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# User Involvement in RPA

## Addressing design & development weaknesses of RPA through user-centred design

**Master Thesis** by Stela V. Hristova

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Supervisor: Tanja Svarre Jonasen
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## Addressing design & development weaknesses of RPA through user-centred design

A study on identifying the strengths and weaknesses of RPA, analysing the weaknesses' connection to user involvement, and the potential implementation of user-centred design in RPA's design and development.


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## Abstract

Robotic process automation (RPA) is a new technology which is gaining recognition and popularity within organisations and literature with a growing speed in the last five years. RPA is a way of automating processes and tasks that are of high volume and repetitive nature that can be described in rule-based development. However this technology does require coding which makes it easily accessible and easy to integrate which is why companies see the benefits of utilizing it.

RPA is software robots that are built to perform certain processes and tasks which were previously handled by humans. As such this technology is built to mimic human actions and therefore is heavily based on knowledge about how humans work with specific processes and tasks. Therefore, the development of RPA requires user involvement in order to gain process knowledge, however this topic is not a point of discussion in literature.

In regards to that, this study aims to investigate user involvement in RPA through establishing the strengths and weaknesses of the technology and identifying the weaknesses related directly or indirectly to the development process of RPA and the user involvement. This has been accomplished by conducting a literature review of 15 chosen articles that have been presented in a literature matrix and further analysed to establish strengths and weaknesses of RPA based on academic sources. Furthermore, there have been three semi-structured interviews conducted with specialists in the field who work with RPA, in order to investigate the topic from the perspective of practitioners.

The results from the literature review and interviews have then been analysed and compared in order to gain an unbiased conclusion about the weaknesses of automation and how they relate to user involvement.

Furthermore, the weaknesses have been connected directly or indirectly to the factor of user involvement in order to assess how user-centred design could potentially address those weaknesses and result in an improved approach to RPA's development.

However, no specific recommendations or suggestions towards user-centred design approach have been made throughout this study, as applying specific methods would be based on factors such as the content, context and users within a specific case or RPA which is the reason why such recommendation can not be generalised. In order to create a specific outline for implementing user-centred design in RPA further studies would be required.

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# 1. Introduction

As technology is evolving companies and organizations are looking for ways of working smarter and utilizing innovative technological advancements to optimize their digital performance (Osman, 2019, p. 66). Digitalization of processes and services has been widely adopted by large companies and has become the new way of working, but the future trends in technology surpass simply digitalization and focus on optimizing services and processes in order to decrease cost by increasing efficiency. One efficient way to cut costs within an organisation is to identify processes or services that are repetitive in their nature, meaning the process of completing the desired task usually follows the same steps every time the process is completed and ideally has a low to a minimum amount of manual human involvement to complete the task (Matthews & Greenspan, 2019, p. 71). Such human involvement within an IT process could simply be approving a task through a specific software or updating the state of the task within the software as to inform other users that the task is complete. In such an example companies see an opportunity for minimizing or completely eliminating human involvement while the process is being completed by the means of automation. As the context of this study is digital labour this study will not investigate automation through physical robots but rather software robotics (Nof, 2009, p. 17).

Hyperautomation is one of the predicted technological trends of 2021 (Cooney, 2020, p. 2). One of the reasons for that is the fact that there are many different types of automation, with a different level of automation and different levels of human interaction with the automated system. Automation can be utilized by any company, whether it is in the IT sector or heavy machinery, depending on their ability to invest in this innovative way of handling tasks and processes. This following research is mainly interested in automation, applied within information technologies, that has some point of interaction with users and how the user aspect can be involved in the design of automation.

As automation is usually achieved by the development of complex software systems, most of the knowledge available on the subject addresses the technical and business aspects of the process and is targeted at individuals with a very technical background. Literature sources often focus on the different types of automation and different tools for developing, programming and testing automation. Such literature often focuses on identifying the process to be automated based on a business perspective, where requirements are defined by what the business wants to achieve with automation. Exploring the users involved, or otherwise called human operators, is a topic that still lacks enough knowledge. This provides an opportunity for new ways of exploring the complex process of automation

where the focus can be brought on the design process instead of the technical software development aspects and more importantly on the design and users. In order to do that, this research is going to investigate the process of automating a service or a system by gaining an understanding of robotic process automation (RPA) in specific, its purpose, its strengths and weaknesses, the way companies work with automation and RPA and design methodologies for achieving automation (Matthews & Greenspan, 2019, p. 71). Furthermore, we will explore user-centred design principles, characteristics and tools for achieving user-centred design and we will explore how those can be applied to automation in order to address weaknesses in regards to design and development.

In general, user-centred design is also a big field that can result in many considerations, relevant to the topic of automation design and RPA. In order to bring a more specific point of view, the research would look at automation systems as information systems, as they are often based on large amounts of data in order to be able to function independently.

The purpose of this study is to bring a new perspective on a subject that is growing in popularity - RPA. Research shows that user-centred design is often ignored by IT organisations because it is believed to be a long and complicated process and companies do not always understand its value (Mao, Vredenburg, Smith & Carey, 2005, p. 106). By doing this research, a new way of approaching automation and RPA can be developed and its benefits can be further investigated to discover the value and benefits it can bring. Furthermore, if achieving such results can be successful, this study can be used as an example of tackling complex IT systems and processes and proving the importance of user-centred design to achieving that success.

# 2. Problem formulation

The following section will elaborate further on the scope of the research in terms and will introduce the research questions.

## 2.1. Project scope

Automation covers a wide field of technologies, however, this thesis will focus specifically on RPA, due to its growing popularity in the past five years, in order to reach a deep understanding of its characteristics as well as opportunities and weaknesses for user involvement. In order to gain a deep understanding of the subject which would allow for a discussion of applying user-centred design to RPA, the thesis will first investigate the topic in regards to current identified strengths and weaknesses. The knowledge gained on the strengths and weaknesses of RPA will be used to analyse if they can be connected to the

design and development stages of the process and if they can be impacted by the use of user-centred design practices. Therefore this thesis will conduct the research in two phases which are represented in the research questions below.

### 2.2. Research questions

*What characterizes the strengths and weaknesses of RPA?*
*How can user-centred design address RPA's weaknesses in regards to design and development?*

## 3. Theoretical framework

The following section will present an overview of the used and applied theoretical framework within this thesis. First, the topic of automation will be theoretically presented, in order to provide the reader with a definition and to explore the scope in which automation will be explored and investigated. As the aim is to provide answers to one of the research questions based on the theory of user-centred design, the theoretical framework will also explore this subject and provide a definition and understanding of what that subject entails and how it can be applied throughout this project.

### 3.1. Automation and RPA

The following section will present the topic of automation and some of the core methodologies associated with gaining an understanding of the subject. In order to be able to conduct a proper analysis of the strengths and weaknesses of automation, this section will provide a solid ground for defining what automation is as well the different types of automation as that might have an effect on the associated weaknesses and challenges as well as the relevancy to user involvement in the design and development process. Apart from that, the section will present a subject connected to the design and development of automation which is different design methodologies for automation.

According to Parasuraman (2000) "Automation can be defined as the execution by machine, usually a computer, of a function previously carried out by a human" (Parasuraman, 2000, p.931). The term 'automation' has a very broad meaning as there can be found many different types of automation based on the technology they use and their purpose. Covering all types of automation within this thesis would pose a challenge in terms of the depth in which the research questions can be investigated. Therefore, the research questions lie within the field of information technologies (IT) which would imply that this thesis would only investigate IT process automation and more specifically RPA. Therefore, this

subsection will provide an elaboration on what defines RPA, how it is used and where it is applied, by exploring design methodologies and examples of RPA implementations.

### 3.1.1. Definition of RPA

Process automation has been used by IT organizations due to its ability to improve the ways in which organisations deliver IT services to their users. Within this context, the word 'process' refers to a set of tasks, which can be designed to include roles, responsibilities or tools (Fung, 2014, p. 1). IT process automation can be referred to in the form of different synonyms, one of which is robotic process automation (RPA). "According to Institute for Robotic Process Automation, robotic process automation is the application of technology to enable employees to configure a "robot" or computer software so that it can interpret and control existing applications in processing transactions, manipulating data, triggering responses as well as communicating with other digital systems" (Fung, 2014, p. 1). IT process automation or RPA can also be connected to terms like IT-based automation, office automation and business process automation. That is due to the fact that these types of automation all aim to reduce the need for manual human involvement in order to facilitate productivity or automate office processes (Fung, 2014, p. 1-2).

Defining the meaning of RPA can be found described in many different ways, however, the different definitions do not contradict each other, but rather repeat some of the same core principles. A short and precise way to define RPA is that it is a "technological imitation of a human worker with the goal of automating structured tasks in a fast and cost efficient manner" (Aguirre & Rodriguez, 2017, p. 66). A very similar definition can be seen in this example "RPA involves the use of software that mimics human actions while interacting with applications in a computer and accomplishing rule-based tasks" (Tripathi, 2018, p. 10). Other authors describe it as a more generic concept where RPA is seen as "an umbrella term for tools that operate on user interfaces in the same way as humans" (Hindel, Cabrera & Stierle, 2020, p. 2). As can be seen in these definitions, even though the wording of the descriptions can differ they all include a focus on mimicking human actions and structured tasks that can be performed based on rules.

What is interesting about RPA, in particular, is that it is a type of automation that is very closely connected to human tasks behaviour. Therefore the reason for the interest in RPA in specific is because of the way RPA is made and intended to function. Tools made through RPA perform processes or tasks that humans normally would do by mimicking them, which is what makes this subject relevant to studying users and potential user involvement through user-centred design. Those tools can also operate as the user interface part of other

systems meaning that RPA mimics the same form of user interaction that users had previously with the systems. This connection can also be seen within a definition of RPA which states that "RPA tools perform [if, then, else] statements on structured data, typically using a combination of user interface interactions" (van der Aalst, Bichler & Heinzl, 2018, p. 269). RPA systems are often meant to replace humans, however, not all processes are fully automated which means that there are cases where there are certain tasks that need to be handled by humans. Such tasks can be making decisions or entering missing information. In these cases, humans are considered "the "glue" between different IT systems" in which the RPA performs its functionality (van der Aalst, Bichler & Heinzl, 2018, p. 270).

How RPA performs at its core is through robots. It is important to distinguish that robots do not refer to physical robots performing human tasks (Willcocks, Lacity & Craig, 2015, p. 5). Within this context, the word 'robot' is used to describe "software programs that mimic human actions" (Tripathi, 2018, p. 9). Even though the name of those software programs derives from the name of RPA, the robots can also be referred to as bots (Syed, Suriadi, Adams, Bandara, Leemans, Ouyang, ter Hofstede, van de Weerd, Wynn & Reijers, 2020, p. 1). Based on that, the robots in RPA are able to interact with the user interface of applications on a computer, based on the action that humans normally take in order to accomplish rule-based tasks. Such tasks can often revolve around reading, typing or clicking elements of the user interface of the applications, the same way humans would. In that sense, through the use of RPA, automating tasks can be an easy process, as long as there is sufficient understanding of the exact steps humans take to perform them. In most organisations, departments ensure that employees are trained how to perform certain procedures by defining the processes step by step and documenting it so it is available to employees. Therefore RPA can also benefit from previously well-documented processes with clearly defined steps (Tripathi, 2018, p. 10). What distinguishes RPA from traditional automation is how the software robot is made. Traditional automation is usually based on code, whereas RPA robots are trained to complete a task using steps that are rather illustrative than coded. This is possible due to the functionality of the platforms available for building RPA and it allows that people with a low level of programming skills and experience can also learn to build RPA robots that handle simple to complex processes through these platforms (Tripathi, 2018, p. 10). Therefore RPA is considered more lightweight compared to non-robotic automation as it only targets "the front-end user interface rather than the back-end and data layers" (Syed et al., 2020, p. 3).

The relevancy of delving into humans involved in automation is not only related to the implemented RPA processes and systems that may require human interaction, but also to the approach in which RPA is designed and built. RPA is built on what is called "an "outside-in" approach" which indicates that the way automation is developed is by purely

replacing humans by agents without redesigning the existing information systems (van der Aalst, Bichler & Heinzl, 2018, p. 271). This fact is also important in the context of this thesis as it indicates the need for analysing humans, or otherwise the users, their tasks and their behaviour towards them. However, human decision making can also be influenced by contextual changes and can be hard to investigate for the purposes of designing agents, which is why context should be investigated alongside the humans/users (van der Aalst, Bichler & Heinzl, 2018, p. 271).

In conclusion, RPA is usually built to perform repetitive tasks performed by humans, that do not involve a high level of decision making and aim to replace humans by imitating their behaviour which can therefore provide an interesting opportunity for studying the humans as users and integrating user-centred design within the design and development of the automation process (Hofmann, Samp, & Urbach, 2020, p. 100). For that reason, it is also worth noting that while RPA can be a cheap and easy way to optimize processes by automating them, RPA "doesn't transform your organization all by itself, and it's not a fix for enterprise-wide broken processes and systems. For that, you'll need end-to-end intelligent automation" (Taulli, 2020, p. 4). The following section will elaborate further on what companies and organisations use RPA for and how it is applied.

### 3.1.2. Types of RPA

Before we delve into how RPA is used by organisations, in order to fully understand its definition and scope it is important to also gain knowledge about the different types of RPA. The types that are going to be identified within this paragraph are especially relevant to the thesis as they are partly based on the level of interconnection between robots and humans, or otherwise the users. There can be found three variations of RPA - attended RPA, unattended RPA and intelligent process automation or RPA (Taulli, 2020, p. 6).

Attended RPA can also be referred to as robotic desktop automation (RDA). Its name derives from the fact that there is a collaboration between the software and the user in order to complete certain tasks. In this sense, the software is actually helping the user with the task at hand. The robot and the user operate on the same local workstation which allows the robot to assist the user based on trigger events (Amini, 2019, p. 19). An example for attended automation can be viewed below in Figure 1.

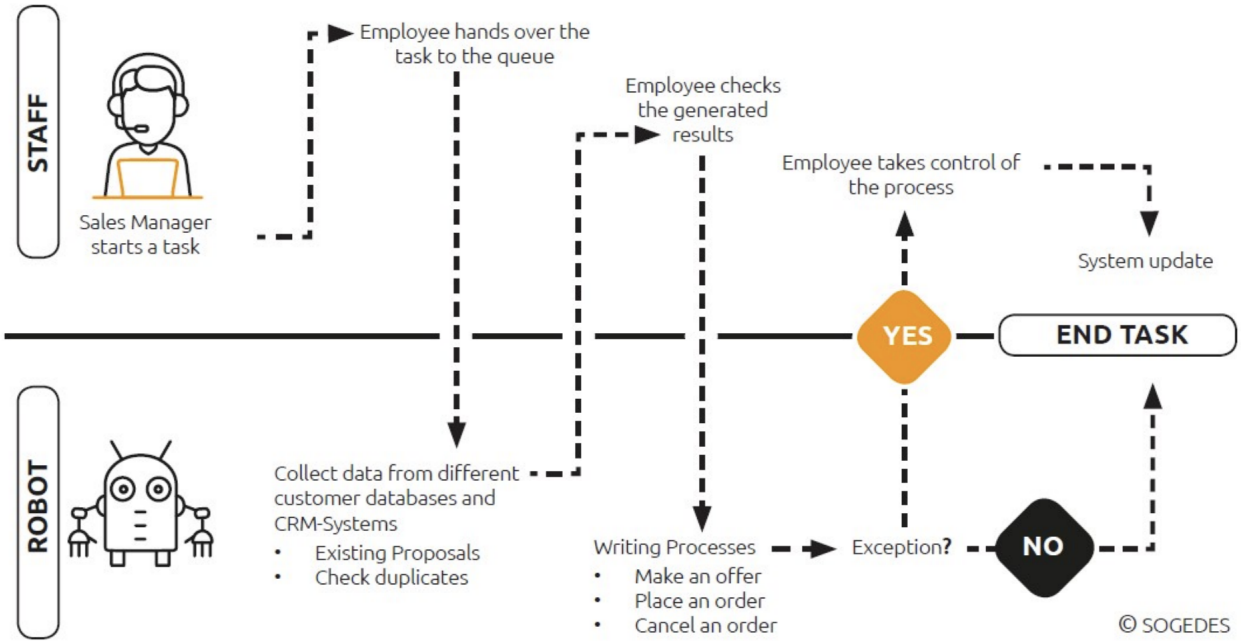


Figure 1. (Amini, 2019, p. 19)

This approach to automation can create a potential for making a difference in the way organisations work as users can benefit from the help of the robot while still applying their own skills to solve problems. Therefore, organisations can reap the benefits of their collaboration and explore "the best of humans and machines" (Taulli, 2020, p. 296). For these reasons, RPA "is better equipped to handle unexpected scenarios because of the accompanying human intelligence" (Soeny, Pandey, Gupta, Trivedi, Gupta & Agarwal, 2021, p. 2). However, unattended automation is the technology that has been utilized the most, due to the fact that it is very easy to handle (Taulli, 2020, p. 296).

Unattended RPA is an easier approach to automation since the software works independently and the lack of user involvement can ensure that the robot performs the exact pre-defined rules for the automation (Soeny et al., 2021, p. 2). Similar to the attended RPA, this approach is also triggered by certain events, however, in this scenario, the robot runs autonomously and executes a task without collaborating with a human (Amini, 2019, p. 20). As in this case, the robot does not need to assist the user through specific parts of the automated process, here the robot can automate any number of processes (Tripathi, 2018, p. 25). An example of an unattended process that is run in the background can also be previewed in the illustration below in Figure 2. Even though unattended RPA does not collaborate with the users it is important to remember that the robot is still built to mimic the way humans work with the processes and tasks so user research is still just as relevant as it is for attended RPA.

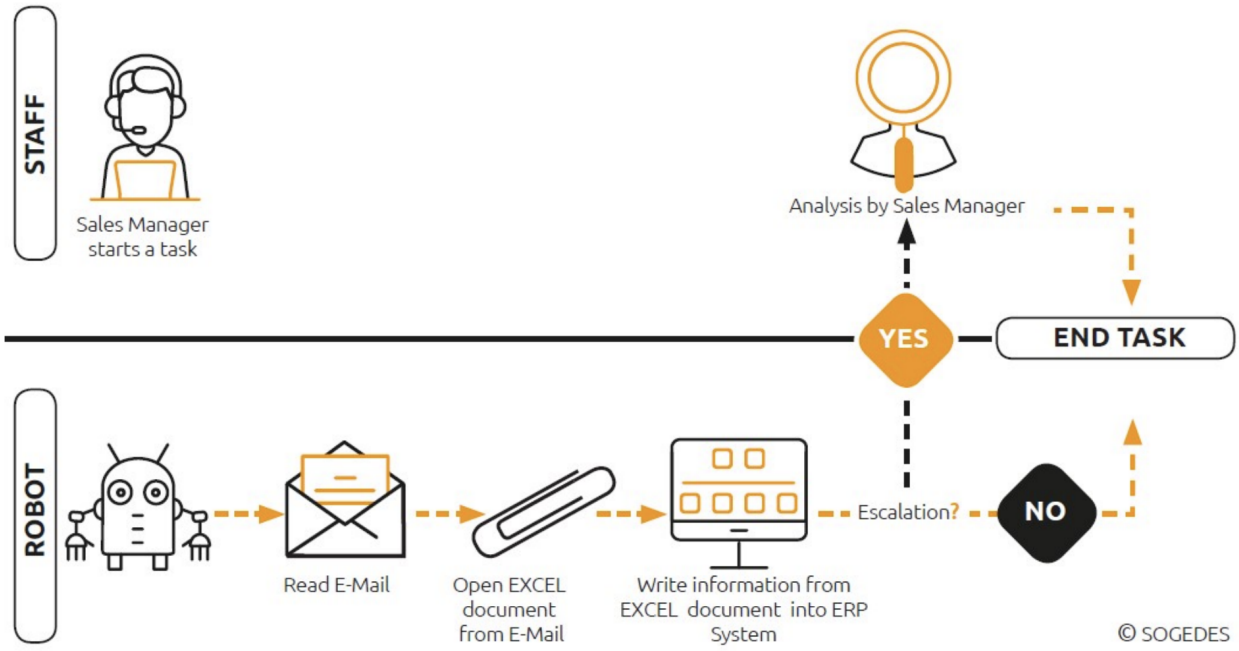


Figure 2. (Amini, 2019, p. 20)

The third type of RPA is intelligent process automation. As established so far throughout the theoretical framework, RPA is based on standardized and repetitive tasks that can be translated to a rule-based process. This counts for both attended and unattended RPA. However, IPA can be considered as a more modern approach to automation as it uses artificial intelligence (AI) (Asatiani et al., 2020, p. 219). IPA is meant to handle tasks beyond the scope of RPA since using AI allows for the handling of more complex processes that might entail decision making. Therefore this type of automation would be harder to visualise in a figure like the previously presented. Even though this type of RPA has been accounted for in the theory, the focus of the research will remain only on attended and unattended RPA as the involvement of AI in IPA is reaching beyond the scope of this thesis.

### 3.1.3. RPA in context

As it has been established what RPA is from a more theoretical perspective, it can be relevant to present some examples of what RPA can be used for in order to put the theoretical definitions into context.

As described earlier in the definition of RPA, robots represent software agents or otherwise called bots. However, it is also relevant to identify what the word process stands for before we delve further into what RPA is used for. As the word is not particularly descriptive by

itself, its meaning within this context can only be interpreted by some of the explanations of RPA in regards to performing human tasks. Therefore the word 'process' in RPA can be understood as a synonym for 'tasks' which can then be viewed as "individual action items that are a part of a process" (Taulli, 2020, p. 3).

As mentioned earlier in this thesis, within an organisational context, RPA can be connected to business processes and is considered a powerful tool for these purposes. "Robotic Process Automation enables you with tools to create your own software robots to automate any business process. Your 'bots' are configurable software set up to perform the tasks you assign and control." (Taulli, 2020, p. 4). Software robots are also referred to as a "digital workforce" due to their ability to work efficiently since "an RPA software robot never sleeps, makes zero mistakes and costs a lot less than an employee" (Taulli, 2020, p. 4).

When it comes to automating a process with an RPA solution, what makes a process a good candidate can be defined by a few principles. The process should consist of standardized tasks that can be rule-driven and appear in high volume, meaning that there is a level of repetitiveness that would suggest that automation would optimize the process. Furthermore, there shouldn't be any need for "subjective judgement, creativity or interpretation skills" so that the robot can function entirely based on the created rules (Aguirre & Rodriguez, 2017, p. 70). Examples of such processes can be "accounts payable, accounts receivable, billing, travel and expenses, fixed assets and human resource administration" (Aguirre & Rodriguez, 2017, p. 70).

### 3.1.4. Design methodologies

As the theoretical framework has presented, the definition of user-centred design and the way it is applied by involving users through specific methods, it is relevant to look at design methodologies for automation. Understanding the steps through which automation is designed can not only point to some potential weaknesses in the process but can also provide a clear framework for applying user-centred design practices in the relevant steps throughout the design methodology. Therefore, this section will aim to present the steps in a design methodology for automation and the action taken in each step.

There can be found several design methodologies but many of them address specific parts of the process somewhat indirectly (Bindewald, 2015, p. 11). Firstly there will be presented a methodology that grasps the whole process of automation and can be defined within a few specific steps.

Researchers and practitioners in the field have established that the process of automation is more complicated than "'blindly' automating all possible features" whenever it involved human interaction (de Visser, Cohen, LeGoullon, Sert, Freedy, Freedy, Weltman & Parasuraman, 2008, p. 2). Some researchers have been particularly interested in researching a way to design an automation system in a way that responds to user needs as well as environmental demands and context and that goes by the name of adaptive automation (de Visser et al., 2008, p. 2). The main feature of adaptive automation is that it is "tailored to unique human user needs" (de Visser et al., 2008, p. 2). As this type of automation usually involves some level of user interaction, there can be principles that are relevant to RPA that have a degree of user interaction.
Within the realm of adaptive automation, there is a design methodology that is meant to be applied by both designers and developers and can be therefore relevant to user-centred design practitioners. The methodology is meant to be used at the early stages of the automation system interface design and consists of five steps - "1) collect observational data of a system; 2) conduct task analyses; 3) construct a quantitative model 4) create preliminary design; 5) validate design" (de Visser et al., 2008, p. 2).
The first step and second step, collect observational data of a system and conduct task analyses, are closely related to each other. Whenever a new process needs to be automated, the developers need to learn it step by step in order to create a robot that can perform the task and therefore they need to come in contact with the users. Some of the most common ways data is collected from users within this step is by interviews, task observation or reviewing documentation where the focus is on understanding the process and analysing the tasks. During these steps, developers aim to understand the user's "goals, plans and actions" in order to design the best possible interface by defining clear system requirements (de Visser et al., 2008, p. 2).

The third step within this methodology is related to constructing qualitative or quantitative models of expert users which is achieved by breaking down their tasks and transforming them into rules for the automation. This process is done by the use of different frameworks which depend on the type of automation as the appropriate model should be chosen based on the particular needs of a design (de Visser et al., 2008, p. 2-3).
The fourth step is where preliminary design is created. At this step in the methodology, there are considerations towards what users would be exposed to and more specific considerations towards the interface design of the system. This step is followed by the last one on the methodology which is validating the design. Validation can be conducted in different manners, as most commonly there can be simulators attached to the interface or by the use of usability studies (de Visser et al., 2008, p. 3).

The next methodologies presented are relevant specifically to RPA. Those methodologies are not defined in steps but rather as a way of approaching the process of automation.

First is the Lean methodology (Taulli, 2020, p. 55). The way this methodology works isn't defined in steps but can rather be described in a few core principles. The first principle is value. This entails that value needs to be created by ensuring that customer or user feedback is taken into deep consideration as well as market trends. The second principle is value stream. After gaining an understanding of the customer's or user's value that can be applied across development, production, and distribution (Taulli, 2020, p. 56). Here is also where any factors which reduce value are identified and eliminated. The next principle is flow which entails that even if a process or service is bringing value to the user, there can still be a way to optimize the process for efficiency. This can be achieved by breaking "down the process into small steps and find ways to optimize them" (Taulli, 2020, p. 57). Second to last is the pull principle. This principle claims that inventories are not always beneficial and there should be a strive for producing quantities only when needed. The last principle is perfection and is considered the most important step within the methodology. What this principle stands for is constant continuous improvement and empowering employees to take actions towards it (Taulli, 2020, p. 57). Even though this methodology can be quite unclear compared to the previous one presented, the way of work and approach towards RPA can be concluded as a pursuit of continuous improvement of services, which can only be achieved by a deep understanding of the users, value creation and optimization in order to reduce value waste.

Another methodology used for RPA is Six Sigma (Taulli, 2020, p. 60). Implementing Six Sigma can be done through different approaches, however, one of the most popular ones includes five stages - "define, measure, analyze, improve, and control" otherwise called DMAIC (Taulli, 2020, p. 63). The Define stage covers the very first steps within the process where a team gets assembled and the work begins by trying to identify problems to solve. In this stage the more clarity a plan has been defined with, the easier it would be to achieve it (Taulli, 2020, p. 63). The next stage in the methodology is Measure. After the process has been mapped out, the team can start defining the type of data that needs to be obtained and the means for obtaining it. Following this is the Analyze stage. This part of the process is not mandatory but is used by teams who want to identify the root causes of a problem in order to prevent it. Naturally, the next step is the Improve stage. Here is where solutions to the problem are designed by means of error-proofing and quality control. The solutions are designed by reviewing all steps in order to pinpoint potential errors in the future (Taulli, 2020, p. 64). The final stage is Control. After a solution has been developed, it is dependent on its environment and changes. Therefore it is important to have monitoring systems in place and keep reassessing if the solution can be improved even further (Taulli, 2020, p. 65).

Lean and Six Sigma are powerful methodologies used widely for RPA and also have certain similarities. Therefore, teams often aim to utilize the best of each, which forms another type of methodology by merging both of them. That methodology is called Lean Six Sigma (Taulli, 2020, p. 67-68).

The knowledge of the presented methodologies would allow for a deeper understanding of the collected data by analysing how organisations work theoretically and methodologically and how and if that differs from the described approaches. It would also bring clarity towards the reasoning behind RPA developers' way of working and what an RPA process requires in order to be designed and implemented.

## 3.2. User-centred design

Defined by Mao et al. (2005), user-centred design "is a multidisciplinary design approach based on the active involvement of users to improve the understanding of user and task requirements, and the iteration of design and evaluation" (Mao et al., 2005, p. 105). This approach has been avoided in the past and replaced with system-centred design instead because its principles have been considered "intimidating in their complexity, too time consuming, and too expensive to implement" (Mao et al., 2005, p. 106). However, user-centred design has gained popularity with the rise of e-commerce which has led researchers to investigate several different aspects of the impact and practice of user-centred design. One of the most interesting findings is that there have been indications that a significant impact on product development within companies has been accomplished through the use of user-centred design methods. That impact has been connected to the improvement of usefulness and usability. User-centred design is linked to impacting the end result and quality of a project and is therefore gaining more and more acceptance across industries (Mao et al., 2005, p. 109).

### 3.2.1. Definition

Defining the meaning of user-centred design is an important first step of the theoretical framework as it would provide for a better understanding of what is needed within a design process in order for it to qualify as user-centred. This knowledge, in combination with the more specific methods of achieving user-centred design, will be applied after the analysis to start a discussion on the ways in which this approach can be applied to automation in order to target specific weaknesses.

In order to understand what user-centred design is, it can be valuable to understand where the practice has originated. User-centred design is very closely related to usability and can often be understood as the same practice. Usability is described as "the study of how humans relate to any product" (Lowdermilk, 2013, p. 5) and is the main methodology from which user-centred design has emerged. More specifically, user-centred design is rooted in human-computer interaction which relates to the interaction between humans and computers in specific. The purpose of applying user-centred design to an application is to ensure that the needs of its users have been met and such methodology is meant to be applied by developers and designers (Lowdermilk, 2012, p. 6).

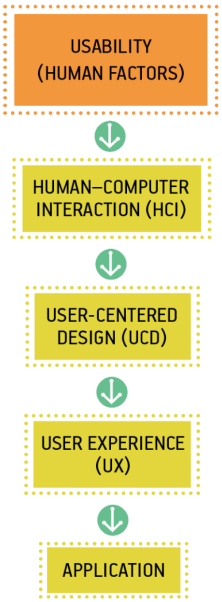


Figure 3. (Lowdermilk, 2012, p. 6)

Adopting such an approach would impact the usability of an application or software due to the link between usability and user-centred design which was explained above and visualised in Figure 3. As can be seen, this practice is also related to user experience. If the users of an application play a central role in the design and development process, the functionality and overall experience can be impacted and therefore user-centred design can also ensure a great user experience (Lowdermilk, 2012, p. 6).

For a more precise definition of user-centred design, we can look into the different ways this approach has been defined throughout literature. One definition describes it "as a process that sets users or user data as the criteria by which a design is evaluated or as a generative source of design ideas" (Karat, 1997, p. 37). Similar to that, it can also be defined as a "design philosophy that puts the user of a product, application, or experience, at the center of the design process" (Pratt & Nunes, 2012, p. 12). Both of these descriptions involve a focus on the users by making them the main criterion for the design. However, another way to define this practice is as a "process focusing on usability throughout the entire development process and further throughout the system lifecycle" (Göransson, Gulliksen & Boivie, 2003, p.116). This example also includes the purpose of the user involvement which is the focus on usability. Therefore the user-centred approach can also be described by three principles that can support usability which are "early focus on users", "empirical measurement" and "iterative design" (Maedche, Botzenhardt & Neer, 2012, p. 13).

As mentioned earlier the process of user-centred design requires that users are involved directly in order to learn about their needs. By doing this, all design decisions made in the process will be based on gathered data which becomes proof. Therefore, the data becomes the way of eliminating design decisions made based on assumptions or personal preferences and ensures that the design is built on a statistical stable foundation. It is also important to mention that user-centred design does not refer purely to design's aesthetics but rather "how effective an application is in achieving its designed purpose" (Lowdermilk, 2012, p. 7). It is also important to mention here that while user-centred design puts a lot of focus on the users, the user must be studied in connection to the system. In other words, user-centred design is "an approach in which the relations between user and environment (that is, affordances and information) are the distinct objects of study" (Flach & Dominguez, 1995, p. 21).

User-centred design is an approach that has been recognised for its value in the design and development stages of an application or software. By being reflective over design choices and user feedback and having an understanding of the user's needs, some of the benefits can be saving time due to potentially eliminating mistakes in the design. In other words, if the user requirements have been understood correctly, there wouldn't be a reason for rebuilding the application or software (Lowdermilk, 2012, p. 6).

To sum up, user-centred design is a methodology used by designers and developers, which relies on data gathered directly from users, which is meant to provide an understanding of the user's needs and serve as proof and argumentation for the design decisions. The purpose of this approach is to accommodate usability and good user experience while ensuring that the application or software will support the user and in that way will eliminate costly development by avoiding rebuilding and readjusting the product.

### 3.2.2. Users & user involvement

"UCD is an iterative process whose goal is the development of usable systems, achieved through involvement of potential users of a system in system design" (Gulliksen, Goransson, Boivie, Blomkvist, Persson & Cajander, 2003, p. 397). As established, user-centred design requires that users are involved in the design or development phase in one way or another in order to have influence over the application or software design. This requirement makes the term very broad and does not necessarily guide a clear way of how users must be involved. In order to address some of the weaknesses of automation, related to design and development through the theory of user-centred design, this subsection will explain how users can be involved and discuss specific methods. This information will then

be used and applied to the findings of the analysis in order to open a discussion for suggestions or recommendations for specific actions or methods that can be applied to automation design.

User-centred design can be applied at different stages throughout a process and have a different intended use. For example, users can provide data which can be used for forming design requirements early in the process or do usability testing before a product's implementation stage. Another way to involve users is by assigning them a partner role in the design process where they can "have a deep impact on the design" by working side by side with designers (Abras, Maloney-Krichmar & Preece, 2004, p. 1). However, given how impactful user involvement can be on a system's design it is important to carefully consider who qualifies as a user.

Users are usually described as the "people who will use the final product or artefact to accomplish a task or goal" (Abras et al., 2004, p. 4). However, there are other users who, even though, might not be using the product or system directly, might still be affected by it in some way. Therefore, users can be identified as three types - *primary, secondary* and *tertiary* (Abras et al., 2004, p. 4). The type of user is closely related to the type and level of use they practice where the primary users are the ones who use the system the most, the secondary use the system occasionally and tertiary are the people "who will be affected by the use of the artefact or make decisions about its purchase" (Abras et al., 2004, p. 4). With that said, not every type of user needs to be directly involved, but in order for a design to be successful, the effect of the system on all three types must be considered. This particular principle can be a very important part of the analysis since even automation processes that are heavily automated and might not support any user interaction should still include considerations towards the users that are affected by the use of the automated system or process.

### 3.2.3. Methods

The purpose of user involvement throughout the design and development process is to collect information from the users, in order to minimize the risks of completing the process with a system that does not reflect the user needs. Therefore, "the design process should be iterative" in order to allow for adjustments in the design specifications so the system can successfully reach the user need requirements (Chammas, Quaresma & Mont'Alvão, 2015, p. 5400). Iterative design is supported by agile methods (Beyer, 2010, p. 1). This subsection will present methods that can be used in order to achieve a user-centred approach which could also be combined with an agile approach. Integrating user-centred design and agile approach is often focused on the design and usability testing aspects of a process (Silva da

Silva, Martin, Maurer & Silveira, 2011, p. 83) These methods can later be applied to the findings of the analysis in order to address weaknesses in the design and development of automation depending on the methods' purpose and use.

Some of the most common methods applied in user-centred design are interviews and questionnaires, focus groups, on-site observations, role-playing, walkthroughs and simulations, and usability testing. Before we explore where each method is applied based on what the data they can collect can be used for, first we will explore the steps within a design cycle within a design process. The first step is to do a *pre-study and business analysis* (Göransson et al., 2003, p.117). That is where the first requirements are formed based on "comprehensive analysis of work procedures, business processes, etc" (Göransson et al., 2003, p.117). The second step in the cycle is *planning the user-centred systems design process*. In this step the team gets prepared to start assigning roles, assigning activities and choosing methods for their iterative approach ahead. The next step in the cycle is *do iterative user-centred system design*. This step is where the design of the software has actually started and is conducted through an iterative approach of collecting data. This step also represents the principles by which user-centred design has been described so far. Following in the design cycle is a *formal summative evaluation*. This step is connected to evaluation and testing of the designed or developed software whereas if the evaluation proves a need for further adjustments there can be a new iteration of the design cycle. If the evaluation has a positive outcome the design cycle can reach its last step of *introducing and operating the system* where the system gets implemented and its future users can receive training (Göransson et al., 2003, p.118). The whole design process can be categorized into three main phases or cycles being "*requirements analysis, growing software with iterative design* and *deployment*" those are represented in the text below as the early, mid-point and final stages of a design cycle (Göransson et al., 2003, p.118).

Interviews and questionnaires are usually used either at the beginning of a design project, early design stages or final design stages. They are a method for collecting data that can indicate user needs and expectations and therefore be used as a way of identifying design requirements. If applied at the final stages of a design process, it can also be used as a source for understanding the users' satisfaction with the application or system. Focus groups, on the other hand, are intended to ideate regarding issues and requirements and usually include a wide range of stakeholders. This method is, therefore, more appropriate for the early design stages, as it can help with forming clear design requirements. Observations can also fit in the same stage of the design cycle, however, this method can provide not only information on the user's behaviour but also information relevant to the context or more specifically the environment in which the application or system will be used. Role-playing, walkthroughs, and simulations are methods that can be used in the

early design cycle in order to collect additional insights on user needs, or they can be used in order to evaluate alternative design or prototypes at the mid-point of design cycles. The last of the mentioned methods, usability testing, can be used in order to collect data which can be used to measure the usability of the application or system based on certain defined criteria. Usability testing is often used at the final stage of a design cycle in order to evaluate the product, but in cases of a needed redesign of a product, it can also be used in the early process in order to determine what needs to be improved. A system or application can be measured on usability criteria such as "effectiveness, efficiency, safety, utility, learnability and memorability" as well as user satisfaction (Abras et al., 2004, p. 5).

Overall, there can be many methods applied throughout a design cycle, however, in order for the design to be identified as user-centred, the users must be directly involved to some degree. Involving and collecting data from users through an iterative process can ensure refined product and "lead to developing more usable satisfying designs" (Abras et al., 2004, p. 12).

### 3.2.4. Benefits

As established throughout this section, user-centred design is an approach that requires user involvement and design iterations which can lead to the perception that it is a time consuming and expensive process. However, the importance of this approach lies within the possibility of designing and developing effective and efficient products that have a higher chance of acceptance and success (Abras et al., 2004, p. 3-4). As automation can also be a very expensive investment for a company's performance and efficiency, designing and developing the automation system successfully by any means possible should be considered a priority.

### 3.2.5. Weaknesses

User-centred design has been so far described as an approach that can help discover user needs, user goals and user pain points and use that knowledge to design better software solutions that support better usability. However, this approach is not always considered a beneficial step in the design and development of software or an application. Some associate this process with the discovery of problems and describe it as a "loose collection of human-factors techniques united under a philosophy of understanding users and involving them in design" whereas "Although helpful, none of these techniques can replace good design. User studies can easily confuse what users want with what they truly need. Rapid iterative prototyping can often be a sloppy substitute for thoughtful and systematic design.

Most importantly, usability testing is a relatively inefficient way to find problems you can avoid through proper design" (Göransson et al., 2003, p.105).

As can be understood from this example of a statement, user-centred design can be challenging in the ways that involve users. Designers and developers who interact with the users need to have the proper knowledge or training towards how to interpret the gathered data and avoid considering every wish of the users as an actual design requirement. If designers trust what users tell them blindly, that can potentially lead to design solutions that are overly complicated and aim to please the users instead of providing smart solutions to their problems. Some authors also emphasize the importance of differentiating between "understanding potential users, versus identifying, describing, stereotyping and ascertaining them" (Maedche et al., 2012, p. 13). Furthermore, user-centred design can be considered an inefficient approach or time-consuming process as it requires that both designers or developers and end-users need to be invested in the process of collecting data for the design of the software solution.

# 4. Methodology

The following section will provide an insight into the methodological grounds for this study, by presenting the means for collecting and analysing data, as well as the overall research design approach and theory of science.

## 4.1. Theory of science - Pragmatism

As described so far throughout the thesis, the main focus of this research is to adopt a solution-oriented approach in regards to the lack of attention towards the role of users involved with or affected by RPA. This is mainly based on the literature that can be found on the topic, where users are briefly mentioned as part of the process but are not portrayed as an important aspect for a successful RPA.

With the approach taken, this is considered potentially a problematic area, as automation is heavily based on user task behaviour and includes cases of user-automation interaction. As the strengths and weaknesses of automation will be explored throughout this project, for the purpose of addressing the relevant weaknesses through user-centred design practices, this will be accomplished through a pragmatic approach and pragmatic worldview.

When pragmatism is associated with applications and software the focus usually falls on what works and potential solutions to problems (Creswell & Creswell, 2018, Ch. 1). This creates a relevant connection to the research questions of the thesis as what works will be analysed through looking at the strengths of RPA and automation, whereas problems will be discovered through analysing weaknesses. Those weaknesses will then serve the role of problems and become the basis for designing solutions through user-centred design practices.

Pragmatism allows researchers to guide their research with emphasis on the research question which is achieved by exploring all available approaches for the research design, instead of focusing on particular methods (Creswell & Creswell, 2018, Ch. 1). The main goal of pragmatism is to understand the problem and therefore the researcher has the freedom to accomplish that by the means of any methods available. By applying the pragmatic approach throughout the research, the focus has been brought on "the 'what' and 'how' of the research problem" where the 'what' refers to what characterizes the strengths and weaknesses of automation and RPA, and the 'how' explores how the weakness within design and development can be addressed (Mackenzie & Knipe, 2006).

Pragmatism has brought attention to gaining knowledge about the problems in RPA, reviewed as weaknesses, and in order to do that, the methodology has adopted different perspectives at looking at the problems. Therefore the applied methodology has been designed to provide for a theoretical and practical perspective over understanding the problem. That would be accomplished by combining what can be learned from theory with what can be learned from practice by collecting empirical data. As the world is not seen as an absolute unity through the eyes of pragmatism, this approach for the data collection would also allow for analysing if theory differs from practice within the context of the researched problem (Creswell & Creswell, 2018, Ch. 1). That would also ensure that the considerations based on the analysis won't be biased towards only theory or practice.

Based on the pragmatic worldview, the choices in regards to the research design, data collections and analysis are further elaborated on in the following paragraphs.

## 4.2. Research design - Qualitative approach

When it comes to taking a decision about what approach to take towards the data collection and analysis within this thesis, the considerations have been taken in accordance with the research questions. The choice between qualitative, quantitative or mixed methods approach is part of the "decisions that need to be made by the researcher" but as such it is

mainly based on the purpose of the thesis (Mackenzie & Knipe, 2006, p. 193). As the research questions aim to investigate what characterizes the strengths and weaknesses of process automation, and how user-centred design can address them in regards to design and development, the answers to these questions can't be answered by pure statistics or numerical data. That is because the nature of a 'how' question can not be answered with a percentage for example, but would rather require an explanation described in words. Such an explanation can of course be given credibility or be tested by the means of numerical data, but would still emphasize words rather than pure statistics. Furthermore, in order to answer the research questions, there will be a need for a deep understanding of the subject, and specifically, understanding what are the weaknesses of automation in regards to design, development, implementation and use of RPA, and why are they considered weaknesses. Such an understanding will be required in order to discuss a solution based on user-centred practices which will be the answer to the research question.

Given those considerations, the research design for this thesis would adopt a qualitative approach to the gathering and analysis of data (Bryman, 2016, p. 375). Adopting this approach would also allow for a deep understanding and analysis of the applied theory and the research conducted throughout this thesis in order to discuss recommendations and conclusions based on the results of the data collection.

Qualitative research provides an opportunity for a rich and deep understanding of the researched topic due to the nature of qualitative data. As qualitative data comes in many forms it allows for interpretation of the meaning of the data. Qualitative data is most often connected to methods that involve participants directly in the data collection, such as interviews, focus groups and observations. However qualitative data can also be collected from documents serving as a source of data which can be understood as a "very wide range of different kinds of sources" (Bryman, 2016, p. 545).

The first step in collecting data will therefore be done by gathering qualitative information from theory in the form of documents and more specifically literature sources, such as books, articles, conference papers and the like. Working with such data would allow for qualitative content analysis where the themes of interest related to each topic can be discovered within the documents and extracted for analysis. This approach would also provide more flexibility throughout the data collection and analysis as "the processes through which the themes are extracted is sometimes not specified in detail" (Bryman, 2016, p. 563).

Furthermore, the thesis' aim is to investigate the research question based on combining a theoretical review of the topic and gathering empirical data from people working in the

field of RPA. The reasoning behind those choices will be elaborated further in the next section. In order to gather the empirical data, there have been considerations made towards the proper methods for the data collection which will further be elaborated on in the data collection paragraph.

## 4.3. Data collection

As this research will be based on a theoretical perspective combined with empirical data, the data collection will consist of a general investigation on the topics of interest that relate to the research questions as well as data collected directly from users.

The first step in gathering relevant data is to research the latest or most relevant scientific information on the topic of automation in the form of scientific articles, books, case studies or any other type of information document.

Each document will be closely examined, as the main points of interest is to characterize the strengths and weaknesses of automation that don't necessarily appear in literature under those terms. As there might be many different examples that might result from such a search the data which is going to be selected for the analysis would be data, that can be related to some of the main concepts of the essence of automation and the purpose of this project, such as user involvement, software design, system design, design and implementation, testing and interaction design as well as a general view on the topic related to automation as a tool within an organisation.
The gathered data based on theory will be presented in the analysis in the form of a literature review, presenting the most relevant literature found on the topic.

In the essence of the research questions, what this thesis is trying to investigate is if the two practices of RPA and user-centred design can be combined to work together for the design of even better software robots. As this combination of practices is not acknowledged to be applied by organisations or by literature, the analysis in the thesis will present the ways in which that might be achieved, based on addressing RPA's design and development weaknesses through user-centred design. Because this is not a practice that has been acknowledged, the main means for investigating is through the literature review mentioned above. However, since the analysis and result will then be based purely on theory they might not represent how organisations are actually working with RPA in the current time. Therefore the data collection will also include a form of data collection gathered from participants who work with automation on a daily basis and are employed at organisations that utilize RPA. By combining both forms of data collected from theory and from people

working in the field, the data will also show if there are differences between the theory and practice.

The second part of the data collection is gathering data from people working in the field. Following will be presented some of the considerations towards how data collection has been planned and conducted. As this thesis investigates automation, its weaknesses and strengths as well as the ways in which automation is achieved, the empirical data will be collected from users who possess such knowledge. In this sense, users would be people who work with automation, and more specifically people who design or develop RPA processes and systems, meaning RPA developers.

Extracting data from such users would have the purpose of learning about the RPA practice within different organisations and comparing it to what we know from theory to discuss further recommendations. Therefore there is no interest in the way they interact with their work, but rather learning from their experience and thoughts on the subject. As the aim is to gain a deep understanding of the subject the data collection has been designed by the use of interviews as a method.

Qualitative interviews have been identified as a suitable method for the data collection within this thesis due to the flexibility they provide in terms of their level of structure (Bryman, 2016, p. 465). As within the qualitative approach, the interest falls on the interviewee's perspective of the investigated topic qualitative interviewing allows for a more open-ended approach that can be used to form new follow up questions depending on the interviewee's replies (Bryman, 2016, p. 465). This is an especially important feature of the method as the interviewees might use technical terms specific to RPA developers which might not be understandable and open-ended questions can ensure that follow up questions can help with clearing up misunderstandings of certain statements. As the thesis is interested in very specific aspects of automation, the interviews will be designed with a guide to carry out specific questions by leaving enough room for follow up questions. Therefore, the method can be identified as semi-structured interviews (Bryman, 2016, p. 468).

Designing the interview guide has been accomplished by defining topics considered most essential for this study and using them as a guideline for constructing the questions. The first topic represents the RPA methodologies applied by the participants. By investigating this topic, the aim is to gain an understanding of the step by step approach organisations take towards RPA development and more importantly does any user-involvement happen in the process. This part of the interview includes further questions on this topic that address directly user involvement and investigate the ways in which they are involved and the

reasons why. The next topic represented by the questions concerns identifying opportunities for improvement. Here the participants were asked what they believe the impact could be of more involved users in the design and development phases of RPA, as well as the ways in which they can be further involved. This information can potentially discover interesting suggestions as it is assumed that the participants will answer based on their experience in the field, inspired by challenges they might have. The remaining part of the interview guide concludes the topic by investigating examples of processes that were considered success as well as processes that were challenging, as well as discussing the strengths and weaknesses of RPA. This last part of the interview guide aims to conclude on general benefits and challenges of automation by potentially connecting the challenges to the amount of user involvement described in the previous questions in order to make final conclusions. The full interview guide with all questions can be found in Appx.1.

Another part of preparing the data collection process has been to consider the relevant participants. This has been accomplished by the means of purposive sampling (Bryman, 2016, p. 408). Purposive sampling controls the sampling in a way that is relevant to the research question and for that reason eliminates choices made on a random basis. As mentioned earlier, one of the criteria for the sampling is that the participants must fit a certain professional background, meaning they must work with automation design and development. Applying such criteria to the sampling process makes it a strategic process that has the purpose of ensuring that the data collection would be relevant to the research question but can also feature variety. In terms of achieving a variety in the data, the participants have been chosen with different maturity of experience in the field, as well as different organisations of employment. Furthermore, the official titles of the participants differ as well. The data collection has been therefore conducted with three participants employed under the following titles - RPA Developer, RPA Specialist and an RPA Team Lead. The three companies of employment characterise as a government administration, telecommunications and retail.

After the participants were sampled they were invited for the interview session which was conducted online and the participants had the choice to take the interview from the comfort of their private home or a quiet room at their office. All interviews were conducted as a video call where only the audio has been recorded in order to transcribe the data. Therefore all participants were asked to sign a declaration of consent which allows for the recording of the audio and for the transcribed data to be used within this study. A template of the declaration of consent can be found in Appx.2. Each interview was scheduled for thirty minutes, however the first interview was extended to an hour since the participant had the possibility and the desire to continue the interview.

As the analysis of the interviews would describe, despite the differences in experience and context of the organisation of the participants, the way they work with automation is often described in a similar way which has led to the conclusion that there isn't a need for a further sampling of participants as there isn't enough new knowledge generated through the interviews. Furthermore, as the main focus falls on the theoretical analysis of the research questions, the interviews can be considered as secondary data which can provide another perspective over the topic and enrich the analysis.

## 4.4. Analysis of the gathered data

The analysis part of this thesis would go through two stages. First, the gathered qualitative data from theory will be presented in the form of a literature review. The literature review will first present 15 articles that have been chosen to be analysed based on their relevance to the topics of RPA, its strengths and weaknesses or otherwise benefits and challenges. The articles will be presented in a literature review matrix. Following, a close analysis of the articles will be presented where the structure will be guided by grouping the different literature sources in different themes, such as weaknesses and strengths of automation that can then be explored in subthemes based on the context in which they are reviewed. As the terms 'strengths' and 'weaknesses' can be quite generic, the subthemes will be used to categorise the key concepts in focus which can include strengths and weaknesses in regards to planning, designing, testing and implementing RPA processes which can be analysed through business perspective, user perspective and the technology perspective.

Following will be presented the analysis of the empirical data gathered through the semi-structured interviews. The process of analysing will be done through the use of coding (Bryman, 2016, p. 581). In order to apply coding, all interviews will be first transcribed in order to adopt a text format. All transcriptions can be found in the appendices (Appx.3-5). After all interview transcriptions have been read through, any chunks of data that represent remarks or patterns will be marked with the use of notes. The notes will later be refined in the form of index terms which will be used as codes (Bryman, 2016, p. 583). All coded interviews can be found in the appendices (Appx.6-8). After the coding process has been completed, the process will be continued as a thematic analysis (Bryman, 2016, p. 584). By using this approach all codes will be reviewed and grouped into specific themes or categories which will then be used as a structure for the analysis and a way to ensure that all data within a certain theme is taken into consideration during the analysis. The themes have been identified as Introduction, Development Approach, User involvement and finally General characteristics of RPA. All codes can be found in Appx.9, whereas the final themes and subthemes can be previewed in Appx.10.

# 5. Analysis

The literature review section of the analysis will present the strengths and weaknesses of RPA according to the data found in theoretical sources. The review has been made through thorough research on the subject of RPA where a number of articles have been read and a select few of those articles that include relevant knowledge have been chosen to be analysed. Relevant knowledge is considered information on the subject of potential strengths, weaknesses, benefits or challenges related to RPA, as well as the impact or effect that RPA can have on an organisation or its employees.

The analysis will be presented in three sections, whereas the first section will present a literature review matrix of the analysed articles, followed by the next section which will present an in-depth analysis of the strengths and weaknesses of RPA. The third section will present the analysis of the conducted interviews in order to compare the knowledge gained from theory to the empirical data gathered from specialists in the field.

## 5.1. Literature review matrix

The literature review will be presented in two sections. The first section will present a literature review matrix that presents 15 articles that have been analysed in order to identify weaknesses and strengths of RPA. The 15 articles presented in the matrix have been chosen due to their direct or indirect reference to RPA's benefits and weaknesses, challenges, impact or overall extensive discussion over the subject of RPA.

| Source | Purpose of the study | Methodology | Findings | User focus |
|---|---|---|---|---|
| Aguirre & Rodriguez (2017) | The authors investigate the results from applying RPA on front and back office activities as they claim that other case studies have only focused on automating processes that correspond to back office business. | • Literature review presents different RPA applications that shortly describe the automated processes within an organisational context.<br>• Case study of a process for generation of a payment receipt is analysed. The already automated process has been introduced and illustrated in a step by step approach. | The findings have shown that a group of agents working with RPA could handle 21% more cases than a group without RPA. However, time reduction achieved by the group working with RPA equaled only 2%. The comparison has been made within the span of one week. | No discussion over user involvement |

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|---|---|---|---|---|
| Asatiani & Penttinen (2016) | The case article investigates a particular organisation and the pros and cons of RPA for user organisations | • Case study of the company OpusCapita which is "a Finnish company offering financial processes and outsourcing services to medium-sized companies and large corporations". | The findings provide information on the challenges of implementing RPA, business models for RPA and market opportunities which concern OpusCapita directly. | No discussion over user involvement |
| Asquith & Horsman (2019) | The discipline of digital forensics (DF) is searching for ways to process digital data quicker and more accurately which has led the authors to investigate incorporating RPA into DF processes and define its limits within that context. | • A case study where the robot carries a keyword search<br>• A case study where the bot "import evidence files for processing and carry out image extraction processes" | The authors have concluded that the study can neither recommend nor condemn the use of RPA for digital forensics. The study has proven that RPA can handle basic preprocessing tasks within digital forensics, however, its application within this context is limited. | No discussion over user involvement |
| Cabello, Escalona & Enríquez (2020) | The aim of this paper is to investigate how positive impact can be achieved through incorporating RPA robots and humans in process mining. | The study doesn't present a methodology section, however, the authors have tested their proposal in a real project entitled RAIL. | The authors have presented a hybrid approach to automation that is built on non-intrusive monitoring, automatic discovery, evaluation dn machine learning. | No discussion over user involvement |
| Chakraborti, Isahagian, Khalaf, Khazaen, Muthusamy, Rizk & Unuvar (2020) | The study's purpose is to investigate the effect of recent advances in machine learning and AI on the automation steps of RPA. | The study doesn't present a methodology section nor a data collection method. | The authors have presented challenges related to intelligent process automation and future research opportunities on the related topic. | No discussion over user involvement |
| Fernandez & Aman (2018) | This article uses a case study approach to investigate what is the impact of RPA on individuals and organisations within global accounting services. | • Qualitative approach of selecting a company for a case study that has been using RPA since 2015.<br>• Semi-structured interviews with eleven employees of the company. | The findings conclude that individuals are impacted by the changes in tasks and job roles and overall feel in competition with the bots. The organisational impact has translated into the need for skilled IT employees, a reduced | No discussion over user involvement |

| | | | | |
|---|---|---|---|---|
| | | | number of workers and proactive planning. | |
| Fung (2014) | The objective of this study is to provide a clearer description of the criteria for IT process automation (RPA) as well as present some use cases for ITPA. Furthermore, the authors discuss the benefits and negative effects derived from ITPA. | • Qualitative content analysis of literature.<br>• Interviewing 37 IT professionals. The participants were sampled from different IT organisations that have implemented ITPA projects. | The study findings have identified nine criteria for IT process automation that relate to the type of transactions, systems, environment, human intervention and handling. They have also identified benefits such as repeatability, predictability, productivity and cost-effectiveness, whereas downsides relate to job loss and IT staff job complacency. | No discussion over user involvement |
| Hindel et al. (2020) | As the rising interest and knowledge and RPA expands, the authors of this study aim to gain an understanding of the RPA trend and to "objectively discuss the strengths and weaknesses" associated with it. | • Literature review of 14 peer-reviewed journal articles and 13 scientific conference papers.<br>• Case of automating a business report creation process.<br>• "Qualitative survey with a senior manager for RPA implementation at a leading sportswear manufacturer". | The study concludes that "the strengths of RPA outweigh the weaknesses in terms of number of mentions" in literature. However, currently, RPA is described as being overrated. | No discussion over user involvement |
| Kopeć, Skibiński, Biele, Skorupska, Tkaczyk, Jaskulska, Abramczuz , Gago & Marasek (2018) | The article explores "a hybrid, human-centered approach to the development of software robots" achieved through participatory design, AI and machine learning. | The article doesn't provide an elaboration of methods used to reach a conclusion. The authors rather elaborate on RPA implementation challenges and discuss the already proposed solutions. | The result of the authors' discussion is defined as a hybrid approach that supports employee participation in the development of RPA in the form of participatory design, supervised training within AI. | Proposed participator y design of RPA |
| Mendling, Decker, Reijers, Hull & Weber (2018) | A panel discussion which revolves around the extent to which recent technologies and RPA can reduce the human factor in business process management. | As this source represents a conference paper the document does not provide a methodology section. | The panel has discussed that technologies will impact and create challenges throughout employment, technology acceptance, ethics, customer experience, job design, social integration and regulation. | No discussion over user involvement |

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| Noppen (2019) | The authors investigate the impact of RPA in order to create guidelines for reducing the negative and reinforcing the positive ones. | • Literature review combined with data from 9 semi-structured interviews with participants from different organisations. | The guidelines proposed by the study represent governance, the process of automation and the workforce. | No discussion over user involvement |
| Siderska (2020) | The author presents arguments for considering RPA as an enabler of digital transformation by reviewing definitions, trends and predictions for development. | The author doesn't collect data within this study apart from conducting a literature review that aims to indicate "roadmaps for effective deployment" of RPA. | The article presents characteristics and advantages of RPA implementation as well as future opportunities, whereas the most critical challenge is claimed to be selecting an appropriate process for automation. | No discussion over user involvement |
| Syed & Wynn (2020) | The authors aim to build an RPA trust conceptual model as trust is one of the challenges of organisational acceptance of RPA. | • Literature review of "33 articles with a focus on IT artefacts and user trust".<br>• Semi-structured interviews with 6 IT staff employees from different organisations that have been using RPA for at least a year. | The findings of the study point towards the importance of "building a mutual understanding between the operations teams and RPA designers" as well as "rigorous quality assurance and performance assessment" of RPA bots. | "end-user engagement is crucial for building trust in bots" |
| Syed et al. (2020) | The article aims to provide unbiased information on the state of the art of RPA and identify key research gaps over the benefits and challenges of RPA. | • Literature review of 125 papers "of which only 36% (45 out of 125) were academic papers". | The authors summarize the 4 main benefits of RPA, define RPA readiness and capabilities factors, discuss RPA methodologies and technologies, as well as present 15 challenges that require further research. | No discussion over user involvement |
| Wellmann, Stierle, Dunzer & Matzner (2020) | The study presents a framework design aiming to evaluate RPA process candidates by analysing thirteen criteria that "offer different evaluation aspects". | • Literature review of sources from "databases Scopus, Google Scholar, and IEEE Xplore Digital library" has been presented in a concept matrix that connects the identified criteria to sources and the number of mentions. | The proposed framework has been tested on a real-life data set and has proved its efficacy and validity. However, the authors note the need for further validation of the framework, applied on "multiple and | No discussion over user involvement |

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| | | | different kinds of processes". | |

The purpose of the literature review has been to identify strengths and weaknesses related to the lack of user involvement and user focus in the design and development stages of RPA, however, no sources have presented information on those subjects. As can be observed through the matrix, the articles mostly do not discuss the user involvement in focus, and even though two of the articles mention partly that there are potential benefits to new ways of involving users in the automation process, the authors do not provide in-depth information or elaboration to how that can be achieved. Furthermore, the articles haven't provided any in-depth information on RPA methodologies or design and development processes, which has made it impossible to make conclusions about the amount of user involvement that is practised in the field. This leads to the conclusion that researchers do not investigate RPA from the perspective of user-centredness and since the field of RPA is still relatively new, knowledge of methodologies and applied practices is still not sufficient to draw conclusions from.

However, the strengths and weaknesses discussed in the above reviewed articles will be presented in the next section, where the gained knowledge has been analysed and presented in themes in the next section, in order to provide an in-depth understanding of the theory. Even though there has been no weaknesses identified in the articles that relate directly to lack of user involvement, the following section will investigate how user involvement could potentially have an impact on those weaknesses. First the identified strengths will be presented, after which the weaknesses will be analysed.

## 5.2. Strengths & weaknesses themes found in literature

When it comes to RPA, its integration and implementation do not only affect the organisation, but also the employed humans, whose workload is impacted by the change. In that sense, some authors view the challenges related to RPA in three main categories - *technical*, *organisational* and *socioeconomic* (Kopeć et al., 2018, p. 2).

In order to be present the information in a structured manner, the strengths and weaknesses will be presented in three different categories inspired by Kopeć et al. (2018) way of categorisation, representing the technology, organisational and user perspective as they also refer and can represent the content, context and user perspectives. Within these categories, specific concepts of strengths and weaknesses will be identified, which have been the most prevalent examples found in the analysed articles.

### 5.2.1. Strengths of RPA

As mentioned throughout this thesis so far, when it comes to the strengths of RPA, the literature often points towards the benefits related to lowering costs for businesses and increasing efficiency for task completion. One of the reasons for these two particular strengths is the fact that RPA is usually applied to standardized high-volume tasks, works by interacting with already existing applications and doesn't require coding to be built. However, different authors focus on different aspects of what can be considered strengths or benefits of RPA and this section will explore this further.

RPA can be analysed from different perspectives since it is a technology that affects the performance of an organisation, the way different tasks and processes are handled, as well as the impact it has on the employees, by potentially removing certain tasks from their list of responsibilities. A representation of these perspectives combined has resulted in one example set of benefits which include "accuracy, improved employee morale, productivity, reliability, consistency, non-invasive technology, compliance and a low technical barrier" (Asquith & Horsman, 2019, p. 2). In order to dig deeper into each strength, the perspective of the technical aspect will be presented first, as it would also provide the context for the rest of this section.

#### 5.2.1.1. Technical strengths

The technical strengths presented within this section represent the ways in which the technology of RPA can be utilised by companies based on its specific capabilities. Understanding these strengths is important as they play a role in the ability of RPA to provide value to the organisation and its users, however, some of these strengths can also be directly connected to weaknesses as can be observed after reviewing the full length of the analysis.

##### 5.2.1.1.1. Process accuracy & consistency

Process accuracy in this context refers to the fact that RPA can ensure that there are fewer or no errors during the completion of a task (Asquith & Horsman, 2019, p. 2). That is however given that the robot is performing the tasks correctly from the start and there are no errors in the data that the robot is pulling from. In order to ensure accuracy, the robot needs to be tested and verified to define that it functions successfully. If successful the robot can potentially reach better accuracy than a human worker as humans can be more prone to make a mistake in typing, overlooking data or miscalculating. Based on this RPA robots are considered a very reliable way of handling processes.

Another strength of this technology is consistency (Asquith & Horsman, 2019, p. 2). This feature of RPA is somewhat connected to the accuracy as well. What consistency relates to is the fact that the robot performs each task as specifically predefined and programmed. In that sense, the robot is unable to act unexpectedly or deviate from its assigned process steps. A benefit resulting from this strength is that the technology instils trust.

#### 5.2.1.1.2. Process quality

Process quality can also be found in literature as quality of service (Syed et al., 2020, p. 4). This factor contains similarity to the previously described accuracy. Due to the fact that RPA is a software robot programmed to perform its tasks correctly, the technology can eliminate "transactional errors such as incorrect data inputs, missed steps, and mistakes" that might be common for humans to make (Syed et al., 2020, p. 4). It has also been discovered that some organisations believe that RPA can deliver "service excellence" to their customers as the robots are considered to provide "reliability and continuity of service" (Syed et al., 2020, p. 4). By reducing the number of work errors, RPA "can smoothen the service process that is carried out and improve the performance of the organization" (Fernandez & Aman, 2018, p. 129). Furthermore eliminating mistakes and errors previously made by humans can also lead to savings generated from cost and time reductions (Wellmann et al., 2020, p. 207).

#### 5.2.1.1.3. Easy software integration

RPA is considered a non-invasive technology since it doesn't disrupt the IT architecture and IT systems that organisations are already utilizing (Asquith & Horsman, 2019, p. 2). As described in the theoretical framework, RPA is built on top of the applications where the robot simply interacts with the applications' interface in the same way humans do. Because of that RPA is compatible with any system that has a user interface and in addition to that the software robots can function without disrupting existing processes. "This is a substantial advantage compared with automation achieved through back-end integration, which frequently requires a significant redesign of the existing systems" (Asatiani & Penttinen, 2016, p. 68). Apart from that, the technology has a low technical barrier which can also be considered a strength, since due to the no coding required, this approach to automation can be easier to implement.

Another benefit connected to RPA's low technical barrier points towards the easy implementation and integration of RPA. This feature is once again in accordance with the previous specification of RPA as a non-invasive technology defined by Asquith & Horsman (2019). RPA technology is also referred to as a "low-code approach" (Cabello et al., 2020, p. 185). It has been previously mentioned that RPA can be considered an easy process, but the

authors Syed et al. (2020) have managed to put that statement into context by providing some examples for an actual time frame based on some cases. Based on their research, they have found examples that a robot built to handle a simple process has been "ready in three weeks" whereas another example mentions a fully developed and released automated solution within six weeks (Syed et al., 2020, p. 4). Furthermore, the technological advancements also provide some benefits in terms of "Next-generation RPA platforms come equipped with sophisticated dashboards, which focus on KPIs for your business" which can provide the option for insights and analytics (Taulli, 2019, p. 94).

#### 5.2.1.2. Organisational strengths

The strengths categorised as organisational are the benefits that impact the overall performance of a company through RPA. As such, they can also apply to the other two major categories as they are also based on the technology and ultimately include a user perspective. However, in general, this category can be linked to "improvement of work efficiency, reducing work routines, improving the quality of statements and management analysis, improving motivation in learning and innovation, improving IT and professional skills, and also improving competition pressure" (Fernandez & Aman, 2018, p. 125).

##### 5.2.1.2.1. Increased productivity

RPA is also connected to improving productivity levels (Asquith & Horsman, 2019, p. 2). The main reason for this increase is due to the fact that the software robots can complete the tasks within a process much faster compared to humans performing the steps manually. With technology like this which is able to run in the background, working during all hours of the day without interruption, no matter how experienced the human worker can be, the computational speed of the robot simply exceeds manual work. Apart from the possibilities of the RPA to work efficiently and fast, the tasks removed from employees, completed by the robot, create more time for humans to engage with other potentially more complicated tasks or processes. It is also believed that "In the long run, robotic automation itself could create jobs in robot management, consulting and sophisticated data analytics" (Asatiani & Penttinen, 2016, p. 68).

##### 5.2.1.2.2. Increased efficiency

Alongside productivity, one of the most prevalent strengths of RPA can be defined as operational efficiency. This term can be considered as an umbrella term for all the generated in decreased time, cost, human resources and manual labour, and the increase in productivity (Syed et al., 2020, p. 3). All of these factors result in reduced operational cost. Organisations usually measure this by the number of "full time equivalent employees

(FTEs) replaced by robots" where bases on literature the authors have established that the cost of human resources has been cut by the implementation of RPA technology by 20-50% and can furthermore "reduce the cost of transaction processing by 30–60%" (Syed et al., 2020, p. 3). Efficiency is also one of the main factors impacted by integrating RPA technologies, where process cycle time gets reduced from 30% to 70% which also applies to task-handling time and waiting time (Syed et al., 2020, p. 4). Furthermore authors (Syed et al., 2020) also mention the connection to increased productivity, which similarly to the previously explored benefits is due to the fact that the software robots can work non-stop throughout the day and week, whereas humans can indulge in other activities that add more value to the organisation.

#### 5.2.1.2.3. Control over risk & compliance

Another aspect connected to the standard way in which RPA operates a sequence of tasks is compliance. In the case that organisations have certain policies that need to be followed by employees when working with particular tasks, the RPA robots can follow those compliances as they are built based on mimicking how humans conduct the processes. This also allows users to find issues quicker based on the fact they know the process and they can trail the steps the robot has taken (Asquith & Horsman, 2019, p. 2).
Syed et al. (2020) have also reviewed case studies in which "clients "reported that compliance increased with RPA" and the higher compliance is due to the fact that "software 'robots' were configured to follow regulations and [that] processes are all recorded and thus easily audited"." (Syed et al., 2020, p. 4). In other words, compliance can be built into the process, which would ensure that it is always followed, and can, therefore, be a major strength as it can ensure avoiding legal problems and fines (Taulli, 2019, p. 94).

### 5.2.1.3. User perspective

In regards to the strengths analysed from the user perspective, it is interesting to see that not many benefits can be connected directly to the users. That can also be considered logical as the main purpose of RPA is to replace humans doing manual work.
In regards to this, there are no specific strengths seen from a user perspective, however, some of the previously mentioned examples could apply to the benefits of users. Some of those are, for example, the increased productivity which is the result of reduced workload.

#### 5.2.1.3.1. Reduced workload

From a user perspective, productivity is connected to the possibility to remove dull and boring repetitive and tedious tasks from the user's workload which can allow them to engage in more creative and challenging work. "The reduced workload frees up time for

decision making and other tasks providing more value" (Noppen, 2019, p. 24). In cases where users have positive experiences with RPA software can transform them into RPA ambassadors within the organisation and even inspire them to identify new opportunities for automating processes. The change in workload can even result in climbing up the organisation and receiving new responsibilities.

### 5.2.2. Weaknesses of RPA

Literature and other sources often represent RPA technologies through a positive perspective on the impact they can have on organisations. As presented above, according to the benefits of RPA, this technology can be a great tool for the development of organisations, but integrating it can also have its challenges.

#### 5.2.2.1. Technical weaknesses

The technical aspect represented in the first category is based on weaknesses of RPA such as costly and tedious maintenance, multiple input data formats, keeping paper documentation and low quality of existing data (Kopeć et al., 2018, p. 2). Even though technical challenges might be impossible to address through user involvement, some of the mentioned weaknesses can potentially be impacted by joined efforts form end-users and developers.

##### 5.2.2.1.1. Data quality

In regards to data quality, RPA robots can be difficult to maintain due to the fact that they are very dependent on the format and structure of data that they process, meaning if there are any changes to the format the robot might run into errors (Kopeć et al., 2018, p. 2). As this type of technology runs through interacting with the user interfaces of other applications, "RPA can easily break if there are changes in the underlying applications" (Taulli, 2019, p. 95). Any changes in the user interface can also disrupt the process of the robot, which in result requires constant maintenance in cases of updated data formats or updated user interfaces. RPA robots can function well with structured data, however, "Unstructured and hardly accessible data impedes RPA" (Wellmann et al., 2020, p. 206). Apart from that, the robots might be processing poor quality data in cases where current systems may be outdated or follow old regulations. In such scenarios, the use of RPA does not necessarily create a better-optimised process.

The importance of quality data is also found in other studies. In a case study by Syed & Wynn (2020) that investigates the relationship of trust between RPA bots and users,

participants in data collection have highlighted the dependency of the robots on consistent and well-defined data inputs. In cases where data sources are inconsistent the ability of the RPA bots to complete the task would be affected and might lead to a situation in which users need to devote time and effort to clean up the data (Syed & Wynn, 2020, p. 152). Overall this scenario can also result in negative perceptions created by the users which can lead to loss of trust in the ability of RPA to bring value to an organisation.

Even though this weakness relates to the technical capabilities of RPA there might be a connection to user-involvement. In some cases the issues connected to the data might be based on the way users handle their data in terms of input, storing and updating it. As users might not be aware of the technical possibilities of RPA they might not understand the need for clear and structured data that is kept consistent. By involving users in the design and development they can potentially learn some of the requirements for a successfully functioning robot, such as data quality and work together with developers to identify guidelines for how data should be handled by users so the robot can perform the tasks.

#### 5.2.2.2. Organisational weaknesses

Organisational challenges are represented in weaknesses such as lack of clear processes, multiple fragmentary solutions and unique legacy software (Kopeć et al., 2018, p. 2).

##### 5.2.2.2.1. Complex business processes

The root of some of the weaknesses connected to the organisational factors starts with the fact that many organisations have complex processes that might involve multiple contractors or clients and therefore require a number of approval steps and internal procedures (Kopeć et al., 2018, p. 2). “A critical component to the success of RPAs is identifying the opportunities for automation to add RPAs in the right place and maximize their potential” (Chakraborti et al., 2020, p. 219). Usually, many companies with complex processes have built custom solutions over the years or otherwise referred to as legacy software, that has been developed to match their organisational needs. Such systems can potentially pose a challenge when attempted to pair with RPA technologies. Furthermore, working with complex business processes would require sufficient knowledge that can also account for potential exceptions to the rules. This can be considered as another opportunity where a more focused user-involvement could potentially make a difference as such knowledge can only be gained by experienced workers. However, organisations are overall advised to approach RPA by choosing the simple processes first (Fung, 2014, p. 8). Therefore, a fundamental issue for any organisation can be “the appropriate identification

of processes to be automated using RPA technology" (Siderska, 2020, p. 24). Involving users in identifying process candidates for automation may not be the best solution as that would require knowledge about the extent of RPA's capabilities, however involving users early in the process evaluation could potentially prevent investing in unsuitable complex processes as they can provide insights for any exceptions to the rules.

#### 5.2.2.3. User perspective

The last category within this thesis is referring to the socioeconomic challenges or the user perspective. This category includes some of the more popular negative impacts connected to RPA and automation in general which refer to the ethical dilemmas of implementing software robots at the workplace. Automation and RPA are often related to organisational restructuring and job loss. This perspective over the technology often acts as a barrier to adopting the technology as managing staff and employees are especially aware of the risks "but have limited knowledge of how to mitigate them" (Kopeć et al., 2018, p. 3).

##### 5.2.2.3.1. Job loss

A conference paper that summarizes a panel discussion on the topic of emerging new technologies and their effects on humans within a business process management context mentioned some underlying challenges that can match with the previously defined ones. The main points of concern within this conference paper relate to employment, technology acceptance, ethics, customer experience, job design, social integration, and regulation (Mendling et al., 2018). More importantly, the panellists have concluded that within the next decade "a good share of today's job profiles will change or disappear" (Mendling et al., 2018, p. 302). However, those statements do not imply that humans would run out of work as technological progress over the past two centuries has not had such a result. However, this example feeds the negative awareness of automation technologies and RPA as we can not foresee the overall impact in the future. However, statements like this can easily be misunderstood by users and result in fear. Some of the reasons for that might be that users lack knowledge about the benefits and limitations of RPA. If we look at the RPA technology critically it is described as a cheap way to automate standardized tasks, in that sense a robot can not replace an employee but rather a specific task. If users were involved in RPA development stages they would be able to gain a new perspective over the technology and might even feel a sense of ownership due to the fact that their insights impacts the robots development.

Similarly, other articles also claim that many organisations are investing in RPA technology instead of hiring IT staff (Fung, 2014, p. 7). In contrast to that other sources claim that "RPA

post-implementation feedback has been mostly positive and no significant job losses have been observed because of RPA" (Asatiani & Penttinen, 2016, p. 68). However, as RPA is scaled up and organizations clear their backlog, that can have a direct impact on employee terminations (Noppen, 2019, p. 26). As these studies contradict each other, it creates the assumption that this challenge is mostly impacted by other factors and the described approach to user involvement could potentially have an impact as well.

#### 5.2.2.3.2. Change of environment (adoption and re-skilling)

As new technologies get implemented in an organisation, change becomes inevitable, mainly due to the fact that this means that new skills become required in order to keep up with the new ways of working. Much similar to the fear of job loss that may arise in humans, the simple change in tasks and roles can also create fear (Fernandez & Aman, 2018, p. 128). As there are many employees who might feel used to and comfortable with the job position they have, they might be reluctant to change. As a result, the integration of RPA causes competition between humans and robots (Fernandez & Aman, 2018, p. 128).

Furthermore, some studies have also shown that additional responsibilities for maintaining RPA software after implementation should not be underestimated (Fung, 2014, p. 7). As the automation robots may require maintenance the employees would need to have the proper skillset and therefore re-skilling and additional training might be required.

#### 5.2.2.3.3. User-robot relationship

Some authors have also investigated the relationship of trust between RPA bots and users (Syed & Wynn, 2020). They have also identified this to be one of the key challenges that affect RPA adoption. As established earlier, Syed & Wynn also report that users associate automation with the fear of losing their job which creates a level of resistance towards change. Furthermore, the authors claim that "As a bot takes over a significant amount of responsibilities from human users, the bot's performance is vital for the successful acceptance of RPA by users" (Syed & Wynn, 2020, p. 148). They further proceed to make a conclusion that "We contend that the social acceptance of a bot as a "digital colleague" requires a deeper understanding of users' perspectives" (Syed & Wynn, 2020, p. 148). The challenge of distrust has also been acknowledged by other authors that explain that users often feel the need to check how and what the robot has performed, and they have also provided a quote from a user which states "I review what the robot has done because I do not trust" (Cabello et al, 2020, p. 191). As the users feel the need to look after the robot, it creates an assumption that they fear the robot might not be doing the task properly or has not been developed properly. Once again this challenge might be directed to the fact the

users might have been involved enough in the design and development of the robot to feel like all the design requirements have been covered.

Another aspect of this weakness in relation to communication is the diminishing personal touch at the workplace. Based on data from some organisations that use RPA technologies, RPA "has reduced the personal touch of IT staff towards their end users" (Fung, 2014, p. 7). Examples of such cases are automation applied in call centres or service desks. The lack of personal touch can have an effect on user satisfaction and overall user experience. However this challenge can potentially be addressed by further investigating what users are actually lacking and improving the robot's functionality.

### 5.2.3. Summary

The main motivation for writing this thesis has been the lack of user focus presented in the literature in regards to RPA technologies. What is interesting about the presented literature review is that this problem can also be observed through the strengths and weaknesses of RPA that have been found prevalent in literature sources. As can be observed, the strengths pose benefits mainly for the improvement in technological capabilities and the overall performance of an organisation. However, no directly identified benefits have been connected to users. In regards to that, in the weaknesses section, it can be observed that the users are the most affected entity from the integration of RPA. This is an interesting discovery and can be used as another argument for why looking at this software from a user-centred perspective might result in more strengths and benefits generated for the users. Furthermore, even though there isn't any evidence yet to prove that the lack of user involvement might be impacting the rest of the weaknesses, implementing user-centred design could potentially have a positive impact.

The strengths and weaknesses of RPA in relation to user involvement would be further analysed based on the data collected from the semi-structured interviews which will be presented in the next section of the analysis.

## 5.3. Interview analysis

The following section will present the analysis of the gathered data from the semi-structured interviews with participants working professionally with RPA. After the data has been coded and grouped into themes as explained in the methodology section, the themes will be used to guide the structure of this section of the analysis. The themes that refer directly to the research questions 'Development approach' and 'User involvement' will

be analysed in greater detail as they investigate the design and development approach to RPA and the applied user involvement.

### 5.3.1. Introduction

Before we delve into the specific issues of design and development and user involvement it is important to gain an understanding of how organisations approach the process of automation. As RPA is relatively new technology it is assumed that there is a specific amount of skills needed that might be practiced only by IT employees. However, as RPA is easy to build organisations have tested different approaches to its integration.

> *"(...) that's two way you can go with RPA you could have people sitting with the manual task and then teach them to do RPA development and you can have the other way around where you have one as it was in my instance is an RPA developer that then gets hired to do the manual tasks that the other people are doing and there's pros and cons in of both of them and with the if you teach these people that already sits with it of course they do not they understand the task perfectly they know what task they can they can do but of course if they are not very good developers then the robot might not be in a very good quality where in my instance I do not know what they're sitting with so I kind of have to figure out what where to look you know how do I find the processes that needs to be done (...)"* (Appx.6, p.4, l.121)

As can be understood from this quote, neither of the two examples creates a perfect scenario for RPA development, as either the users or the developers lack particular knowledge relevant to their domain. This issue might be related to the fact that within the two examples given, there is always a superior entity working on RPA, whereas a combined effort with equal responsibility might result in a better software robot. Such a combined effort could potentially be achieved through user-centred design by involving the users to a higher degree, throughout the whole design and development process.

### 5.3.2. Development approach

Within this theme the analysis will present the organisations' approach to the development process and what are the weaknesses that can be identified.

#### 5.3.2.1. Defined approach or methodologies

When the participants were asked about the methodologies they follow when approaching RPA, none of them identified a particular one, but rather explained the steps they take in

the process. Furthermore, the process they continued to explain was not in regards to the design and development of RPA, but rather identifying processes that are suitable for automation.

> *"(...) typically you create a pipeline of the projects that you collect and you can collect them in various ways but you would you would create a pipeline and then you do some pre-assessment on the pipeline in terms of ranking it how beneficial would this process be in terms of in terms of in terms of automating it then based on that ranking you decide to move into a deep analysis where you take a more detailed view and you create some more detailed process maps or process flows uh and then based on that you decide whether to continue or to or to drop the process sometimes you end up dropping the process because it can be done in a better way with some other tool uh sometimes you end up dropping it because it's not feasible in terms of how many work hours to put in it as opposed to what you get out of it so there's very there's various criteria in terms of for what you decide uh and of course that depends on the organization that you're working with as well what their criteria are after that you basically begin developing it (...)"* (Appx.7, p.1, l.24)

Even though put in different words, all participants described the same approach of collecting different RPA process candidates and assessing their value and ease of automation. Based on that example it can be assumed that they follow the principles of the Six Sigma methodology which can be described in define, measure, analyze, improve, and control stages (Taulli, 2020, p. 63). However, as can be observed in this quote the participant described very thoroughly the collecting process candidates and assessing their value, whereas the development stage was described as "you basically begin developing it" (Appx.7, p.1, l.24).
As it has been established in the literature review identifying processes for automation is one of the biggest challenges when working with RPA, and therefore it is not surprising that organisations spend a lot of effort during this step. Furthermore as RPA is easy to develop technologically, it seems that developers might be undermining the design and development stages. The following paragraph will present what challenges have been further identified.

#### 5.3.2.2. Challenges

There have been a lot of challenges identified in the development phase of RPA which can be translated to weaknesses of not involving users to a sufficient degree. Even though users are inevitably involved in the design and development of RPA due to the fact they are the

providers of the process knowledge, the research shows that most often a targeted group of users are represented by one person only.

> *"(...) here at [...] we have some guys called process consultants and they are describing new processes they're also looking into existing processes and thinking about how to improve those kind of processes and so they are the process experts and an important thing when we're talking about RPA is that RPA is yeah of course robotic process automation and it's not magic but many think that but we are only automating a process so the process needs to exist before we start automating it (...)"* (Appx.8, p.2, l.56)

As can be understood by the quote above, companies trust dedicated employees called process consultants or process experts who are expected to know the specific processes in detail and guide the automation process without necessarily involving other users. This poses the question if this level of user involvement provides sufficient enough knowledge to develop a robot successfully. Furthermore, in those cases where the robots are built through a collaboration only between the developers and a process expert, that might be the starting point for other challenges related to the users, as the distrust in the robot's capabilities described in the literature review as well as the fear of potential job loss and competitive attitude towards the bots.

Furthermore, one of the participants in the interview gave an example of a particular issue that affected the success of automating a process due to lack of sufficient knowledge provided by the process expert.

> *"(...) I would like to mention the example I gave you before with the conversion of the subscription types so the idea and the process was actually pretty fine um we were explained how this process should be like we couldn't see any obstacles doing this and there was not a lot of variables so we started the the the project management and started the development as well and when we actually were almost finished I was asked by the developer and he said oh the input data here is it's really complicating and I asked him what is what is the what is the what is what is wrong yeah this Excel file is just this Excel sheet it's just changing all the time and I can see there is typos in the Excel sheet compared to the data in the CRM system and people are writing dates eh differently some some people are writing 1st of June with letters and some with numbers and so on and then I just oh if this Excel sheet is the starting point from the entire automation process we will see and experience a lot of variables forever so we need to do this more generic if if this is going to be a success so actually now we are backing if we should continue this project or just skip it and say okay we spent five weeks but that's that's how it is sometimes"* (Appx.8, p.5, l.142)

What is explained in the quote above is an example of a process which was automated based on the knowledge provided by the process expert, however as mentioned earlier in the project RPA is very dependent on the format of the data that has to be processed. However the process expert didn't account for the behaviour of users in terms of the different ways the input date formats in the systems which caused the robot to fail. If the team of developers had put more effort into studying the users instead of trusting only the process expert, this issue could have been prevented. This example also perfectly relates to the challenge of data quality mentioned in the literature review. The interviewee also continued to explain:

> *"(...) I trusted the process consultants which said this Excel sheet it's fine it's the same it's the same sheets they are using they're finding this on SharePoint and we trusted that and said okay then it will be fine but the reality was totally different a lot of the sales reps downloaded the file from SharePoint and had it locally on their machines so when we updated the sheets on SharePoint people were still having an old local version of the Excel sheet which also made the robot to fail"* (Appx.8, p.5, l.160)

The interviewee also expressed that process consultants still don't posses enough knowledge about RPA's capabilities as they didn't regard the data format as an important factor:

> *"(...) we thought they understand this kind of issue with the input data but no it's still too early for them to to make decisions like this they need more experience in how this should be in the in the future"* (Appx.8, p.5, l.170)

In conclusion, process experts can provide great suggestions about optimizing existing processes based on their experience and knowledge, however, developers still need to involve users in the process in order to address challenges in regards to the development process, data quality and user-robot relationship.

### 5.3.3. User involvement

Within this theme the analysis will present how organisations involve users in design and development of RPA currently, as well as identified needs for user involvement. Furthermore this topic will be analysed from a critical perspective and present some of the challenges of involving users in the process.

#### 5.3.3.1. Current approach to user involvement

User involvement is a crucial part in the development of RPA as the robots are built to mimic the users' actions. As can be understood by the quote from one of the participants some organisations include both process experts and end-users:

> *"(...) I would say RPA is more agile by default because you need you need a lot of interaction with you need a lot of interaction with the end user although the process expert are the ones that are typically doing the process (.) so I don't know if you know of the agile framework of scrum or something similar to that but when you typically do a sprint after you've done a sprint so that means you actually you actually demo what you have done so far uh and that is a good way to gather new requirements so we you actually keep the end-users in the loop every second week (...)"* (Appx.7, p.2, l.43)

The interviewee continues to explain that:

> *"(...) even if you are at a low maturity at a low maturity level of your organization or in RPA you will have to include the end-user because they are the ones who know how the process has been it's been worked so I can't really see a place where you can't involve the end-user actually (...)"* (Appx.7, p.3, l.80)

Another participant explains that after a process has been chosen to be automated, they begin talking to the users to gather knowledge about the steps and rules.

> *"(...) when they have done the prioritization of of the different robots or the different processes I would then take whatever they found is most relevant and and start talking with the with the colleague that are doing the the task as it is now and I'll start to make a PDD process design document where I would kind of say this is how the employee are doing it they click here they do all of these different things how often do they do it eh what kind of systems do they need access to what kind of roles do they need to to have the access and all this kind of stuff to kind of give me a foundation of how should I automate it (...)"* (Appx.6, p.5, l.152)

When describing the user involvement, the participants haven't referred to specific methods for collecting data from them but rather explain that they simply talk with the users to understand the process and tasks. However, this can sometimes be challenging for developers as they need to fully understand the process.

> *"(...) the biggest weakness I have in my position is definitely that I do not understand the domain completely I do not have an economic background at all really and so whenever people*

*are talking about their processes and what they're doing I simply do not understand the terms that they use because it is economic terms and the yeah the abbreviations they use and that is definitely the biggest weakness that I have with my task is is that and more often than not they kind of because all of them are in economics so they kind of take it for granted that I understand it so I have to really be persistent and like I don't understand it what does that mean and yeah because I don't think they really they don't talk about it that much they have a hard time explaining it to me sometimes too you know and then they just throw in 10 other verbs that I that I do not understand and uh yeah so that is definitely my biggest hurdle (...)"* (Appx.6, p.8, l.273)

The same way users can feel out of their domain when trained to develop RPA robots, the developers can also experience this challenge when they have to understand the processes. When doing research in regards to designing software the perspective of the user, content and context should be regarded as equally important and therefore developers might struggle to gain sufficient understanding (Arango, Morville & Rosenfeld, 2015, p. 316). It could be assumed that in order to target these challenges, the process expert might have an important role as the mediator between users and developers, however, as established earlier users still need to be involved in order to achieve better results with RPA.

Another example given from one of the participants, describes that developers record human interaction before they start talking with users which is an interesting approach to understanding the process:

*"(...) we have a small tool called UI path screen capture which records the human interaction of the system and then we simply export it into our programming interface called UI path studio and then it forms the basics of the development and the code and so on it can do that but it's not necessarily the thing we're doing all the time (...)"* (Appx.8, p.3, l.70)

As this is not something the organisation is doing all the time it can be assumed that this approach is suitable only for very simple tasks that might not need a lot of elaboration from users or that this approach is not very successful at understanding why the users perform the certain actions.

As can be understood from these examples, organisations involve users to some degree, but still struggle with defining the right approach for doing it. Users are mainly involved in the very beginning of the design and development process as a source of knowledge about the process with the exception of one of the examples where an agile approach allows for feedback every second week. The next paragraph will present shortly the importance of

involving the users based on the participants' responses, followed by a paragraph that would also present the challenges of involving the users.

#### 5.3.3.2. User involvement need

The need for user involvement in RPA does not only refer to understanding the process that will be automated, but also how the robot interacts with the users afterwards. The following quote which explain this requirement is expressed by the participant who described involving the users every second week and this might be the reason for that:

> *"(...) even though you have unattended robots you still need to talk with the employees that are going to use the output of the of the robots to kind of be like how do you want it how do how do you need it how often do you need it eh you know is it maybe they also don't want to be spammed with emails that the robot is writing to them every single time it's done one thing and you have a hundred of those a week that's not going to be fun for the uh for the employees too so it's not only to to get the information of how to do the robot but also to what when it's done how do we want it to communicate it (...)"* (Appx.6, p.10, l.335)

Apart from that, another example shows that there are cases where the developers discover through the development phase that they are missing certain steps in the process which might require getting in contact with the users once again.

> *"It's very often that we are missing information of steps and that is a bit related to how development is different than how a human would do the task because we have intuition a robot does not or an automation does not have intuition so so that means we have to ask some very stupid questions sometimes because we have to make sure that the robot acts correctly (...)"* (Appx.7, p.6, l.176)

Furthermore the challenges of involving the users will be presented in the next paragraph.

#### 5.3.3.3. Challenges

As discussed in the theoretical framework, some of the weaknesses of user-centred design relate to the amount of data generated through user involvement and the challenge of extracting the important information and leaving out the unnecessary. This can also be observed in the following quote:

> *"in IT systems there's multiple ways you can do one thing and it's not necessarily the best way do a process if you just listen blindly to a process expert to what they are saying (...)"* (Appx.7, p.3, l.85)

Another example shows that only talking to users often leaves uncovered areas of the process as users might not think of all possible scenarios in the context of a process:

> *"(...) sometimes when people are talking about the task or showing it they forget a lot of stuff because it's kind of obvious to them but it is not obvious to me unless I have worked with the task (...)"* (Appx.6, p.5, l.167)

The quote above can also be understood as another reason why users should be more involved throughout the whole process as the development requirements for the robot might have to be revisited often. Another example given by another participant also depicts a slightly different scenario that in reality is caused by the same issue:

> *"(...) if I run into problems uh for example with the robot more often time they're like oh but that's because in this in the system that works in the economy system that we work with eh you always need to have this number there but everybody knows that so I didn't tell you but you need that number in this little column okay you know stuff like that and so it's it makes the process a bit slower than it probably would have been if I would have known it (...)"* (Appx.6, p.9, l.295)

When reading the above quote it can seem like the fact that the user who has been in communication with the developer hasn't done more than slowed down the process, however that phrase might in fact mean that the robot was developed and has run into errors which has made the developers discover that something is missing. Another example for this issue is described by another interviewee:

> *"(...) there's also problems that they do not tell you the correct thing sometimes that's like communication misunderstandings between the two of us the two of us meaning me the developer on the other one the process owner and yeah it's and most of the time it is where I am being told how to do it I make the robot to do what they actually told me and then after some time I'm like oh but there's an error like here and here and these ones it doesn't do what it's supposed to do and then we had it often is like but you told me that it just needs to do this this this it's hard to tell when you don't have an example but they would then later say oh oh but that's because for example on treatment code X X Y you don't need to do that (...)"* (Appx.6, p.7, l.225)

Some might argue that an increase in the user involvement in the design and development process might lead to more challenges since it can be time consuming and it could potentially generate a lot of data that can be hard to process, however, the examples given in this section can also be used as proof that simply talking to users or process experts doesn't provide sufficient knowledge to automate a process and therefore developers often need to involve the users again, however after the robot has already run into an error. This by itself can be used as an argument for why involving the users to a higher level through user-centred design can potentially address these weaknesses.

### 5.3.4. General characteristics of RPA

The last section of the interview guide was designed to investigate the general benefits and weaknesses of RPA, and here the answers given by participants were in accordance with the presented themes in the literature review. Within the strengths category, participants mentioned mainly the benefits of accuracy and consistency, easy integration, as well as reduced workload and increased efficiency. Furthermore, the general weaknesses referred mainly to challenges with data quality and the fact that RPA technology has very limited abilities. One of the participants expressed an opinion about the future of RPA as follows:

> *"I think RPA technology is it's you know it's a really popular technology right now and it's just we have just seen the beginning but here in the Nordics where a lot of things are already digitized then the need for RPA is not that big compared to the rest of the world and it's also located to big old classic eh companies with pretty much a lot of old systems where RPA can be the glue the technical glue between the systems and that is absolutely brilliant but imagine if we took our current CRM system here (...) if we changed that to a good system a modern system a modern platform we wouldn't have the need for RPA so it will be outfaced pretty quick here so I don't think RPA in the way we understand it today will be present in 20 years 10 to 20 years it will be outfaced again"* (Appx.8, p.6, l.191)

Based on that statement, even developers think RPA "in the way we understand it today" (Appx.8, p.6, l.200) will not stand the test of time, which is yet another reason why there might be a need for change in the way organisations approach RPA, and that change can start with a user-centred approach.

## 5.4. Summary

Comparing the literature review to the interview analysis, gives an overview of how many weaknesses or challenges connected to the development process and user involvement are still undiscovered by academic literature. Therefore combining both approaches has

resulted in a extensive overview of both the factors that affect the success on a organisation level such as the data quality, the complexity of processes and the relationship between the robots and users, as well as the factors that affect the development process such as insufficient process knowledge due to lack of user involvement in cases where only process experts are involved, or need to involve the users to a higher degree in order to ensure error free development.

# 6. Discussion

The following section would provide a discussion over the interpretations and implications of the data, by discussing the meaning of the findings and the importance of this research. Furthermore, the section will discuss the limitations of the findings and suggestions for further development.

The combination of a literature review and interview analysis have resulted in an interesting perspective over the weaknesses of RPA. What is covered in academic literature concerns mostly the whole organisation in which RPA is implemented, as they present weakness and strengths within how the technology is used within the organisation and how users feel about RPA within the organisation. The literature does not provide a close look on the design and development process, or the user involvement. However, as the data from the interviews has established there can be plenty of challenges identified within the development stages of RPA, and users are very much involved in those challenges. As RPA is new technology that has recently gained popularity, it could be that there hasn't been enough studies yet to provide different variety of perspectives and investigate RPA from different angles, but this only means that a study like this, which investigates user involvement in RPA can only provide new knowledge on the subject.

As it has been established, user involvement is a part of RPA's development, as the users are the only source of process knowledge. In that sense their involvement in the process is indisputable and that might be the reason why no studies have elaborated further on this topic. However, as the analysis has demonstrated, there are many challenges related to the ways in which users are involved in the process.

The results from the interviews have clarified that since RPA is a new technology, organisations often experiment with defining the best approach for implementing it. The interview participants had mentioned organisations training their employees, or otherwise the users, to develop RPA, which didn't work out to the organisations' interest as even

though RPA doesn't necessarily require coding, it still requires rule-based thinking that non IT employees simply couldn't comprehend. The other approach to RPA development is by employing developers who have the proper skills and understanding of the technology who then need to extract knowledge from the users. However, developers are not usually the people within an organisation that are assigned to conduct user research or handle communication with end-users, which might be the root cause to all challenges. Furthermore, we can ask how user-centred design has never been discussed in relation to RPA, and the reason might be that developers simply do not recognise the benefits of this approach and are rather focused on the actual development of the robot. One of the examples of the interviewees given, where he explained that he had trusted the process expert to tell him how the robot should have been developed which resulted in errors is a proof for the nature of most developers, which are used to working with predefined requirements. Another reason for that could be that user-centered design might be considered beneficial only for products that the end-user will interact with. As RPA can be attended or unattended, there can be very minimal amount of interaction with the user, which could be a reason why user-centred design approach hasn't been suggested for RPA before. However, RPA is technology that is built to imitate humans, as such it requires a very extensive understanding of the actions users take and the reasons behind every action. In that sense, in order to build the robot successfully the user needs to be put in the center which is the meaning of the user-centred design approach. This claim is also supported by the fact that all the examples given by the interview participants for robots that failed to function was due to insufficient knowledge about some of the actions that users take.

As it was presented in the analysis, the amount of user involvement definitely impacts the quality of the developed robots which in turn is related to the technological weaknesses and can have an impact on the organisational and socioeconomic weaknesses. The development and implementation of the robots can be seen as a starting point of a chain reaction which can affect the quality of work, the organisation's performance and morale of the employees. For that reason, the development process should be considered of highest priority for the success of utilizing RPA technologies. However, the development process is dependent on the knowledge provided from users and that is what makes the user involvement extremely important. Therefore, by implementing user-centred design and promoting a higher level of user involvement through different methods for user-centred design applied throughout the entirety of the design and development process can potentially result in a better approach for RPA that results in a higher success rate.

However, none of the data collected and analysed within this thesis has been able to point towards the appropriate user-centred design methods that can support user involvement. A reason for that can be the fact that choosing the appropriate method will be based on the

desired outcome, meaning the data we want to collect from the user and the purpose for collecting it has to be clear. That would therefore require more context into specific processes or development issues in order to make a clear recommendation. Furthermore, as each process can be different and therefore pose a different challenge of gathering enough data, it will be hard to conclude generic recommendations in the form of user-centred design methods as they might not fit every case.

The data collection of this study has been limited to identifying the strengths and weaknesses of automation in order to address the weaknesses through user-centred design. Even though the weaknesses have been addressed in terms of analysing their dependency on user involvement and the potential benefits of improving the approach towards user involvement, the overall topic requires further investigation towards the specific methods that can be appropriate within specific contexts. Furthermore, future studies within this area can evaluate the impact that user-centred design can have over RPA development in order to conclude if there can be any improvements measured scientifically that can be used as proof for the need for more user-centred oriented RPA development.

# 7. Conclusion

The motivation for writing this thesis was the fact there was a lack of focus on the user involvement in literature in regards to RPA development. Therefore the first step in analyzing that aspect was to gather enough knowledge about the strengths and weaknesses of RPA in order to be able to analyse where the user involvement creates an impact.

The literature review based on academic sources has provided an overview over the severe lack of focus on the users in literature in terms of their impact on RPA, and rather discusses how users react to and feel towards the already developed robots. As the user perspective towards RPA has provided multiple challenges such as fear of change and losing jobs as well as general distrust in the technology's capabilities, that fact points towards an assumption that the users are not properly integrated into RPA which can be addressed through user-centred design and higher degree of user involvement.

Furthermore, the analysis of the data collected from RPA specialist, working in the field, has proven that even though user involvement is applied in RPA's development currently, as they are the only source of process knowledge, the way users are involved does not result in sufficient data for requirements and therefore results in dysfunctional robots or abandoned automation of processes. However the fact that there is user involvement justifies the

relevance of investigating this topic and analysing how this step of the process can be improved.

In that regard, the identified weaknesses from the literature review can indirectly be linked to the impact that user-involvement creates, as the development process is the very start of RPA's integration. Furthermore, the weaknesses identified from the interview analysis can be directly linked to the user involvement in RPA. Therefore, user-centred design can be used to identify new approaches to user involvement through different methods for data collection or collaboration with users, that would address the weaknesses presented both in the literature review and the interview analysis, as some weaknesses might be impacted indirectly.

However, suggestions or recommendations for specific methods of user-centred design applied to RPA can not be made at this stage in the research as choosing the appropriate method is highly dependent on the design cycle stage, the targeted users, the context of the research and the desired outcome. Therefore recommendations can not be generalized and would therefore require further research in order to determine specific suggestions based on specific cases.

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