core-it applications or systems [78, 79, 70, 80]. We suggest that the need for different angles on technology acceptance can be sated by comparing different types of technology.*	[77]