Using the Wisdom of the Crowd to Digitalize:

Designing a workshop-based process selection method for the identification of suitable RPA processes

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Using the Wisdom of the Crowd to Digitalize:

Designing a workshop-based process selection method for the identification of suitable RPA processes

A study assessing the contribution of a workshop as a method for identifying suitable business processes for the implementation of Robotic Process Automation

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Preface

Enschede, 17 October 2021

Dear reader,

Thank you for your interest in reading my master thesis. This thesis was written as part of finalizing my master programme Business Administration at the University of Twente. After seven years of studying in Enschede, my career as a student has come to an end. Now it is time to take up a new challenge and to start a new phase. But before this, I would like to thank the ones who assisted me through this career and helped me finalize this thesis.

First of all, I would like to thank my supervisors from the University of Twente, Abhishta, Aizhan and Wouter, for guiding me through the process of conducting research and writing this master thesis. Abhishta, thank you for all the valuable feedback and useful papers you have given me during our meetings. Also, thanks to your cat for accompanying us during these meetings. She was never too critical. Aizhan, thank you for the valuable feedback as a prior consultant and keeping me confident during this project. Wouter, thank you for critically assessing the final version of my thesis, this helped me to dot the i's and cross the t's.

Moreover, a huge thank you to my supervisor, Rick at Ernst & Young, for letting me do this project, guiding me through the process and giving me the opportunity to get a hands-on experience with RPA by programming digital bots. Also, thanks to Jarno for introducing me to the company and for helping me out as a new colleague during our weekly buddy meetings. With regards to Ernst & Young, my sincere thank you to the colleagues who I got to interview and the colleagues who participated in the workshop.

Lastly, I would like to thank my family and friends for supporting me the past couple of years and particularly while I was writing this thesis. Especially my girlfriend, Merle, for making sure I am not insulting the English language too much and her sister Eline, for being a critical reader and for giving me advice on my thesis.

I hope you will enjoy reading this thesis.

Kind regards,

Lars Berghuis

Management Summary

Many businesses are currently automating their business processes by implementing Robotic Process Automation (RPA). This software has proven itself worthy by increasing firm performance through digital robots replacing standard, repetitive and often boring processes executed by humans. Processes such as invoice processing, onboarding and the sending of payment reminders are no longer required to be performed by humans. Because benefits such as FTE savings and increase in employee satisfaction are recognized, businesses are hopping on this digitalization train. However, they often end up at the wrong stop where successful implementation of RPA tends to fail.

This failure is mainly due to businesses selecting the wrong processes for automation, by starting projects without the careful analysis of a process' RPA suitability. Businesses often tend to select processes that are too complex or that require tasks that can only be performed by humans. Not carefully assessing a process leads to overly long development time and digital robots that require too much maintenance. Current process selection methods, such as interviews and process mining might help with the identification of suitable processes, but are time consuming, complex, unsystematic and dependent on the individual. This study created a new method in the form of a workshop. This workshop uses a group of process experts to come up with ideas, evaluate them and select the best ideas in order to identify suitable RPA processes within their businesses. Because no study has yet shown the contribution of a workshop towards this identification, the research question in this study was formulated as followed: *"How can a workshop-based process selection method contribute to the identification of suitable business processes for the implementation of Robotic Process Automation?"*.

To answer this research question, this study was split in two parts. The first part focussed on designing the workshop. To design the workshop mostly literature was studied in order to know what elements should be included within the workshop for the successful identification of suitable RPA business processes. As foundation for the workshop and to have a systematic approach, the Business Process Management Lifecycle was used. This model serves as a funnel, narrowing down all processes in scope to processes that fulfil the desired criteria. Explaining RPA, its functionalities and the criteria of processes, such as standardized and repetitiveness, were important factors as input for the participants during the workshop to come up with useful ideas. Nominal Brainstorming was used as a method to help participants generate ideas and effectively evaluate them. RPA, the Business Process Management Lifecycle, and brainstorming were synthesised to a generic framework (figure 3.1) and the detailed steps organizations can take during the workshop (table 4.1, 4.2 and 4.3).

The second part of this study focused on conducting an experiment with this workshop within the Technology Risk department of Ernst & Young (EY). While this department already implemented an RPA robot, it was assumed that more processes were capable of being automated via RPA. Two virtual sessions of two hours were conducted within two days together with six participants varying from staff members to managers and one Business Champion as facilitator. The results of this workshop showed that one new process was identified as a quick win for the Technology Risk department. Interviews with two RPA experts

showed that participants and experts both evaluated this process as non-complex to automate via RPA and that automating the process will lead to saving FTE for both senior and manager IT-auditors. Lastly, a survey conducted by the participants showed that participants perceived the workshop as easy to understand and easy to apply.

The quick win process identified for the Technology Risk department includes the "budget versus actuals' process' and is used to track the progress of engagements. The idea is that the digital robot will extract both planned hours from the planning system and extract the actual written hours by employees from the time tracking system and export this data to a dashboard in Excel. The workshop showed that this process is a very standardized and low cognitive process, occurring weekly with an approximate duration of 1 to 2 hours. This robot can serve as an attended robot, requiring the human to trigger the process to help save the manual effort. For the Technology Risk department, it is recommended to start automating this process with RPA. In addition, it is recommended to first record the manual process and have one of the employees start automating this process. As a result of letting own employees start developing, more knowledge is gained about RPA's capability which may help to identify future RPA processes. Furthermore, Ernst & Young already has an alliance with the market leader of RPA tooling, namely UiPath, and it has a separate department including specialized UiPath developers. Because of this, it is recommended to involve UiPath developers in the development process to discuss development duration and to obtain advice.

For other organizations, this workshop can be used to find a Proof of Concept or additional RPA suitable business processes. For them it is important to have a Business Champion, someone who is motivated to assess RPA's capabilities and its potential within the organization. This Business Champion can then initiate the workshop by following the steps provided in the framework and look for colleagues with different experiences for the appropriate group composition. After the workshop is conducted and a quick win or strategic RPA process is found, the organization can start assessing different RPA tooling and start with the development of their new digital colleague.

Table of Content

Abstract

Previous studies have shown that organizations are still struggling with identifying suitable processes for Robotic Process Automation. While process selection methods such as process mining and interviews do assist organizations, they still have their issues. Issues such as complexity, time-consumption and the lack of a systematic approach with these current process selection methods cause organizations to select non-suitable processes, leading to overly long and expensive RPA projects. This study assesses the contribution of a workshop as a method for the identification of RPA suitable processes by using the wisdom of the crowd.

The first three steps of the Business Process Management Lifecycle combined with Nominal Brainstorming were used as systematic approach and foundation for the workshop's design. In addition, as input for the participants to generate, evaluate and select ideas, an understanding of what RPA is, its primary functions and process criteria had to be provided. Therefore, a Systematic Literature Review (SLR) was conducted leading to an explanation of RPA, the identification of RPA's 48 primary functionalities and 20 process criteria to be shared with the participants. As a result of these findings, a framework of the workshop was created and a detailed overview of the steps to be taken including the recommended group composition.

An experiment with the workshop was conducted with employees of an IT-audit department within one of the Big Four audit firms. The workshop results and interviews with RPA experts showed that participants were capable of identifying a new process as a quick win for RPA adoption. In addition, the survey finding showed that participants perceived the workshop as easy to understand and apply. Through these findings, this study argues that the workshop can assist both experienced and non-experienced organizations with the identification of suitable RPA processes and counter some of the issues of current process selection methods. Future research should evaluate the workshop's contribution within other contexts and compare its outcome with current process selection methods.

PART I: Introduction

1 Introduction

Innovation is a key element for businesses to stay strong against competitors. Through the digitalization of our world, businesses have started innovating by introducing new software and IT-systems to enhance products, people and processes. An upcoming innovative solution for businesses to enhance their processes is Robotic Process Automation. This new technology has led some businesses to fully automate their processes, leading to an increase in efficiency and quality of processes.

1.1 Background

"Robots replacing men". Something that only appears to be real in movies is also nearing our world. These robots ensure that work, previously done by humans, will be replaced by machines consisting of mechanical parts representing the human body and transistors symbolising the same electronic network as the human brain. Where production lines were previously occupied by people, machines have taken their place. Self-driving cars and e-invoicing did not seem possible until twenty years ago and could now replace taxi-drivers and bookkeepers. A well-known paper, "The future of employment", written by Osborne and Frey (2017), talks about the effect of automation on the current job market. Osborne and Frey (2017) write about the susceptibility of jobs to computerisation in their paper and even go so far as by calculating the probability of jobs that are most at risk of automation replacement. They predict that 47 percent of the current jobs will be replaced within the upcoming twenty years by machines and software. Furthermore, Osborne and Frey (2017) predict that among the jobs with the highest probability are jobs such as accounting workers and auditors, with a probability of 94%, compared to engineers and sales mangers only having a 1 percent chance of being replaced by technology. While there are some doubts about the correctness of these numbers, by comparing the use of technology in 2017 with 2021, the numbers seem to become more realistic.

A recently introduced technology that contributes to this automation and intents to reduce workload is 'Robotic Process Automation' (hereafter: RPA). RPA is a software that makes tasks, previously executed by humans, become automated. The software allows, via a script, to let a digital robot access websites and system applications to read, extract or fill in data (Van der Aalst, Bichler, & Heinzl, 2018). This automation of processes may lead to many benefits such as increasing the efficiency and quality of processes, by reducing Full Time Equivalent (FTE) and preventing manual errors. Furthermore, compared to traditional process automation, which may require more software developments skills, RPA does not change any of the underlying IT-systems. This increases accessibility and reduces risks during implementations (Van der Aalst et al., 2018). While the RPA technology is already a few years old, it has recently received more attention because of organizations recognizing its potentials, vendors adding features and more user-friendly RPA products.

1.2 Problem Statement

Even though RPA has a lot to offer, it also has its challenges. A survey done by Deloitte found that out of 400 firms, 63 percent of them did not meet the expected deadline for RPA projects

(Trefler, 2018). Furthermore, they found that 30 to 50 percent failed their initiative project. Rutaganda, Bergstrom, Jayashekhar, Jayasinghe, and Ahmed, (2017) state that the reason many RPA initiatives fail is because of the difficulties of finding processes fitting the RPA solution. Literature too mentions that one of the key challenges organizations face, once initiating RPA projects, is to effectively identify RPA suited processes (Leopold, Van der Aalst, & Reijers, 2018; Moffitt, Rozario & Vasarhelyi, 2018; Van der Aalst et al., 2018). Geyer-Klingeberg et al. (2018) mention that RPA is not a technology applicable to each process and rather requires a careful analysis of the automation potential as well as its benefits and risks. Selecting the wrong processes could lead to excessive bot maintenance and unexpected risks (Van der Aalst et al., 2018). Risks such as updates or failures of systems could result in bots processing data wrongly or disrupting the bot's activities (Van der Aalst et al., 2018). Hence, leading to longer and more costly implementations than expected, lowering the enthusiastic expectations of businesses and therefore missing out on promising automation opportunities (Syed et al., 2020).

The past few years, methods have been created addressing the challenges of selecting RPA suitable processes. Whereas some methods addressed the identification problems via semi-structured interviews with process experts (Agaton & Swedberg, 2018a; Syed et al., 2020), others created methods involving calculations via scorecards or extracting user interface logs to apply process mining algorithms (Leshob, Bougouirn, & Renard, 2018; Wanner et al., 2020). However, issues are faced when using such methods. Interviewing people to extract suitable business processes for RPA can be quite time consuming. Conducting more than five interviews to obtain multiple views takes time if people are not familiar with RPA. In addition, conducting interviews only considers the view of an individual. But because processes need to be carefully analysed, the view of others may be required to avoid misconceptions. Individuals can easily misjudge processes' RPA suitability by forgetting activities requiring human thinking or through a misunderstanding of RPA.

The use of process mining might be a solution to these issues, due to the use of algorithms to extract a process and calculating RPA suitability (Wanner et al., 2020). However, Dumas, La Rosa, Mendling and Reijers (2013) describe that for most organizations such a project requires quite some effort, because of process mining relying on the availability of event logs. Organizations, especially smaller or medium sized ones, do not possess such architecture or expertise to implement process mining. As a result, making process mining a rather context specific option. Besides these issues such as complexity, being dependent on individuals and large time consumption, none of the methods show a systematic approach of the steps to be taken during process selection. While most literature refers to establishing a "process-selection method", Wanner et al. (2020) state that there is a lack of any systematic selection of processes. And even though a framework (Agaton and Sweberg, 2018) and scorecards with calculations (Leshob, Bourgouin, & Renard, 2018) are introduced as solutions there are no empirical examples with procedural steps given. Thereby, making it less useable for practicioners.

1.3 Research Goal

This research will address the problems of current process selection methods by designing a new process-selection method. This study creates a method that ensures organizations to start RPA initiatives without the extensive effort of collecting event logs or conducting multiple interviews. In other words, a method which is less complicated and more systematic than a method such as process mining, and a method that, compared to interviews, accounts for multiple views and requires less time.

A method that might be appropriate for this situation is a workshop-based approach, where a group is involved in the process. Alexander and Beus-Dukic (2009) define a workshop as "*a specialised meeting, structured to bring exactly the right people together to solve a problem using a planned sequence of activities. Those people may be any stakeholders in the project, members of the development team or, if need be, external experts to assist with specific tasks*" (p. 286). This study hypothesises that a workshop might be a more efficient, systematic and useable approach for the identification of RPA suitable processes. Also, Goris (2019) mentions in his research that a workshop might be a more appropriate alternative for the identification of suitable business processes, but that no study has yet been done assessing this approach. Compared to interviews, where only one person at a time is heard, multiple stakeholders can be addressed at the same time. As a result, a group can start discussions, hear each other's questions, and reach to agreements (Alexander & Beus-Dukic, 2009). Especially the latter will be very beneficial compared to other process-selection methods. Dumas et al. (2013) mention that workshops can generate a rich understanding of business processes. Even though perceptions of the processes can be inconsistent, groups provide the opportunity to directly resolve this by debating with each other. In addition, compared to process mining, there is no complexity about the resources, such as the availability of event logs. For this reason, the goal of this research is:

"Improving RPA initiatives by creating a workshop-based process-selection method that shows a systematic approach in order to identify suitable RPA business processes".

To create this workshop-based process-selection method the following research question is formulated:

"How can a workshop-based process selection method contribute to the identification of suitable business processes for the implementation of Robotic Process Automation?"

To answer this question a number of sub-questions have been formulated. Each sub-question will be described below including an explanation of why it is important to address these in order to reach this study's goal.

Before businesses can start introducing new technologies, such as RPA, it is important for them to know what the technology means. Slack and Brandon-Jones (2019) mention that before introducing a new process technology, managers, process owners and other decision

makers need to know what RPA is and what its primary functions are. Likewise, participants in the workshop need an understanding of what RPA 'can' and 'cannot' do. For this reason, SQ1 is formulated as follows:

SQ1. What is RPA and what are its primary functions?

Next to knowing what RPA and its primary functions are, it is required to understand what process criteria a process should contain in order to be a viable candidate for RPA. Process criteria show specific traits of a process. For example, the overall duration of a process, its frequency, requirement of low or high cognitive activities, presents of multiple application during the process and whether these applications are stable. Previous RPA process selection methods describe, that if the right criteria are not taken into account, wrong processes can be selected (Agaton & Swedberg, 2018; Syed et al., 2020). For this reason, these criteria should be collected, listed and shown to participants so they can determine where within the business process automation potential and value is located. For this reason SQ2 is formulated as follows:

SQ2. What criteria are of importance for the selection of business processes regarding the primary functions of RPA?

The automation of a process via a process technology such as RPA can be seen as a project related to Business Process Management (BPM). BPM is a discipline that encompasses methodologies, tools and techniques to create, redesign and manage business processes (Dumas, La Rosa, Mendling, & Reijers, 2013). A model that accompanies BPM is the BPM Lifecycle. Dumas et al. (2013) describe that this model presents systematic steps and helpful tools to identify processes, analyse them and determine, based on criteria, which process needs to or can be optimized. They furthermore mention that a workshop can be a suitable method for businesses to address this lifecycle. Therefore, SQ3 is formulated as follows:

SQ3. What is the BPM Lifecycle and how can it function as a foundation for the workshop?

Even though a workshop is a suggested method to address this approach, the BPM Lifecycle, as will be further explored in Chapter 2, does not elaborate on the structure of a workshop nor the group composition. However, due to this workshop's aim of bringing a group together to generate and evaluate ideas it is important to know what structure and group composition will enhance the results. An initial literature review showed that brainstorming may be an appropriate technique to structure group ideation. However, literature also showed that also for brainstorming multiple techniques can be used (Dennis & Reinicke, 2004; Maaravi, Heller, Shoham, Mohar, & Deutsch, 2020). For this reason, SQ4 is formulated as follows*:*

SQ4. What brainstorming technique complements the BPM-lifecycle best?

The results from the previous sub-questions will eventually be synthesised leading to the design of a workshop that is suitable for testing. Therefore, SQ5 is formulated:

SQ5. How can the workshop be designed based on the results of the previous four sub-questions?

The effectiveness of the workshop has to be evaluated eventually. Two parts of the workshop need to be assessed, namely the outcome of the workshop as well as the workshop's processes. As discussed previously, a method is required that is more systematic, less complex, accounts for multiple views and still leads to an effective identification of RPA processes. As a result, SQ6 is formulated as follows:

SQ6. How did the designed workshop contribute to the identification of RPA suitable processes?

1.4 Approach

The foundation of this research is built on Design Science Research described by Wieringa (2014). Design Science Research is commonly used within information system and software engineering research to solve problems or create opportunities by designing software or systems that fulfil the required needs the stakeholder. Wieringa (2014) mentions that in Design Science iteration happens over two activities. 1) Designing an artifact that improves something for stakeholders and 2) empirically investigating the performance of an artifact in a context. This artifact can be seen as a treatment which objective is to solve a problem. For this reason, the design cycle also refers to a treatment design and validation of a treatment. Artifacts that will be designed and studied can consist of methods, techniques, notations, algorithms, components and business processes. These artifacts can then interact with people, organizations, software, hardware etc. (Wieringa, 2014). Because of the current process selection methods being very context specific and non-systematic and thus not appropriate for most organization wanting to adopt RPA, this study will focus on the creation of a new method. This study will create an artifact, in the form of a workshop, that leads to the selection of suitable RPA processes for organizations wanting to start RPA initiatives (i.e., a process selection 'method').

The goal of creating a new selection method relates to a design problem and will therefore follow the Design Cycle, which is part of Design Science Research and helps researchers and designers in their path to creating a new artefact (Hevner, March, Park, & Ram, 2004; Wieringa, 2014). The four phases of the design cycle include 'Problem Investigation', 'Treatment Design', 'Treatment Validation' and 'Implementation Evaluation, see Figure 1.1. The problem Investigation has already been addressed in the previous section and refers to the lack of a systematic and usable method of identifying suitable RPA processes. The Treatment Design phase will help with designing the workshop to fulfil the requirements addressing the problem. As mentioned previously, the first four sub-questions serve as the building blocks for the artefact. SQ1, SQ2, SQ3 and SQ4 are answered for the initial design. Three of these sub-questions will be answered by conducting a Systematic Literature Review (SLR), namely SQ1,

Figure 1.1: The Design Cycle (adopted from Wieringa, 2014)

SQ2 and SQ4. The reason for answering SQ1 and SQ2 via an SLR, is because of the increasing amount of literature about what RPA is, its functionalities and the different criteria processes should have in order to be suitable for RPA to be implemented. Besides these two sub-question, SQ4, finding an appropriate brainstorming technique, will also be addressed via an SLR. This will help identifying the different techniques and choose one that fits best to achieve this study's goal. After these sub questions are answered, they will be synthesised to create an initial design.

After the first design of the workshop is finished, an experiment will be ran in order to evaluate the design. This is built around the Treatment Validation part of the Design Cycle and is required to know whether no further adjustments within the design must be made (Wieringa, 2014). Here the process of the workshop will be evaluated as well as its outcome (the identified RPA processes). If the workshop is evaluated as a successful design, it is ready for implementation. Otherwise, improvements are needed and another experiment including evaluation should occur. Hence, going through another iteration of the Design Cycle. Figure 1.2 gives an overview of this study's approach, showing the treatment design, validation and implementation phases.

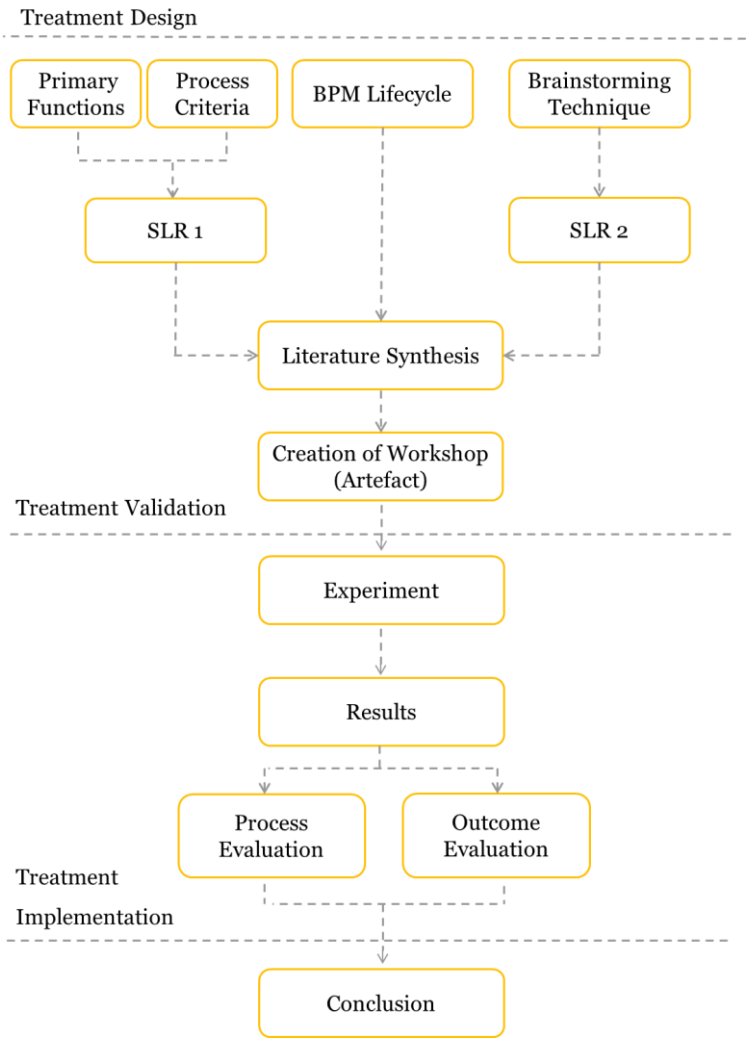


Figure 1.2: Overview of This Study's Approach

1.5 Structure

The structure of this study is also built on the phases of the Design Cycle. Figure 1.3 depicts the Chapters in this study in relation to the phases.

Chapter 1 described the problem businesses are currently facing when selecting processes for RPA, and hypothesised a workshop as a suitable solution. In Chapter 2, Theoretical Framework, all relevant literature will be described required for the design of this workshop. This Chapter will include how an SLR was conducted and to which results this lead. Next, Chapter 3 will describe how this literature is synthesised in order to create the initial design of the workshop. As a result, a framework is presented showing the overall steps and phases of the workshop.

This framework will then be used for an experiment. Chapter 4 will describe in which context this experiment was conducted and how the workshop was put into practice. Chapter 5 then describes the method used for evaluating the workshop and its outcome and will present these results. After evaluation, Chapter 6 will discuss these results, describing limitations, theoretical and practical implications, and opportunities for future research. Lastly, Chapter 7 will conclude this study and provide an answer to the research question.

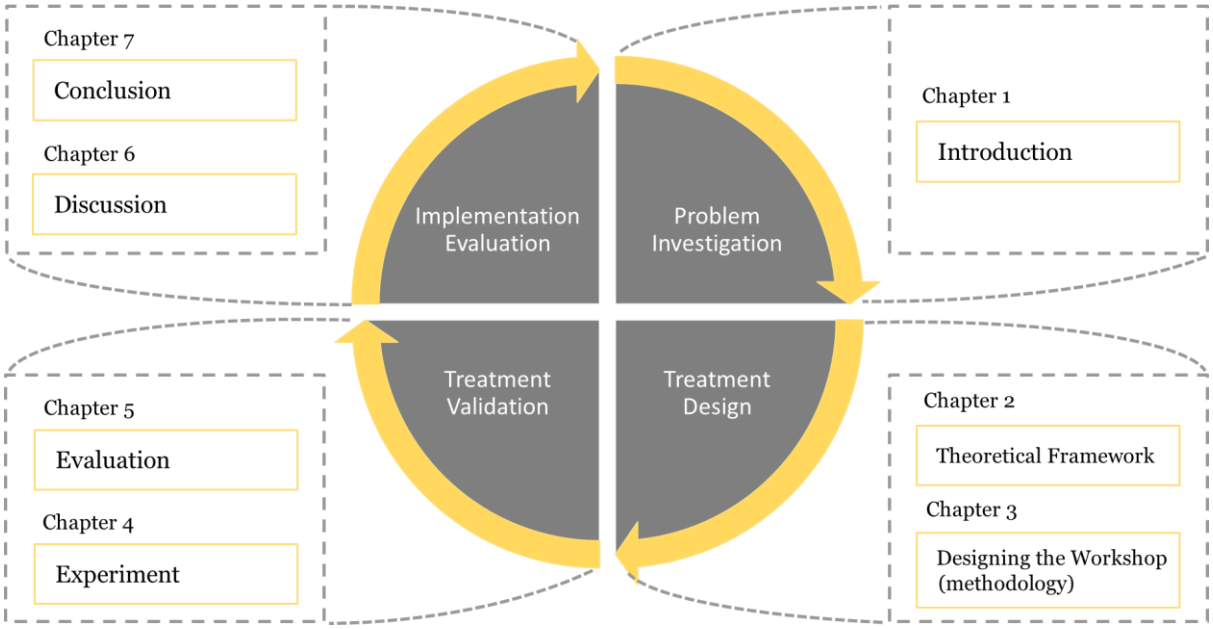


Figure 1.3: Structure of this Study

2. Theoretical Framework

This Theoretical Framework Chapter will collect all the information required before creating the initial design of the workshop. First, Section 2.1 will describe how a Structured Literature Review (SLR) is used to answer SQ1 and SQ2. Section 2.2 will then present the results of this SLR and therefore describe what RPA is its primary functions. and the process criteria. Next in Section 2.3, it will be described how the BPM Lifecycle can serve as a foundation for the workshop and help identifying processes. Section 2.4 will describe how a second SLR was conducted to answer SQ4. Section 2.5 will then answer this question by describing how brainstorming and specifically Nominal Brainstorming, complements the BPM Lifecycle. Lastly, Section 2.6 will end the chapter by giving a recap of the main finding of this Chapter.

2.1 Methodology for SQ1 and SQ2

To answer sub-question 1, 2 and 4, a Systematic Literature Review (SLR) was conducted. An SLR is a research method that can be used as a mean to identify, evaluate and interpret available research relevant to certain topics, interests or answers to research questions (Kitchenham, 2004). Kitchenham (2004) mentions that one of the main reasons for conducting a systematic review is to "summarise the existing evidence concerning a treatment or technology" (p.1). In this study, a Systematic Literature Review of both the technology, RPA, as well as the treatment, the workshop, will be held in order to answer sub-question 1, 2 and 4. Firstly, as shown in figure 2.1, recent years show a big increase in the number of published papers regarding RPA. Many of these papers describe what RPA is and its capabilities. In addition, many of these papers also include studies about the process-selection criteria for RPA that are gathered via interviews and surveys from case studies.

This collection of data can serve as a rich source of evidence and as useful input for the elements within the workshop design. Secondly, an SLR was conducted to find out which brainstorming technique best complements the BPM Lifecycle. One of the reasons for using this methodology for answering SQ4 is because an SLR is appropriate for looking at benefits and limitations of specific methods and comparing them with one another. Kitchenham (2004) mentions, for example, that a good reason for using a SLR within software engineering is that it looks at the specific benefits and limitations of an agile development method. As a result, such a review will help identifying and justifying a suitable method. By conducting a

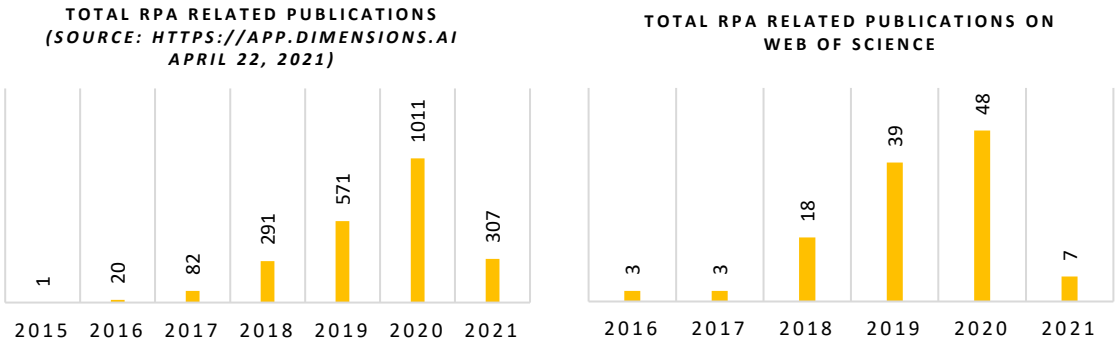


Figure 2.1: Bar charts showing the increase of scientific publications related to RPA.

systematic review on both RPA and different workshop designs, the results from both reviews can be combined to create a suitable artefact.

Kitchenham (2004) mentions that a SLR consists out of three stages. 'Planning' the review, 'Conducting' the review and 'Reporting' the review. The planning phase consists out of identifying the need for a review and the development of the review protocol. The need for this review is to set up an appropriate initial design for the workshop by collecting evidence from literature. The Review Protocol specifies the steps, methods and criteria used while conducting the review and is necessary to avoid possible researcher bias (Kitchenham, 2004). These steps are shown in figure 2.2 and will be used to answer the sub questions.

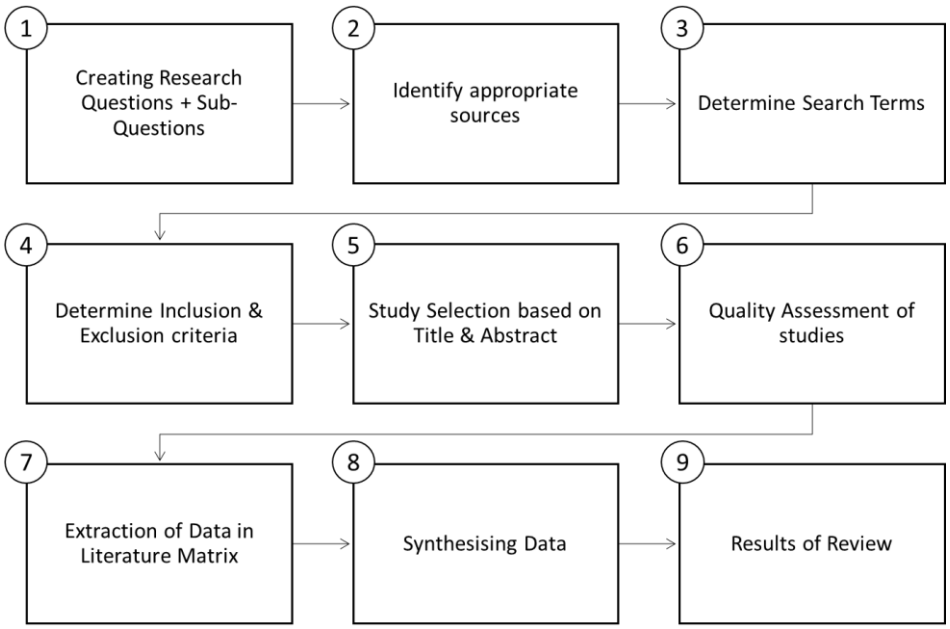


Figure 2.2: Review Protocol Outline as proposed by Kitchenham (2004)

2.1.1 Review Protocol for SQ1 and SQ2

This subsection describes the specific SLR steps that will be taken and how data from the literature will be extracted and analysed to answer the first two sub questions:

SQ1: 'What is RPA and what are its primary functions?'

SQ2: 'What criteria are of importance for the selection of business processes regarding the primary functions of RPA?'

As mentioned in the previous section, to answer these sub questions a review protocol is established. Table 2.1 shows the Review Protocol used to identify all relevant literature.

Table 2.1

Review Protocol: RPA, Primary Functions & Process Criteria

Protocol Element	**Translation to RPA's Primary Functions**
SQ 1	*"What is RPA and what are its primary functions?"*
SQ 2	*'What criteria are of importance for the selection of business processes regarding the primary functions of RPA?'*
Sources	▪ Scopus ▪ References from Scopus Sources ▪ Grey Literature
Search Term	"Robotic Process Automation"
Search Strategy	▪ No publication date limit ▪ Search Term contained in Title or Abstract
Inclusion Criteria	Robotic Process Automation Capabilities Quantitative Process-selection methods Qualitative Process-selection methods Case Studies
Exclusion Criteria	Papers that are not in English Papers that are not accessible
Data Extraction Tool	Literature Matrix & Mendeley
Results	Explanation of what RPA is List of primary functions List of process criteria

The following five remarks can be made about this protocol. Firstly, the search term used is focused on "Robotic Process Automation" within the Title or Abstracts of papers. The term RPA was not used because a preliminary search showed that within many fields and subject areas 'RPA' is used as an abbreviation. Secondly, only Scopus will be used during the initial

searches for relevant literature. While other databases such as Web of Science or IEEE were considered, Scopus is seen as the database that most of the time gives all peer-reviewed literature from other databases and that therefore Web of Science or IEEE were not necessary to be used. However, papers that are selected from the Scopus source might contain references which could not be found on Scopus but are still seen as relevant. These papers are added manually via a so called snowballing method, where references from sources are found to be relevant to add within the SLR. Thirdly, no publication date limit was set, due to RPA being quite a new topic that is being researched. For example, one of the earlier written papers about RPA dates back to 2014. Fourthly, inclusion criteria are mainly aimed at other process selection methods because these are likely to contain process criteria of RPA to evaluate whether processes are suitable for RPA. In addition, as mentioned in the Design Science framework by Wieringa (2014), these methods can help with using tooling or elements from other process-selection methods to potentially integrate within the workshop.

Besides Scientific literature, also so called 'Grey literature' was read in order to find more details and up-to-date information about the primary functions of RPA. This is adopted from Tursunbayeva, Pagliari, Lauro and Antonelli (2021), who mention that such method "is suited to emerging areas of innovation where formal research lags behind evidence from professional or technical sources" (p.1). RPA is just as other technologies being innovated all the time and therefore lags behind academic sources as well. For this reason, its primary functions keep growing through the years and are more likely to be found on websites from vendors and consultants. For this reason, sources from the Internet, such as tooling, and consultancy websites (Grey Literature) were approached to see if there are any recent developments regarding RPA functions. This grey literature was found via references of other academic sources (snowballing) and by searching for "Robotic Process Automation" within the google search bar. In addition, most RPA vendors give potential buyers the opportunity to explore the functionalities of their RPA product. For this reason, software from the most popular vendor, UIpath, was downloaded and experimented with to get a better feeling of RPA's capabilities.

2.1.2 Extraction and analysis

To analyse the data, a literature matrix was used to understand what RPA is. This literature matrix helped structure the content found within the literature by setting up questions such as, 'How does RPA work?', 'How is AI involved in RPA?", "What RPA products/tooling is used" and extracting different or similar answers to these questions from different authors of both academic and grey literature.

The primary functions and process criteria were analysed by extracting different sentences, concepts and keywords from the found literature. After all data was extracted, keywords were used to categorize the data. This was both done for the primary functions and process criteria. Keywords were either qualitatively created by the researcher or used from other authors. Once this categorization was finished, each category was re-assessed by looking at non-frequent criteria and determine whether it was appropriate not to categorize them under another criteria. Criteria that were seem as redundant or only mentioned once, were also evaluated in more detail to determine whether they should be excluded.

The results of this SLR consists out of an explanation of what RPA is, a list of its primary functions and a list of the process criteria. This outcome can then be used within the design of the workshop by explaining to participants what RPA is and by using the primary functions and process criteria within the proposed BPM-lifecycle phases.

2.1.3 Validation Meeting

For validation of the results from the SLR, two unstructured interviews with RPA developers were held. These developers have more than 2 years of experience with developing RPA projects. To them, the primary functions and the process criteria were shown to assess whether all and the most important primary functions and process criteria were found as well as their opinion about categorization.

2.2 RPA, its Primary Functions and Proces Criteria

The first search within Scopus, based on the review protocol described in Table 2.1 resulted in 294 articles of which first all titles were read. 68 articles were selected based on their title, of which then each of their abstract was read. This resulted in eventually a selection of 43 papers suitable for initial screening. Five of these papers were unfortunately not available due to access constraints. The remaining 38 where screened (skimmed), by reading the introduction, conclusion and parts of sections in order to evaluate whether the paper was seem to be relevant enough for answering SQ1.

A Google advanced search was done to find relevant grey literature. Specifically articles from the biggest RPA vendors, such as UiPath, Blue Prism and Automation Anywhere, were looked for as well as articles from the bigger consultancy firms, for example, Deloitte and Accenture who have assisted many organizations with their RPA journey (Deloitte n.d.; Accenture n.d.). From this search 15 articles, mainly webpages, were analysed and used for answering SQ1.

In addition, 12 more articles from other scientific databases were manually added due to snowballing references. This lead to a total of 65 articles, consisting out of grey literature and scientific literature to be fully analysed. During this analysis it became clear that much of this literature referred back to earlier published sources about RPA, its primary functions and the process criteria. For instance, Wanner et al. (2020) used for their quantitative RPA process selection method, which uses different formulas to calculate RPA suitability, the criteria described by authors such as Asatiani and Penttinen (2016), and Willcocks, Lacity and Craig (2017) and transformed these criteria into quantitative measurements. While papers like Wanner et al. (2020) mention these criteria, they were not included within the analysis. However if new criteria were described, they were added to the list. As a result, 30 papers were eventually excluded.

The results from the Systematic Literature Review resulted in the selection of 35 papers which were fully analysed and of which the results are presented in the following sub-sections (see Figure 2.3). Sub-section 2.3.1 to 2.3.6 will discuss some of the main findings of what RPA is. Sub-sections 2.3.7 and 2.3.8 consists out of the extraction of different sentences and keywords from the found literature, which are consolidated to a set of primary functions and process

criteria. As a result, these findings will be used as input for the participants to come up with ideas and select the most suitable RPA process.

Figure 2.3: Resulting steps from the SLR

2.2.1 An introduction to RPA

RPA is a software that makes tasks, previously executed by humans, become automated. The software allows, via a script, to let a digital robot access websites and system applications to read, extract and process data (Van der Aalst, Bichler, & Heinzl, 2018). While RPA is now already a few years old, a general definition has not been provided yet. Literature gives multiple, but overlapping, meanings to RPA. Van der Aalst et al. (2018), for instance, describe RPA as an umbrella term for tools that operate on the user interface of computer systems in the same way a human would do this, in contrast to other automation initiatives it operates via an "outside-in" manner. Tools in this case refer to various techniques that are integrated with the RPA technology, such as Image Recognition and Optical Character recognition to handle execute tasks previously done by humans. Cewe, Koch, Mertens (2018) state that RPA can be regarded as a special kind of Business Process Management System that uses the Graphical User Interface (GUI) as automation adaptor instead of regular interfaces for intersystem communication. Syed et al. (2020) describe that "RPA is a technology comprising software agents called "bots" that mimic the manual path taken by a human through a range of computer applications when performing certain tasks in a business process" (p.1). These bots can be seen as software robots programmed by the RPA developer to perform various actions within different web and desktop applications.

RPA performs its actions on the GUI (Cewe, Koch & Mertens (2018). This is the reason that RPA distinguishes itself from other automation initiatives. RPA sets itself apart from other more traditional business process management (BPM) tools that are automated via interactions with the back-end and its data layers (Willcocks, Lacity & Craig, 2015). A typical approach for automating processes is via business process management systems (BPMS) (Cewe, Koch & Mertens, 2018). Cewe, Koch & Mertens, (2018) state that within such systems processes are defined as rule-based workflows that are executed in a process engine and that communication between these applications go via Application Programming Interfaces (APIs). However, the deployment of an API requires quite some development effort. Comparing RPA with more non-robotic automation and BPM automation initiatives it can be considered as a more lightweight solution for innovations (Mendling, Decker, Hull, Reijers & Weber, 2018; Penttinen, Kasslin and Asatiani, 2018), which does not invade existing IT infrastructures (Bygstad, 2017; Penttinen et al. 2018). As Van der Aalst et al. (2018) states,

innovating processes with RPA happens via an “outside-in” manner. RPA uses an approach of integrating the bot with the presentation layer by interacting with the user interface (Cewe, Koch, Mertens, 2018). As a result, underlying IT applications do not have to be adjusted, making RPA an easier alternative than some other automation initiatives.

2.2.2 RPA tools

An RPA solution goes together with an RPA tool. Leno, Polyvyanyy, Dumas, La Rosa and Maggi (2020) mention that an RPA tool operates by mapping a process to the RPA language which is then translated into a script that can be carried out. Currently, there are multiple vendors offering organizations their RPA tooling. To this day the most famous RPA tooling providers are UiPath, Blue Prism and Automation Anywhere (Gotthardt et al., 2020; Leno et al., 2020; Van der Aalst et al., 2018), see Figure 2.4. These vendors offer organizations RPA tools in the form of product licenses. Most of these vendors allow organizations to build one bot for free via a community version that can be extended to multiple bots via the purchase of a license. Furthermore, while these vendors offer the most capabilities regarding RPA, there are also open-source RPA tools available that provide libraries which can be called via R or Python as programming language. This allows the more experienced programmer to develop multiple bots for free and to integrate the programmer’s own machine learning algorithms to operate within an RPA script. However, it may be questioned whether this open-source tooling can be scaled under RPA as one of the strengths of RPA is mainly based on the easy creation of scripts via dragging-and-dropping of activities by non-programmers.

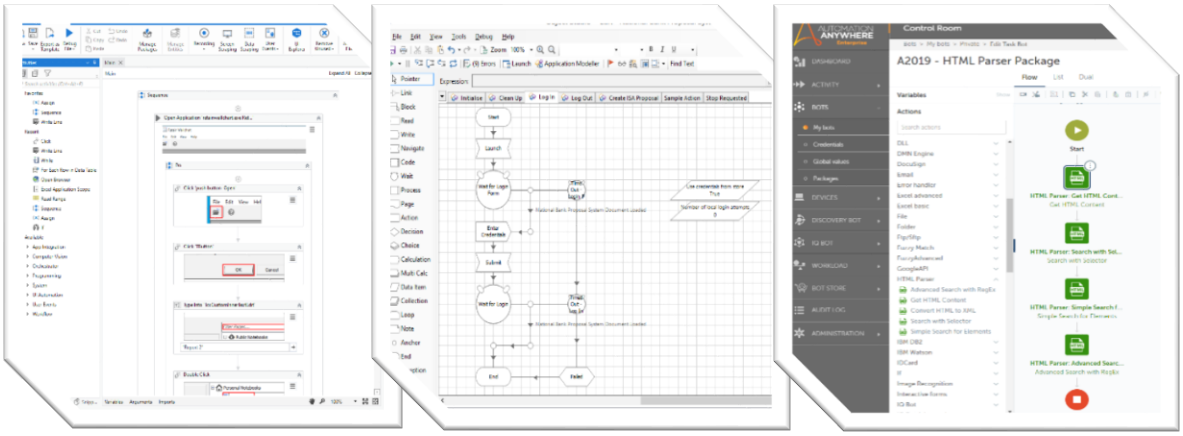


Figure 2.4: Process mapping interfaces of RPA respectively UiPath, Blue Prism and Automation Anywhere

2.2.3 Attended vs Unattended Bots

The execution of the produced script by the RPA tooling can be triggered via two ways, namely an attended trigger or an unattended trigger (Wanner et al., 2020). This difference in triggers also clearly distinguishes between two types of bots. Mullakara and Asokan (2020) refer to these as attended bots and unattended bots. Unattended bots are bots that run autonomously, without the interference of any human and are mostly suitable for simpler processes that do

not vary between instances (Syed et al., 2020). Unattended bots are suitable for executing deterministic routines of processes that are easy to divide into steps and more easy to codify (Leno etc. 2020). In addition, unattended bots are often placed on a server together with a virtual machine where they perform their actions in the background (Mullakara and Asokan, 2020; Jimenez-Ramirez, Reijers, Barba, Del Valle, 2019). For example, weekly updating source-data for BI dashboarding could be an action performed by an unattended bot, as a result collecting efficiently up-to-date management information.

Attended bots, however, are bots that must be triggered by individuals. These bots are, unlike unattended bots, often fulfilling a part of the overall process and are actively monitored by the user. Le Clair, Cullen, & King (2017) describes this way of bot triggering as trigger points that kick of processes after a specific event, such as pressing a hotkey or a file that enters the database. For example, a routine process suitable for attended bots can be the transferring of invoice data from a pdf to an Excel spreadsheet and then to a financial system (Leno etc al. 2020). In such a setting it might be important to have someone attending this automated process to prevent any accounting mistakes. Another example is hiring new employees. Whenever a new employee enters the organizations, new accounts must be created, user access must be defined and information needs to be obtained and updated. These activities are all very structured and easy to parse into steps. Therefore, making it a suitable candidate for RPA implementations. However, there are still processes that require human decision and judgement, such as the initial hiring of employees and evaluating due diligence. As a result, having a process consisting of both manual as automated user activities.

2.2.4 Digital Colleagues and Twin

Once attended bots and unattended bots are developed, organizations need to remain in control regarding their automated processes. For process managers and auditors, it can be hard to detect and manage active bots within the process landscape of organizations. In addition, having robots as digital colleagues can also be risky (Enriquez, Jimenez-Ramirez, Dominguez-Mayo and Garcia-Garcia, 2020; Gotthardt et al., 2020; Syed et al., 2020). A user has to act if a robot fails to finish a process due to an error or system failure. Kokina and Blanchette (2019) describe that companies avoid these risks by including process monitoring and exception management within the implementation stages to control RPA governance. To assist this management, most vendors provide dashboards. Figure 2.5 shows a dashboard from the company UIpath, called UIpath Orchestrator. This dashboard visualizes and shows data about the different bots running within an organization and lets the user manage these processes (Leno et al. 2020). This data consists for instance out of the amount of successfully ran processes, failures of processes and logging of the processes. Furthermore, users can schedule via this dashboard different processes to be ran by the robot. As a result of this overview of processes, Reinkemeyer (2020) refers to a new Digital Twin arising for organizations. A digital twin is a virtual equivalent of a certain physical system. For instance, an engine of a car can be fully virtualised in order to generate simulations and see whether optimizations should be made (Grieves & Vickers, 2017). In the case of RPA, its dashboard serves as a digital twin of the processes automated by RPA (Reinkemeyer, 2020). As a result, organizations adopting RPA can get an overview of their processes as well as insight into potential optimalization.

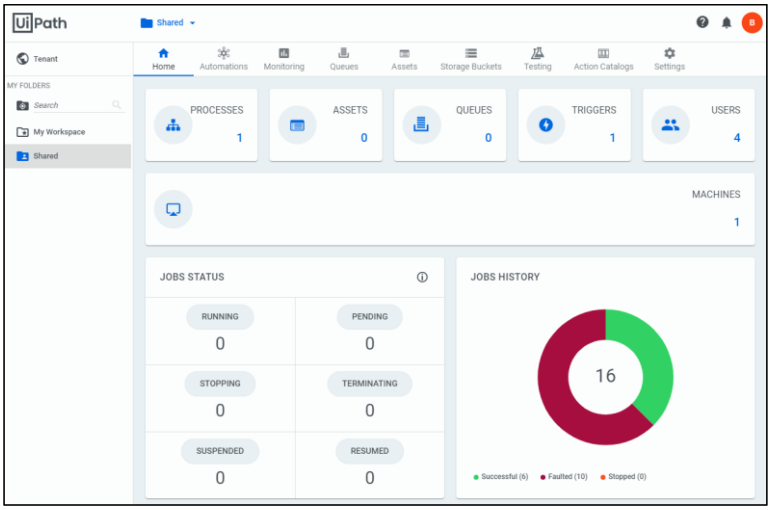


Figure 2.5: UiPath Orchestrator showing an RPA dashboard

2.2.5 RPA & AI

RPA has also recently become smarter due to the further additions of artificial intelligence (AI) features. Besides the basic function of RPA, such as screen scraping, copy-pasting and filling in data, RPA has through the years been upgraded with functionalities containing different AI solutions. Most of these AI solutions help with processing unstructured data. Some AI techniques currently integrated within RPA tooling are Computer Vision, such as Optical Character Recognitions and Image Recognition (as previously mentioned), Fuzzy Matching/Logic, Natural Language Processing, Statistical Methods and Neural Networks (Ribeiro et al., 2021). An example of AI being used in combination with RPA is the prediction of risk scores regarding Customer Due Diligence processes and evaluation. For instance, a bot collects risk factors (independent variables), by scraping Google searches and collecting other data, where then a Machine Learning Algorithm, such as logistic or multiple regression, can calculate a score regarding the risk level. However, Cooper, Holderness, Sorensen, and Wood (2019) describe that the majority of RPA work is still ruled based and requires little to no judgement and believe that in the future RPA will continue to become smarter.

2.2.6 List of Primary Functions

The previous chapters gave an impression about the general capabilities and usages of RPA, which will later be used as an introduction within the workshop to explain what RPA is in essential. However, in order for decisions makers to know whether RPA can be an interesting innovative solution to their processes, RPA's primary functions should be explained during the workshop. Slack et al. (2019), mention that the first things decision-makers should do is to be capable of articulating the basic capabilities of a new process technology by telling what it 'can' and 'cannot' do.

Resulting from the SLR, 65 Primary functions were found. Appendix B shows the overall list of RPA functions found in both scientific and grey literature. The descriptions about RPA's functionalities, given by different authors, have first been categorized into functionalities

described in one or two words, such as opening/closing application, logging in, copy/pasting data and saving data. In addition, because of the size of the total amount of functionalities, further categorization was done to help participants get a better understanding of where and how primary functions are used. This last categorization eventually led to the categories 'Application', 'Data', 'Desktop', Email', 'programming functions', 'Web applications', 'Process', 'Triggers', 'User' and 'Advanced', see appendix C. The categories 'Process', 'Triggers' and 'User' were eventually classified under 'Other' because these were not commonly mentioned. Table 2.2 gives a short description of how each of the categories refers to the different functionalities RPA has.

Table 2.2

A short explanation of how each category represents the functionalities of RPA

Category	Description
Application	Automation activities that an RPA robot can perform within an (web)application.
Data	Activities the bot can perform related to processing data.
Desktop	Desktop, refers to activities the bot could perform on desktop level. This refers to general activities such as the robot typing, clicking or moving files from one folder to the other
Email	Activities the bot can perform related to email.
Programming Functions	Just as program languages, RPA functions, such as for/while loops and if then else statements can be written. This makes is possible to automate some decision making.
Web Applications	Automation activities that an RPA robot can perform within a web application specifically.
Other	Some others mentioned functionalities that could be used within RPA tooling, such as auditing and logging processes. Or functionalities which triggers the bot by pressing hotkeys or the appearance of images.

As mentioned in the methodology section, these functions have, during the initial design of the workshop, been discussed with two developers by interviewing them (unstructured). Both developers noted that the functions described in Appendix B are indeed the primary functions of RPA and that the categorization was also clear to them. However, something noticed both in literature and mentioned by the developers, is that the focus of primary functions should be based on the 'basic' functionalities of RPA. Therefore, the AI functionalities, such as predictive

analysis, email classification and computer vision were excluded. Both the respondents as well as Syed et al., (2020) mention that for organizations starting RPA projects, the focus should be on the simple capabilities of RPA. For this reason, the AI functionalities resulted from the literature review, a total of 17, were left out as primary functions during the workshop as the aim of this workshop is mainly to help organizations 'new' to RPA with the identification of potential suitable RPA processes. As a result, a total of 48 primary functions were used and will serve as the functionalities necessary for decision-makers to understand RPA's capabilities and therefore its implications for their business. Table 2.3 presents all the identified primary functions. Further details about the categorization can be found within Appendix B. As mentioned before, these functionalities will serve as input for the participants (i.e., process experts) during the workshop.

Table 2.3

List of primary functions split into 7 categories

Application	Data		Desktop	Email	Programming functions	Web application	Other
Opening/closing Applications	Saving Data	Extracting Data	Typing	Open/closing emails & Attachments	For/while Loops	Opening/closing browsers	Auditing
Logging in	Entering Data	Validating Data	Clicking	Reading Emails	If-then-else rules	Locating URL's	Logging
Logging off	Archiving	Dealing with Structured Data	Dragging	Generating/Sending Emails	Exception handling	Web scraping	Trigger by image appearance
Expanding applications	Converting Data	Entering Queries	Moving files/folders	Moving Mails to folder		Web recording	Trigger by hotkey
API integrations (SAP, Excel, Outlook, PDF)	Uploading Files	Calculations	Screen scraping	Generating/Sending emails			User Interaction
Accessing Databases	Encoding Files	Copy/pasting	Storing files/folders				
Reading databases	Detecting file changes	Collecting statistics					

Writing to databases	Migrating Data	Updating data
OCR		

2.2.7 Process Criteria

Next to knowing RPA's primary functionalities, this study aimed to know what criteria processes should possess in order to implement RPA. Knowing these criteria will help with the initial identification of RPA suitable processes and is commonly one of the first activities being performed during BPM projects (Dumas et al. 2013). Collecting these criteria is therefore very important and will help participants during the workshop to come up with processes that fulfil most of these criteria. SQ2 was formulated as followed:

SQ2 "What criteria are of importance for the selection of business processes regarding the primary functions of RPA?"

Again, sentences and keywords from the found literature were first copied from the different sources, analysed and then categorized into one or two words as initial criteria. These criteria were then evaluated again to combine criteria and remove duplicates. This list was eventually consolidated to a list of 18 and used for the interviews with the two RPA developers. During the interview, one of the developers mentioned that there were two criteria missing which were in his opinion important to be added. These were added, resulting in a total amount of 20 criteria.

During the literature review, it was noticed that process criteria were mostly summed up and presented in a single list by authors. No distinction was made between criteria with regards to the benefits of RPA and the criteria determining automation potential. However, presenting a list of 20 criteria to the participants in order for them to determine whether RPA can be suitable or not, is likely to make it harder for participants to evaluate. A way to determine the suitability of a process is by assessing the complexity of a process to be automated and comparing this with the benefits resulting from this automation. Looking at the list, the same structure could be applied to the criteria by making a distinction of criteria related to 'Automation Potential' and criteria related to 'Business Value'.

Automation potential

The analysis of the criteria showed that we can distinguish between two sets of criteria. The first set refers to Automation potential. Automation potential refers to the criteria found in literature that describe aspects of processes that will make the process more potential to be automated by RPA. Example criteria of processes mentioned by different authors are for instance 'Low cognitive', 'Standardized', 'Multiple Systems' and 'Structured data' (Agaton & Swedberg, 2018; Asatiani & Penttinen, 2016; Lacity & Willcocks, 2016). So, a process is more likely to be suitable for RPA when it does not require too much thinking (personal judgement), follows a known path, accesses and uses multiple systems, and is only using structured digital data. However, it should be mentioned that a process does not need to fulfil every criterion to be a viable candidate for RPA. For example, if a process is very standardized and mature, but it only uses a single application it can still be a viable option for RPA automation. For this reason, these criteria should be seen as guidelines.

Business Value

The other set of criteria is referred to as Business Value criteria. These criteria can indicate how much value the business will receive once a process is automated via RPA. Compared to the Automation Potential criteria, these criteria cannot only be answered as binary by stating Yes or No. The Automation Potential criteria should also include interval or ratio variables. For instance, the criteria 'Duration' cannot be answered by Yes or No. Instead, an average number should be written down. The same goes for 'High in Volume'. This criterion should be evaluated on whether the process runs daily, weekly or monthly. If a process scores high on these criteria, for example a process that has average durations lasting longer than one hour, occurring each day, has high chances of human error, requires much manual effort and will increase in compliance via RPA, the more value will be gained if it is automated by RPA. However, just as with the Automation Potential criteria, the Business Value criteria are seen as guidelines and not requisites. Table 2.4 shows the categorized criteria resulted from the SLR. Appendix D shows the overall list of process criteria found in both scientific and grey literature. In conclusion, these process criteria will be used in order for participants to recognise suitable RPA processes and therefore be integrated within the workshop.

Table 2.4

List of process criteria split into Automation Potential and Business Value

Automation potential	**Explanation**
Mature	All ins and outs are known within the process
	No adjustments to the process are made / will be made (within the short term)
	Every activity within the process is predictable (Cause and effect are known)
Standardized	Process is executed the same by colleagues/departments/business units
	The order of the process doesn't change
	No exceptions during the process
	Minor difference between other process variants and happy path
	knows little to no different process variants
Rule-based	The process is easy to be written in steps
	The process is easy to be formulated in if-then-else statements
	The process is structured/well defined and non-subjective
Stable applications/systems/websites (1)	Interfaces will remain stable, so no changing interfaces due to updates

Stable applications/systems/websites (2)	No connection or capacity problems during the process
Multiple systems	There are multiple applications/websites the user has to act on during the process
Few decision points	No or few decisions have to be made during the process
Structured digital data	Data is structured and digital
Low cognitive	Low cognitive activities within the process Decisions within the process are not based on intuition or experiences
Easy Data Access	Data is easily accessible
Lifetime (mentioned by developer)	The process should still exist after 5 years
Internal/external (mentioned by developer)	Are the applications within the organization or external

Business value	**Explanation**
Duration	Average duration of the overall process
High in volume	Is the process executed weekly monthly, four time per week
Repetitive	The process returns frequently
Human errors	Human mistakes are made within the process
Manual effort	A lot of manual activities by the user
Essential business process	Without this process the business cannot operate
Increase in Compliance	For example, data privacy, accuracy or due to a process being better logged
Trigger options	Attended: the user is present and watches the robot operate Unattended: the robot can perform on a virtual machine and the user doesn't have to present Hybrid: the process can be executed within the background on the user's computer where the user can still take control if or once necessary

2.3 BPM-Lifecycle

As mentioned before, the treatment, which is the artifact of this research, is in the form of a workshop that can help organizations identify processes suitable for RPA adoption. With 'right' processes it is meant that the processes have enough automation potential for RPA software to be applied. Furthermore, the right processes are processes that will benefit the most once they are automated (i.e., business value). Another requirement of the workshop is that it will provide a systematic approach consisting of clear steps that give organizations the opportunity to identify processes from scratch, without having to use any documentation or other resources besides the knowledge of participants. A well-known model that can be used to systematically identify business processes from scratch is to make use of the Business Process Management (BPM) Lifecycle provided by Dumas et al. (2013). For this reason, SQ3 was formulated as followed:

SQ3. What is the BPM Lifecycle and how can it function as a foundation for the workshop?

The BPM Lifecycle shows the overall management of business processes and uses a range of methods and tools in order to identify and manage business processes (Dumas et al. 2013). For businesses this framework is often used for optimizing business processes. In addition, Dumas et al. (2013) mention that an appropriate way to address this lifecycle is by conducting 'workshops' to identify processes. They then state that this identification can be based on criteria in order to find appropriate processes. This is one of the reasons that makes the BPM-lifecycle even more viable to use as a framework, because this study wants to identify RPA suitable processes based on the process criteria that can indicate whether a process is suitable for RPA or not. Moreover, recent literature has shown that this cycle can be helpful regarding RPA projects and showed that also using the BPMN language can be a good method to find suitable processes (Flechsig, Lohmer, & Lasch, 2019). This section describes the three steps from the BPM-lifecycle that are used as the framework for the workshop design, see Figure 2.6. These three phases are the 'Process Identification', 'Process Discovery' and the 'Process Analysis' phases. Moreover, these phases indicate the scope of this study. The goal of this study is to identify processes suitable for RPA initiatives, which can be seen as part of the planning phase within similar IT-projects. The phases after the Analysis phase are about the redesigning processes and the implementation of them. While these phases might also be viable for the rest of RPA projects, it is part of the development and therefore extending the scope of this study. The rest of this section describes the first three phases of the BPM-lifecycle respectively.

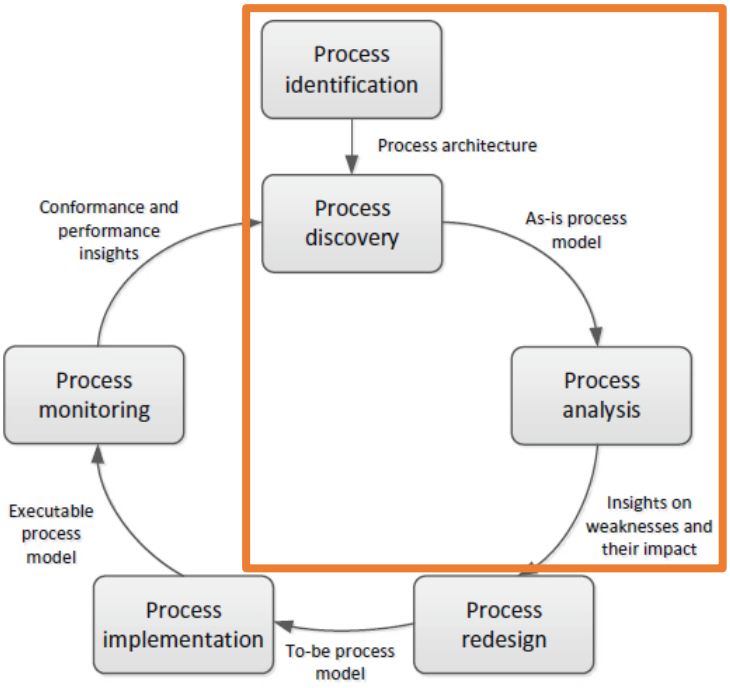


Figure 2.6: Process identification, discovery and analysis within the BPM-lifecycle as scope of this study (adopted from Dumas et al. 2013)

2.3.1 Process Identification

The Process Identification phase is the phase where a business problem is posed (Dumas et al., 2013). Within this study, the business problem is the challenge of identifying suitable RPA processes. This identification phase focuses on identifying the processes that can be relevant for further discovery and analysis, to ultimately be redesigned and implemented. For businesses this phase is often used to find out which processes exist within the organization (Dumas, 2013). Moreover, this phase gives an abstract identification of all processes within an organization, a business unit, a division or a subdivision, depending on the intention of the Business Process Management Initiative. This abstract identification can then be visualized and presented in a Process Landscape as depicted in Figure 2.7. Dumas et al. (2013) mention this as the first level of identification. A Process Landscape shows all the processes on an abstract level and categorizes processes into Core Processes, Management Processes and Support Processes. The core processes are the processes the business is actually driven on, which are supported by Support Processes and Managed via the Management Processes.

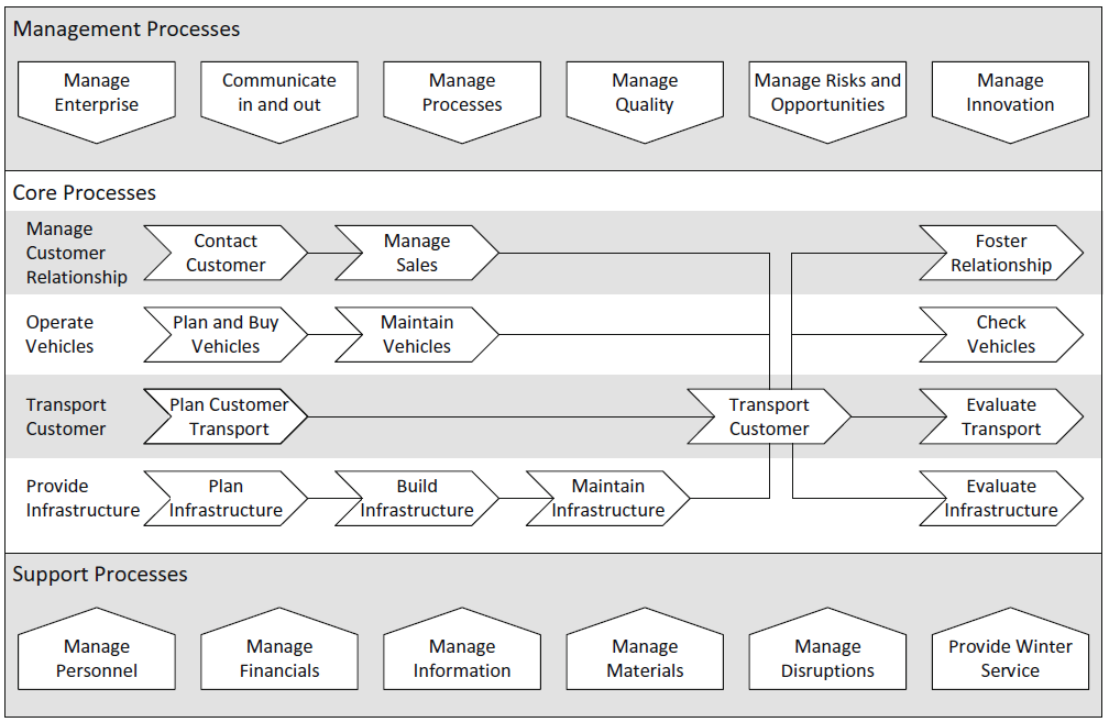


Figure 2.7: Example of Process Landscape adopted from Dumas et al. (2013)

After a Process Landscape has been created for the concerned business unit, identification can be continued by going one layer deeper to level 2. Processes that fulfil the determined criteria can be selected from the Landscape. This Landscape can serve as a mnemonic device for decision makers to identify relevant processes. Furthermore, level 2 lets the BPM initiative fill in a Process Profile, see Figure 2.8, of one of the identified processes within the process landscape. A Process Profile can be used to extract further knowledge about specific processes and might include the name of the process, its vision (goal), its process owner, how it is triggered, the first/last activity and its required resources, hence getting more insight of the As-Is Process. A sidenote should be made. Dumas et al. (2013) mention the Process Profile as one of the last steps within level 1. However, in this study it is relevant to see this as a separate level. This will become clear in the workshop design.

Name of Process: Procure-to-Pay	
Vision: The objective of the procurement process is to secure that the entire range of external products and services becomes available on time and is at the required level of quality.	
Process Owner: Chief Financial Officer (CFO)	
Customer of process: • Requesting unit	**Expectation of customer:** • Timely, economic and complete provision
Outcome: Delivered products or provided services for the requested unit	
Trigger: Need is identified	
First activity: Submit Request ..... **Last activity:** Create Purchase Order	
Interfaces inbound: Plan-to-Procure **Interfaces outbound:** Construct-to-Complete	
Required resources: • Human resources: Site Engineer, Clerk, Works Engineer • Information, documents, know-how: procurement guidelines, supplier rating, framework contract • Work environment, materials, infrastructure: Procurement information system	
Process Performance Measures: • Cycle Time • Operational Costs • Error Rate	

Figure 2.8: Process Profile Example adopted from Dumas et al. (2013)

2.3.2 Process Discovery

The second phase involves Process Discovery. In this phase the processes identified in the first phase and described within the Process Profile are decomposed into a clear process (AS-IS process) as a starting point for the third phase (Process Analysis) (Dumas et al. 2013). This process has to be modelled in order to dive deeper into the selected processes from the identification phase. In order to model a clear process, the Business Process Management Notation (BPMN) can be used (Dumas et al. 2013). This language consists out of many notations, represented as symbols, to model business processes. The most commonly used symbols are the use of a circle indicating persons, a square for activity, a gateway for decision points or splits, a source as applications or systems and a data object as input or output files, see Figure 2.9.

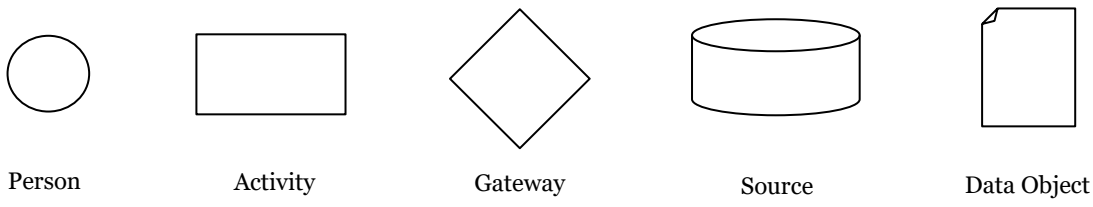


Figure 2.9: Most common used symbols to model business processes

Dumas et al. (2013) mention that there are many reasons to model business processes. The main reason to model is to get a better understanding of the process and to share and receive knowledge with and from practitioners performing these processes. Such a model of a process can then help determine the process' weaknesses and strengths and Dumas et al. (2013) mention that within a workshop often these processes can be modelled via sticky notes. Agaton and Swedberg (2018) have used the BPMN language to create such a model to determine whether the process is suitable enough for RPA implementation through obtaining more insight in whether process criteria can be applied or not. Figure 2.10 shows an example of a new employee being added to the HR system and shows how the different symbols are used.

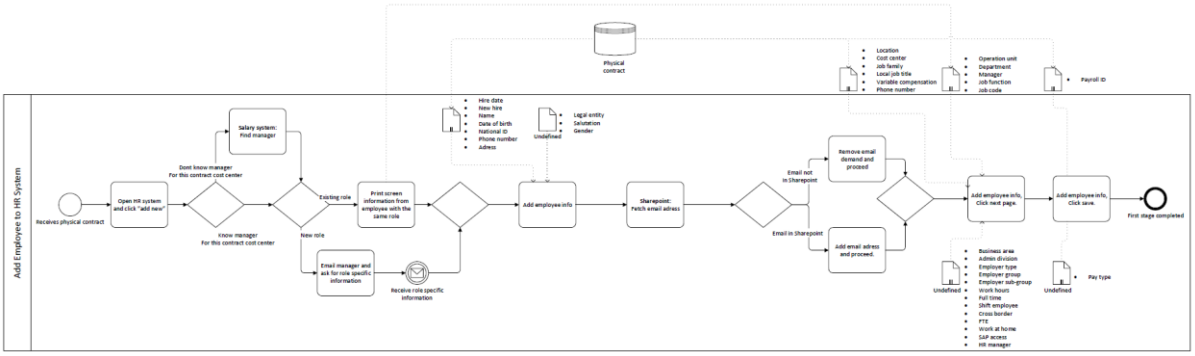


Figure 2.10: Process Model of adding a new employee to the HR system adopted from Agaton & Swedberg (2018).

However, one of Agaton's and Swedberg's (2018) conclusions was that the BPMN setup did not provide the appropriate setup to determine whether a process does fulfil the criteria for RPA suitability. For this reason, they came up with an extended version and called it BPMN-R. BPMN-R offers the following three improvements for evaluating RPA suitability compared to the standard BPMN:

- Improved description of Data Quality and Data Source by categorizing it into three different data objects, namely physical, digital or undefined.
- Using lane elements specifically for showing application and systems being approached.
- Specific description of decision points being used indicating it by a yellow triangle.

Figure 2.11 shows the added elements within BPMN-R. This way of modelling can just like Dumas et al. (2013) help with the identification of the processes' strengths and weaknesses, but then focussed on RPA projects.

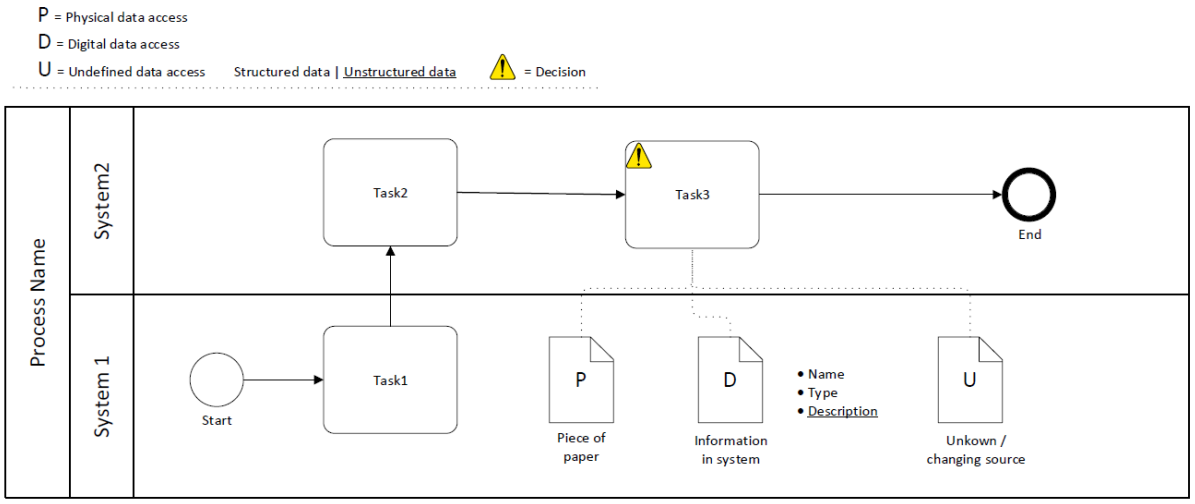


Figure 2.11: The three added elements to BPMN by Agaton & Swedberg (2018). 1) Swim lanes representing systems/applications, 2) data object categorized by P, D and U and 3) decision points marked by an exclamation mark.

While there are more notation languages to model business processes with such as Petri net, EPCs, BPEL (Van Der Aalst et al., 2012), no other studies have shown a specific language for modelling processes to assess RPA suitability. Furthermore, Agaton and Swedberg (2018) do account for some of the more important aspects that need to be evaluated for RPA suitability, such as the data types, decisions points and the different applications being used. This can be seen in Figure 2.12, it shows the earlier shown process model of adding a new employee modelled in BPMN converted to BPMN-R. For this reason, this language can be used within the process discovery phase of the BPM-lifecycle framework to help identify suitable RPA processes. Figure 2.13 shows the decomposition of processes necessary for the final process analysis regarding RPA suitability.

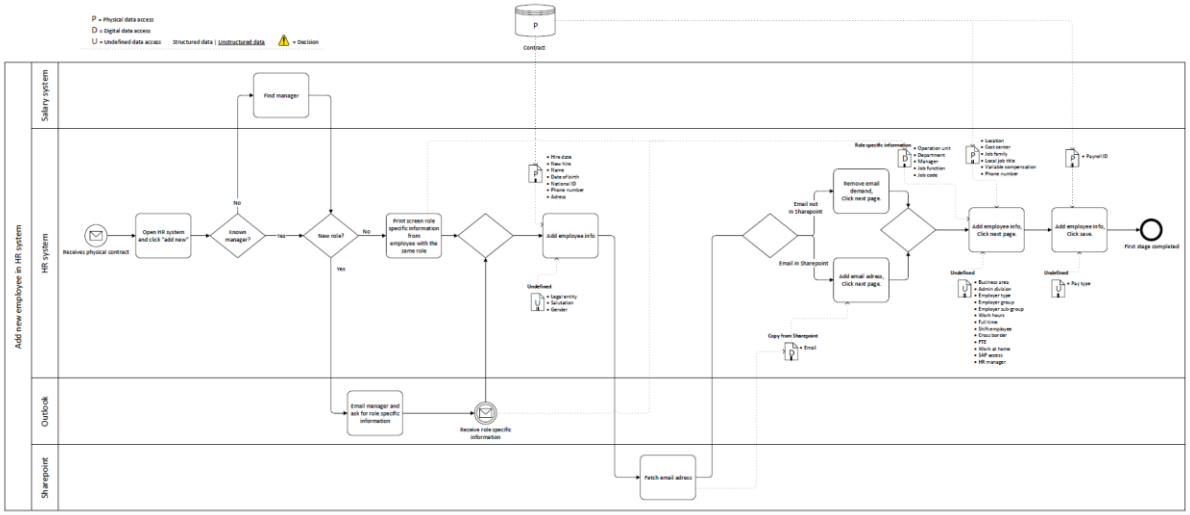


Figure 2.12: Process Model of adding a new employee to the HR system adopted from Agaton & Swedberg (2018).

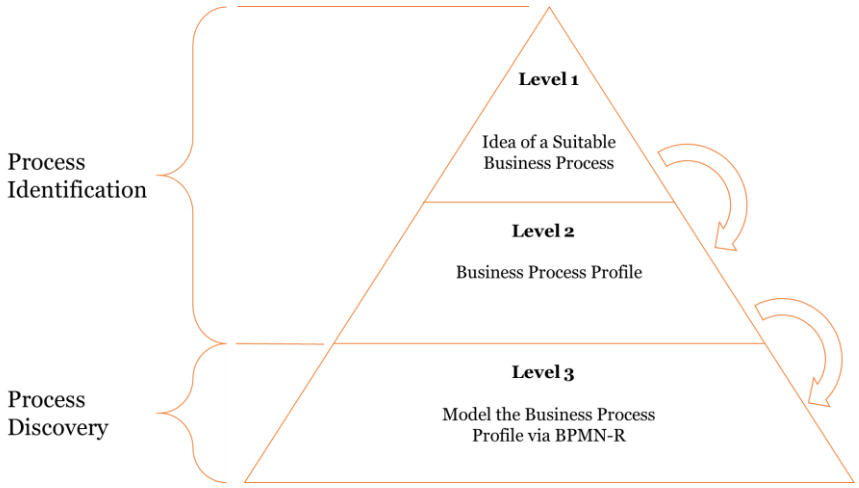


Figure 2.13: decomposition of the processes within the first two stages of the BPM lifecycle

2.3.3 Process Analysis

The third phase consists out of an analysis of the modelled process. In this phase criteria can be further evaluated based on a more detailed identification of processes through the created process model showing how complex and what exact steps the process actually includes. This phase decides which processes are most valuable to continue with (Dumas et al. 2013). While most of the time this phase is used for determining whether processes should be optimized by reducing their cycle time, operational costs or error rate, it can also provide a good way to determine whether further development of RPA can be pursued. Moreover, this phase could also help determine whether processes should and can be redesigned before RPA developments are made. This last evaluation leads to a list of processes presented within a process portfolio, see Figure 2.14. A process portfolio can eventually help managers with decision-making regarding the selection of processes and further developments. Within Figure 2.14, 6 different processes can be classified as “Limited”, “Potential”, “Strategic” or “Quick Wins” for RPA. The Strategic class, for instance, tells managers that automation potential is actually too low, but that the benefits can be rather high.

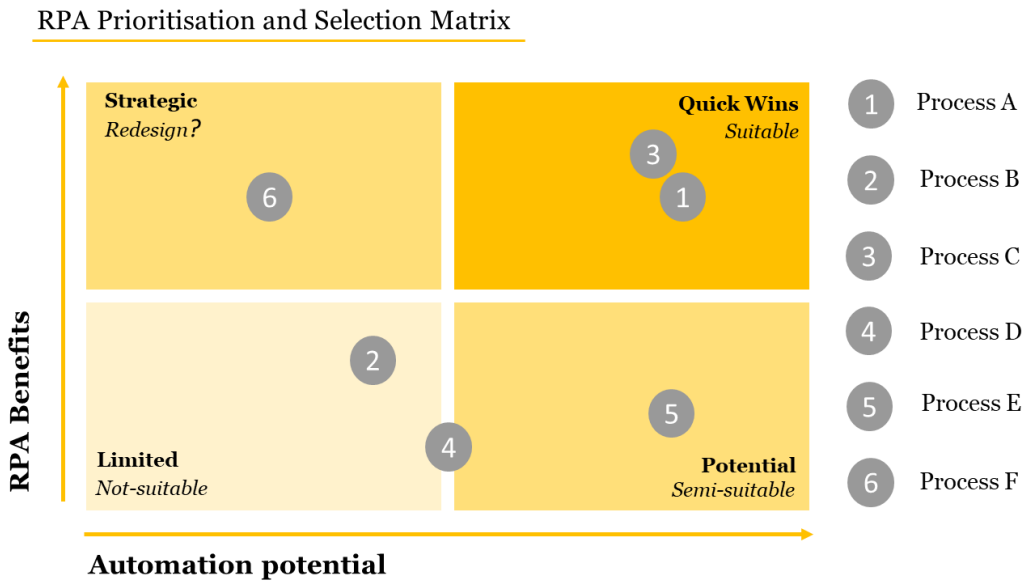


Figure 2.14: Conceptual model of Process Portfolio Output

2.3.4 Workshop Structure and Group Composition

While the BPM-Lifecyle by Dumas et al. (2013) serves as a suitable framework for the steps to be taken within the workshop's design and the BPMN-R as a better way of modelling the processes, there are some crucial details left out that are relevant for the design of the workshop. Even though Dumas et al. (2013) mention in their book that a workshop is good method to identify and manage business processes via the BPM-Lifecycle, only minor details are given and a few suggestions are being made on how to organize one. For instance, they mention that for the modelling part participants could make use of sticky notes in order to model processes. However, aspects, such as the way to come up with ideas and how to let a group discuss, are left out. The ultimate goal of this study is to find suitable RPA processes based upon the ideas of a group and a discussion to evaluate these ideas. As a result, many psychological factors are in place which are likely to determine the outcome of the workshop. For example, the number of participants, their experiences, the duration of the workshop and if ideas will be generated and selected individually or as group. These are factors that still need to be determined.

2.3.5 Key Takeaways of BPM Lifecycle

Regarding this research there are three key takeaways from the BPM Lifecycle important for the design of the workshop. Firstly, the three phases, namely the Process Identification, Process Discovery and Process Analysis phase of the Lifecycle, will be used as sequential steps to be taken during the workshop. These three steps have shown to help businesses with funnelling processes. The identification step will help with identifying suitable processes by looking at all the processes in scope within the business and selecting the ones for further evaluation based on specific criteria (i.e., process criteria). The Process Discovery phase will then model these processes to get a detailed understanding of the process. And lastly, the Process Analysis phase will analyse these processes and re-evaluate the criteria.

Secondly, resources such as the Process Landscape, Process Profile, BPMN-R and Process Portfolio will be used within the workshop design to enhance the identification of processes. During the Process Identification phase, a Process Landscape can be used to determine the scope of identification. For example, determining whether only processes of a specific department will be evaluated or all processes within the organization. The Process Profile can be filled in by participant to get an understanding of their idea and to assess which criteria (automation potential and business value) apply for the identified process. In addition, this profile will help as start for modelling the processes during the Process Discovery phase. During this phase the BPMN-R language is used to model processes. And lastly, the process portfolio can be used during the Process Analysis phase to determine whether a process is suitable for RPA or not.

Thirdly, the BPM Lifecycle lacks information about the required structure and group composition to generate multiple qualitative ideas. However, due to this workshop's aim of bringing a group together to generate and evaluate ideas it is important to know what structure and group composition will enhance these results.

2.4 Methodology for SQ4

An important dependent factor and core element within the workshop leading to the identification of suitable processes, is using a group of process experts. The biggest difference between a workshop-based process-selection method and other methods, is that processes will be obtained by multiple individuals. This group of process experts should come up with ideas, discuss them, evaluate and select the best ones. However, there are many ways to organize such a setting in terms of its structure and group composition. For example, a way to arrange the structure is to let a group generate ideas by collaborating with each other, so they can discuss ideas directly or build upon ones. However, it is also possible to let the group generate ideas individually and only let them collaborate during evaluation. While the BPM-lifecycle provides a good basis for the overall steps to be taken, variables such as the duration of the workshop, the number of sessions, number of participants, their experiences and the role of the facilitator etc. still needs to be determined. It is the intention of this workshop based approach to have these variable arranged in such a way that it will lead to the most efficient and effective way of identifying processes. In other words, the setting should be set up in such a way that participants generate and evaluate ideas most effectively and ultimately choosing the best of them. For this reason, a Systematic Literature Review, as mentioned in the beginning of this chapter, will be conducted in order to find a method that will help validating the structure and group composition of this workshop. Using such method also contributes to the standardization of this study's process-selection method and thus making it a better artefact for organizations to adopt in different settings.

2.4.1 Review Protocol SQ4

A Systematic Literature Review for the purpose of finding suitable methods is commonly used in design science research. Kitchenham (2004) mentions for instance that using a Systematic Review can be a helpful method for choosing between different agile software development methods. Moreover, a Systematic Review gives the opportunity to find multiple methods, to

compare them and choose one based on its descriptions and limitations which fit best with the treatment's design. This SLR was conducted to eventually answer the following sub question:

SQ3. *'How can the workshop be designed in order to identify the processes containing the criteria from SQ2?'*

The BPM-lifecycle described in the Chapter 2, "Theoretical Framework", did already partly answer this sub question by providing a good foundation for the overall steps to be taken during the workshop. This section aims to finalize the answer to this question by searching for relevant literature that will help with an efficient yet effective way of generating ideas (identification) of processes that are suitable for RPA and evaluating them effectively. After some initial searches regarding "ideation" and "idea generation" in Scopus, it showed that a method matching the goal of generating and evaluating ideas is an old technique but still widely used called "Brainstorming". While methods involving workgroups joining and collaborating to solve problems such as, Design Thinking (Brown, 2008) and Focus Groups (Kitzinger, 1995) were considered, they seemed to be less appropriate for this study's setting. For this reason, brainstorming techniques will be the focus of this study.

Next to this nice integration within the BPM-lifecycle, is that brainstorming is a research area with much literature regarding causality between the independent variables, such as structure and group composition leading to the dependent variables quantity and quality of ideas. Therefore, research about brainstorming can help find and validate the right elements to add within the workshop design.

Table 2.5

Review Protocol: How can the processes containing the criteria within SQ2 be identified

Protocol Element	**Translation to RPA's Primary Functions**
SQ 3	'*What criteria on workshop structure and group composition are of importance in designing a workshop?'*
Sources	▪ Scopus ▪ References from Scopus Sources
Search Term	SUBJAREA (arts OR busi OR deci OR econ OR psyc OR soci) TITLE-ABS-KEY ("brainstorm" OR "brainstorming") AND (LIMIT-TO (EXACTKEYWORD , "Brainstorming")) AND (LIMIT-TO (SUBJAREA , "BUSI") OR LIMIT-TO (SUBJAREA , "PSYC"))
Search Strategy	▪ No publication date limit ▪ Search Term contained in Title or Abstract
Inclusion Criteria	Paper comparing and evaluating different Brainstorming Methodologies
Exclusion Criteria	Papers that are not in English

Data Extraction Tool	Literature Matrix & Mendeley
Results	▪ Different Brainstorming Techniques determining the structure of the workshop ▪ Group composition of the Workshop ▪ Additional elements, such as tooling, virtual sessions etc. influencing the outcome of the identification of Processes

For the above-mentioned reasons, Table 2.5 was created in order to conduct an SLR that will help find relevant methods regarding brainstorming. A preliminary search showed that Searching for 'brainstorm' and 'brainstorming' and filtering on 'social sciences' lead to more than 2000 results. For this reason, a search was filtered on the keywords 'Brainstorm" and 'Brainstorming" and specifying the search with subject areas regarding 'business' and 'psychology'. Business, because of the common use of brainstorming by managers and other decision makers and psychology, because of the psychological factors that are highly dependent on the outcome of brainstorm sessions.

2.4.2 Extraction and analysis SQ4

To analyse the data, a same literature matrix was used to get an understanding of brainstorming and its different techniques. Again, this literature matrix will help structure the content found within the literature. Each technique found during the review was added to the matrix, so a comparison could be easily made.

2.5 Brainstorming and Implications

Figure 2.15 shows the process of the second Systematic Literature Review. The search term, used from the Review Protocol in Chapter 2.4 (Table 2.5), lead to a total of 227 articles to be reviewed on their title. As a result, 45 articles where selected based on their title. Next, 21 articles were selected based on their abstract and then screened. Due to snowballing references, 9 articles were added manually. In total, 30 articles were analysed and extensively read of which 11 articles were determined to be excluded. As a result, 19 articles were used for the results in this chapter. Also, the tips from the Lorentz centre webpage (Lorentz Centre, 2021) were used and manually added. The Lorentz Centre conducts each year more than 100 workshops. They present a whole list of tips and tricks to positively influence the results of a virtual workshop.

Figure 2.15: Steps of the SLR including added or removed articles

Findings from the literature review showed that there are many ways to organize a brainstorm session. For this reason, many choices had to be made which were believed to lead to the most effective session. With 'effective' this study aimed for generating both multiple ideas as well as qualitive ideas. The rest of this section will explain some of the most common used brainstorming techniques and will explain which one is assumed to be a best fit in order to reach the workshop's goal.

2.5.1 Introduction to brainstorming

Brainstorming is a technique that has been proposed by Osborn in 1953 and is often used for finding innovative solutions to problems by letting multiple individuals use "the brain to "storm a creative problem" (p.297). Brainstorming allows people with multiple areas of expertise to come together with the effect that the whole is greater than the sum of the individual parts. Boddy (2012) states that brainstorming is a commonly used method by managers and practitioners to come to decisions as to where the focus regarding idea or product development should be put on. In addition, brainstorming is often used to evaluate whether products are feasible, reliable and economically interesting (Boddy, 2012). This is exactly what this study is aiming for. To find the most feasible and economically suitable process for RPA by bringing a group together. Furthermore, brainstorming characterizes itself by distinguishing in two phases, namely an idea generation phase and an evaluation phase (Boddy, 2012). This is also in line with the framework of Dumas et al. (2013). It is a process of generating ideas and evaluating them. Take for instance the identification phase. This phase requires individuals to come up with processes that fit the predetermined criteria. As a result, individuals have to generate ideas and evaluate whether they fulfil these criteria. The same goes for the Discover and Analysis phase. Individuals have to generate ideas about how a process should be modelled by determining which activities and systems it includes. In the analysis phase these modelled processes then have to be evaluated on their completeness and accuracy. For these reasons, Brainstorming is seen to be an appropriate ideation technique that can be integrated within the BPM-lifecycle to complete the steps to be taken during the workshop.

The rest of this section will explain some of the most common used brainstorming techniques and discuss which one fits best in order to reach this study's goal. These techniques will be explained and compared in Section 2.5.2. Next to brainstorming techniques, the composition

of the group will be explained in Section 2.5.3. Lastly, tooling for Brainstorming sessions and findings related to the setting will be described in Section 2.5.4.

2.5.2 The three Brainstorming Techniques

The results from the SLR showed that there are three common brainstorming techniques. Maaravi, Heller, Shoham, Mohar, and Deutsch (2020) describe that these are Brainstorming (standard), Nominal Brainstorming (NBS) and Electronic Brainstorming (EBS).

Standard Brainstorming

Standard Brainstorming is probably the most well-known brainstorming technique. The original technique of brainstorming is to gather participants into a single room to generate ideas verbally (Boddy, 2012) and it has been used for all kinds of reasons. Osborn (1953), started off with the idea of bringing employees together to help gathering new and unusual ideas in business meetings. Brainstorming sessions generally consists out of two phases, namely the idea generation phase and the evaluation phase (Boddy, 2012; Girotra, Terwiesch, & Ulrich, 2010; Maaravi et al., 2020). The idea generation phase let's all participants generate ideas, so they can later be collected. Boddy (2012), state that this phase often starts with an explanation of the rules and the goal of the brainstorm session. There are in essence four rules that have been set up by Osborn (1953):

1) Criticism is ruled out during the emerging generation of ideas. As a result, the generation of ideas by participants are not disrupted and downgraded by the once critiquing participants.
2) Verbalise all ideas without the fear of being criticised.
3) Group members should try to generate as many ideas as possible without thinking too much about the quality of the idea.
4) Combine and think of ideas based on the ideas generated by others.

However, with regards to the last rule, Girotra et al., (2010) researched that groups building on ideas of others does not particularly lead to better ideas than the once already generated. Boddy (2012) adds an additional rule to lower individual egoism of ideas, by stating that

5) ideas generated should be seen as ideas generated by the group instead of individuals.

After the rules and goal is made clear, participants can then start with generating ideas and simultaneously discuss them, while the moderator writes down the ideas on a page or whiteboard (Boddy, 2012). After all ideas are collected the first phase is finished.

The second phase of brainstorming is the evaluation phase (Boddy, 2012; Girotra et al., 2010; Maaravi et al., 2020). Ideas can then be sorted and categorized based, for instance, on expense workability, practicality and feasibility (Boddy, 2012). Boddy (2012) states that during this stage participants are allowed and encouraged to critique the generated ideas. He furthermore states that it is important to critique the ideas and not the individual people who suggested them. After the ideas are evaluated, ideas can be selected. This selection can occur by rating or ranking ideas based on previous determined criteria or let participants select their top three

by voting (Boddy, 2012). As a result, a few ideas are picked which are considered for further implementation. Figure 2.16 shows the two phases with its four steps taken during a common brainstorm session.

Figure 2.16: The two phases during a Brainstorm session

Nominal Brainstorming

Another brainstorming technique is Nominal Brainstorming (NBS). Standard Brainstorming, as mentioned previously, characterises itself by having an interactive session during each of the steps depicted in figure 2.16. NBS, however, lets participants generate the ideas individually during the first phase of brainstorming (Dennis & Reinicke, 2004; Maaravi et al., 2020). So, instead of the group generating ideas, each individual will have a limited amount of time to come up with ideas without the input of others and write them down (Boddy, 2012; Dennis & Reinicke, 2004). After time is up, these ideas will be collected and then be evaluated by the group. Evaluation can then start off with participants giving a short explanation about the idea, so participants can then start commenting on and discussing the ideas (Boddy, 2012). Hence, following the second phase the same as standard brainstorming.

In terms of idea generation, many studies have shown that the number of ideas generated increase whenever the NBS technique is applied (Boddy, 2012; Dennis & Reinicke, 2004; Diehl & Stroebe, 1987). Girotra et al., (2010) even showed that, compared to standard brainstorming, the NBS technique not only increases the number of ideas, but that on average the quality of them also increases. They state that this is likely caused by three shortcomings of standard brainstorming. The first cause is so-called 'free riding'. Free riding is a behaviour of participants to not work as hard due to them relying on their peers (Diehl & Stroebe, 1987). Second, Girotra et al., (2010) mentions evaluation apprehension as a factor disrupting the ideation. Evaluation apprehension is the fear of participants to be negatively evaluated by others, preventing them from presenting their ideas (Diehl & Stroebe, 1987). Third and last, Girota et al., (2010) mentions production blocking as a factor decreasing the amount of ideas created. Production blocking literally means that the session is less productive due to participants having to wait on expressing their ideas until its their turn to speak and that production blocking is caused by disrupting thoughts of participants (Nijstad, Stroebe, & Lodewijkx, 2003). As a result, Nominal brainstorming was introduced to prevent this production loss.

Electronic Brainstorming

Electronic Brainstorming (EBS) is the last to mention brainstorming technique that is used in practice, that characterises itself by participants being fully anonymous. EBS was introduced, just as NBS, to overcome production blocking issues but to also still benefit from collaborative ideation (Maaravi et al., 2020; Paulus, Dzindolet, & Kohn, 2012). In EBS sessions, participants will communicate by sending (chat)messages, emails or images to other participants via the computer which compared to the other techniques causes everyone to be fully anonymous, which causes it to further reduce the evaluation apprehension (Maaravi et al., 2020; Paulus, Kohn, Arditti, & Korde, 2013). In addition, by uploading text online, everyone can share their ideas or opinions simultaneously and therefore causing production blocking to be reduced (Gallupe, Bastianutti, & Cooper, 1991). Participants don't have to wait before someone is finished typing. Moreover, because ideas can be uploaded, ideas can directly be shown to other participants giving them inspiration if they struggle with finding ideas. Nijstad, Stroebe and Lodewijkx (2002) mention that exposing the ideas of others will enhance the generation of ideas by other participants, something which is not possible during an NBS session.

While Maaravi et al., (2020) mentions in their literature review that EBS does offer the opportunity to increase the quantity and quality of ideas, literature has not yet proven it to perform better than NBS due to the two techniques being too different. For this reason, it will depend on the context. Next to these three previously mentioned advantages, four disadvantages will be discussed. First, while anonymity and collaborative ideation are some of the positive factors of EBS there are also negative ones possibly leading to a worse result than if standard brainstorming or NBS is used. For instance, while anonymity helps with removing status biases, it can also increase free riding by participants and lowering satisfaction (Alnuaimi, Robert, & Maruping, 2010; Nunamaker, Dennis, Valacich, Vogel, & George, 1991). Due to being fully anonymous during the session, participants might have a lower feeling of responsibility and motivation for generating and evaluating ideas and therefore reducing productivity. Second, to stay anonymous during the entire session, participants have to type everything out. While Nunamaker et al,. (1991) state that by typing participants will think their ideas and comments more through, they also mention that it lowers the communications process during the session, potentially leading to a lower quantity of ideas and worse evaluation. Third, collaborative ideation is seen as the strength of EBS, making it outperform the NBS techniques. However, state that this might also disrupt the individual thinking process (Baruah & Paulus, 2011) and that building upon other ideas might be counterproductive (Girotra et al., 2010). Fourth and lastly, Maaravi et al., (2020) mention that EBS is less productive when held with smaller groups (<8 or less) compared to standard brainstorming or NBS.

Technique used for the workshop

Most studies agree that the NBS and EBS technique outperforms original brainstorming in both the quantity of ideas as well as the quality of them (Dennis & Reinicke, 2004; Maaravi et al., 2020). Maaravi et al., (2020) mention in their literature review regarding the three brainstorming techniques, that nearly all studies agree that standard brainstorming leads to fewer ideas than NBS and EBS, however that there is less agreement wheter nominal or

electronic brainstorming is more effective. For this reason, a determination should be made based on the context.

For the design of the workshop in this study, the NBS technique is assumed to be the more suitable one. There are two main reasons why the NBS technique is preferred over the EBS technique. First, an essential part of this approach towards process-selection is the discussion between group members. So, for instance, process profiles that are gathered during the idea generation phase should be explained by each member. In addition, after explanation, group members will give feedback to the idea. With EBS, the goal is to keep everyone anonymous by letting members type their explanation and feedback. However, explaining and producing feedback might result in more difficulty communicating due to process profiles being quite extensive and thus slowing communication way down (Nunamaker et al,. 1991). With NBS however, participants can just verbally communicate ideas, comments and questions. Hence, making it more user-friendly and efficient.

The second reason for choosing NBS over EBS, are the group sizes. EBS was argued to only be more effective when the group is large enough (>8). However, this might become a bottleneck whenever arranging a workshop which not only includes a brainstorming session, of approximately 40 minutes (Maaravi et al., 2020), but also a full presentation about RPA. As a result, a minimum of 9 participants should then be available for a longer period of time. In conclusion, the NBS technique will likely lead to a less time consuming and more user-friendly technique to be integrated within the workshop.

2.5.3 Group Composition

Brainstorming literally means, “using the brain to storm a problem”. But how many of these brains are required in order to get the most optimal results? And should they possess the same background knowledge? Osborn (1953) described that the team composition is an important factor determining the success of a brainstorm session. In this section we will discuss three important elements of the group composition during brainstorming, namely the two roles, group size and multidisciplinary.

Roles

During brainstorming there are two roles present. A facilitator, someone who facilitates the brainstorm session, and a participant, someone who participates the workshop. A facilitator will help improve the overall brainstorm session (Osborn, 1953). Maaravi et al., (2020) state that the task of the facilitator consists out of explaining the guidelines of the session, the specific goal and presenting. In addition, facilitators might help improve the session by maintaining a balanced input from the participants and keeping them focused on the task. Oxley, Dzindolet, and Paulus (1996) furthermore state that one of the most important tasks of the facilitator is to reduce participants fear of being evaluated and state that they can do this by encouraging participants and interfere if necessary. A participant’s main task is to follow the brainstorming process by generating ideas and evaluating others’. For them it is important to remember the brainstorming rules as mentioned by Boddy (2012). As a result, the entire process can be run more adequately if attendees focus on their roles.

Group Size

The group size is also an important factor to account for during the brainstorm session and thus the workshop. Alnuaimi et al. (2010) describe that groups too large or too small can both lead to undesired results. Large groups might increase freewheeling, while having a group too small might lead to only a few generated ideas. In addition, a large group can also prevent others from having enough time to express their ideas, therefore increasing production blocking (Nijstad et al., 2003). However, during the literature review, no clear amount of participants was found. Paulus et al., (2013), state that the number of participants depend on the context and the goal of the brainstorm. They furthermore mention that it is important to at least account for the differences in participants' expertise.

Multidisciplinary

Several studies have mentioned that it is important to include participants with different knowledge and expertise as this might increase the amount of ideas as well as their quality (Paulus et al., 2013; Paulus & Nijstad, 2010). For this reason, the brainstorm session and thus the workshop will account for a diverse team. With regard to the identification of suitable RPA processes, it will be important to have at least members present that have experiences with all the processes in scope. For instance, employees sharing the same role within the organization, can still have experiences with different tasks. Moreover, the same goes for different statuses due to hierarchical structures. A manager has of course broader experience regarding most of the processes compared to staff employees. Managers often know processes on an operational, tactic and even strategic level. For this reason, a manager might have more ideas than if only a staff member is included. However, this staff member should still be present, as they are the ones probably knowing all the ins and outs of the operation processes. In addition, Sutherland and Canwell (2004) mention that it is necessary to invite external members for brainstorming sessions to prevent team bonding issues. They state that external members can be more likely to question other participants. For instance, colleagues that worked with each other might be more likely to conform with each other's ideas because of the bond between team members.

2.5.4 Setting and Tools

The setup of the workshop will be virtual. Therefore, the workshop can be joined by participants from every place. Two reason why a virtual workshop is preferred over a physical one. Firstly, it will be more accessible for participants to join the workshop due to no travelling to a single location (Lorentz Centre, 2021). Because it was recommended in the previous sector to account for external participants, it can be harder to schedule a physical workshop. Secondly, the workshop, as will be shown in Chapter 3 and 4, will make use of digital artifacts and tooling, such as digital process profiles, Padlet and Draw.io. This requires participants to be behind a computer during most of the workshop. The Lorentz Centre (2021) presents a list of tips and tricks for conducting a virtual workshop. The following is relevant for the design of the workshop:

- It is recommended to limit the sessions to a maximum of 2 hours to avoid mental fatigue by participants.

- Take breaks during the workshop, because participants have to look at a screen for quite a while.
- Cleary state the goal and the outcome of the workshop (also mentioned by Boddy 2012)
- Explain how participants can ask questions and comment during the virtual workshop and how they should make use of tooling.
- Strictly stick with the time planned.
- Send around the program of the workshop as well as the platforms being used.
- Consider creating couples, for instance, regarding exercises by creating breakout rooms.

Tooling

Because the workshop will be held virtually, digital tooling can be used in order to optimize the brainstorming process. Offline brainstorming sessions often use sticky notes and whiteboards (Boddy, 2012). Participants can then write on sticky notes their ideas and place them on a whiteboard. However, there are also options making it possible to use such items digitally. Siegle (2020) recommend for online brainstorming sessions to make use of Padlet. Padlet is a free online tool where everyone can join to share their ideas, comment on them, order them and vote. Figure 2.17 shows an example of a Padlet Template. Now some of the important elements to account for during the workshop are known, they can be applied to the design of the workshop.

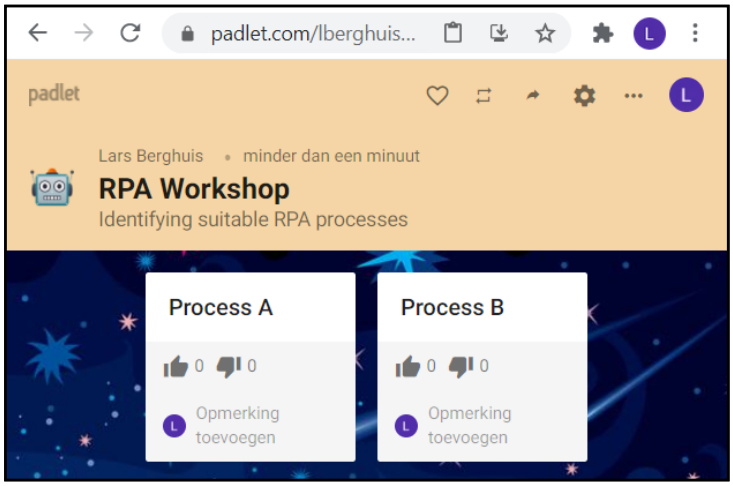


Figure 2.17: Screenshot of a Padlet dashboard

2.6 Recap of main findings

This chapter was mainly focussed on studying describing literature to find all relevant parts to be included within the workshop. These finding have answered the first four sub-questions and will be used as building blocks for the following chapter describing the design of the workshop. In this section a recap is given on the main.

For decision makers it is important to know what a specific process technology such as RPA is and what it can and cannot do. Knowing what RPA is and what its primary functions are will

help participants to understand how RPA can be used for the automation of processes. An SLR was conducted which resulted in the analysis of 35 papers consisting of both scientific papers and grey literature. This literature described that RPA consists of software that helps to program digital bots, which operate on the GIU, in order to automate processes and to remove boring repetitive tasks from workers. Furthermore, it was found that the robot can be triggered either attended or unattended and that AI functionalities, such as Optical Character Recognition and Natural Language Processing, are becoming more standard within RPA tooling. The exact functionalities were obtained by consolidating primary functions from literature. The SLR findings and the findings from the interviews resulted in a total of 48 primary functions of RPA, which will help participants (process experts) with understanding RPA's capabilities.

Next to an explanation of PRA and its primary functions, process criteria, determining the feasibility and value of automating a process via RPA, were searched for in literature. The outcome of the SLR and the interviews showed that a total of 20 process criteria were identified. A distinguishment was made between two sets of criteria, namely between criteria referring to automation potential and criteria referring to business value. Automation potential criteria will help participants understand whether a process has the criteria to be automated via RPA. The business value criteria will help participants to know if a process will be valuable enough to be automated via RPA.

The BPM Lifecycle was found to be suitable model to serve as a foundation for the workshop design. This model presents systematic steps and helpful tools to identify processes, analyse them and determine, based on criteria, which process needs to or can be optimized. In particular the first three phases of this model, namely the Process Identification, Process Discovery and Process Analysis phase, are used as a funnel to filter out processes and obtain the most suitable ones. In addition, to further structure the workshop and help participants come up with as many qualitative ideas, the NBS technique will be used for complementing the BPM Lifecyle. The findings showed that the NBS technique characterises itself by having participants individually generating ideas preventing free riding, production blocking and evaluation apprehension. Lastly findings showed, that using a multidisciplinary as well as including external members is likely to enhance idea generation and evaluation. Therefore, this will be taken into account in the design of the workshop.

The above findings are some of the main findings within the Theoretical Framework. These findings and the more specific findings will be used as building blocks for designing the workshop.

PART II: Design

3. Workshop Design

The previous chapter has collected all the results necessary for the design of the workshop. In this chapter SQ4 will be answered *"How can the workshop be designed, based on the results of the first three sub-questions?"*. This chapter will start off with presenting the designed workshop in the form of a framework. This framework was created by synthesising the findings from the previous chapter and is depicted in Figure 3.1. The rest of the chapter will describe how this framework is built. In the next chapter an experiment with this framework will be conducted.

The framework presents the generic process to be taken when an organization wants to conduct the workshop and is split into two parts. Part 1 consists out of the Process Identification phase and part 2 out of the Process Discovery and Process Analysis phase. Within these phases the findings from the previous chapter can be found. This chapter will elaborate on the design of this workshop and explain the generic steps to be taken. The different coloured borders in the frame, see Figure 3.1, indicate the three elements being synthesis namely the BPM Lifecycle, NBS and RPA (i.e., what RPA is, its primary functions and the process criteria). Noticeably is that each of the parts consists out of three main phases, namely 'input', 'NBS' and 'output'. These three phases represent the funnel, where part 1 of the workshop starts off with all processes in scope, using NBS to generate and evaluate ideas, and ends with a few selected processes filled in within the process profiles (i.e., the output). These process profiles then serve as input for part 2 of the workshop and using NBS to model and evaluate the processes. The output of part 2 then consists of evaluating these modelled processes and positioning them into the process portfolio (matrix).

Section 3.1 will begin with explaining the roles within the workshop by describing its recommended group composition and the recommended setting based on the findings of Chapter 2. Section 3.2 will then describe the first part of the workshop, the Process Identification phase. Lastly, Section 3.3 will describe the generic steps to be taken during the second part of the workshop. These last two sections elaborate on the design of the framework and will explain what purpose the findings from the previous chapter serve.

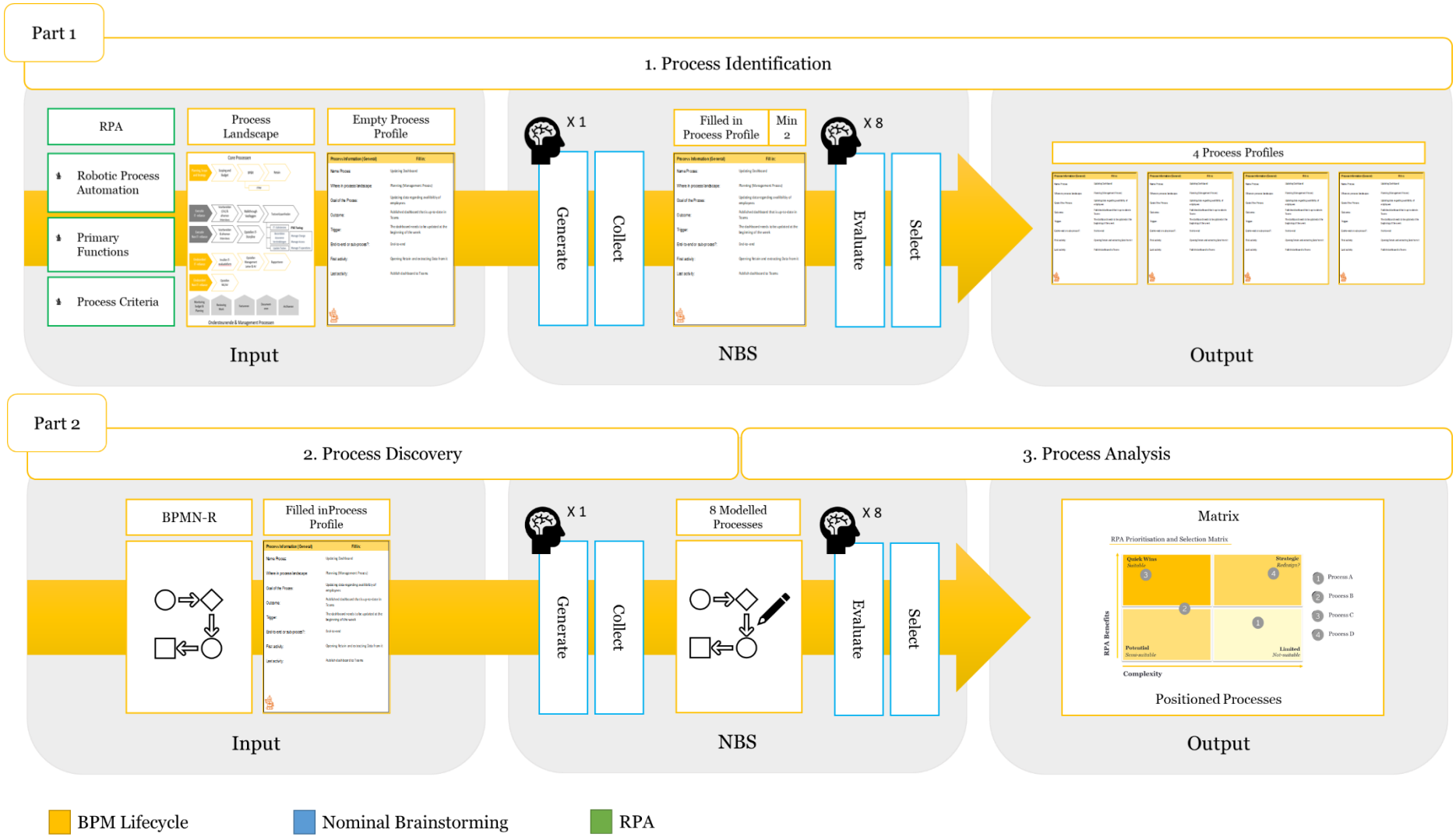


Figure 3.1: Workshop Framework for the Identification of RPA suitable Processes

3.1 Roles, Group composition and Setting

Section 2.5.3 “Group Composition” described the importance of an appropriate group composition, as it might both influence the generation of ideas as well as their evaluation. This section will use the results from this section and describe how it is integrated within the workshop. This includes the different roles that should be taken during the workshop, its group composition and lastly the setting of the workshop.

3.1.1 Roles

Two roles should be present during the workshop, the facilitator and the participant. The role of the facilitator is to ‘facilitate’ the workshop. It is recommended to have 2 facilitators present during the workshop who will lead and assist the workshop participants. It is preferred to have at least one facilitator who is leading the RPA initiative, the RPA Business Champion, and one facilitator knowing the processes under scope, a Process Expert. A Business Champions is motivated to automate processes and notices opportunities with RPA. They are the ones already having some knowledge about RPA. A Business Champion’s role is to take the lead of finding RPA suitable processes and should be the one taking the lead and initiate the workshop. His or her task is to lead, prepare and present the workshop and answer questions during. Lastly, the Business Champion should have some basic understanding of the BPMN language, as this will be used for modelling during the second phase of the workshop. The Process Experts (the second facilitator) on the other side, assists the Business Champion with the preparation of the workshop, for example creating the Process Landscape, and helps with answering questions and filtering unique ideas during the first phase of the workshop.

The participants main task during the workshop is to think and evaluate about processes they are experienced with during their daily practices. Participants in this workshop will be process experts working within the same department or business unit of the organization. Their thinking and experiences are required for coming up with ideas and evaluating their colleague’s ideas.

3.1.2 Group Composition

As was made clear previously, the group composition during a brainstorm session influences the efficiency and effectiveness of the outcome. There are three important variables regarding the group composition during the workshop which are considered within the design of this workshop.

First, the number of participants. Within the design of this workshop the recommended number of participants is eight (n = 8). This number is chosen, because too many participants (>8) attending might cause too little time for everyone to explain their ideas and comment on them. In addition, having only two to three participants will also take away the purpose, namely having a group discuss ideas, therefore likely lowering the number of generated ideas.

Second, the participants should have different experiences regarding years of work and daily tasks performed. For instance, many companies have employees within a department or business unit having different rankings or specialities. This causes them to have different

knowledge about processes. For instance, a manager of a department is likely to know more processes than staff employees and is therefore likely to come up with different ideas. In addition, they often have a lot of experience with the processes and therefore knowing which generic paths most processes will go through. On the other side, managers are most of the time, as the name states, managing. This will make it less likely for them to know all ins and outs of the processes performed within the department. For this reason, it is also important to include employees on a more operational level, because of their daily experiences and them knowing how each process goes in more detail, which is important to know to assess RPA viability. Third and lastly, is it preferred to not only have employees knowing each other, but to also have external employees participating.

3.1.3 Setting

The workshop is recommended to be conducted virtually due to the use of digital tools during the workshop, such as Padlet, Draw.io and Excel files and also to face no limitations with regards to traveling by participants. On the other side, as was discussed in Chapter 2.5, being in front of a computer screen for several hours might lower motivation and proactive behaviour faster than a setting where everyone is physically present in one room. The Lorentz Centre (2021) recommends conducting a virtual workshop no longer than two hours. As a result, the workshop is split up into two sessions to account for this problem. In Chapter 4 a detailed descriptions of the sessions and the taken steps of the experiment are given.

Now that the desired group composition and setting are addressed, the overall process of the workshop will be explained, consisting out of two parts. The design of part 1 of the workshop consists out of the Process Identification phase. The design of part 2 consists out of the Process Discovery and Process Analysis phase.

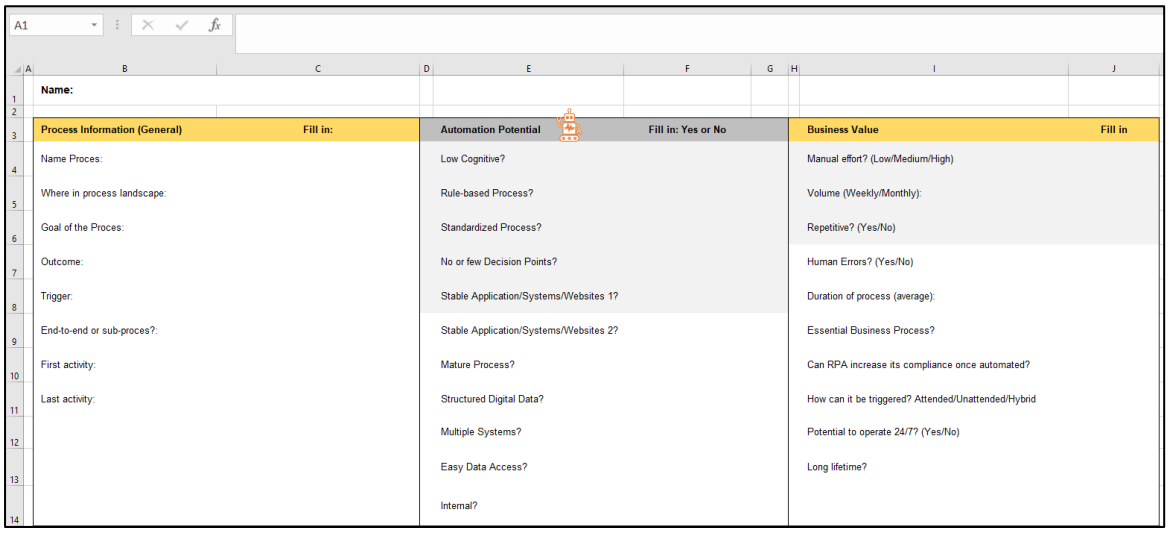
3.2 Process Identification

The first task to address during the workshop is to identify processes which have a probability of being automated via RPA. This is the first step of the BPM-Lifecycle and the first part of the workshop. This section describes the design of this first part, see Figure 3.1, consisting out of the Process Identification phase. The goal of part 1 is to extract processes that have the highest probability of being automated via RPA. As output these ideas are filled into Process Profile, as discusses in Section 2.3 “BPM Lifecycle”. This Process Profile is depicted in Figure 3.2. Notice, that this profile includes ‘General Process Information’, the ‘Automation Potential’ and the ‘Business Value’ as columns to be filled in. Process Information will help the other participants to get a better understanding of the process, whereas Automation Potential and Business Value will help determine whether a process can be suitable for RPA. However, before these Process Profiles can be filled in (the output), participants require input and perform the NBS technique.

3.2.1 Input Session 1

In order for participants to come up with initial processes suitable for RPA, certain input is required. This input refers to information that is required for participants to come up with the best ideas and to fill them into the Process Profiles. As is described by Slack and Brandon-

Jones (2019), it is important for decision-makers to know what RPA is and what its Primary Functions are in order to evaluate whether a process technology, such as RPA, can be applied within the business and will also deliver value. For this reason, the first sub-question was answered in Section 2.2 'RPA, its primary functions and process criteria', explaining what RPA is and listing its primary functions. An explanation of what RPA is and its 48 primary functions are used as input for participants to come up with suitable RPA processes. Furthermore, Dumas et al. (2013) stated that for finding the desired processes, in this case RPA suitable processes, criteria need to be setup and given to decision-makers (i.e., the participants). These Process Criteria were described in Section 2.2 and also serve as input for identification. The framework in Figure 3.1 shows the green coloured border within the 'input', representing RPA, its primary functions and the process criteria. An explanation of RPA, its primary functions and process criteria should first be explained within the first part of the workshop (see Figure 3.1, green coloured borders representing the RPA elements within the workshop).



Name:					
Process Information (General)	**Fill in:**	**Automation Potential**	**Fill in: Yes or No**	**Business Value**	**Fill in**
Name Proces:		Low Cognitive?		Manual effort? (Low/Medium/High)	
Where in process landscape:		Rule-based Process?		Volume (Weekly/Monthly):	
Goal of the Proces:		Standardized Process?		Repetitive? (Yes/No)	
Outcome:		No or few Decision Points?		Human Errors? (Yes/No)	
Trigger:		Stable Application/Systems/Websites 1?		Duration of process (average):	
End-to-end or sub-proces?:		Stable Application/Systems/Websites 2?		Essential Business Process?	
First activity:		Mature Process?		Can RPA increase its compliance once automated?	
Last activity:		Structured Digital Data?		How can it be triggered? Attended/Unattended/Hybrid	
		Multiple Systems?		Potential to operate 24/7? (Yes/No)	
		Easy Data Access?		Long lifetime?	
		Internal?			

Figure 3.2: Process Profile to be filled in by participants

In addition, a Process Landscape as described by Dumas et al. (2013) can be used to help participants with recalling every process within the business. Figure 3.3 shows an example of a Process Landscape. This Process Landscape is given to the participants is a support tool, as suggested by Dumas et al. (2013), and used as input for participants to help them recall all processes in scope.

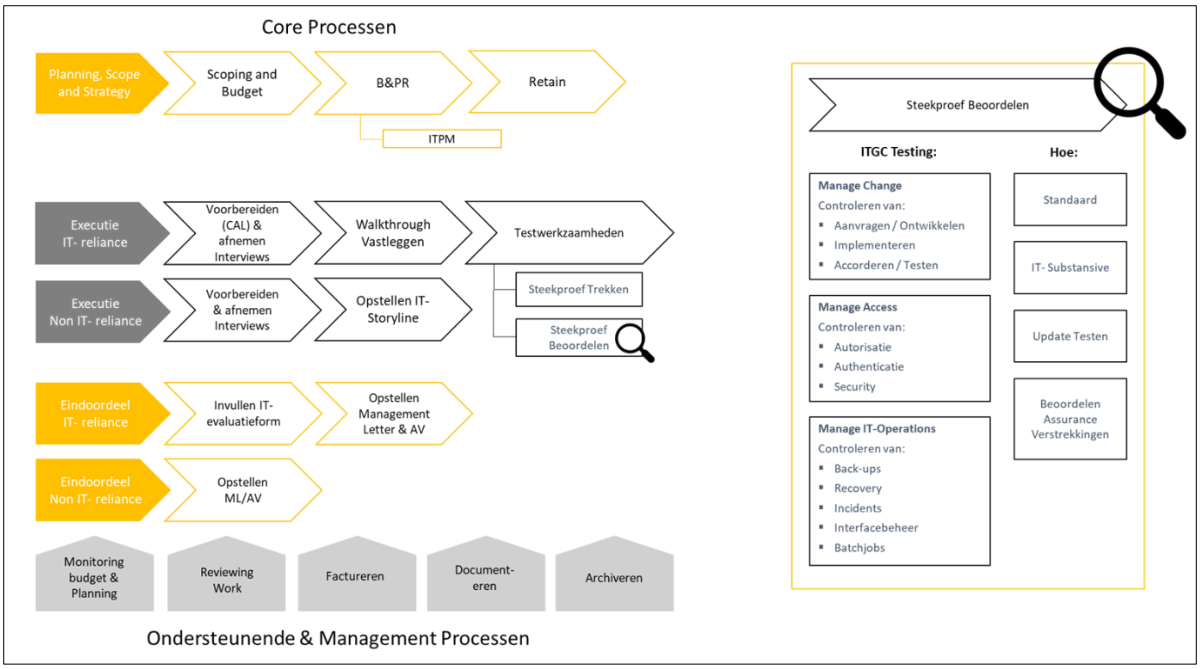


Figure 3.3: Example of a Process Landscape

All these elements, including the Primary Functions, Process Criteria, Process Profile and Process Landscape, should be made clear by the facilitator to the participants before Brainstorming begins.

3.2.2 Nominal Brainstorming Session 1

Just giving this information as input to the participants will not directly lead to the desired outcome of the workshop. Participants need to come up with ideas and discuss them with their colleagues. As a result of the SLR conducted in Chapter 2.5 “Brainstorming and Implications”, the Nominal Brainstorm (NBS) technique was chosen as the most suitable technique to let participants generate ideas and evaluate them effectively. The NBS is implemented according to the four steps of brainstorming, see Figure 3.4, and are represented by the blue coloured borders within the framework.

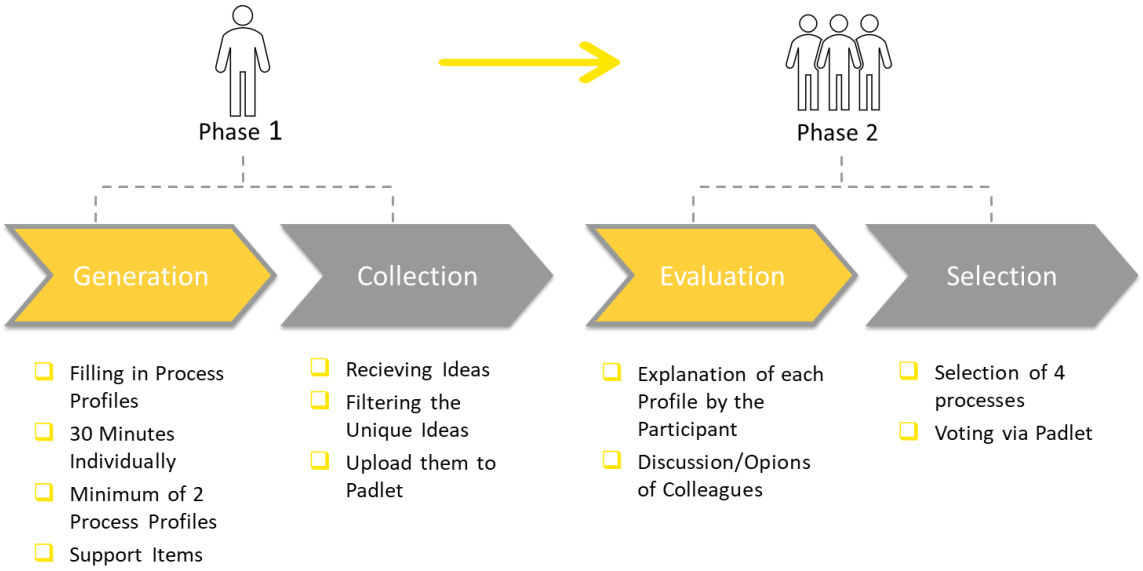


Figure 3.4: NBS Technique integrated within the Process Identification step of the Workshop

The Brainstorming part of the Process Identification step consists out of two phases. First, after participants received all the information (i.e., the input), they will each have a limited amount of time to come up with processes they think are suitable for automation via RPA. Within the framework of this workshop the time to fill in the Process Profiles is set to 30 minutes and the minimum amount of process profiles that must be filled in by participants is set to two. The reason for filling in two Profiles is to increase stimulation and avoid free riding. Support items, such as the Process Landscape, the Primary Functions and Process Criteria are given to the participants before the idea generation step occurs. Moreover, the brainstorming rules as described in Section 2.4 "Brainstorming" should be mentioned by the facilitator to the participants before the session starts. Rule number 4 however, stated that ideas can be built on each other, is optional. This is due to the debate about the effect on the quality of ideas when applying this rule.

After time is finished and participant individually filled in their ideas, the Process Profiles can be collected by the facilitators. Their task is to filter the duplicate processes to determine how many unique ideas there are. Next, each unique Process Profile must be explained by the participant stating why he or she thinks that this process might be a good candidate to be automated via RPA. Then the discussion can start, and comments can be made about whether the answers provided in the Process Profile are true. This part is important as it shows who agrees or disagrees with the idea. The facilitator should lead this discussion by managing time, minimize critique and giving everyone the chance to speak. After each idea has been explained and discussed, participants will get the opportunity to vote for the processes they think are most suitable. Within the framework of this workshop, it is recommended to select four processes. Therefore, each participant must select their top four processes.

3.2.3 Output Session 1

Based on the final voting, the output is generated, consisting out of four Process Profiles, see Figure 3.1. These 4 processes will be further assessed regarding RPA suitability during the second part of the workshop including the Process Discovery and Process Analyses phases.

3.3 Process Discovery and Process Analysis

The second phase of the workshop consists out of the Process Discovery and Process Analysis steps. During the Process Discovery step, processes will be visualized via a process modelling language to get a better understanding of the selected processes. Then, after modelling, the processes can be analysed to determine whether the Process Criteria still apply for them. The overall objective of this phase is to place the processes on the Process Portfolio by evaluating them based on their complexity and their added value to the business (Benefits of RPA). As a result, it will become clear whether RPA can cause a Quick Win or if it is too Limited to be implemented within the business. This phase follows the same steps as the previous phase by requiring input for participants to start modelling, nominal brainstorming to generate and evaluate the ideas, and the output consisting out of each process being positioned on the Process Portfolio.

3.3.1 Input Session 2

Process Modelling helps visualizing the process and therefore helps discovering its specific steps and activities. Moreover, it helps discovering any steps or activities that might not have been thought of during the Process Identification phase. In addition, it can help with getting a better understanding of activities requiring cognition or activities which involve decision making which might turn out to be too difficult for the robot to perform. Therefore, the objective of the Process Discovery step is to get a better understanding of the processes selected from the first phase, by explaining a BPMN language and letting the participants each model a Process Profile from the first phase. As mentioned in Section 2.3 ‘The BPM Lifecycle’, the BPMN-R language will be explained to the participants and serves as input for the process discovery phase. After the BPMN-R language is explained to the participants, an example or use case of a modelled process can be shown as input. Figure 3.5 shows an example created for the first experiment of the workshop and shows the process of a Power BI dashboard being weekly updated.

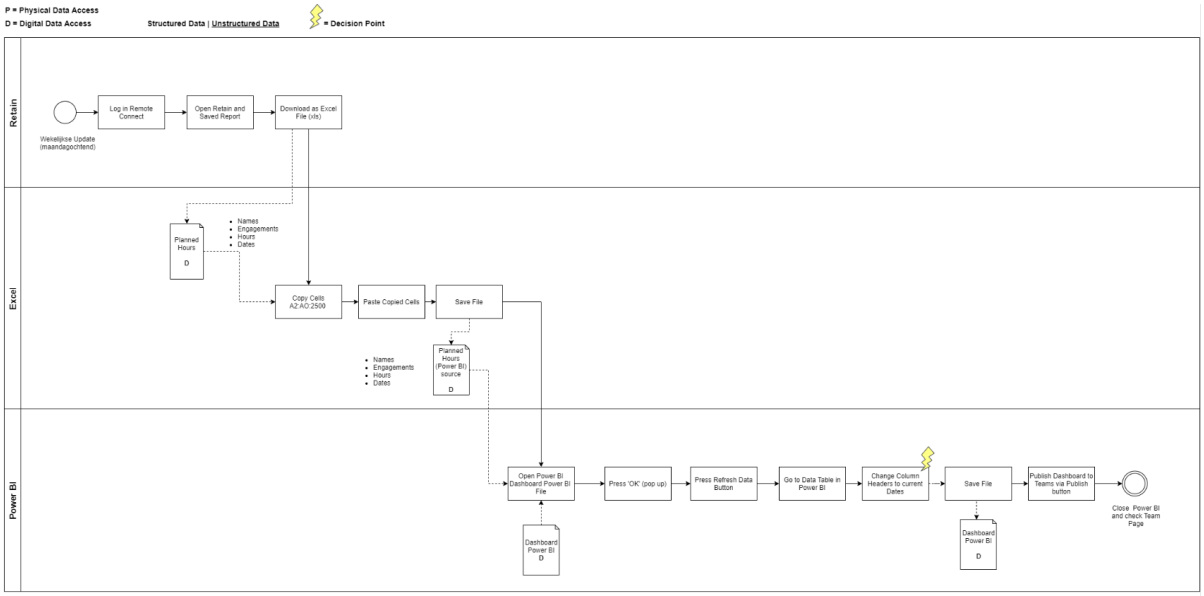


Figure 3.5: Example of Dashboard Updating process via BPMN-R

Each participant gets a Process Profile from part 1 assigned in order to model. A standard template within Draw.io with the specific notation for the BPMN-R language can be set up by the facilitator and send to each participant together with the filled in Process Profile from part 1 of the workshop.

3.3.2 Nominal Brainstorming Session 2

The Nominal Brainstorming technique is also be used during part 2 of the workshop, see Figure 3.1. As mentioned previously, each participant must first model a process individually for 30 minutes. The facilitators will help participants if any problems are being faced. The goal is to get the visualization of the process to be as complete and detailed as possible. For this reason, participants should first model the general steps of the process and then start adding the additional steps including more detail. Again, the general brainstorm rules are explained to the participants. Once time is finished, the processes can be collected. As a result, two models of each Process Profile have been created, as there are only 4 Profiles from the first part and 8 participants recommended to be present. The reason for having two participants model the same process is to have at least two persons think thoroughly enough about one process. This might stimulate a better discussion as each participant can have a different outcome.

Once time is finished, the participants can each show their model, so the models van be evaluated. Each participant again explains his or her model, so the group can discuss the model's completeness and representation. Once every model has been evaluated, the processes will be positioned somewhere within the Process Portfolio depending on the re-evaluation of the criteria by the participants. This positioning is discussed by the group of which each participant can give their opinion regarding the complexity of the process and its benefits of being automation via RPA.

3.3.3 Output Session 2

The output of part 2 consists out of the four modelled processes being positioned within the Process Portfolio, see figure 3.6, and is the final result of this workshop. The desired outcome for organizations wanting to assess RPA suitability is of course to find many processes that can be positioned at the top left, i.e., as Quick Wins. However, the group should stay critical and try to position each process as representative as possible by looking at the models and re-evaluating the process criteria.

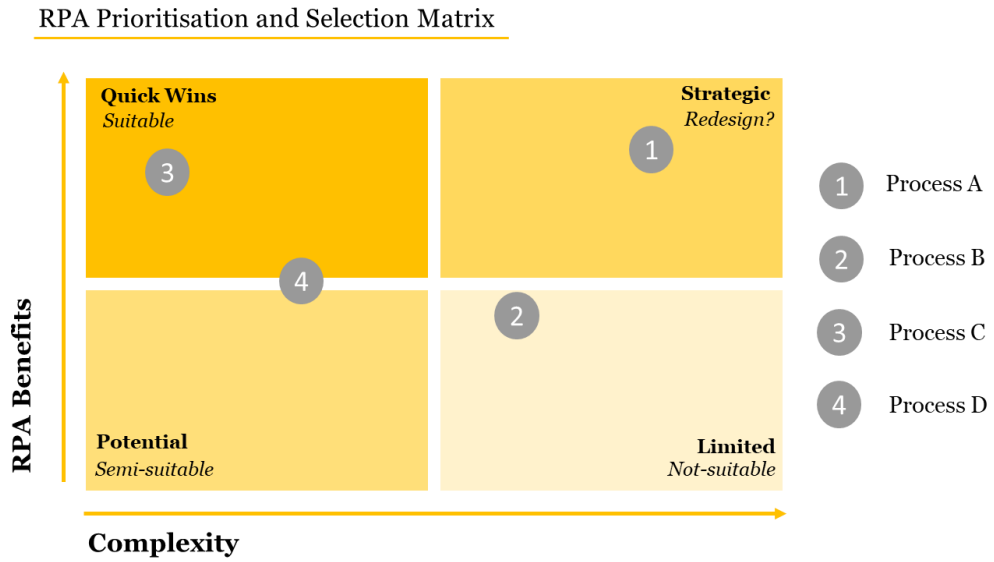


Figure 3.6: Output of processes positioned within the Process Portfolio Matrix.

3.4 Generic Design

This Chapter described the design and the generic process of steps to be taken to conduct the workshop. In addition, this created framework serves as a systematic approach towards the identification suitable RPA processes. Moreover it can be seen as a funnel, having a broad scope of processes in part 1 and reducing this scope to the evaluation of a few processes in part 2. Part 1 focuses on a 'rough' identification of suitable RPA processes by having participants fill in process profiles, based on an explanation of RPA, its primary functions, process criteria and the Process Landscape. In addition, the NBS technique is used to help with generating, collecting, evaluating and selecting the ideas of participants. As a result of the part 1, four processes are selected.

These four processes will be analysed in more detail by having participants model them in part 2. Modelling is done via the BPMN-R and where for each process two models are created by participants. Again, the NBS technique is used to help with modelling, collecting and evaluating the processes. After re-evaluating the process criteria per model, each model will be positioned within the Process Portfolio. As a result, this will indicate whether there are indeed suitable processes. How this framework is exactly used in practice is described in the next chapter. Here more details will be described about how each of the parts from the framework is conducted. Furthermore, the framework will be tested and, if required, improved.

4. Workshop Experiment and Results

To evaluate whether the Workshop Framework designed in the previous chapter will lead to the desired results, an experiment was conducted. This experiment describes the full process from initiation to the results and shows how the workshop can be set up in practice. First of all, some context about this experiment is given in Chapter 4.1. In this section background information is provided about an IT-audit department that wants to identify more RPA suitable processes, as they were at the start of their RPA journey. Chapter 4.2 describes the preparations made before the start of the workshop. Chapter 4.3 describes the full workshop setup of how it is conducted in practice. A table was created to show each step taken and a description per step is given. Chapter 4.4 then presents the results from the first phase of the workshop and Chapter 4.5 the results from the second phase of the workshop. As a result, both the process of the workshop and its outcome are evaluated.

4.1 Context

The workshop framework was tested within an IT-audit department at one of the big four audit firms located in the Netherlands. This IT-audit department has over 200 IT-auditors employed. Their tasks mostly consist of auditing IT processes relevant for the Annual Financial Statement reporting. Some of the processes within this department, ranging from core processes to management and supporting processes, are assumed to be quite repetitive and standardized. These include processes where accessing multiple systems is performed and processes requiring less cognitive effort. For this reason, the department has already started their RPA journey and are now experimenting with the implementation of two RPA robots. However, because of the department's wide range of tasks, and therefore processes, it is assumed by management that there are still processes left viable for RPA adoption.

4.2 Preparation

Before the workshop can be conducted, preparations are required. These preparations are likely to be executed by Business Champions, as they are the one facilitating the workshop. Preparation for this workshop mostly consists out of collecting examples, creating templates and preparing the presentation. In addition, appropriate participants should be contacted, fulfilling the group composition recommendations. Therefore, for the experiment, eight participants and a facilitator were contacted. The second facilitator was one of the managers within the department who had both interest as well as experience regarding RPA. Via this co-facilitator, names of potential participants were given of whom he thought were mostly interested in joining the RPA workshop, while still accounting for the recommended group composition. This resulted in a diverse group of participants with different roles and experiences. The group consisted out of three Staff IT-auditors, three Senior IT-auditors and two Managers.

Several templates were created before the workshop, such as the Process Profile, a Draw.io template and the Process Landscape. The first two templates were made by the Business Champion. The Process Landscape was made by interviewing three managers within the department, asking them which Core, Management and Supporting processes there are within

the IT-audit department. Appendix G shows the Process Landscape created for this workshop. Appendix H shows an empty Process Profile that will be filled in by the participants during the first phase of the workshop. Within Draw.io a simple template was made for the second phase of the workshop so that participants could directly start modelling (see figure 4.1).

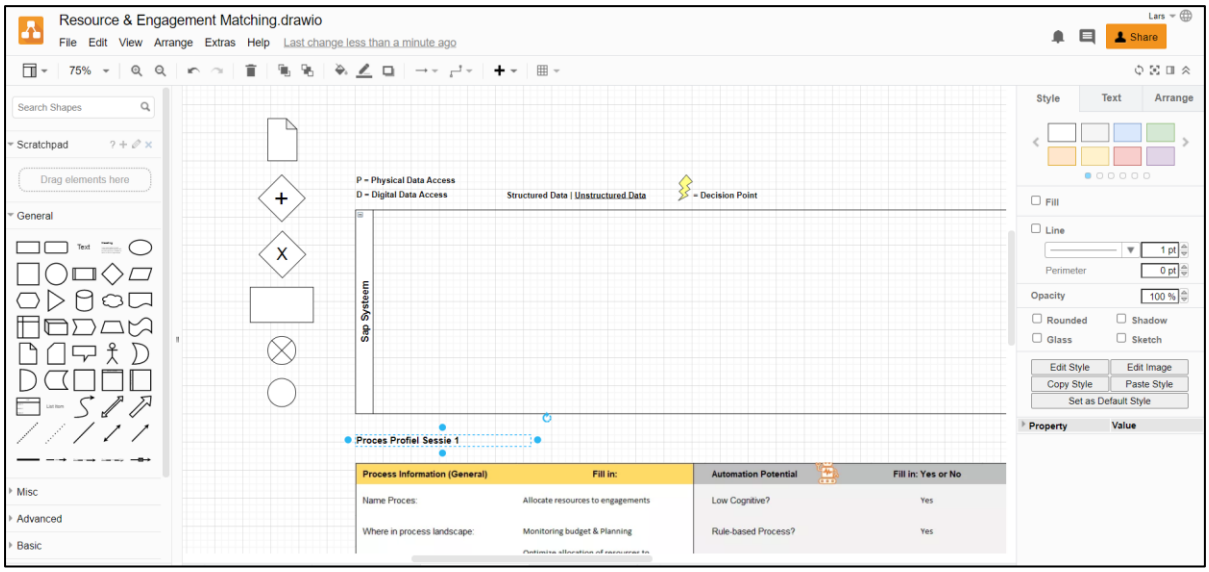


Figure 4.1: Draw.io template

4.3 Experiment

The workshop was conducted virtually and divided into two 2-hour sessions respectively to the two phases, 'Process Identification' and 'Process Discovery and Analysis' steps and spread over 2 days. Tables 4.1, 4.2 and 4.3 show the overall setup of the workshop and give an understanding of how the framework depicted in Figure 3.1 can be applied within practice for businesses wanting to identify suitable RPA processes. First, Table 4.1 shows the group composition of the experiment. Second, Table 4.2 shows part 1 of the workshop including its steps, approximate time and a description per step. Third and last, Table 4.3 shows part 2 including its steps, approximate time and description per step. Both sessions were conducted virtually via Microsoft Teams.

Noticeably, is that this composition, see Table 4.1, differs from the one described in the design of the workshop. Unfortunately, upon reaching the date of the first workshop session, three participants, consisting of two senior IT-auditor and one manager, had to cancel. As a result, the group composition became 5 participants and 2 facilitators. For this reason, it was decided to have the assistant facilitator (being a manager) join as a participant. Changing the role of this facilitator to a participant was seen as the best option for two reasons. First, having more participants is likely to equal more ideas. Second, having two managers will maintain the group diversity. As a result of having 6 participants, the selection of ideas during the first session went from 4 to 3, so it was still possible to have two participants model one process.

This brings us to another deviation between the experiment and the framework. During process modelling (session 2 step nr. 3), it was decided to let participants work together on modelling a process. At the end of session 1, three process profiles were selected to be modelled

during session 2. However, 2 out of the three processes consisted out of management and supporting processes. These processes are better understood by managers and senior IT-auditors than by staff members. For this reason, it was decided to create couples during the process modelling exercise. One staff member was coupled to either a manager or the senior IT-auditor. As this deviated from the original design of the workshop, it is argued that it negatively affected the outcome of the workshop, due to staff participants not having any or less experience with these processes. Moreover, the Lorentz Centre (2021) even state that using couples might positively affect the outcome, due to participants stimulating active participation to one another.

Table 4.1

Group composition of the first workshop experiment

Role	Facilitator	Participants
Nr. Present	1	6
Tasks	▪ Leads Workshop ▪ Answers Questions ▪ Stimulates discussion	▪ Generating Ideas ▪ Evaluating Ideas ▪ Selecting Ideas
Function	N/A	▪ 2 managers ▪ 1 Senior IT-Auditor ▪ 3 Staff Members

Table 4.2

Session 1: Process Identification: Detailed description of the steps taken (Approximate 2 hours)

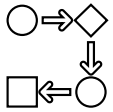
No.	Step	Image	Time (ca.)	Description
1.	Introduction to the Workshop & Session 1		10 min	First of all, a short introduction to the workshop is given to set the general objective of the workshop. During this introduction some background information about the workshop and its goal will be explained. It should be explicitly mentioned that the goal of the workshop is to find out if there are any processes within the department or organization (depending on the context) that can be (partly) automated by RPA. During this step it is also important to inform the participants what benefits the outcome of this workshop might imply for them. For instance, increasing the time employees can spent on more challenging tasks. Lastly, an explanation about the goal of session 1 is given, which is identifying processes and filling them into the Process Profiles. **Additional:** • Introduce the facilitators and participants to each other • Show a short video of a general RPA process to give participants an initial understanding • Participants can ask questions during the workshop.

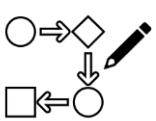
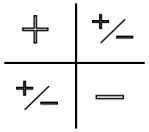
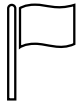
2.	Explaining Robotic Process Automation		30 min	During this step a detailed explanation about RPA will be given. RPA will be explained as written down in Chapter 2.2, including What RPA is, It's Primary Functions and the process criteria processes should possess in order to be suitable for RPA. In addition, different examples of processes where RPA is being used can be mentioned. For example, the procurement process, creating new customers or the onboarding process. What is most important during this step is to give the participants, i.e. the process experts, a well enough understanding of RPA and the process criteria. **Additional** • If available, some use cases can be shown (video material). • Primary functions that can be harder to understand should be shortly explained. • All process criteria should be explained and the most important once should be highlighted. • The Business Champion should be capable of answering questions from participants about the capabilities of RPA.
3.	Exercise: Generating Ideas (NBS)		45 min	During this step, the exercise for the participants is explained as well as the steps that are taken (Generating, Collecting, Evaluating and Selecting). It is important to be very clear about the goal of this exercise as well as its instruction, in order to avoid mistakes. The goal of this exercise is for participants to brainstorm individually (30 min) and fill in processes within the Process Profile (see Figure 3.1). The minimum amount of process profiles filled in by participants should be set to 2, to prevent free riding. A Padlet link will be created and send to the participants to upload their Process Profiles. Lastly, the general brainstorm rules should be mentioned to the participants before the exercise, see Section 2.5. **Additional:** • Participants will enter breakout rooms within Teams to work individually on their exercise. • The facilitators will enter during the exercise different breakout rooms to answer questions from participants. • Participants have received via email the Process Profile including the process criteria as well as two tools to support them with the generation of ideas. • These two tools are the Process Landscape and the listing of the Primary Functions, see Appendix F and G.
4.	Break, Collecting and Sorting the Ideas		10 min	Once the participants have uploaded all their process profiles to Padlet, all unique ideas are being sorted by the facilitators. For this reason, it is important to have a facilitator who is familiar with all of the processes that are in scope. He or she must evaluate which of the uploaded processes within Padlet are similar. During this step participants will have a ten-minute break.

5	Evaluating Ideas (NBS) and selecting top three		20 min	After the ideas have been collected and sorted, the process profiles will be evaluated and selected by the group. First, each of the unique ideas will be explained shortly by its creator. This explanation should include a short introduction to the process and the reason for thinking it might be suatable for RPA. Once the creator is finished explaining, other participants have the opportunity to ask questions and elaborate on the idea. During this step it is important that participants engage the discussion as this is one of the core elements of the workshop that distinguishes itself from other process selection method.
6	Selecting the Ideas by voting		3 min	After each unique idea has been discussed the selection step can take place. During this step, four processes will be selected to the next session. Every participant has to vote for four processes of which they think have the most RPA potential. This voting can be easily done in Padlet. Session 1 is ended once the voting is finished and therefore processes are selected.

Table 4.3

Session 2: Process Discovery and Process Analysis: Detailed description of the steps taken (Approximate 2 hours)

No.	Step	Image	Time (ca.)	Description
1.	Recap		5 min	Before starting with explaining the goal for the second session, a short recap of the results from session 1 will be given. This will help refresh the participants memory. Moreover, the goal of filling in the Process Portfolio can be explained.
2.	Explanation of BPMN(-R)		20 min	Participants will be introduced to the Business Process Modelling Notation (BPMN), explaining that it's a language consisting out of standard notations to model processes. At the beginning of this step the goal of this modelling should be explicitly explained, such as getting a better understanding of the process and re-evaluating the process criteria. **Additional:** • A use case or other example of a process, where RPA is yet implemented, can be modelled to show as an example (see Figure 3.5). • With this modelled example, process criteria can be re-evaluated.

3.	Exercise: Process Modelling via BPMN(-R)		30 min	After the BPMN(-R) language is clear to the participants, they can start with modelling one of the selected Process Profiles from session 1. Because there are eight participants present, one Process Profile will be modelled by two participants. As a result, a process will be modelled two times. Modelling can be done in www.draw.io. Again, each participant will be put into a breakout room for 30 minutes. **Additional:** • The focus should not be on the correct usage of the BPMN notations, but visualizing the process in a detailed way, so new insights will be obtained. • The facilitator can give a demonstration to the participants on how to use Draw.io • Participants will enter breakout rooms within Microsoft Teams to work individually on their exercise. • The facilitators will enter different breakout rooms, during the exercise, to answer questions from participants.
4.	Break		15 min	After time is finished, participants have the opportunity to catch a break for 15 minutes.
5.	Evaluating the Modelled Processes		25 min	Once the break is finished, participants will join the Teams meeting again to start a discussion about the completeness and accuracy of the modelled processes. Each participant will first share his or her screen to give a short explanation about the model including its different systems, gateways and activities. BPMN-R uses a 'bolt' as a notation that shows the requirement of a certain discussion. These bolts are especially important to evaluate as this might be a difficult step to execute for the robot. The facilitator will furthermore emphasize the importance of re-evaluating the Process Criteria. After each model is explained by its creator, participants can start the discussion by asking questions and comment.
6.	Positioning processes within the Matrix		10 min	The last step is to fill in the RPA Prioritization and Selection Matrix (i.e., Process Portfolio). This will be done as a group. Participants will give their opinion about where each of the processes should be positioned within the matrix. During this step it is important for the participants to reach a consensus. Therefore, it is the facilitator's task to let everyone share their opinion.
7.	Concluding		5 min	The facilitator will then thank everyone for their cooperation and effort.

4.4 Results from the Workshop

The goal of the first session was for participants to generate ideas and fill them into Process Profiles. While most of the participants managed to fill in a minimum of two Process Profiles, some came up with three or more. This lead to a total of 16 Process Profiles having collected, see Figure 4.2.

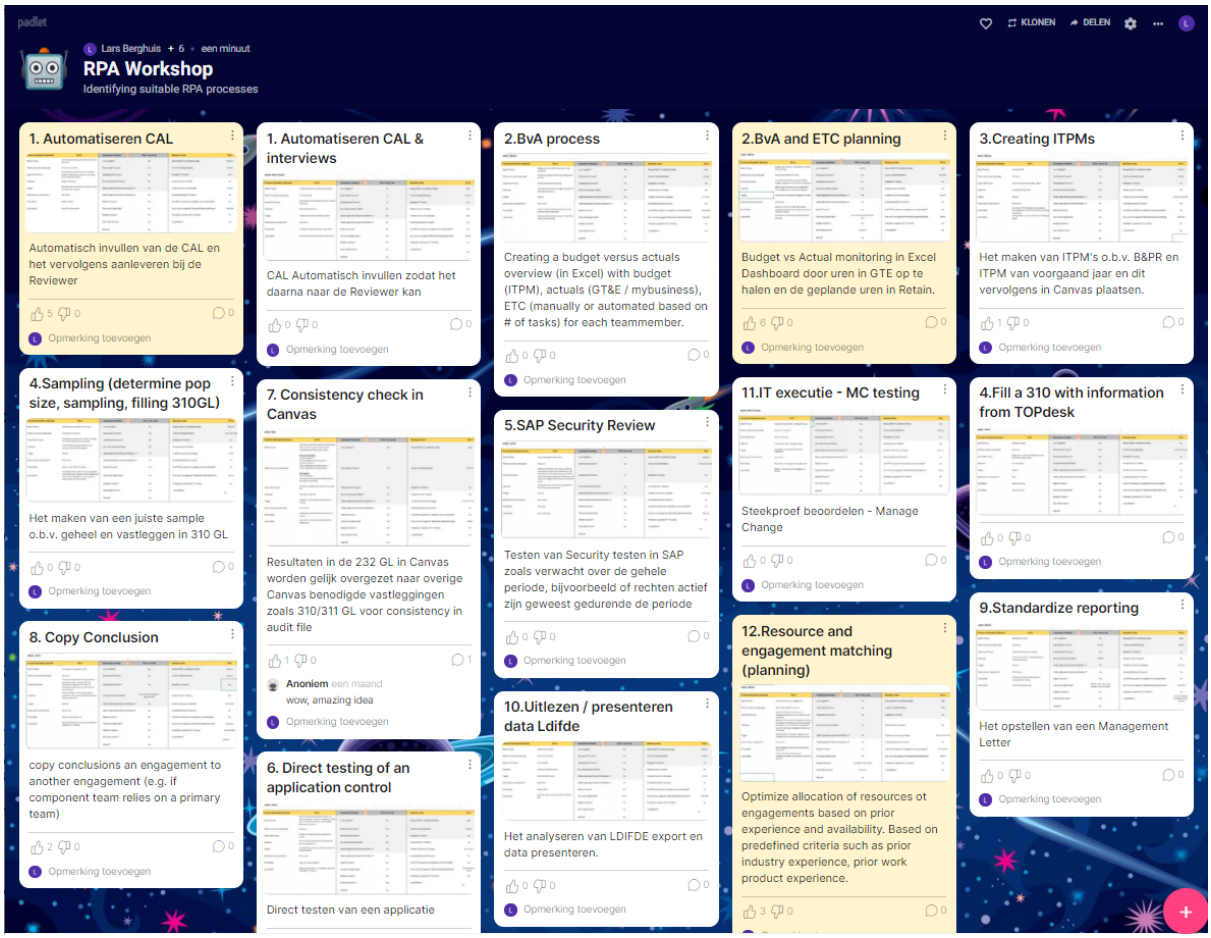


Figure 4.2: All 16 ideas generated by the participants

Once collected, all processes were numbered. Processes which were similar, received the same number to identify each unique idea. As a result, 12 unique ideas were identified. From here on, participants got 20 minutes to explain each of their ideas and start discussing about the accuracy of the Process Criteria and thus the suitability for RPA automation. After this discussion, participants had to vote on their top three. Table 4.4 shows the results of this voting.

Table 4.4

Processes voted on at the end of session 1 (Top three are highlighted).

Process Nr.	Nr. of Votes	Title	Description
2.	6	BvA and ETC Planning	Budget vs Actual Monitoring and Estimated Time Consumed in a Excel Dashboard by extracting data from time registration and budget application.
1.	5	Automating CAL	Filling in the client assistance letter automatically.
12.	3	Resource and Engagement matching (planning)	Optimize allocation of resources to engagements based on prior experience and availability. Based on predefined criteria such as prior industry experience, prior work product experience.
8.	2	Copy Conclusions	Copy conclusions of one engagement to another engagement.
7.	1	Consistency Checking in Filing application	Results from one file will be automatically transferred to another file within Filing Application.
3.	1	Creating ITPMs	Creating an IT planning memo based on the budget and planning application as well as the memo from last year.

Note: See figure 4.2 for references.

Three processes got selected at the end of session 1. These include the 'BvA and ETC Planning', 'Automating CAL' and the 'Resource and Engagement matching' process. Within the Process Landscape of the IT-audit department, two of these processes, Process Nr. 2 and 12, are Management and Support processes whereas process Nr. 1 is considered a Core process. Figure 4.3 shows the Process Profiles of the selected ideas. Out of the 12 uniquely identified processes, these are seen as the processes most likely to be suitable for RPA automation and taken to the next phase.

1.BvA and ETC Planning (Process Nr. 2)

Process Information (General)	Fill in:	Automation Potential	Fill in: Yes or No	Business Value	Fill in
Name Proces:	Budget versus Actuals + Estimate to Complete (ETC) planning	Low Cognitive?	Yes/No	Manual effort? (Low/Medium/High)	High
Where in process landscape:	Monitoring budget & Planning	Rule-based Process?	Yes	Volume (Weekly/Monthly):	Monthly
Goal of the Proces:	Automate BvA analyses to support better budget management and check with planning.	Standardized Process?	No	Repetitive? (Yes/No)	Yes
Outcome:	Beter budget monitoring and management, and management of planning accordingly.	No or few Decision Points?	Yes	Human Errors? (Yes/No)	Yes
Trigger:	Automated, monitoring of engagement codes	Stable Application/Systems/Websites 1?	Yes	Duration of process (average):	2 hours
End-to-end or sub-proces?:	Sub-proces	Stable Application/Systems/Websites 2?	Yes	Essential Business Process?	Yes
First activity:	Read hours writen in GT&E, percentage completed (estimate to complete), and hours planned in Retain	Mature Process?	Yes	Can RPA increase its compliance once automated?	Yes
Last activity:	Produce BvA and propose changes to Retain planning	Structured Digital Data?	Yes, majority (except for the ETC)	How can it be triggered? Attended/Unattended/Hybrid	Hybrid
		Multiple Systems?	Yes	Potential to operate 24/7? (Yes/No)	Yes
		Easy Data Access?	Unknown	Long lifetime?	Yes
		Internal?	Yes		

2.Automating CAL (Process Nr. 1)

Process Information (General)	Fill in:	Automation Potential	Fill in: Yes or No	Business Value	Fill in
Name Proces:	Automating requesting documentation from the client	Low Cognitive?	Yes	Manual effort? (Low/Medium/High)	Medium
Where in process landscape:	Execution (non) rely	Rule-based Process?	Yes	Volume (Weekly/Monthly):	Weekly
Goal of the Proces:	Automate generating the CAL by selecting relevent subjects (e.g. cyber in- or outscop, MO for SaaS application)	Standardized Process?	Yes	Repetitive? (Yes/No)	Semi
Outcome:	Ready to send CAL	No or few Decision Points?	No	Human Errors? (Yes/No)	Yes
Trigger:	Starting with a new client, and need to send a documentation request	Stable Application/Systems/Websites 1?	Yes	Duration of process (average):	30-45m
End-to-end or sub-proces?:	Sub proces	Stable Application/Systems/Websites 2?	n/a	Essential Business Process?	No
First activity:	Select subjects	Mature Process?	Yes	Can RPA increase its compliance once automated?	Yes
Last activity:	Extract Excel document	Structured Digital Data?	Yes	How can it be triggered? Attended/Unattended/Hybrid	Attended
		Multiple Systems?	No	Potential to operate 24/7? (Yes/No)	No
		Easy Data Access?	Yes	Long lifetime?	Yes
		Internal?	Yes		

3.Resource and Engagement Matching (Process Nr. 12)

Process Information (General)	Fill in:	Automation Potential	Fill in: Yes or No	Business Value	Fill in
Name Proces:	Allocate resources to engagements	Low Cognitive?	Yes	Manual effort? (Low/Medium/High)	High
Where in process landscape:	Monitoring budget & Planning	Rule-based Process?	Yes	Volume (Weekly/Monthly):	Daily
Goal of the Proces:	Optimize allocation of resources to engagements based on prior experience and availability	Standardized Process?	Yes	Repetitive? (Yes/No)	Yes
Outcome:	Allocation of resources to engagements based on predefined criteria such as: prior industry experience, prior work product experience (e.g. SOC reporting), engagement phase and availability.	No or few Decision Points?	Yes	Human Errors? (Yes/No)	Yes
Trigger:	Hybrid, based on initiation / registration of engagement and linked required resources.	Stable Application/Systems/Websites 1?	Yes	Duration of process (average):	40 hours per week
End-to-end or sub-proces?:	End-to-end	Stable Application/Systems/Websites 2?	Yes	Essential Business Process?	Yes
First activity:	Read engagements and required resources (vacancies)	Mature Process?	Yes	Can RPA increase its compliance once automated?	Not relevant
Last activity:	Submit allocaiton of resources to engagements based on predefined criteria for approval.	Structured Digital Data?	Yes	How can it be triggered? Attended/Unattended/Hybrid	Hybrid
		Multiple Systems?	Yes: BP&R, GT&E, Retain	Potential to operate 24/7? (Yes/No)	Yes
		Easy Data Access?	Unknown	Long lifetime?	Yes
		Internal?	Yes		

Figure 4.3: The three selected Process Profiles

The goal of the next phase was to model these three processes by using the BPMN-R language. Figure 4.4 shows the three modelled processes by the participants. A more detailed overview of the modelled processes can be found in Appendix E.

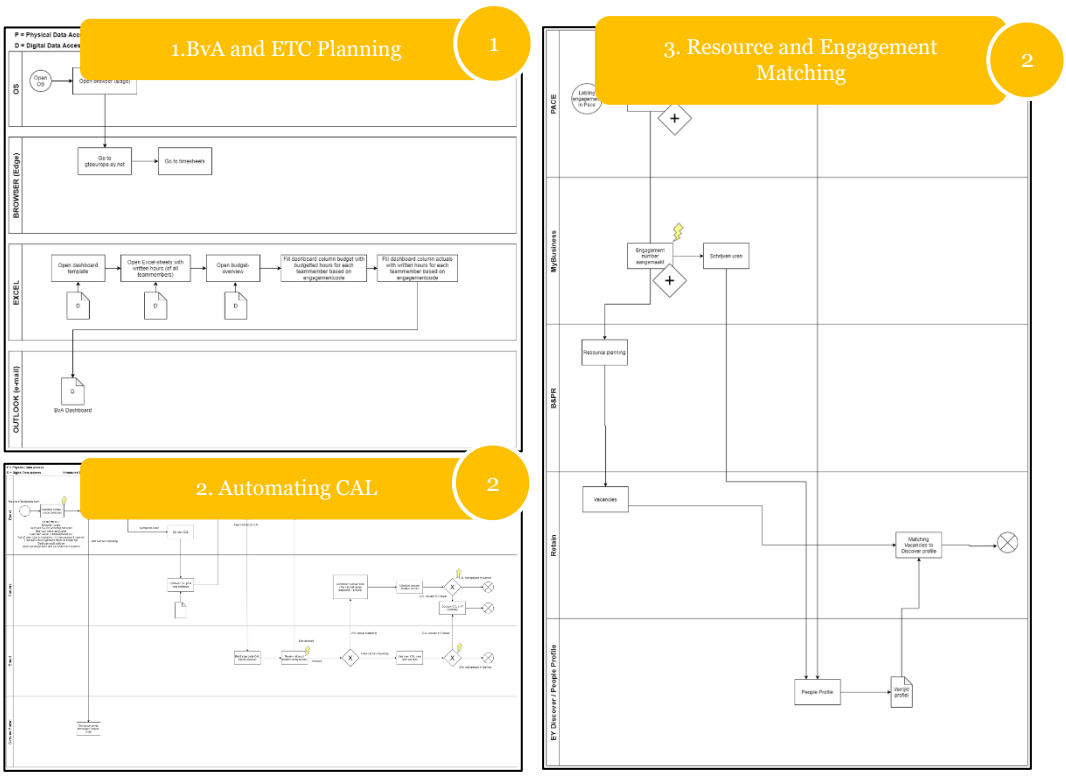


Figure 4.4: Three modelled processes resulted from the second phase

During the final part of the workshop, participants had to evaluate the three modelled processes based on their complexity to be automated as well as the benefits rising from this automation. Figure 4.5 shows the processes positioned within the 'RPA prioritisation and selection Matrix', as the outcome of the second session and thus the workshop. One of the processes, the BvA and ETC Planning process, was identified as a quick win for the IT-audit department.

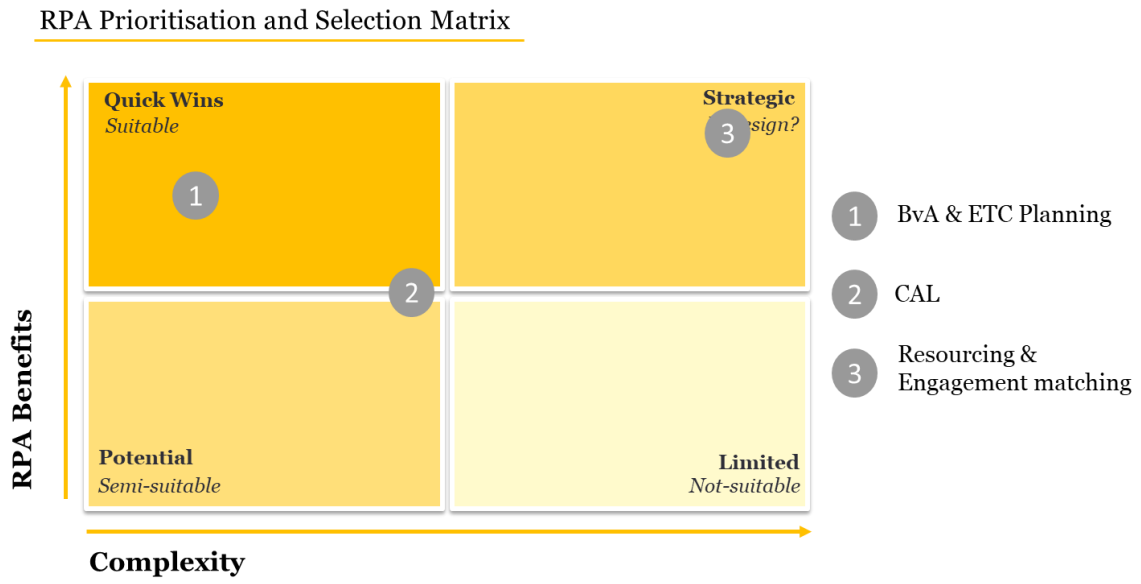


Figure 4.5: The final outcome of the workshop

PART III: Evaluation

5. Evaluation of the Workshop's Process and Outcome

In this chapter, the workshop's process and outcome are evaluated to answer sub-question 6 and the overall research question. Section 5.1 will evaluate the workshop's process as well as the workshop's outcome of the experiment by surveying participants and interviewing two RPA experts, evaluating the workshop's complexity and effectiveness. Section 5.2 will then describe the outcome of the survey. Based on the results of this survey, Section 5.3 will describe recommendations for improving the workshop. Section, 5.4 will show the results from the interviews with the RPA experts on the effectiveness of the workshop. These interview results help to understand whether participants identified valuable processes, selected the best ones, and evaluated these processes correctly. Lastly, based on these results, an answer to this study's research question is given.

5.1 Methodology for Evaluation

The validation of the workshop serves as the third phase of the design cycle and will be completed by surveying participants and interviewing two RPA experts. This validation determines whether the fourth phase of the design cycle, the treatment implementation, can be followed (Figure 5.1). This validation phase will address the sixth sub-question *'How did the designed workshop contribute to the identification of RPA suitable processes?'*. Again, the goal of this study is to create a less complex, systematic and still effective approach for the identification of RPA suitable processes. The first part of the treatment validation will focus on assessing the workshop's process and evaluate whether participants perceived all the elements of the workshop (i.e., filling in the Process Profile, modelling with the BPMN-R, etc.) as easy to understand and to apply. As a result, the complexity of the workshop can be assessed. In addition, further evaluation will be done by asking participants to give recommendations for further improvements of the design. The second part of the treatment validation will assess the effectiveness of the workshop's outcome by interviewing two RPA experts. By evaluating the treatment, it can become clear whether the workshop requires improvements and go through another iteration in the design cycle before implementation (Wieringa, 2014).

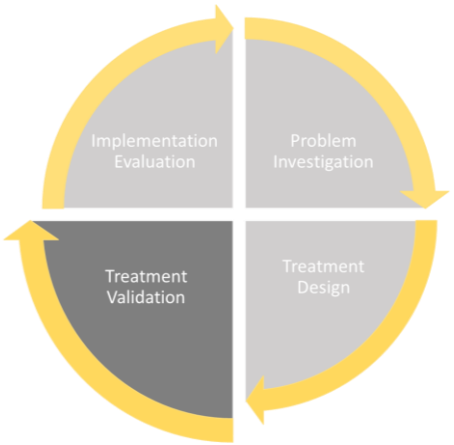


Figure 5.1: Treatment Validation

5.1.1 Workshop's Process Evaluation

The workshop design (i.e., the acceptance criteria of this study's artifact) was evaluated via a survey based on one created by Geissdoerfer, Bocken, & Hultink (2016). They developed a workshop that help organizations to look for sustainability opportunities and also aimed at creating a tool that can be used by other organizations. To evaluate the design of their workshop and to determine whether further adjustments have to be made, they let the participants fill in a survey asking their experiences with the overall workshop process and if they have any recommendations for future designs. In addition, their survey contains the

acceptance criteria this study aims for; User-friendliness, systematic and effectiveness, by focussing on the 'Ease of Use' of the tool and its 'Usability". Ease of use refers to whether the different elements within the workshop are made clear enough, easy to apply (complexity) and if the steps taken are clear (systematic). Furthermore, the perceived effectiveness of the different elements will be asked. Table 5.1 shows the survey provided to the participants after the workshop.

Table 5.1

Survey for Participants (1 = strongly disagree, 5 = strongly agree)

Statement	**1**	**2**	**3**	**4**	**5**
Ease of use:					
The goal of the workshop was made clear	o	o	o	o	o
I understand what RPA is.	o	o	o	o	o
I understand the Primary Functions of RPA.	o	o	o	o	o
I understand the Process Criteria for RPA suitability.	o	o	o	o	o
I understand the Process Landscape.	o	o	o	o	o
The Process Profile was easy to understand and apply.	o	o	o	o	o
The BPMN-R language was easy to understand and to apply.	o	o	o	o	o
The steps within the workshop were clear and easy to understand.	o	o	o	o	o
The facilitator gave a clear presentation.	o	o	o	o	o
Overall, I found the Workshop clear.	o	o	o	o	o
Useability:					
The Process Landscape helped me to identify potential RPA suitable processes?	o	o	o	o	o

The brainstorm sessions helped me to think of processes with automation potential.	o	o	o	o	o
The Process Profile was useful to evaluate the Process Criteria and thus RPA suitability.	o	o	o	o	o
I thought the BPMN-R language was useful to evaluate the Process Criteria and thus RPA suitability.	o	o	o	o	o
Overall, I found the Workshop to be effective.	o	o	o	o	o

What should be started, stopped, considered, and continued to be done in the workshop??

Started:

Stopped:

Considered:

Continued:

5.1.2 Workshop's Outcome Evaluation

The processes resulting from the workshop experiment were evaluated by interviewing two RPA experts. Two RPA experts, also working within the IT-audit, were interviewed to evaluate the resulting processes from the workshop. This was done in two phases. Within the first phase, RPA experts are shown all the Process Profiles resulted from the first session of the workshop. The experts then have to choose which one they will take with them to the next session where the chosen process profiles will be modelled. As a result, it can be evaluated whether participants have selected the best process profiles to model. In the second phase the process models are shown to the experts. They then, just as the participants, place the processes on the Process Portfolio. This will help evaluating whether participants scored the processes for RPA suitability well enough. The review protocol for the two interviews can be found in Appendix A.

Within a perfect situation, experts take the same process profiles to the next session as the participants and place the modelled processes on the same spot within the Process Portfolio as the participant. Hence, validating that participants have selected and placed the best ideas correctly.

5.2 Evaluation from Participants

At the end of the workshop, the six participants filled in the survey to assess the workshop's complexity, its perceived useability and to provide recommendations regarding the workshop. Asking the opinions of the participants will help with future improvements of the workshop. In addition, this survey can be seen as a tool for future research to evaluate the workshop within other contexts.

5.2.1 Complexity

The answers to the first ten questions of the survey show whether participants understood all the parts of the workshop and understood how to apply the different tooling. Such as understanding the Process Criteria and knowing how to apply the BPMN-R language. The outcome of this survey shows how easy the workshop is perceived by the participants and if parts such as applying the BPMN-R were not too difficult to apply. If so, this would interfere with one of this workshop's goals, creating a less complex process-selection method. Table 5.2 shows the outcome of this survey as well as some descriptive statistics per question and participant.

Table 5.2

Survey outcome regarding Ease of Use questions based on a 5-point Likert scale (1 = Strongly disagree, 5 = Strongly agree) (P=Participant).

Statement	P1	P2	P3	P4	P5	P6	Mean
1. The goal of the workshop was made clear	4	4	5	5	4	4	4,3
2. I understand what RPA is.	4	5	5	5	5	5	4,8
3. I understand the Primary Functions of RPA.	4	4	5	5	5	4	4,5
4. I understand the Process Criteria for RPA suitability.	5	4	4	5	5	5	4,7
5. I understand the Process Landscape.	4	4	4	4	5	4	4,2
6. The Process Profile was easy to understand and apply.	4	4	3	4	3	4	3,7
7. The BPMN-R language was easy to understand and to apply.	3	4	4	4	4	3	3,7

8. The steps within the workshop were clear and easy to understand.	5	4	4	4	3	4	4,0
9. The facilitator gave a clear presentation.	5	5	4	5	5	4	4,7
10. Overall, I found the Workshop clear.	5	5	4	4	5	4	4,5
Mean	4,3	4,3	4,2	4,5	4,4	4,1	

The result from the survey show that each participant scored above the average of 4 (*Mean > 4)*. Likely meaning that overall, the participants perceived the workshop as easy to be used. Looking at the scoring of each question, it can also be seen that most participants scored all of the questions above a mean of 4. This indicates that most of the participants either agreed or strongly agreed with the statements. However, statements 6 and 7 scored below an average of 4, they both have an average of 3.7. Looking at the scoring per participant, each participant scored statement 6 and 7 lower than a 5, but not lower than a 3. Statement 6 states 'The Process Profile was easy to understand and apply' and statement 7 states 'The BPMN-R language was easy to understand and to apply'. These two results show that some improvements can be made related to the Process Profile and the BPMN-R language. Improvements, for instance, by giving a more in-depth explanation or giving a live demonstration of how to apply the Process Profile and BPMN-R language to a process. In conclusion, the answers to the different statements show that in general participants agreed upon the workshop being easy to use and understandable.

5.2.2 Perceived Usability

The answers to statement 11 to 15, see Table 5.3, show whether participants perceived the different elements of the workshop and the overall workshop as effective. The answers to these questions give an indication about which of the workshop elements are perceived as effective and less effective. Table 5.3 shows the outcome of this survey as well as some descriptive statistics per question and participant.

Table 5.3

Survey outcome regarding Useability questions based on a 5-point Likert scale. (1 = Strongly disagree, 5 = Strongly agree) (P=Participant).

Statement	P1	P2	P3	P4	P5	P6	Mean
11. The Process Landscape helped me to identify potential RPA suitable processes.	4	3	4	3	4	4	3,7
12. The brainstorm sessions helped me to think of processes with automation potential.	3	4	2	5	4	5	3,8
13. The Process Profile was useful to evaluate the Process Criteria and thus RPA suitability.	5	4	3	4	4	5	4,2
14. I thought the BPMN-R language was useful to evaluate the Process Criteria and thus RPA suitability.	5	4	4	4	4	3	4,0
15. Overall, I found the Workshop to be effective.	4	5	4	4	5	5	4,5
Mean	4,2	4	3,4	4	4,2	4,4	

Looking at the Table with regards to the usability of the workshop, in general participants scored the overall useability of the workshop between 4 and 4,4. This means that most of the participants agree with each statement. Statement 11 and 12 stand out as they scored lower. With regards to statement 11, two participants stated that they neither agreed nor disagree with the Process Landscape to help them identify RPA suitable processes. However, 4 out of 6 participants still agreed with the Process Landscape being useful. With regards to statement 12, one participant scored it with a 2, indicating that the participant disagreed with the brainstorm session helping with thinking of process with automation potential. However, it should be noted that this same participant also recommended to perform the brainstorm session in couples. In conclusion, most of the participants either agreed with the statement or strongly agreed, indicating that most of the parts and tooling used during the workshop were perceived to effectively help identifying potential RPA processes.

5.2.3 Recommendations

The participants were also asked to give recommendations. Asking for what should be 'started', 'stopped', 'considered' and 'continued' to be done in the workshop. Each of the participants'

answers to question 16 to 19 are presented in Appendix I. This section will only address some of the more noticeable answers provided, which can help with future designs of the workshop.

Started/Added

To the question 'What should be added to the workshop?", two participants mentioned to add and show good practices. One of the participants mentioned it as followed: "*Showing best practices of RPA, even though there was a video. But besides this video, show a company including its RPA implementation*". Although, during the workshop an example was given of an RPA robot within a procurement process, two participants suggested to add a best practice example. For this reason, a new design of the workshop should include an example showing how an organization went from a manual process (AS-IS) to an RPA process (TO-BE).

Another recommendation made by two participants, was to increase the duration of some workshop parts. Specifically, more time with regards to the exchange and evaluation of the ideas and during the modelling of the processes. This was also noted by the researcher that more time was needed for the evaluation part of the first session and more time during process modelling.

Stopped/Removed

To the question 'What should be removed from the workshop?', three participants gave the same answer. All stated that the overall explanation was too long. One participant answered to the question the following: "*Overall it was an information overload (especially during the first section). Participants were quite IT minded and do have some prior knowledge regarding RPA. Therefore, you could reduce some of the time spend regarding explanation and instead give participants more time to do the exercises*". Because of the participants having some prior knowledge regarding RPA and processes, most of the explanation was easy to understand. While multiple examples were given, probably one would have sufficed. For this reason, the explanations given during the workshop, and therefore the design of the workshop, should be tailored to the context. In this case, IT auditors are quite familiar with process technology. Their answers show that time to exchange and evaluate ideas is rather required than time spent on explanations.

Continued

To the question "What should be continued?", multiple answers were given. Overall, participants mentioned to continue with the exercises during the workshop and especially the modelling of the processes (via BPMN-R). Also, the templates, such as the Process Profile and the Prioritization matrix were answered as elements of the workshop that should be kept. Therefore, the major parts of the workshop are perceived as relevant by the participants.

5.3 Analysis and Improvements of the Workshop Design

The evaluation of the workshop's process by the participants shows that some improvements to the design should be made. First, an improvement to the time management. The workshop should account for more time regarding the evaluation of ideas during the first session and the

modelling of the processes during the second session. However, as previously recommended, the workshop should not take longer than two hours. To avoid exceeding this duration, a solution might be to subtract some time from the explanation part as recommended by some participants, and to add the overhead time to the evaluation and modelling part. However, within different contexts (a less IT-minded context for instance) more time might be needed to give the explanation. In such a case, a solution might be to reduce the minimum amount of process profiles per participant to one instead of two.

Second, a future design of the workshop should include best practice examples to improve the explanation part. In the initial design, examples of processes being currently automated by RPA were given. However, participants suggested to include a best practice example showing a company's successful implementation of RPA to help participants get a better understanding when and why to automate a process via RPA. This can help participants with understanding how a manual process is converted to an automated one. As a result, participants might get a better understanding of what processes might be more suitable and come up with more ideas.

Lastly, the outcome of the survey showed that some of the participants neither agreed or disagreed to the statement that the process profile and BPMN-R language were easy to understand and to apply. For this reason, a future design could maybe extent explanation of these two elements, as they are the main artefacts during the exercises. A solution might be to give a live demonstration of filling in a process within the process profile and modelling a process.

5.4 Evaluation from an Expert

To evaluate whether the outcome of the workshop is effective, interviews with two experts were conducted. Both experts are experienced with the identification, development and implementation of RPA, work within the IT-audit department and are part of an innovation team within the department. They recently introduced a new robot within the IT-audit department. The interview protocol, as described in Appendix A, was used for the interviews.

5.4.1 Results from Part 1 of the interview

Part 1 of the interview evaluated the idea generation part of the workshop by assessing the capability of the group to generate qualitive ideas and select the best ones. Two separate interviews with the experts were held. At the beginning of the interviews the goal of the workshop was explained as well as its design.

After the introduction, the respondents were shown all the generated processes from session one and asked which three they would vote for and take to the next session. The respondents had to pick the processes they thought were most suitable for RPA implementation. Important to mention is that, during the evaluation, respondents did not see the selection of the participants nor would they see the number of votes given by the participants. The goal of the first part of this interview is to assess if participants generated and selected the best ideas. Figure 5.2 shows the processes voted by the respondents compared to the ones voted by the participants. The blue and red dots show the processes voted for by the respondents and the yellow dots show the processes voted for by the participants.

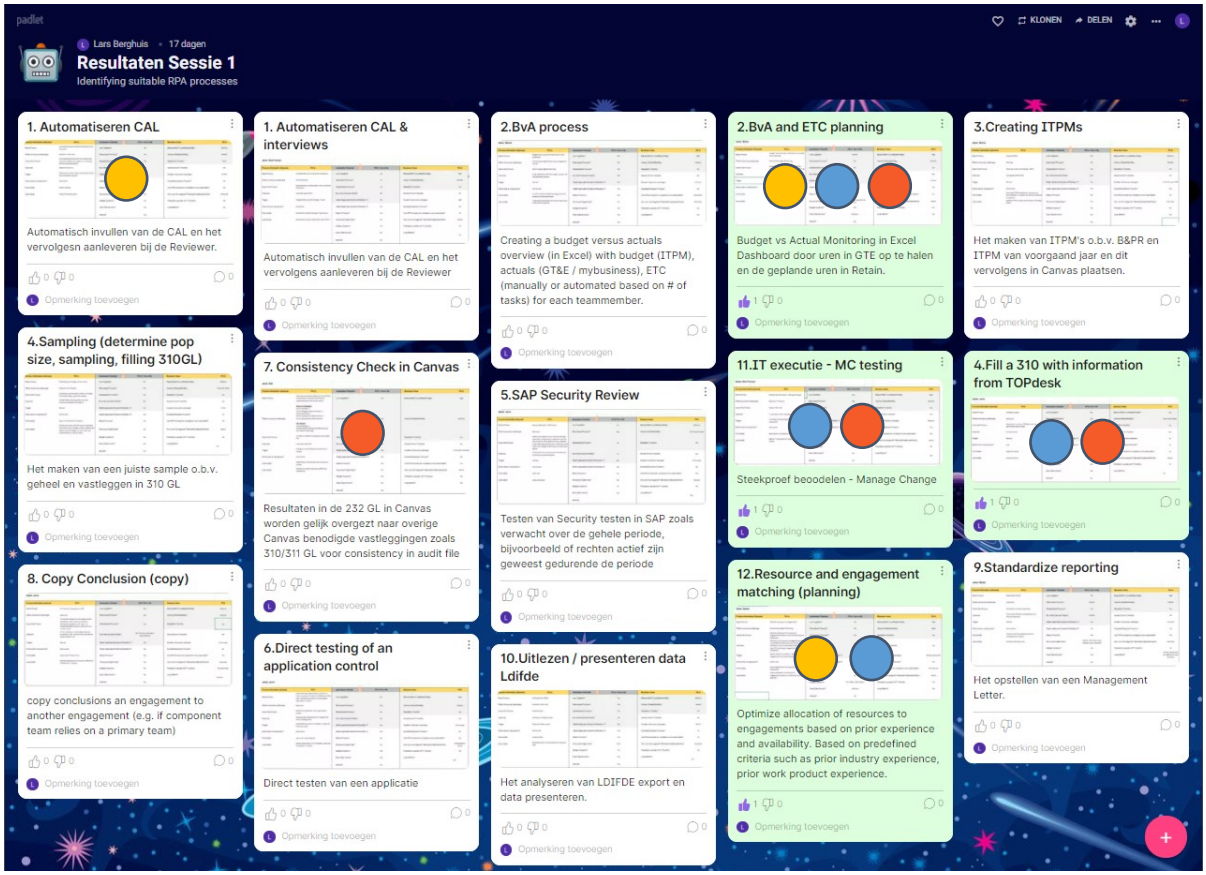


Figure 5.2: Processes voted for by the respondents compared to the processes voted for by the participants. (Blue = Respondent 1, Red = Respondent 2, Orange = Participants)

The outcome shown in Figure 5.2 shows three things. Firstly, both respondents and the participants selected process nr. 2 as best idea. This shows that participants did manage to select one of the best ideas. Secondly, while process number 12 was selected by respondent 1 and the participants, respondent 2 did not select this process. This indicates that there can also be a variation between the selection of experts. Thirdly, the respondents both chose process 4 and 11 (which should be seen as one process) to be taken to the next session. Process 4 and 11 refer to the process mentioned at the beginning 'evaluating the manage change process at the client'. Process number 4 is the first part of this process and number 11 is the second part. During both interviews, the respondents mentioned that this process was currently into a testing phase regarding RPA automation, and that it was expected to be implemented soon. This answer tells us two things. First, it shows that participants managed to come up with a good idea (because of the process now being automated via RPA). Second, unfortunately participants did not select either process 4 or 11, meaning that a suitable RPA process was left out for further evaluation. A reason for this could be due to the time constraints faced during evaluation as mentioned in the previous sector by both the researcher as well as the participants.

To further validate whether the most viable processes were selected from all the processes currently running within the IT-audit department (the total scope), the experts were asked "Do you think that there are more relevant processes suitable for RPA within the IT-audit department that have not been generated by the participants?". In other words, is the

innovation team considering other processes within the IT-audit to be automated via RPA. Besides the manage change processes, mentioned previously, one respondent notified that a 'Leaver control' is also further evaluated for RPA suitability. This leavers control refers to the process of employees leaving a company. Besides this process, no further processes were mentioned by the expert.

The relevant highlights from the evaluation of part 1 and its interpretation:

1) Participants were able to select 1 process that was selected by both respondents. Process nr. 2 received the most votes (total of 6) by participants and was selected by the RPA experts as one of the three most suitable processes for further evaluation. This shows that participants were capable of selecting one of the three best ideas.

2) While process nr. 4 and 11 were generated as ideas, they were not one of the top three selected processes by the participants. Both RPA experts choose this process as it was mentioned to be one currently being tested into practice. This indicates that participant missed out on one good idea.

3) The selection of the third process varied between the experts, showing that their judgement on RPA suitability could vary. While process nr. 12 is both selected by participants and one of the experts, the other RPA expert selected process nr. 7.

4) To Q5 (see appendix A) one of the RPA experts mentioned that one process was missing as generated idea. This shows that participants did not generate this idea as a process suitable for RPA. However, this answer by the RPA expert also shows that process nr. 2 is new to them.

5) Overall, these results show that one or two new potential RPA suited processes were identified by the participants. The next part will assess the evaluation of the experts, indicating whether one or more processes can serve as a 'Quick Win' or 'Strategic' choice to automate via RPA.

5.4.2 Results from Part 2 of the interview

The second part of the interview showed both respondents the three processes modelled by the participant. The respondents were then asked to position each of the process within the matrix, similar to the participants' task. Hence, determining whether participants were capable of effectively evaluating the processes. Figure 5.3 shows the blue dots which shows the positioning of the processes by Respondent 1, the dark-blue dots represent the positioning of the processes by Respondent 2 and the grey dots represent the positioning by the participants.

Looking at Figure 5.3, a remark about each process can be made. First, most noticeably is the positioning of process number 1, BvA & ETC Planning, by both participants and respondents. The positioning within the matrix shows that every thought this process was quick win. The dots show that this process is expected to be easily automated via RPA and that the business value will become rather high once automated. Not only does this indicate that respondents can select a potential highly suitable RPA process, their expectation about the process being a quick win was also correct. Second, regarding the idea of automating the CAL process, Respondent 1 and the participants nearly positioned it the same. However, related to the

complexity of automating this process, Respondent 2 (dark blue) estimated it to be more complex than the participants and Respondent 1. Just like the result from session 1, this shows that there is a variation in evaluation between the Respondents. Third and last, the positioning of process nr. 3, 'the Resource and Engagement Planning', shows that the participants were overestimating the business value that would arise from automating this process. Even though this process was positioned as a strategic opportunity by the participants, the Respondents tended towards a limited process.

The relevant highlights from the evaluation of part 2 are:

- Respondent 1, 2 and the participants all positioned the process nr.1 (BvA and ETC Planning) as a quick win.
- Participants overestimated the benefits of automating process nr.3 (Resourcing and Engagement Planning)
- Only taking into account the positioning of the respondents, process nr. 2 and 3 are leaning more towards a limited opportunity for RPA suitability.

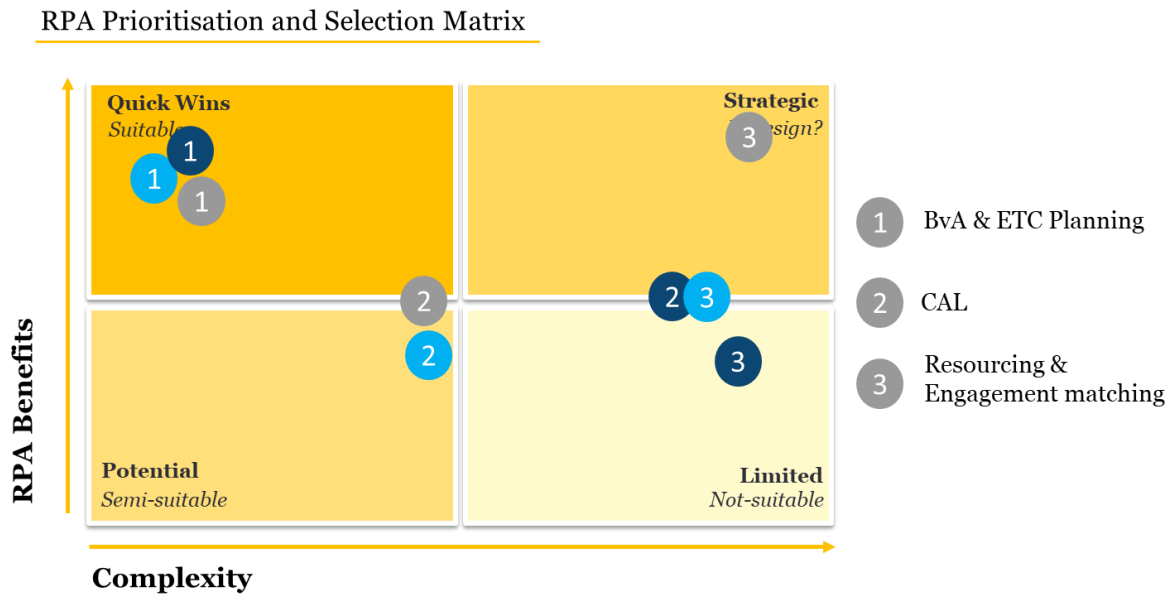


Figure 5.3: Positioning of the processes by the respondents, compared to the positioning of the processes by the participants. (blue = Respondent 1, dark blue = Respondent 2, grey = Participants).

5.5 Contribution of the Workshop

The results in the previous sector provide an answer to the last sub-question. Sub-question 6 states "*How did the designed workshop contribute to the identification of RPA suitable processes?*". With regards to the problems of current process selection methods, the creation of this workshop has tried to tackle these problems by:

1) Creating a process selection method lowering the complexity of identification. The survey outcome shows that the workshop was not perceived as complex by the participants.

Participants agreed that the overall workshop including its different elements were easy to understand and apply.

2) Creating a process selection method that is systematic. The designed workshop framework and detailed description show a step-by-step approach to conduct the workshop. In addition, the survey outcome showed that the taken steps were clear to the participants.

3) Creating a process selection method with an estimated duration of four hours. The workshop setup comprises 2 two-hour sessions spread over two days. Compared to other methods, this workshop consumes little time.

4) Creating a process selection method where ideas and views are directly discussed and evaluated. As a result, individualistic views about the process technology, process-steps and RPA suitability can either be validated or renounced.

5) Creating a method that helps identifying suitable RPA processes. The conducted workshop identified a process which was unanimously voted for and evaluated as a quick win by both participants and respondents. The process, resulted from the workshop, helped the IT-audit department with identifying a new RPA suitable process. Moreover, the outcome from the first session has shown that multiple unique ideas were generated (12 processes). As a result, the department might consider re-evaluating some of the processes.

6. Discussion

In the previous chapter, the workshop has shown its capability of identifying a suitable RPA process. This hapter makes some remarks as well as limitations about the results. In addition, this chapter discusses the theoretical and practical implications of the workshop and opportunities for future research.

6.1 Remarks

While the workshop has shown its contribution towards identifying a suitable process, there are two remarks to be made. First, while participants were able to select and evaluate one quality idea (2. BvA and ETC Planning process), one highly suitable process was not selected (4. Fill a 310 with information from Topdesk and 11. IT execution – MC Testing). The experts mentioned that this process was now nearing its implementation phase regarding RPA automation. This shows that even though a quality idea was generated, it did not proceed to the next session. In other words, if this process was not already currently being automated, the department would have missed out on a suitable RPA process. One cause for this might be, as suggested by the participants, the short duration of the evaluation step during the first session. Participants had 20 minutes time to evaluate and select the top three processes. However, due to the many unique ideas generated, not enough time was left to evaluate accordingly. As mentioned in the previous sector, an improved design should take this in account.

A second remark is that the workshop does not conclude whether a process should indeed be automated via RPA. The workshop rather gives an indication whether there are many ideas and whether these ideas are potentially viable for RPA automation. If a suitable process is identified, an organization should still assess whether RPA is the only solution. Penttinen, Kasslin, & Asatiani (2018) state that RPA should be seen as lightweight IT compared to traditional back-end automation as heavyweight IT. Back-end automation is more reliable and seen as a long-term solution. However, it is also more costly than RPA, due to the need for professional back-end developers. For this reason, it is important for an organization to carefully assess what option will create most value.

6.2 Limitations

A limitation of this study is the generalizability of the workshop's process and outcome. Due to time constraints, only one workshop could be conducted and evaluated. Therefore, only the results of one experiment were obtained. While these results did show participants coming up with multiple processes and identifying a suitable process, the previous remarks also show that one suitable process did not get selected. Therefore, the framework needs to be tested more extensively, especially when it is used for actual RPA implementations.

In addition, the setting of this workshop took place within an IT-audit department at a large audit firm. Most IT-auditors started working in this work field because of their interest in IT. As a result, the willingness to participate in this setting was rather high and a minimal amount of effort was needed to gather enough participants. However, within other settings this could

have different implications. For instance, if this workshop would be held with financial auditors, their willingness or motivation to participate could differ from that of the IT-auditors. For this reason, this workshop should also be tested within other departments and industries to test its generalizability and the willingness of other kinds of employees to engage with the project. Next to their affinity with IT, IT-auditors are experts at evaluating processes. This of course could be a huge contribution to the generation of qualitative ideas and the modelling of processes with BPMN-R. This can also be the reason why participants did not perceive the workshop as complex. Therefore, also the generalizability of the perceived complexity can be questioned as it is not yet clear whether qualitative ideas will pop up by people less experienced with processes or IT.

Another limitation of this study was to determine the true validity of the workshop's effectiveness. Even though a process was unanimously assigned as a quick win by participants and respondents, the process still needs to go through the other stages, such as tooling selection, development, implementation, and maintenance to truly determine whether the process can be marked as a quick win. Unexpected development issues can still occur. Although the workshop tries to identify processes that avoid these issues, the workshop's legitimate effectiveness can only be assessed after the workshop is conducted in multiple settings of which the outcome is then eventually automated. As a result, the outcome of the matrix can be compared with the outcome of the overall RPA automation.

6.3 Theoretical Implications

The results of this study have some important theoretical implications. First, as mentioned in the introduction, identifying RPA suitable processes is one of the key challenges for organizations that start their RPA journey. In addition, Enriquez et al. (2020) stated, that of all the phases within the RPA lifecycle, the analysis phase is the most neglected one within literature. This study has contributed to this by designing a new method to help organizations analyse their processes regarding RPA suitability. In addition, this study has shown how the three steps of the BPM lifecycle, in combination with the NBS technique, can be transformed into a workshop. This addresses one of the action calls mentioned by Syed et al., (2020), stating that literature from different disciplines need to be used to enhance the implementation phase during RPA projects. As a result of combining the BPM Lifecycle with NBS, this study managed to create a new process selection method aiming to be more systematic compared to alternatives. Wanner et al. (2020) has stated that current process selection methods lack such a systematic approach. This research has addressed this problem by describing a step-by-step workshop method.

This study has also contributed to literature by showing a method for organizations on how a workshop can be designed for BPM initiatives. While Dumas et al. (2013) mention a workshop as a method to address the lifecycle, no details about its setup are given. This study has shown Nominal brainstorming can help with creating such a setup, by integrating the steps of idea generation, collection, evaluation and selection within the process identification and discovery steps of the BPM-lifecycle. Moreover, during the initial literature review, few studies were found addressing the designing process of a workshop. This study has shown, by conducting a literature review and synthesising the results, how a framework for a workshop can be created.

Although, Geissdoerfer et al., (2016) showed how design thinking can help with the creation of a workshop, this study has shown how brainstorming can be used as method to help structure a workshop.

6.4 Practical Implications

Besides theoretical, this study also has important practical implications. The goal of this study was to create a tool, in the form of a workshop, for organizations to use as start for an RPA project and therefore improve RPA initiatives. As a result, the framework (Figure 3.1) and the detailed description (Table 4.1, 4.2 and 4.3) of the workshop can be used by organizations as a systematic method to assess whether there are RPA suitable processes within their business unit. This new method can both help businesses experienced with RPA as well as businesses without any RPA experiences. For organizations without any RPA experience, this workshop can be a useful as a kick-off for their RPA journey by helping to identify a Proof of Concept (POC). For organization that are already experienced with RPA, this workshop can help with gaining new insight. For instance, to determine whether there are more processes present within the business suitable for RPA. For this reason, an organization with experience can tweak the workshop by including the advanced functionalities of RPA. Hence, increasing the scope of potential RPA processes. Important is to have a Business Champion with some RPA knowledge, motivated to lead and organize the workshop.

Furthermore, this study wanted to create a workshop that can be easily adopted within different contexts. For this reason, the workshop can be tweaked dependent on the context. For instance, for organizations that have less IT-minded employees attending the workshop, more time can be spend on explaining RPA and reducing the minimum amount of process profiles. On the contrary, workshops including IT-minded employees can spend less time on the explanation of RPA and spend more time evaluating the processes. In conclusion, the workshop is adaptable to be conducted within every context.

Once an organization has conducted the workshop and identified a quick win, the next phase is to select an appropriate RPA tooling and start developing. The literature review has shown that the three market leaders are UiPath, Automation Anywhere and BluePrism. Each of these tooling provides a free to use version. These versions make many features available for mostly the development of attended robots on local hosts. For businesses new to RPA it is recommended to assess the differences between these vendors to see which tooling is most eligible to the business' identified processes. Moreover, if many processes are identified which require unattended bots, it is recommended to involve a tooling representative who can guide the organizations. Implementing unattended bots requires quite some effort for setting up the server and maintaining it.

With regards to development, a business can then either choose to outsource or to have their own employees start developing with RPA tooling. It is recommended to have employees start developing, so more knowledge about RPA's capabilities and the eligibility of processes within the firm will be gained. Having employees with hands on practice is likely to help with the identification of future RPA suitable processes. As mentioned before most RPA tooling provide a free version to use. However, this free version is not applicable for bigger organizations (i.e.,

companies not categorized as SME). A recommendation for organizations having their employees start developing RPA bots, is to make use of Test Driven Development (TDD) and screen recording as proposed by Cewe, Koch and Mertens (2018). Via this way the AS-IS processes identified from the workshop will be recorded and used for the employees to develop. This method can help with the quick development of a bot which aligns with the automation approach of RPA, namely being a fast way of automation.

6.5 Future research

By the creation of this workshop, there are opportunities for future research. First, to validate the design of the workshop such as a systematic, less time consuming and complex approach, the workshop needs to be further tested within different contexts to increase its external validity. Additionally, the effectiveness of the workshop compared to other process-selection methods needs to be tested, for instance, by comparing the outcome of process mining as a process selection method with the outcome of this workshop. If the outcome of these methods differs, both processes could go through an implementation process to see which one performs best. Such performance could be measured by looking at the benefits of both automated processes compared to the development and maintenance costs.

Furthermore, the true effectiveness of the workshop can only be validated if the process is eventually automated via RPA. Only then the real suitability of the process can be determined as to see whether quick wins are indeed quick wins and potential processes indeed potential processes for the implementation of RPA. Therefore, future research should study whether the identified process can indeed be automated. For example, by assessing the other stages, such as development, implementation, and the maintenance phase to see if the process could be automated according to the matrix outcome. For example, Flechsig, Lohmer and Lasch (2019) describe how an organization can follow the rest of these stages. This can, for instance, help organizations with firstly optimizing the process, before it goes into development. As a result, by combining the workshop with the stages of Flechsig, Lohmer and Lasch (2019), RPA projects might become more successful.

Another potential for future research is to assess whether the workshop can be used for the evaluation of other process technologies. Instead of assessing the implementation of RPA within a process, the workshop might be usable for assessing the implementation of other process technologies. For instance, Process Mining. Process Mining is a technique that can help visualize an organization's process to determine whether it is compliant or needs to be optimized (Van der Aalst, 2011) However, just as RPA, process criteria need to be evaluated. For Process Mining it is, for example, important that the process is enough digitalized so that it generates the correct event logs (Van der Aalst, 2011). By using the workshop, processes containing such criteria can be identified by the participants and modelled. Modelling these processes can help to see where bottlenecks related to systems and their event log availability occur. As a result, knowing if applying process mining can be a quick win or limited option.

7. Conclusion

More businesses are currently adopting Robotic Process Automation (RPA) as a fast way to automate their business processes. RPA is used to program digital robots to automate the often boring and repetitive tasks performed by employees. Through this automation, processes such as invoice processing, onboarding and payment reminders do not require any more human interaction. As a result, saving businesses FTE and increasing employee satisfaction by having them spend more time on cognitive tasks.

While more businesses recognize the potential of RPA and start their RPA journey, many of their initial projects tend to fail. A key reason for this failure is due to businesses struggling with the identification of suitable RPA processes. Automating the wrong processes causes businesses to face overly long development and requiring too much maintenance of the programmed bots, which leads to losses and disappointment. While existing methods, such as process mining, surveys and interviews, help identifying suitable RPA processes, they still fall short due to complexity, time consumption and individualistic views. This study introduced a workshop as a new way to identify processes, in which a group of process experts is brought together to generate ideas regarding suitable processes and evaluating them together. This resulted in the following research question:

'How can a workshop-based process selection method contribute to the identification of suitable business processes for the implementation of Robotic Process Automation?'

To answer this research question, 6 sub questions were formulated. The first 4 sub questions were formulated in order to collect all required information for designing the workshop. First of all, participants were required to understand what RPA is and what its primary functions are. This was necessary in order for participants to know whether RPA can automate any of their tasks. For this reason, sub question 1 was formulated as follows:

SQ1: 'What is RPA and what are its primary functions?'

To answer this question, a Systematic Literature Review was conducted. This review resulted in an explanation of RPA and 48 primary functions to be shared with participants. Next to knowing RPA and it primary functions, process criteria had to be identified in order for participants to know whether a process is suitable for RPA automation and therefore selecting the right processes. As a result, sub question 2 was formulated as follows:

SQ2: 'What criteria are of importance for the selection of business processes regarding the primary functions of RPA?'

A Systematic Literature Review and 2 interviews with RPA developers were conducted to answer this sub question. A total of 20 process criteria were eventually identified which were distinguished between a set of criteria referring to automation potential and a set referring to business value. Automation potential criteria indicate whether the process 'can' be automated

via RPA. Business value criteria indicate whether automation will deliver enough value. Evaluating processes based on both sets of criteria will help determine a process' RPA suitability. Furthermore, The Business Process Management (BPM) Lifecycle was proposed as a suitable model to serve a foundation for the workshop design. For this reason, sub question 3 was formulated as follows:

SQ3: 'What is the BPM Lifecycle and how can it function as a foundation for the workshop?'

The BPM Lifecycle is a model which can be used by organizations for identifying and optimizing processes. For the design of the workshop, the first 3 phases of this model, namely the Process Identification, Process Discovery and Process Analysis phase, were used as sequential steps for identifying and analysing RPA suitable processes as well as creating a systematic approach. In addition, a Process Landscape, Process Profile, BPMN-R and Process Portfolio were used within the workshop to enhance the identification. However, the BPM Lifecycle lacked elements regarding a proper structure and group composition for the generation of multiple qualitative ideas by the participants. A brainstorming technique was used to complement the BPM Lifecycle hereby. Therefore, sub question 4 was formulated as follows:

SQ4: 'What brainstorming technique complements the BPM-lifecycle best?

To answer this sub question, a Systematic Literature Review was conducted to assess different brainstorming techniques. The results of this review showed that the Nominal brainstorming (NBS) best complements the BPM Lifecycle. The NBS technique consists out of 4 phases, namely generating, collecting, evaluating and selecting ideas. It focusses mainly on having participants individually come up with ideas in order to prevent free riding, production blocking and evaluation apprehension. Therefore, the NBS technique was assumed to best complement the BPM Lifecycle. Based on the results of these 4 sub questions, the workshop was designed. For this reason, sub question 5 was formulated as follows:

SQ5: 'How can the workshop be designed based on the results of the previous four sub questions?'

The results from the previous 4 sub questions where synthesised, resulting in a framework presenting the generic process of the workshop. This framework can be found in Figure 3.1. This Framework consists of two parts. In part 1 participants fill in Process Profiles of processes which they believed are most suitable for RPA. Participants fill this in based on input, consisting of RPA, its primary functions and a Process Landscape and applying the NBS technique. The NBS technique let participants generate, evaluate and select ideas. In part 2 of the framework, participants model these selected Process Profiles based on the BPMN-R language. The NBS technique is again used, however this time to model, evaluate and position the processes. At the end of part 2, participants have to position each of the models within the

Process Portfolio. Here a process is either determined as a quick win, potential, strategic or limited choice to be automated via RPA.

This framework was then tested within an IT-audit department at one of the Technology Risk department of Ernst & Young, in order to know its contribution to the identification of suitable RPA processes. To evaluate the workshop, sub question 6 was formulated as follows:

SQ6: 'How did the designed workshop contribute to the identification of RPA suitable processes?'

To answer this question, the workshop was held and the participants filled out a questionnaire. Two interviews with RPA experts were conducted to evaluate the outcomes of the workshop. On the one hand, these results show that the workshop contributed to the identification of RPA suitable processes by identifying a process as a quick win for RPA adoption. During the workshop, twelve unique ideas were generated and the top three were selected by the participants. One of these three ideas was also selected by the RPA experts and evaluated as a quick win, showing that the workshop enabled participants to identify a suitable process. Furthermore, the survey outcome showed that participants perceived the workshop as easy to understand and easy to apply. On the other hand, the participants failed to point out two processes that were selected by the RPA experts. The workshop thus failed in enabling participants to identify all suitable processes. However, the participants gave suggestions to improve the workshop. They argued they needed more time during the evaluation part in the first session. They also suggested to add some examples of best practices. These improvements might increase the contribution of the workshop.

In answer to the main research question, this study shows that a workshop-based process selection method using the steps of the BPM Lifecycle, nominal brainstorming and sharing a definition of RPA, its primary function and process criteria potentially helps businesses to identify suitable RPA processes. In such a workshop, a group of process experts work through two parts: a process identification part, and a process discovery and analysis part. In part 1 they gain knowledge on RPA, its primary functions and process criteria. Then, they together generate, evaluate and select suitable processes by voting for the top 4 suitable processes. In part 2 they gain knowledge on the BPMN-R language. After that, participant model, evaluate and identify the selected processes from part 1 based on their RPA suitability. This may result in a selection of one or more potential suitable RPA processes (i.e., quick win or strategic choice). The workshop thus offers a systematic approach and can help participants with little knowledge of RPA to identify a suitable process. However, participants might not select all processes as the experts would select. It is therefore important to make sure that participants have enough time and knowledge to increase the contribution towards identification.

For organizations the workshop can be easily adapted, dependent on the context, once having a motivated Business Champion. For non-experienced organizations, the workshop can be used to identify a Proof of Concept (POC), as a kick-off for their RPA journey. For experienced organizations, the workshop can help to gain new insights and find new potential processes. Experienced organizations can adjust the workshop by including the advanced functionalities of RPA. However, this also asks for an experienced Business Champion. In addition, the

workshop can be adjusted to the context, for example to the rate in which employees are IT-minded. For less IT-minded employees, more time can be spent on explaining RPA. Furthermore, the amount of process profiles can be reduced. IT-minded employees might need less explanation of RPA and can spend more time evaluating the processes. Lastly, if a suitable process is found, a digital robot can be developed. One possibility for development is to hire an external consultant. Another option is to let an employee develop a digital bot by using one of the free to use RPA tooling. Through the latter, experience will be gained within the organization. This helps to discover and develop more RPA processes in the future.

This study has not only contributed to practice, but also to theory. Within current studies on RPA, the analysis phase is mostly neglected. This study has focussed on this phase by showing organizations a workshop as a method to analyse their processes. Furthermore, current process selection methods lack a systematic approach. This study developed such a systematic approach by combining the BPM Lifecycle with nominal brainstorming. Lastly, theory has suggested that workshops can be used to address the BPM Lifecycle but does not give clues on how to do so. This study has shown a way to go through the phases of the BPM Lifecycle by using a workshop.

Future research on RPA might focus on four different aspects. Firstly, the workshop needs further testing within different contexts to increase its external validity. Secondly, the effectiveness of the workshop can only be validated if the process is eventually automated via RPA. Future research should therefore study whether the identified processes can indeed be automated. Thirdly, the effectiveness of the workshop could be compared to other process-selection methods. Fourthly, the workshop might also be suitable for assessing the adoption of other process technologies, for instance process mining. Future research may assess this potential and see whether the wisdom of the crowd will help them with digitalizing.

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Appendix

Appendix A: Interview with an RPA Expert within the IT-audit:

To evaluate whether the workshop has led to the identification of RPA suitable processes, the ideas generated by the participants and their evaluation of RPA suitability needs to be assessed by an expert. This evaluation can then show whether the workshop managed to extract useful knowledge from the participants and their judgement on whether processes are suitable for RPA or not. Therefore, two experts have been approached. These two experts have experience with RPA projects related to identifying processes, developing robots and implementing them. In addition, these experts are both working within the IT-audit, which makes them perfect respondents for evaluating whether the workshop has led to RPA suitable processes.

Goal of the Interview:

The goal of the interview is to assess the effectiveness of the workshop and thus its effectiveness of finding RPA suitable processes. This assessment will happen through letting the respondent evaluate the generated ideas by participant and their evaluation regarding the suitability matrix (Figure 2.8). The interview consists out of two parts.

Part 1:

First, all the ideas generated by the participants during the first session will be shown to the respondent. The respondent then has to evaluate these ideas and, just as the participants, select the processes that he or she thinks are most suitable to address for the second session. By letting the respondent select, the researcher can evaluate whether the participants too selected the most suitable ideas (RPA Processes) for further evaluation. For instance, if the respondent selects three other processes than the participants did, it shows that participants weren't capable of selecting the most suitable RPA processes. This can of course be caused by multiple factors, such as participants not fully understanding RPA, its criteria, or status problems between members. As a result, the design of the workshop can be adjusted to solve these issues. The most optimal situation would be that RPA experts select the same processes as the participants, as this would indicate that the group managed to select the best ideas as non-RPA experts

Part 2:

The second part of the interview will show the modelled processes to the respondent. The respondent can then, just as the participants, decide where each of these processes belong on the matrix. As a result, the researcher can evaluate whether the processes were evaluated correct by the participants. With correct is hereby meant that participants did not over or underestimate process complexity and benefits.

Interview Protocol with RPA experts

Introduction:

- Introduction of the researcher.
- Introduction to the problem.
- Explaining the goal of this interview.

- Explaining and showing the workshop design.

Interview questions:

1. Who are you, what is your title and what experiences do you have with RPA?

Researcher shows generated RPA processes, explaining how they are generated and which of the processes are similar and which are unique.

2. After showing you all the generated processes by the participants, which of these processes do you think have the most potential for RPA and should be taken to the next session?
3. Why do you think that these are the most suitable?
4. Do you think that besides these three processes there are more processes generated by the participants suitable for RPA?
5. Do you think that there are more relevant processes suitable for RPA within the IT-audit department that have not been generated by the participants?

Researcher shows process models created by participants, explaining why and how they are created.

6. Looking at these modelled processes, where would you place the processes on the matrix?
7. Do you think that any of these processes should be initiated for further development?

Appendix B: List of Primary functions resulted from the SLR

Source	Primary Function	Conceptualization
Hofmann, Samp & Urbach (2019)	A software robot for example opens a new instance of Microsoft Excel, navigates to a specific spreadsheet, changes values in certain cells, and saves the spreadsheet before closing the application.	Opening applications
		Manipulate data
		Saving data
		closing applications
Hofmann, Samp & Urbach (2019)	data entry, the generation of mass emails, archiving, and the conversion of data format and graphics	Entering Data
		Generating Emails
		Archiving
		Converting Data
Hofmann, Samp & Urbach (2019)	Bots deal with structured and unstructured data.	Dealing with structured data
		Dealing with unstructured data
Hofmann, Samp & Urbach (2019)	Data caching, data encryption, uploading files	Data caching
		Data encryption
		Uploading files
Hofmann, Samp & Urbach 2019	Encode files	Encode Files
Hofmann, Samp & Urbach (2019)	Processing speech into text, optical character recognition	Processing speech tot tekst
		OCR
Hofmann, Samp & Urbach (2019)	Change values in a spreadsheet, access the IS with credentials	Logging in
		Manipulate data
Hofmann, Samp & Urbach (2019)	Posting information on social media platforms	Posting information on Social Media
Hofmann, Samp & Urbach (2019)	Click, drag, expand, close	Expanding
		Clicking
		Dragging
Hofmann, Samp & Urbach (2019)	Detecting file changes, trigger by image appearance, trigger by hot key	Detecting file changes
		Trigger by image appearance
		Trigger by hot key
Hofmann, Samp & Urbach (2019)	Loops, branches, user interactions	(for/while) Loops
		Branches
		User interaction
Hofmann, Samp & Urbach (2019)	However, our tool analysis indicates that RPA also includes elements of accessing business logic and data access layers. Thus, restricting software robots to only actions within the presentation layer does not use RPA's ful potential. Examples include the functional elements of application operator, data transfer, and (cloud) service operator	API integrations
Willcocks, Lacity & Craig (2015)	The first set of generic tools is what I'll call desktop RPAtools like macros, scripting and screen-scraping technologies that offer fast record functionality. The product records what a user does from his/her desktop and captures keystrokes and mouse clicks.	Recording of steps
Willcocks, Lacity & Craig (2015)	The robot can be configured to pull and execute a number of tasks from the component library, like logging on and off multiple systems of record while executing rules.	Component Library
		Logging in
		Logging off
Huan & Vasarhelyi (2019)	An example of the RPA process is the automated retrieval of information from one system and entering of the same information	Extracting Data
		Activating functions within applications

	into another system or activating another system function.	Entering Data
Huan & Vasarhelyi (2019)	validating data, accessing the database, creating documents, and uploading the repository	Validating Data
		Accessing databases
		creating documents
		uploading the repository
Huan & Vasarhelyi (2019)	Most RPA software is equipped with optical character recognition (OCR) and is able to transfer unstructured information (such as images) to textual format.	OCR
		Dealing with unstructured data
Huan & Vasarhelyi (2019)	The following activities were selected: 1) open Internet Explorer browser, 2) go to URL: www.edu.confimation.com,5 3) type userID, 4) type password, and 5) click “Log in” button. Appendix A displays the activities for this step. For some steps, it is necessary to make a judgment, but these judgments can be made based on explicit, deterministic if-then rules. For example, to check whether the client portfolio exists, the program needs to search for the client name and read the output. If the output shows that no existing record for this client exists, the program will automatically trigger the activity of generating a new client portfolio.	Opening Internet browsers
		Locating URL's
		Loggins
		If-then-else rules
Moffit et al. (2018)	For instance, RPA can automate revenue reconciliations by (1) logging in to the server, (2) entering a query to search for the revenue listing and trial balance, (3) extracting the revenue transaction listing and trial balance, (4) importing the revenue transaction listing and the trial balance to Excel or IDEA, (5) calculating the total per revenue transaction listing, and (6) comparing the total per the listing to the total reported in the trial balance revenue account (Moffitt et al., 2018).	Logging in server
		Entering queries
		Extracting Data
		Calculations
		Validating Data
Deloitte (n.d.)	First and foremost, RPA robots conduct work the same way that humans do, through the software presentation layer. Logins, emails, analyses, report building, data entry, and other functions are still completed. RPA robots can be compared to the recorded macros in Excel that automate specific tasks. The primary difference between the two is that RPA “macros” can be recorded to work with virtually any existing desktop or server software	Logins
		Emailing
		Analyses
		Report building
		Entering data
Deloitte (n.d.)	Open, read, and create emails	Opening mails
		Reading mails
		Creating mails
Deloitte (n.d.)	Log in to enterprise apps	Loggins
Deloitte (n.d.)	Move files and folders	Moving files and folders
Deloitte (n.d.)	Copy/paste	Copy/Pasting
Deloitte (n.d.)	Fill in forms	Entering Data
Deloitte (n.d.)	Read/write to database	Reading databases
		Writing to databases

Deloitte (n.d.)	Follow decision rules	If-then-else rules
Deloitte (n.d.)	Collect statistics	Collecting statistics
Deloitte (n.d.)	Extract data from documents	Extracting Data
Deloitte (n.d.)	Make calculations	Calculations
Deloitte (n.d.)	Obtain human input via emails/workflow	Obtain human input
Deloitte (n.d.)	Pull data from the internet	Pulling data from the web
Mullakara & Asokan (2020)	Opening email and attachments	Opening mails
		Opening Attachments
Mullakara & Asokan (2020)	Copying and pasting	Copy/Pasting
Mullakara & Asokan (2020)	Following "If/then" decisions/rules	If-then-else rules
Mullakara & Asokan (2020)	Making Calculations	Calculations
Mullakara & Asokan (2020)	Logging into web/enterprise-applications	Loggins
Mullakara & Asokan (2020)	Filling in forms	Entering Data
Mullakara & Asokan (2020)	Collecting social media statistics	Collecting statistics
Mullakara & Asokan (2020)	Conncecting to system API's	API integrations
Mullakara & Asokan (2020)	Reading and writing to databases	Reading databases
		Writing to databases
Mullakara & Asokan (2020)	Moving files and folders	Moving files and folders
Mullakara & Asokan (2020)	Extracting structured data from documents	Extracting Data
Mullakara & Asokan (2020)	Scarping data from the web	Webscraping
Siderska (2020)	flawless work with multiple systems, interconnecting many computer applications and systems (e.g. PDF, MS Excel, ERP system, PowerPoint etc.);	API integrations with PDF, MS Office applications and ERP systems
Siderska (2020)	a possibility to personalise a solution for an individual user, extract specific information from e-mails and respond with security procedures and data confidentiality;	Extracting Data
Siderska (2020)	Such solutions are userconfigurable, do not require code writing and use non-invasive techniques (operating on HTML pages, “screen scraping” or scripts that enable work in many different environments, e.g. ERP, CRM, workflow, or email programs).	Screenscraping
Siderska (2020)	Report generation, data entry and analysis	Report building
		Entering data
		Analyzing data
Siderska (2020)	Database replenishment	Database Replenishment
Siderska (2020)	Revenue forecasting	Forecasting
Siderska (2020)	Data updating in CRM/ERP transactions	Updating Data in CRM/ERP
Siderska (2020)	Process lists and file storage	Processing lists
		Storing files
Siderska (2020)	Data migration, replication and validation	Replicating Data
		Validating Data

		Migrating Data
Siderska (2020)	typing	Typing
Siderska (2020)	copying/pasting	Copy/Pasting
Siderska (2020)	Extracting	Extracting Data
Siderska (2020)	merging	Merging Data
Siderska (2020)	moving	Moving Data
Ribeiro et al. (2021)	WinAutomation is aimed at desktop environments that have built-in process design, desktop automation, web automation, macro recording, multitasking, automatic task execution, mouse and keyboard automation, User Interface designer, email automation, excel automation, file and folder automation, system monitoring and triggering, auto-login, security, File Transfer Protocol automation, exception handling, repository and	Exception handling
		Email Automation
		Keyboard and mouse automation
		Multitasking
		Excel Automation
		Process design
		File and folder automation
		File transfer protocol automation
Ribeiro et al. (2021)	control images, command line control, web data extraction, PDF automation, scripting, OCR capabilities, computer vision, non-participatory and participatory automation, advanced synchronization, auditing and logs, web recorder, inactive and non-interactive execution, database and SQL, cognitive and terminal emulation	PDF Automation
		OCR
		Computer vision
		Repository and control images
		Command line control
		Auditing and Logging
		Web recording
		recorder, inactive and non-interactive execution
		Cognitive and terminal emulation
		Webscraping
Ribeiro et al. (2021)	In terms of RPA functionalities, the tool provides a set of modules through the “processrobot” module and through a partnership with the company CaptureFast allows to extend its RPA functionalities with information capture engines using AI, data extraction in documents and systems automatic and hybrid document classification. Based on the analyzed literature [42-45], the Cognitive module allows integrating the functionalities with the analytical information analysis engines from Microsoft, IBM and Google's Cognitive. However, it appears that at the level of availability of AI functionalities, the tools do not present evidence. (KOFAX)	Document data extraction
		Document classification
Ribeiro et al. (2021)	The Automagica tool [50] is proprietary with an opensource version (for non-commercial purposes), with its code being made available on GitHub [51]. Developed mainly in the Python language, it can be exploited by other implementations by the community (e.g. of AI techniques or algorithms). Among the basic features of RPA, such as reading OCR, extracting texts from PDF files, automating information in word files, excel, information collected via the browser and creating automation processes, it also allows interconnection with Google Tensorflow for image and text recognition.	Image Recognition
		Text Recognition

Ribeiro et al. (2021)	We conclude that most of the proprietary tools implement algorithms associated with the objectives of AI, such as recognition, optimization, classification and extraction of knowledge from either RPA documents or processes. It also enhances their optimization and exploration of the information by the users of these applications. The AI techniques and algorithms that these tools implement, focus on computer vision (image recognition using for example Artificial Neural Networks), statistical methods, decision trees, neural networks for classification and prediction, fuzzy logic and implementation of techniques associated with text mining, natural language processing and recommendation systems.	Computer vision
		Statiscal methods
		Tekst mining
		NLP
		Recommendations
		Recognition
		Optimization
		Classification
Ribeiro et al. (2021)	UiPath is a tool with a lot of features and a lot of documentation. It has several plugins that can be programmed allowing adaptability to other applications such as PowerShell, SAP ERP, Oracle and Microsoft Dynamics. The Kofax and Automation Anywhere tools implement several RPA processes with interconnection to ERP's mainly to ERP SAP. AssistEdge tool demonstrated the possibility of being integrated with Microsoft (Azure Machine Learning) and Google (cognitive Services) cognitive systems, which allows to enhance the usability of the implementations of these two large technological companies.	API integrations
Singh (2020)	Logging into applications	Loggins
Singh (2020)	Conncecting to system API's	API integrations
Singh (2020)	Copying and pasting data	Copy/Pasting
Singh (2020)	Extracting and processing structured content from documents	Handling structured data
Singh (2020)	Opening emails and attachments	Email Automation
Singh (2020)	Scraping data from the web	Webscraping
Singh (2020)	Understanding documents	Document understanding
Singh (2020)	Handling semi-structured or unstructured data	Handling semi-structured data
		Handling unstructured data
Singh (2020)	Processing language	Processing Language
Singh (2020)	UiPath focuses on "practical AI," applying AI in tangible scenarios that improve automation outcomes. We've built AI into every part of the UiPath Platform, from detecting objects using computer vision, to discovering automation opportunities, and managing and scaling AI. In turn, businesses are moving from simpler automation scenarios to more complex ones, which involve unstructured data, lots of variables, and uncertain outcomes.	Computer vision
		Handling lots of variables
		Handling unstructured data
Singh (2020)	AI can be used to digitize each document, transforming each document from an image to machine-readable text through optical character recognition (OCR) technology. Advanced OCR engines can even read handwritten text while ignoring extraneous marks, corrections, or crossed out items.	OCR

Singh (2020)	Once the document becomes machine readable, AI can be used to identify and sort each document, distinguishing between an application form, an IRS form, a tax return, or payroll information. Then, for each of these documents, AI can be used to extract the relevant information in a payroll document or other documents, regardless of how the information is placed on the page	Classifying documents
Singh (2020)	Once the key loan information is extracted and converted to a structured format, AI can be used to automatically flag errors or anomalies – all of which can reduce the burden on overworked loan approvers. This type of end-to-end automation would not be possible with traditional methods but AI expands automation potential.	Converting Data
Singh (2020)	By bringing structure to unstructured data, AI and ML models unlock the true value of data and enable companies to build predictive models that will help them make smarter, faster, and better decisions. This becomes possible owing to UiPath Document Understanding and UiPath AI Fabric – cutting-edge technologies offered by UiPath for automating highly –manual, complex processes.	Document understanding
Singh (2020)	UiPath Document Understanding helps computers understand and extract data from documents, including unstructured data. It can digitize, classify, extract, and export data for further processing within end-to-end automation workflows. Optional human validation is another important step serving not just as a way to confirm or correct the output, but also to retrain the model based on the custom data.	Understand data Extracting Data Handling unstructured data Digitizing Data User interaction
Singh (2020)	Uipath document understanding: invoice extraction, receipt extraction, purchase order extraction, generic semi-structured extraction.	Document Understanding
Singh (2020)	Open source language analysis: language translation, language detection, sentiment analysis, named entity recognition, question/answering, text classification.	Language translation Language detection Sentiment Analysis Named entity recognition Question/Answering Text Classification
Singh (2020)	Open Source Language comprehend: Question answering, text classification, text summarization.	Text summarization Object detection Image moderation
Singh (2020)	Open Source others: tabular data classification, image moderatoin, object detection.	Data classification Speech translation
BluePrism (n.d.) https://www.bluprism.com/	Text and speech translation. Unifying global customer service requests by translating to and from customer and support primary languages Implementing real-time translation in virtual meetings	Text translation
BluePrism (n.d.)		OCR

	OCR & Computer Vision. Dynamically transform scanned claims forms into actionable data for use with RPA processes Transform secured faxes into searchable text-embedded formats	Computer vision
BluePrism (n.d.)	Cryptographic & Blockchain Technology. Securely analyze millions of transactions to proactively prevent fraud and money laundering activities	Secure analyses
BluePrism (n.d.)	Understanding Language and Emotion Separating and elevating customer support requests by measuring intensity or happiness of customer emails, chats, or voice messages	Sentiment Analysis
BluePrism (n.d.)	Machine Learning Models & Analytics Enhancing chatbot capabilities by predictive responses based on current and historical datasets Leveraging self-enhancing unattended ML models to identify anomalies	Statiscal methods
BluePrism (n.d.)	Elastic Search & Text Analytics Automatically mining Big Data and archival records to extract historical data research and BI analytics Dynamically verifying legal compliance on complex contracts	Text analytics
Automation Anywhere (n.d.)	For example, bots are able to copy-paste, scrape web data, make calculations, open and move files, parse emails, log into programs, connect to APIs, and extract unstructured data. And because bots can adapt to any interface or workflow, there's no need to change business systems, applications, or existing processes in order to automate.	Copy/Pasting

Appendix C: Classification of Primary Functions

Basic
Application
Opening/closing Applications
Logging in
Logging off
Expanding applications
API integrations (SAP, other ERP systems, Excel, Outlook, PDF)
Accessing Databases
Reading databases
Writing to databases
OCR
Data
Saving Data
Entering Data
Archiving
Converting Data
Uploading Files
Encoding Files
Detecting file changes
Extracting Data
Validating Data
Dealing with Structured Data
Entering Queries
Calculations
Copy/pasting
Collecting statistics
Updating data
Migrating Data
Desktop
Typing
Clicking
Dragging
Moving files/folders
Screenscraping
Storing files
Email
Open/closing emails & Attachments
Reading Emails
Generating/Sending Emails
Moving Mails to folder
Generating/Sending emails
Process
Auditing
Logging
Programming Functions
For/while Loops
If-then-else rules
Exception handling
Triggers
Trigger by image appearance
Trigger by hotkey
User
User interaction
Webapplications
Opening/closing browsers
Locating URL's
Webscraping
Web recording

Advanced
Speech to text
Creating documents
Dealing with unstructured data
NLP
Text mining
Document data extraction
Document classification
Document Understanding
Text summarization
Question/Answering (chatbots)
Sentiment Analysis
Language detection
ML / Statistical methods
Computer Vision
Repository and control images
Object detection
Image moderation

Appendix D: List of Process Criteria resulted from the SLR

Source	Description	Coded Criteria
Leshob & Bourgouin (2018)	(Maturity) All units interacting with the business process expect the same service	Mature
Leshob & Bourgouin (2018)	(Maturity) All interactions between the process and software applications are well specified and predicatable	Mature
Leshob & Bourgouin (2018)	(Standardization) The four process views according to Curtis (dynamic, functional, organizational and informational) are/can be specified	Standardized
Leshob & Bourgouin (2018)	(Standardization) All activities are performed in the same way in all branches of the organization.	Standardized
Leshob & Bourgouin (2018)	manual interaction(s) with a software application	Manually
Leshob & Bourgouin (2018)	Predefined business rules	Rule-based
Lacity, Willcocks & Craig (2015)	RPA can deal effectively with complex processes as long as complexity is defined as requiring compound steps and the control of many variables. (Some researchers define process complexity as processes where cause and effect are subtle and dynamic, in which case complex processes would not be ideally suited for RPA	Compound steps Static Cause and effect
Lacity, Willcocks & Craig (2015)	RPA experts and early adopters report that RPA is most suitable for processes with high transaction volumes, high levels of standardization, are highly rules-based, and are mature	Mature Rule-based Standardized High Volume
Lacity, Willcocks & Craig (2015)	One of the advantages of RPA is that it is highly interoperable and can readily run on any platform mainframes, client/server, or cloud systems.	Multiple Systems
Lacity, Willcocks & Craig (2015)	Early adopters have reported that compliance risks are minimal with RPA because every action executed by the "robot" is logged and thus auditable	Increase in Compliance
Lacity, Willcocks & Craig (2015)	Finally, Derek Toone, Managing Director at Alsbridge, suggested, "The degree of business value inherent in the process is worth considering in situations where significantly increasing the speed or accuracy with which a process is executed can yield outsized benefits to the business, for example in terms of enhancing speed to market, product quality, customer satisfaction, regulatory compliance, etc."	Increase in Quality Increase in Compliance Increase in efficiency due to speed.
Lacity, Willcocks & Craig (2015)	High-volume processes provide the most opportunity for reducing costs	High Volume
Lacity, Willcocks & Craig (2015)	The easiest processes to move to SS/O have high degrees of process standardization so that all of the company's business units expect the same service	Standardized
Lacity, Willcocks & Craig (2015)	Processes that are highly rules-based are also easier to migrate to SS/O because rules can be documented, which results in lower knowledge transfer costs compared to processes that require tacit knowledge transfer	Rule-based
Lacity, Willcocks & Craig (2015)	Mature processes are easier to move because they are measured, well-documented, stable, and predictable and their costs are known	Mature
Lacity, Willcocks & Craig (2015)	Butterfield strongly agreed that processes need to be mature and rules-based. He also added that processes need to have identifiable beginnings and endings.	Identifiable beginning and endings

Lacity, Willcocks & Craig (2015)	Robots will only execute exactly what they are configured to execute. In short, robots lack common sense. Thus, the explication of rules for robots must be much more detailed than for humans.	Rule-based High volume Rule-based Mature
Lacity, Willcocks & Craig (2015)	The process of identifying ten candidate processes suggested that the RPA software seemed most suitable where degree of process standardization, transaction volumes, rulebased process, and process maturity were all high	Standardized
Huan & Vasarhelyi (2019)	The audit procedures must meet three conditions to be selected for automation: they must be well-defined, highly repetitive, and mature (Lacity et al., 2015). First, well-defined audit procedures are structured and non-subjective, so that the RPA software is able to complete tasks based on explicit, rule-based instructions. Second, the procedures should be high in volume, which maximizes the potential benefits of automation. Third, mature audit tasks should be automated first because the outcomes and cost are more predictable, and mature procedures are less likely to encounter exceptions and require less human intervention	Mature Repetitive Well-defined
Huan & Vasarhelyi (2019)	Abdolmohammadi (1999) considers audit tasks as structured if they require very little judgment, while tasks with many alternative solutions that require considerable judgment are regarded as unstructured. Semi-structured tasks, which have limited alternative solutions and require a medium level of judgment, fall somewhere on the "structured-unstructured" spectrum. In the early stage of RPA adoption, structured audit tasks are better candidates.	Little judgement
Huan & Vasarhelyi (2019)	Accounting firms need to check and confirm data consistency before implementation of the system.	Data consistency
Huan & Vasarhelyi (2019)	To reduce implementation risk, the accounting firm should evaluate the complexity of potential audit procedures and demonstrate the usability of RPA with a low-complex process through a proof-ofconcept (PoC) or pilot project. After learning more knowledge through initial implementations, auditors can apply RPA to more complex procedures.	Simple process
Moffit et al. (2018)	Second important component of RPA-based audits: whether the data used in those procedures is compatible with RPA software. Data should be in a digital format or be able to be efficiently transformed into digital content (Moffitt et al., 2018).	Digital data
Penttinen, Kasslin & Asatiani (2018)	If back-end system architecture is changing RPA is preferred	Changing back-end system
Penttinen, Kasslin & Asatiani (2018)	Stable user interfaces should be present	Stable user interfaces
Penttinen, Kasslin & Asatiani (2018)	There should be multiple systems	Multiple Systems
(Aguirre and Rodriguez, 2017).	Nevertheless, it is important to emphasize that RPA tools are unable to make decisions or adapt to the changing environment. Therefore, RPA is most valuable in strictly defined, low cognitive, high-volume tasks	Low cognitive Strictly defined High-volume
Aguirre & Rodriguez (2017)	RPA can automate rules-based processes that involve routine tasks, structured data and deterministic outcomes, for example, transferring data from multiple input sources like email and spreadsheets to systems like ERP and CRM systems	Routinely Structured Data Deterministic Outcomes Rule based
Aguirre & Rodriguez (2017)	Low cognitive requirements: Taks that does not require subjective judgment, creativity or interpretation skills	No judgement/creativity /interpretation

Aguirre & Rodriguez (2017)	High volume: Tasks that are preformed frequently.	High volume
Aguirre & Rodriguez (2017)	Access to multiple systems: Process that requires access to multiples applciations and systems to perform the job	Multiple systems
Aguirre & Rodriguez (2017)	Limited Exception Handling. Tasks that are highly standardized with limited or no exceptions handle	Limited exception handling
Aguirre & Rodriguez (2017)	Human error: Tasks that are prone to human error due to manual labor	Chance of human error
Aguirre & Rodriguez (2017)	Standardized, exceptions are known.	Standardized
Moffit et al. 2018	First, well-defined processes are more automatable. Because robots currently still need precise instructions in order to successfully complete tasks, tasks with significant ambiguity are not typically candidates for automation	Well-defined
Moffit et al. (2018)	Second, high volume, repeated tasks can benefit more from automation. Tasks associated with payroll, accounts payable, and accounts receivable are often mundane and recurring, making them good candidates	High volume
Moffit et al. (2018)	Third, mature tasks should be targeted. They have more predictable outcomes and the costs are known. Automating these types of tasks is less risky.	Mature
Moffit et al. (2018)	The business process improvement literature and professional auditing literature suggest that RPA can result in improved processes and economies of scale when the steps to perform a rules-based task are repetitive and manual	Repetitive Manual Rule based
Moffit et al. (2018)	Conversely, RPA is less appropriate for those tasks that require elements of human judgment, that have uncertain outcomes, or that occur infrequently. When implementing RPA for the first time, organizations should look for easy wins; hence, complex and subjective tasks should be avoided.	Certain outcomes Low cognitive Frequent Little Judgement
Kolkina & branchette (2019)	Tasks that are labor intensive, repetitive, high volume, rules based, in digital form using multiple systems and structured data are strong candidates for automation with RPA.	High Volume Rule-based Structured Data Multiple Systems Labor intensive
Kolkina & branchette (2019)	Furthermore, tasks that require little human interaction to make decisions or tasks that do not require judgment throughout the process tend to be easier to automate	Little judgement
Kolkina & branchette (2019)	Processes with paper inputs and processes that interface with external applications that tend to change are less suitable for RPA	external applications Stable interfaces
Kolkina & branchette (2019)	They discussed challenges faced associated with bots breaking when external websites made changes to their site.	Stable websites
Syed et al. (2020)	Highly rule-based: the decision logic needs to be expressed interms of business rules. RPA requires a prescribed rule for everyeventuality, which needs to be unambiguous.	Rule-based
Syed et al. (2020)	High volume: sufficient transaction volumes help to maximisebenefits from the implementation of software bots in an organ-isation. They are generally routine and repetitive tasks whereautomation becomes an ideal choice.	High volume
Syed et al. (2020)	Mature: mature tasks are those that have been in place for a while,are stable and people understand what is going on.	Mature

Syed et al. (2020)	Easy to achieve and show impact: tasks performed within pro-cesses with the best return (a meaningful impact) and simplestdelivery (quick and inexpensive to deploy RPA). Areas where aclear understanding of current manual costs can be calculatedwill make it easier to identify and highlight the business valuefor RPA.	Clear understanding of costs
Syed et al. (2020)	Has digitised structured data input: all input data must be digitaland in a structured format.	Digitized structured data
Syed et al. (2020)	Highly manual: "Swivel chair"-like processes/tasks, which do notrequire much human intervention, but are able to be automated.	Manual
Syed et al. (2020)	Transactional: RPA is well suited for tasks at the bottom of thepyramid dealing with transactional work, as it reduces the risk oftransactional errors (e.g. incorrect data) and can perform manytransactional activities at once, replacing nearly all the transac-tional work that humans do.	Transactional
Syed et al. (2020)	Standardised: processes with a higher degree of standardisation(how consistently process execution follows a predefined path)are generally better candidates for selection, especially in theinitial RPA implementation phases.	Standardised
Syed et al. (2020)	Low-levels of exception handling: processes targeted for RPAshould not have to deal with exceptional behaviours; the moreexceptional the cases that bots need to handle, the more processautomation, testing and optimisation will be delayed or aborted.	Little exception handling
Syed et al. (2020)	Highly repetitive: automating tasks that are 'repeatable enough'will help to yield a better return on investment.	Repetitive
Syed et al. (2020)	Less complex processes: processes should be simple enough so thatbots can be implemented quickly. Increased process complexitydrives robot complexity (which in turn can increase operatingcosts, and potential business disruptions).	Less complex processes
Syed et al. (2020)	Well-documented: process descriptions that accurately detail pro-cesses are essential for bots to be taught behaviours at thekeystroke level. When processes are well known, the program-ming and testing of the bots will take less time.	Well documented
Syed et al. (2020)	Interacts with many systems: good candidates for RPA are pro-cesses that need access to multiple systems. Manual effort for frequent access to multiple systems can be high and lead toincreased human error, inconsistent performance and high costof impact, making such processes good candidates for RPA.	Mulltiple systems
Syed et al. (2020)	For exam-ple, while stability and maturity of processes are highlighted in theliterature as a characteristic supporting RPA [25], when present-ing their selection criteria for automation approaches, the authorsposition RPA as a light-weight technology that is better suited fortemporary processes (implying the opposite of a stable process).	Not-mature
Syed et al. (2020)	Similarly, while the common norm is that RPA is most suitable for high volume transactions, some argue otherwise [66,28,30], statingthat business processes need not handle extremely high transactionvolumes to be suitable candidates for RPA. Medium transaction vol-umes [28] and tasks that are business-critical and high in value canalso be good candidates for RPA [30].	Medium volume Business critical
Syed et al. (2020)	While process standardisa-tion is deemed an essential RPA pre-requisite, RPA is at times alsoseen as a means to achieve standardisation [60,79].	Means to standardize
Asatiani & Penttinen (2016)	To assess the suitability of any given task to RPA, one should evaluate whether the task is routine or non-routine and whether it requires the use of manual or cognitive affordances	Low cognitive Routinely
Asatiani & Penttinen (2016)	Highly cognitive tasks requiring creative thinking, as well as non-routine tasks with no or little recurring patterns and high variability, are a bad fit for automation.	Low cognitive
		Rule-based

Asatiani & Penttinen (2016)	The rule of thumb for task suitability for automation is to determine whether one can precisely write down all the steps of the process, taking into account all possible events and outcomes along the way.	Standardized
Asatiani & Penttinen (2016)	Beyond the manual and routine nature of a task described previously, a company willing to take on RPA needs to consider whether it is viable to replace humans with software robots for particular tasks and what would be the long-term implications of such decisions.	Redeployable personnel
Asatiani & Penttinen (2016)	High volume of transactions Task considered for RPA is performed frequently or includes high volume of sub-tasks	High volume
Asatiani & Penttinen (2016)	Need to access multiple systems Task involves accessing multiple systems. Example: copying data from a spreadsheet to a customer registry.	Multiple Systems
Asatiani & Penttinen (2016)	Stable environment Task is executed within predefined set of IT systems that remain same every time a task is performed.	Stable IT systems
Asatiani & Penttinen (2016)	Low cognitive requirements Task does not require creativity, subjective judgment or complex interpretation skills	Low cognitive
Asatiani & Penttinen (2016)	Easy decomposition into unambiguous rules Task is easy to break down into simple, straightforward, rule-based steps, with no space for ambiguity or misinterpretation. Example: Allocate all incoming invoices from Company X with value €3000 or more to category Y.	Rule-based
Asatiani & Penttinen (2016)	Proneness to human error Task is prone to human specific error, not occurring to computers. Example: matching numbers across multiple columns.	Prone to human error
Asatiani & Penttinen (2016)	Limited need for exception handling Task is highly standardized. Little or no exceptions occur while completing a task.	Few Exceptions
Accenture (n.d.)	The process should be initiated by a digital trigger and be supported by digital data	Digital trigger
		Digital data
Accenture (n.d.)	The process should be functioning and stable	Functioning and stable process
		Not dependent on judgement
Accenture (n.d.)	The process should be rule based and not depend on human judgement	Rule based
Accenture (n.d.)	The bigger the volume of executions of the process the better	High volume
Deloitte (n.d.)	RPA tools are best suited for processes with repeatable, predictable interactions with IT applications	Mature
Deloitte (n.d.)	Repetitive	Repetitive
Deloitte (n.d.)	prone to error	Prone to human error
Deloitte (n.d.)	rules based	Rule-based
Deloitte (n.d.)	involve digital Data	Digital data
Deloitte (n.d.)	Time critical and seasonal	Time critical
Agaton & Swedberg (2018)	A decision is seen as something where it is up to the person performing the process to decide what to do, which is in conflict with criteria such as Rules based and Limited human intervention.	Limited Human intervention
		Rule-based
Agaton & Swedberg (2018)	While there are criteria such as digital and structured data covering the quality aspects as well as saying that the data should be digital there are no criteria regarding how easily accessible the data is. Therefore a new criteria was added: easy data access,	Easy data access

Agaton & Swedberg (2018)	A complex process increases the risk since it increases the difficulty of the implementation and an essential process increases the risk as there is more at stake if the automation does not work correctly. However, since there might be more to gain from automating a key process that also has a high complexity, some companies might choose to go for a high risk strategy. Therefore the choice of strategy comes down to level or risk the company is willing to take and the competency they possess.	Both Simple or Complex Process
Agaton & Swedberg (2018)	Time Savings: This value is often found in processes that are performed often or takes a lot of time to perform. Processes can also be sped up by automating segments that contain bottlenecks, thereby raising the throughput.	Save time (duration) Prone to human error
Agaton & Swedberg (2018)	Quality & Accuracy: This value is obtained by raising the quality and thereby limiting rework or rejections and removing delays because of these. With a robot performing the process, the need for checks to secure quality is reduced or even removed.	Increase in Quality
Agaton & Swedberg (2018)	Employee Satisfaction: This value is obtained by making the workforce focus on meaningful and value-adding work. An important factor is to make sure the personnel is redeployable so it does not end up with nothing to do and can not be let go.	Redeployable personnel Tedious Process
Agaton & Swedberg (2018)	Digital and structured data: The need for digital data is self-explanatory. Without structure, the robot might need human assistance when interpreting data. Human intervention should be minimal. This changes if the RPA engine has advanced features to interpret data.	Digital and structured data
Agaton & Swedberg (2018)	Few exceptions: For each exception, the robot needs additional programming to deal with it. The automation can have reduced performance as a result an the implementation will be more expensive.	Few Exceptions
Agaton & Swedberg (2018)	Repetitive: There is no need to automate processes that are not recurring. A process should be performed in the same way over and over.	Repetitive
Agaton & Swedberg (2018)	Rules based: The process should preferably have as few decision points as possible and the decisions that exist should be able to be solved by establishing simple rules.	Rule-based
Agaton & Swedberg (2018)	Stable process and environment: The process should not have any upcoming changes or be prone to change. The same rule applies to the systems used in the process, which should be stable and not have major changes when updated.	Stable process and environment
Agaton & Swedberg (2018)	Easy data access: There should be well established and easy ways to access all data that is used in the process.	Easy data access
Agaton & Swedberg (2018)	Digital trigger (optional)	Digital Trigger
Agaton & Swedberg (2018)	Multiple Systems (optional): RPA is well suited for processes that uses multiple systems as it can switch between them just like any user.	Multiple Systems
Agaton & Swedberg (2018)	Standardized process: The more standardized the procedures of a process are, the easier it is to map the process. If different people perform the steps of the process in a different manner, it is harder to get a good understanding of the process. Having a single defined way of doing everything makes it easier toprogram the RPA for working with the process	Standardized
Agaton & Swedberg (2018)	Redeployable personnel: If the personnel working with a process cannot be retasked to something else it can be hard to reap the benefits of the project. Many times a robot might not replace an entire full time employee, but rather save some time here and there, creating the need to redeploy personnel.	Redeployable personnel

Santos, Pereira & Vasconcelos (2019)	First, it is important that the process can be decomposed into unambiguous rules, as RPA is only suited for rule-based tasks	Rule-based
Santos, Pereira & Vasconcelos (2019)	Then, it is also important that the process is mature because a mature process can be easily measured, documented and stable, with a better current cost awareness	Mature
Santos, Pereira & Vasconcelos (2019)	Frequent interactions with multiple systems is also a good candidate for automation, as RPA interacts with systems through the presentation layer, whereas doing the same thing with traditional automation would be more expensive and time-consuming.	Multiple Systems
Santos, Pereira & Vasconcelos (2019)	Another important feature is interacting with stable systems that do not change very often, so that the robot can interact with the interface without throwing exceptions that would be costly.	Stable systems
Santos, Pereira & Vasconcelos (2019)	Tasks that are prone to human error are suited for automation because it allows the reduction of costs and the increase of performance, as robots do less mistakes than humans	Prone to human error
Santos, Pereira & Vasconcelos (2019)	Also, tasks with no need or limited need for worker intervention and low cognitive requirements are an important aspect, because robots lack analytical and creative skills.	Low cognitive Limited need for worker intervention
Santos, Pereira & Vasconcelos (2019)	Finally, data is important, in terms of digital availability and quality. To execute the tasks correctly, the data must be correct, so that the robot does not make mistakes and must be available digitally, to be accessible to the robot.	Easy data access Digital data
Wellmann, Stierle, Dunzer & Matzner (2020)	Ideal candidate processes for automation must be standardized. Therefore, the process or task needs to be strictly defined and structured. A high degree of standardization before automation is necessary to result in a low amount of process variations and outcomes	Standardized
Wellmann, Stierle, Dunzer & Matzner (2020)	No or low subjective judgment or interpretation skills are required for decision making as the process follows a rule-based flow.	Low cognitive Monotonous Mundane
Wellmann, Stierle, Dunzer & Matzner (2020)	Well-suited tasks for standardized processes are also mentioned to be mundane, simple and monotonous	Simple process (Preffered)
Wellmann, Stierle, Dunzer & Matzner (2020)	In combination with a high degree of standardization, the execution frequency of a process or task has a big impact on the automation potential. In favor of RPA suitability, tasks need to be performed repetitively and in high transaction volumes	Repetitive High transaction volume
Wellmann, Stierle, Dunzer & Matzner (2020)	Besides the volume of transactions it is mentioned that the transaction of a substantial amount of data implies an aptitude for RPA	Large amount of data
Wellmann, Stierle, Dunzer & Matzner (2020)	Furthermore, the maturity of a process is an indicator as to whether it fulfills fundamental requirements for an automation effort. Maturity describes the frequency of changes to the logical execution flow of the process and further, that the process and its tasks are specified, predictable, stable and measurable	Maturity
Wellmann, Stierle, Dunzer & Matzner (2020)	Contrary to standardization, the failure rate describes the amount of deviations from the defined process flow. Candidate processes suited for RPA show little or no amount of exceptions when tasks are being executed and do not require human intervention.	Few Exceptions Limited Human intervention (few decisions)
Wellmann, Stierle, Dunzer & Matzner (2020)	Additionally, the ratio of process tasks that undergo an unusual process flow or inhibit the structured flow to completion is limited or zero.	Standardization

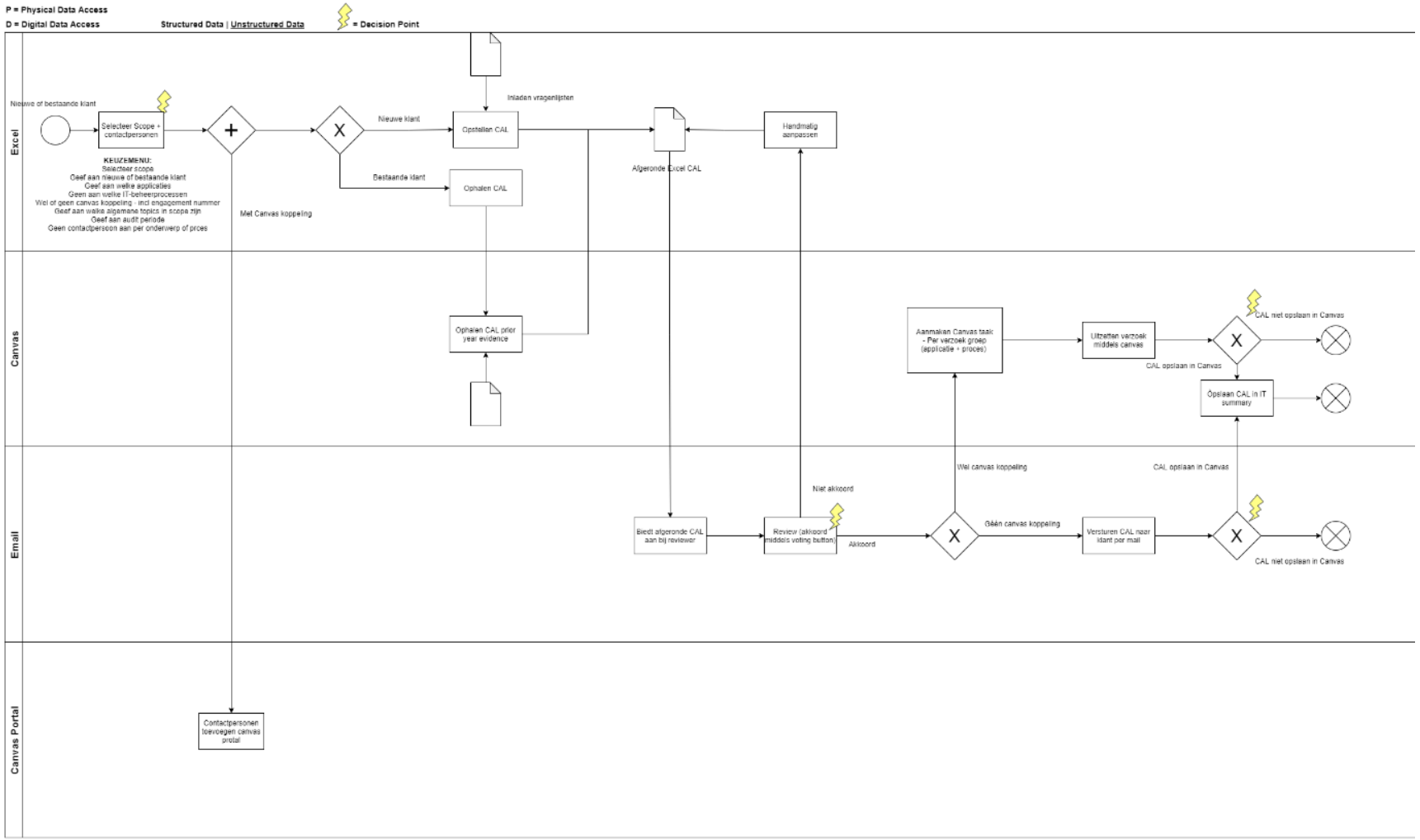
Wellmann, Stierle, Dunzer & Matzner (2020)	With the objective to further minimize the exceptions, stability of the systems in use and the process outcome is crucial.	Stable systems
Wellmann, Stierle, Dunzer & Matzner (2020)	For an execution following the predefined rules, the stability of user interfaces and the interaction between different systems is essential.	Stable interfaces
Wellmann, Stierle, Dunzer & Matzner (2020)	Ideal candidate tasks for RPA have as a result a limited number of exceptions and high predictability of their outcomes to avoid uncertainties and disruptions.	Standardized
Wellmann, Stierle, Dunzer & Matzner (2020)	Whenever multiple systems need to be accessed by a user, the manual effort is high and also reflected by the time consumption for this task. A software robot can work within the different systems flawlessly and execute the tasks more rapidly, enabling not only the extraction of information but also the triggering of events, when a task is completed.	Mannual effort
Wellmann, Stierle, Dunzer & Matzner (2020)	In order for process activities to be performed between multiple systems, the data needs to be in a structured and digital form. When data is structured, the software robot can then successfully interpret the given input and follow the execution flow of the process activities.	Structured digital data
Wellmann, Stierle, Dunzer & Matzner (2020)	Apart from process and process activity characteristics, literature mentions that proneness to human errors is also an indicator for RPA potential. This assumption is based on the fact, that with increasing volume of tasks, humans will more likely cause exceptions by false entry or incorrect data manipulation than a program would.	Prone to human error
Wellmann, Stierle, Dunzer & Matzner (2020)	Moreover, a process or task can be judged by its impact or value to the business. This is where literature does not provide a clear outline due to the small amount of mentions. While some argue that automation potential exists for processes with a low degree of business value [9], others state that processes with a low execution frequency but a high business value are suitable candidates for automation.	Business critical
Wellmann, Stierle, Dunzer & Matzner (2020)	Focusing on the voluminous and repetitive processes, the number of users involved in the execution reflect another perspective on RPA suitability. Kokina and Blanchet [19] indicate potential benefits where several people are performing the same processes, when these are repetitive and require no or low subjective judgment. A different perspective highlights the handovers of work between different stakeholder across departments as a factor to consider [33].	Repetitive
Wellmann, Stierle, Dunzer & Matzner (2020)	Last, the execution time of a process is a criteria to assess the suitability of processes for RPA [33]. Decreasing the time spent with repetitive and highly transactional jobs, increases time for employees to focus on more value-adding tasks [3].	Duration
Wellmann, Stierle, Dunzer & Matzner (2020)	Standardization Number of different activities. Number of variations to execution flow in business	Standardization
Wellmann, Stierle, Dunzer & Matzner (2020)	Maturity: Number of deviation cases over time, Ratio of deviation cases over time, Number of deviation cases over time, ratio of deviation cases over time	Mature
Wellmann, Stierle, Dunzer & Matzner (2020)	Determinism: Number of manual interactions, Time to solve manual interaction	Manual effort
Wellmann, Stierle, Dunzer & Matzner (2020)	Failure rate: Number of unsuccesful terminations, Number of manual interactions, Number of rework loops	Prone to human error
Wellmann, Stierle, Dunzer & Matzner (2020)	Frequency: Number of executions	Frequent
Wellmann, Stierle, Dunzer & Matzner (2020)	Duration Average reaction time	Duration

Wellmann, Stierle, Dunzer & Matzner (2020)	Urgency:Average reaction time	Urgency
Wellmann, Stierle, Dunzer & Matzner (2020)	Structuredness: Consistent use of data objects	structuredness
Wellmann, Stierle, Dunzer & Matzner (2020)	Interfaces: Number of execution steps, Time spent on application interface	Interfaces
Wellmann, Stierle, Dunzer & Matzner (2020)	Stability: Number of exceptions	Stability
Wellmann, Stierle, Dunzer & Matzner (2020)	Number of systems involved (e.g. CRM, ERP)	Multiple Systems
Wellmann, Stierle, Dunzer & Matzner (2020)	Resources: Number of users performing same task, Number of users involved in process	Multiple users
Wellmann, Stierle, Dunzer & Matzner (2020)	Proneness to human error: Number of exceptions, Time to solve exception.	Prone to human error
Wellmann, Stierle, Dunzer & Matzner (2020)	First, standardization refers to a process's degree of structure. In standardized processes, every process element is unambiguous, and the execution order remains the same in each process instance.Thus, we examine the execution order and the number of process variants to measure a process's standardization. We can, for instance, analyze predecessors and successors of the process of interest	Standardization
Wellmann, Stierle, Dunzer & Matzner (2020)	Maturity indicates that no frequent changes to the process flow are observable. Therefore, processes need to be specified and predictable over a period intime. Mature processes usually terminate successfully and show a comparably low number of variants. The evaluation focuses on the number of process variants and the difference between the ideal and variant process paths.	Mature
Wellmann, Stierle, Dunzer & Matzner (2020)	Determinism is one of the most distinctive criteria to assess the viability of RPA. Deterministic activities consist of logical execution steps without any form of cognitive assessment. This is a fundamental requirement for software robots since human judgment aggravates automation. To fulfill the criterion, logical and rule-based steps suffice to describe a process. Hence, the evaluation examines manual interactions and execution time	Deterministic
Wellmann, Stierle, Dunzer & Matzner (2020) Wellmann, Stierle, Dunzer & Matzner (2020)	Last, the failure rate relates to self loops to repair previous executions and a non-recoverable unsuccessful termination. A low failure rate leverages automation.	Failure rate
Wellmann, Stierle, Dunzer & Matzner (2020)	Additionally, the framework includes the duration which expresses the time required to execute a process or an activity	Duration
Wellmann, Stierle, Dunzer & Matzner (2020)	urgency which describes how critical the immediate execution of a process step is.	Urgency
Wellmann, Stierle, Dunzer & Matzner (2020)	data source must be digital [25]. Moreover, the data must at least be semi-structured to enable automation [5]. Typically structured data is in semi-structured forms like spreadsheets, websites, or emails. Unstructured and hardly accessible data impedes RPA.	Semi-structured data Digital structured data
Wellmann, Stierle, Dunzer & Matzner (2020)	Another system-related criterion is the stability. Ideally, systems and applications involved in process automation are stable.	Stable systems

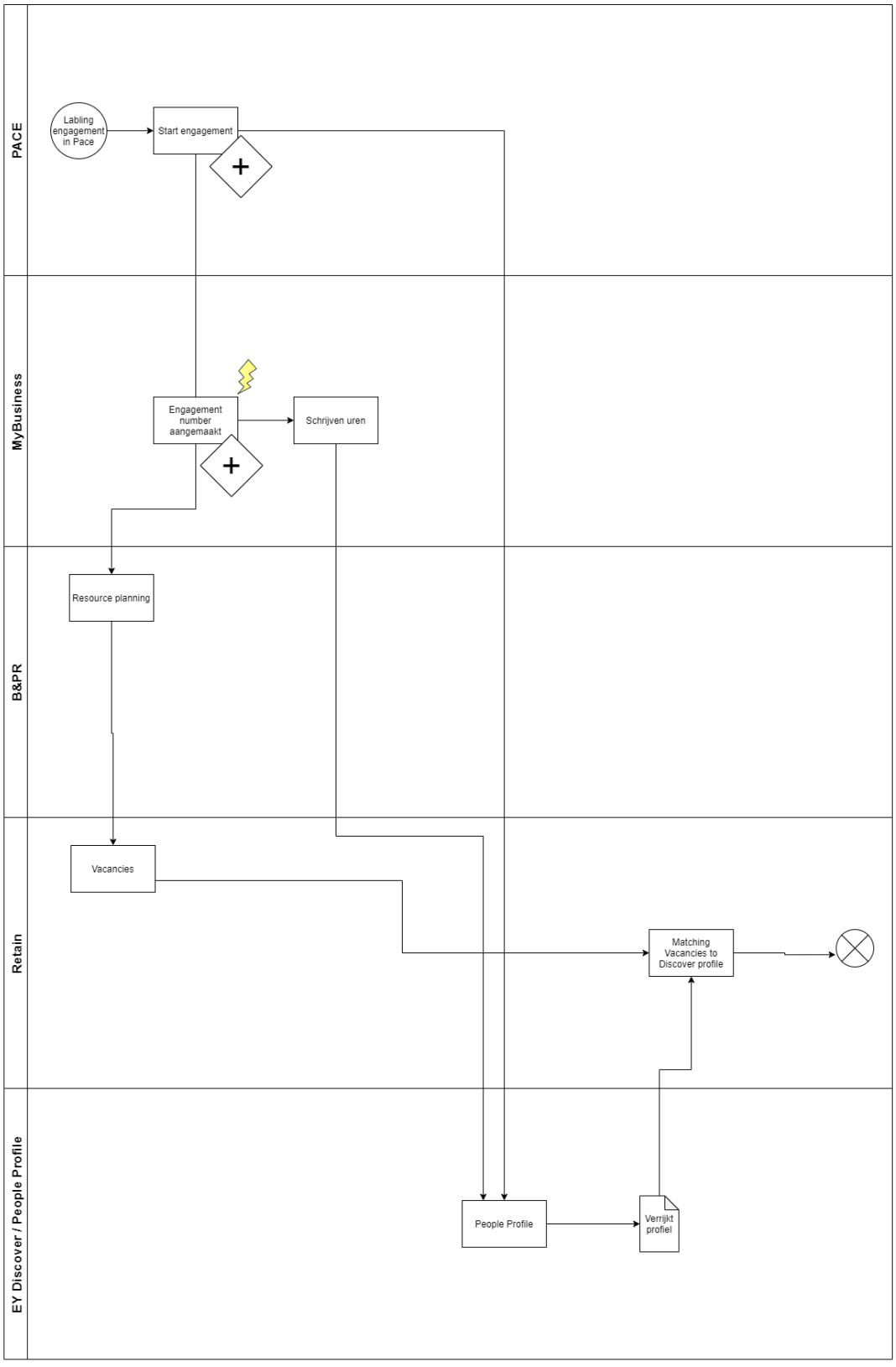
Wellmann, Stierle, Dunzer & Matzner (2020)	A stable operating system also relates to this criterion. It guarantees the absence of system related exceptions during automation. Important in practice is to distinguish between exceptions caused by the systems or applications themselves and external factors such as capacity errors or connection.	Stable systems
Wellmann, Stierle, Dunzer & Matzner (2020)	The last system-related criterion in the framework is the number of systems. It deals with process parts or activities that interact with multiple information systems. Consequently, the interaction between systems is necessary, but no value is added when performed by a person [16,17,25]. In fact, robots outperform humans in atomic operations, like copy and paste [3,9]. Thus, automation candidate tasks transfer information from one to other systems. The potential of more involved systems is higher, if these are running stably.	Multiple Systems
Wellmann, Stierle, Dunzer & Matzner (2020)	The framework includes resources as criterion to highlight the number of users involved in the process. Especially frequent activities require resources to deal with the volume of work. This criteria can be assessed from two view points. First, based on the number of users performing the same task. Second, multiple users contribute to an activity's instance. [19,33]. To assess the resource savings, we utilize the count of users performing the same task, and the number of users involved in one task instance.	Resources
Wellmann, Stierle, Dunzer & Matzner (2020)	The last aspect in the PCEF is the proneness to human errors as a criterion. Humans tend to erroneous behavior when executing monotonous and voluminous tasks which results in such errors that solely relate to human nature [9,13,16,17,29,37]. Eliminating such mistakes with business rules or robots yields to additional savings regarding costs and time. Measuring the error proneness relies on the number of human mistakes and the required time to fix those.	Prone to human error
Wellmann, Stierle, Dunzer & Matzner (2020)	Degree of process maturity. This criterion indicates how frequently the system or the application used in a process flow are changing to accommodate new changes or to stabilize them.	Mature
Wellmann, Stierle, Dunzer & Matzner (2020)	Degree of rule-based This criterion tells us about a business process if its following rules based if then else decisions or they have lots of unambiguity in rules.	Rule-based

Appendix E: Three Modelled Processes by participants

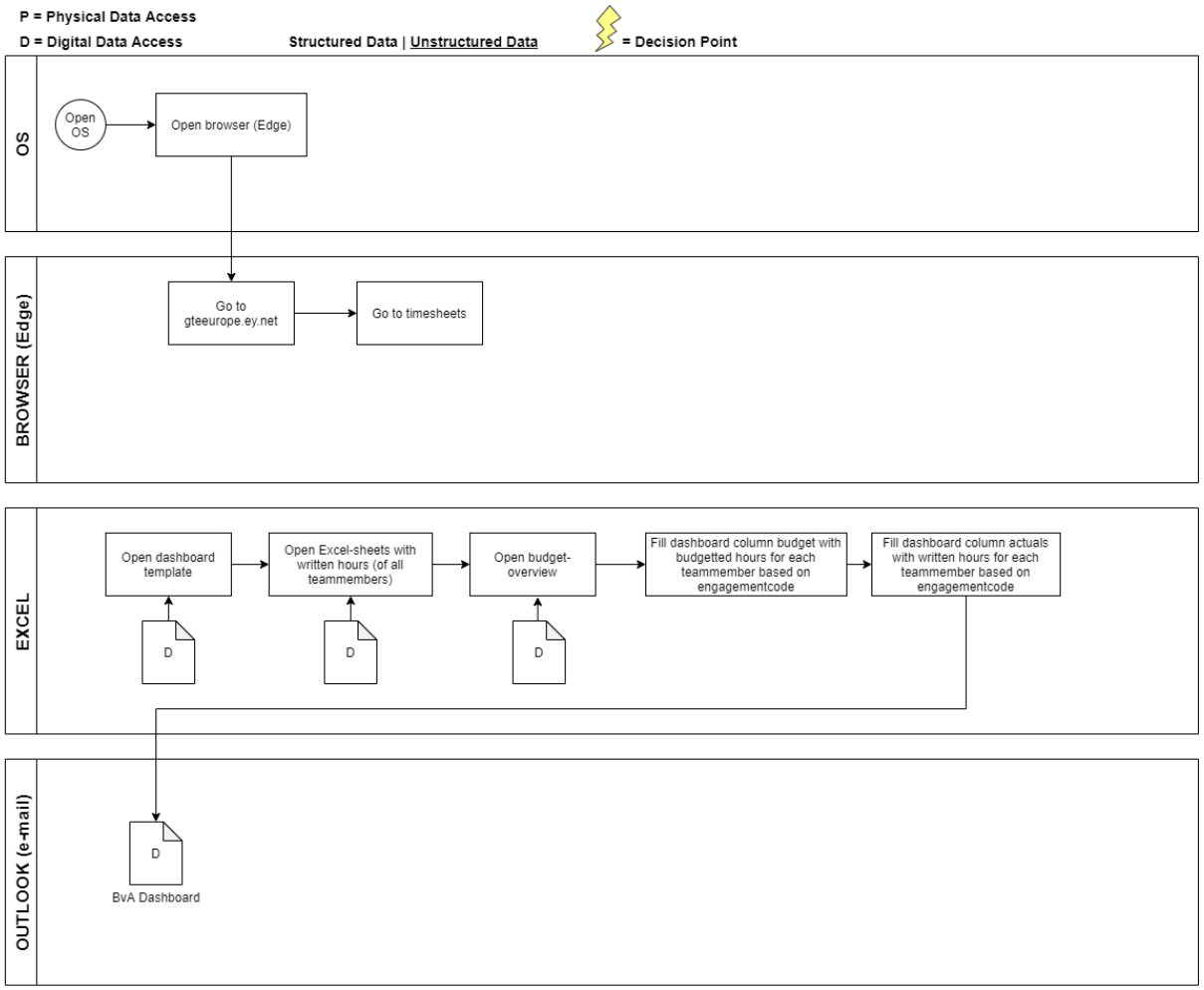
Process Model 1: Client Assistance Letter Automation



Process Model 2: Resource and Engagement Matching



Process Model 3: BvA & ETC Planning



Appendix F: Primary Functions for Participants

Primary Functions of RPA

Application
Opening/closing Applications
Logging in
Logging off
Expanding applications
API integrations (SAP, other ERP systems, Excel, Outlook, PDF)
Accessing Databases
Reading databases
Writing to databases
OCR

Data
Saving Data
Entering Data
Archiving
Converting Data
Uploading Files
Encoding Files
Detecting file changes
Extracting Data
Validating Data
Dealing with Structured Data
Entering Queries
Calculations
Copy pasting
Collecting statistics
Updating data
Migrating Data

Desktop
Typing
Clicking
Dragging
Moving files/folders
Screen scraping
Storing files

Email
Open/closing emails
Opening attachments
Reading Emails

Generating/Sending Emails

Process

Auditing
Logging

Programming Functions

For/while Loops
If-then-else rules
Exception handling

Triggers

Trigger by image appearance
Trigger by hotkey

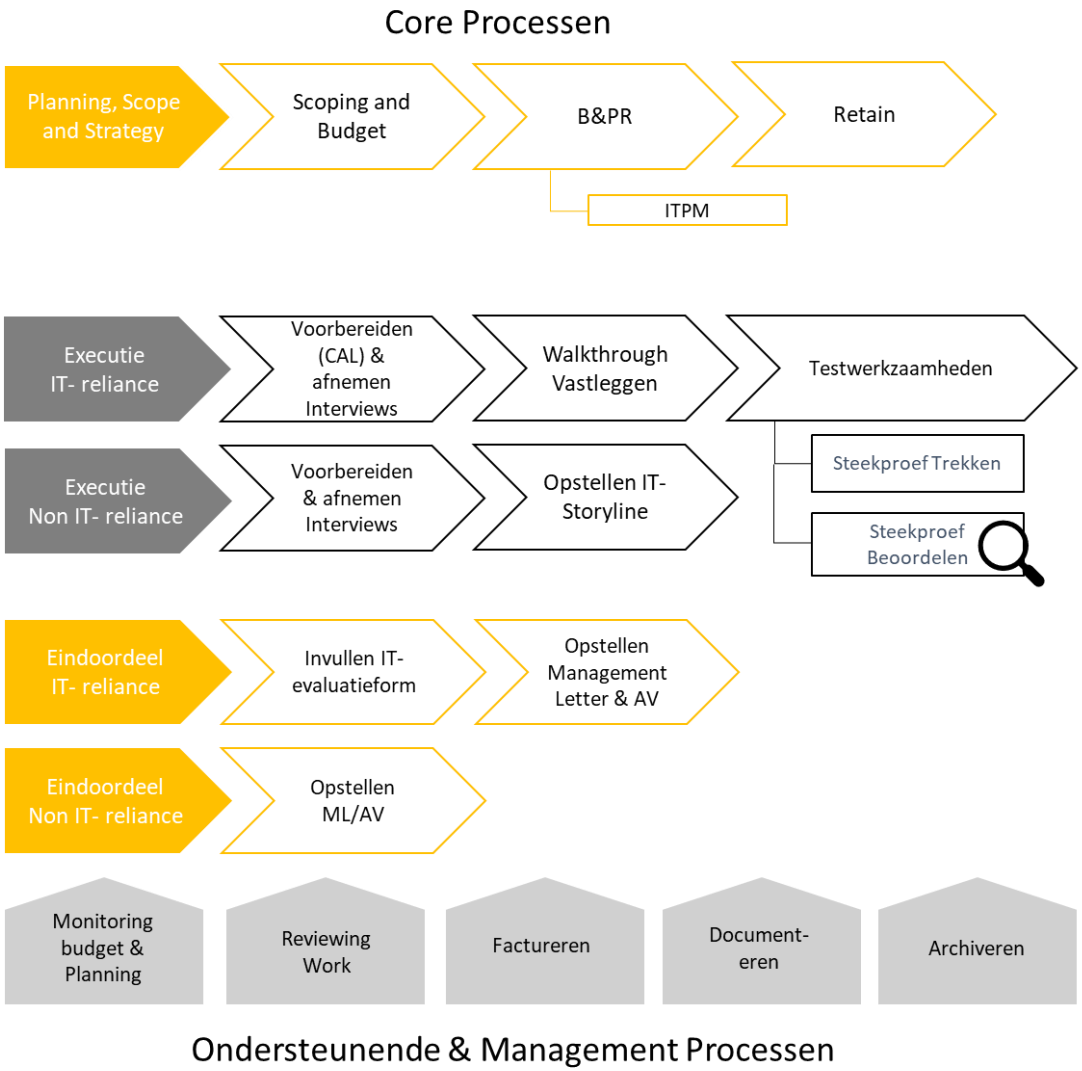
User

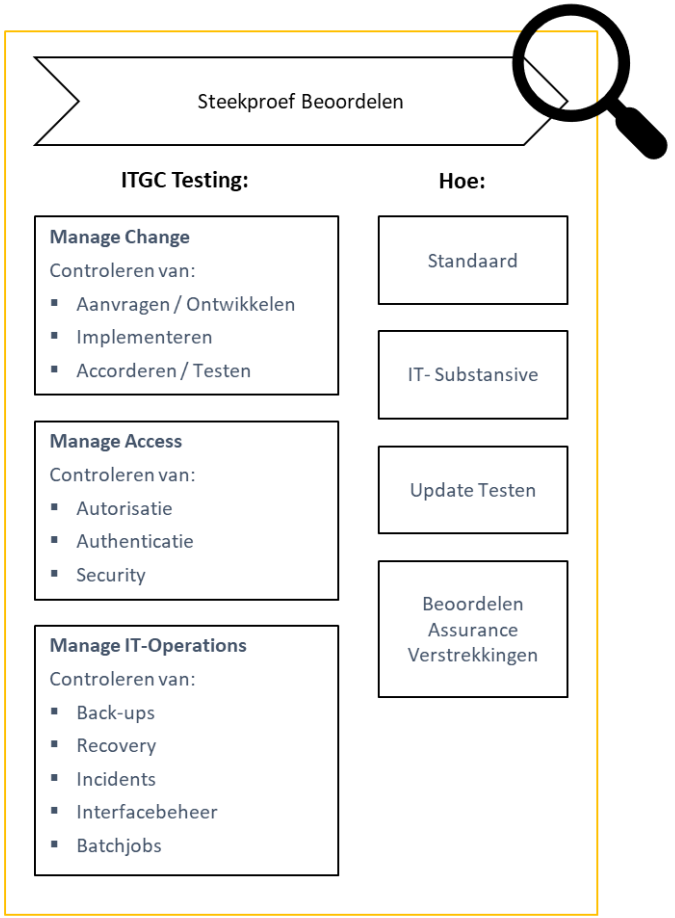
User interaction

Web applications

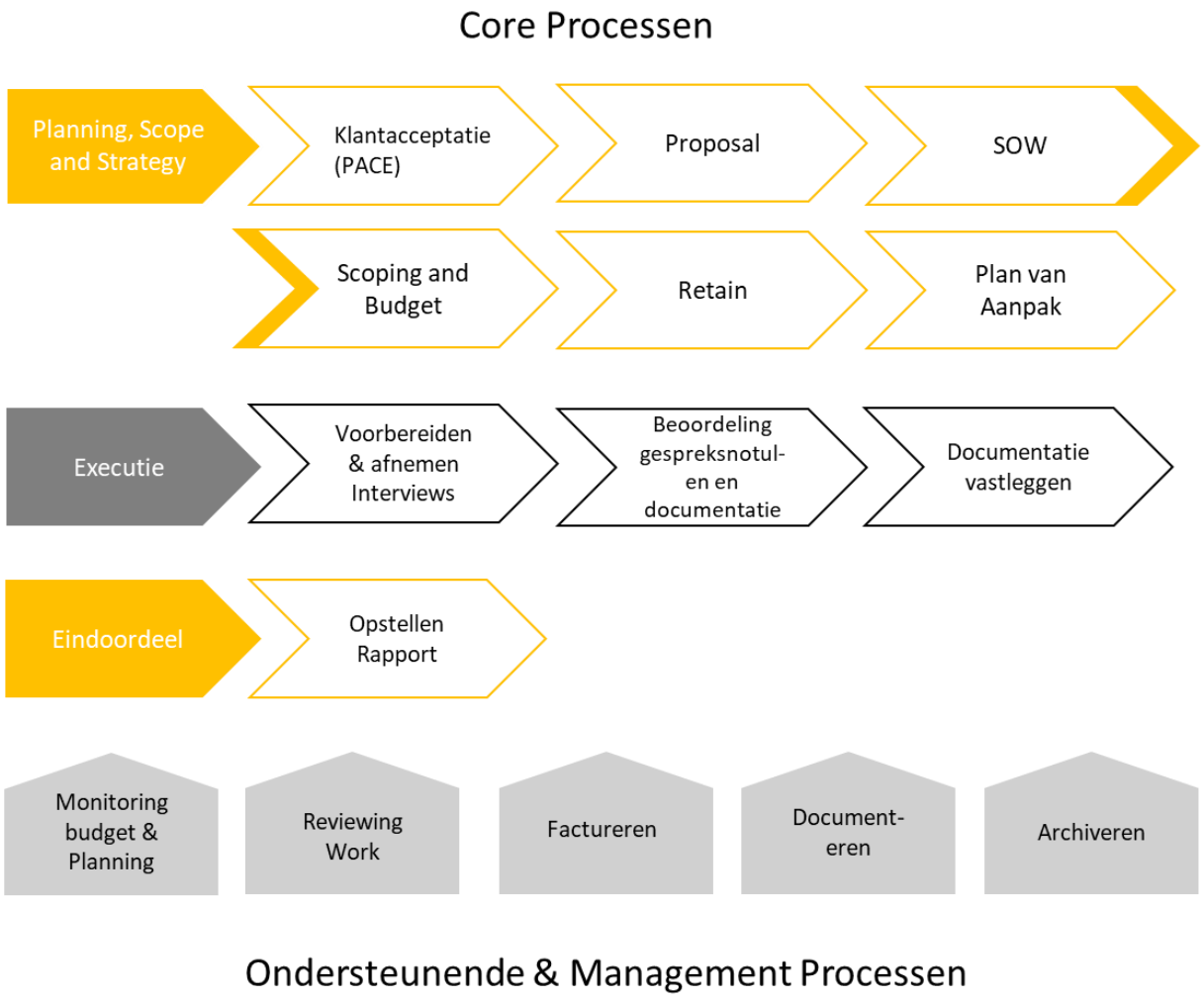
Opening/closing browsers
Locating URL's
Web scraping
Web recording

Appendix G: Process Landscape IT-Audit





Other Tech Risk Opdrachten



Opdrachten:

Financial Audit IT:

- ❑ IT-audit voor de JR Controle
- ❑ Conversiebeoordelingen

Other Tech Risk:

- ❑ SOC Reporting (ISAE 3402 / 3000 A/D)
- ❑ 4400 N
- ❑ IT-implementaties (QA role)

Appendix H: Process Profiles to be filled in by Participants

Name:					
Process Information (General)	**Fill in:**	**Automation Potential**	**Fill in: Yes or No**	**Business Value**	**Fill in**
Name Proces:		Low Cognitive?		Manual effort? (Low/Medium/High)	
Where in process landscape:		Rule-based Process?		Volume (Weekly/Monthly):	
Goal of the Proces:		Standardized Process?		Repetitive? (Yes/No)	
Outcome:		No or few Decision Points?		Human Errors? (Yes/No)	
Trigger:		Stable Application/Systems/Websites 1?		Duration of process (average):	
End-to-end or sub-proces?:		Stable Application/Systems/Websites 2?		Essential Business Process?	
First activity:		Mature Process?		Can RPA increase its compliance once automated?	
Last activity:		Structured Digital Data?		How can it be triggered? Attended/Unattended/Hybrid	
		Multiple Systems?		Potential to operate 24/7? (Yes/No)	
		Easy Data Access?		Long lifetime?	
		Internal?			

Appendix I: Answers to Question 16-19 of Survey

Participant	Q16: What should be added to the workshop (Started)?
1	Showing good practices
2	N/A
3	Brainstorming in couples
4	More time for creating the processes
5	More time for exchanging and evaluating each other's ideas
6	Showing best practices of RPA (even though there was a video). But besides this video show a company including its RPA implementation.

Participant	Q17: What should be removed from the workshop (Stopped)?
1	N/A
2	N/A
3	Performing brainstorming alone. Also, the second explanation took too long (about BPMN-R) .
4	Giving less extensive examples to save time.
5	Shorter explanation.
6	Not something specifically, but overall it was an information overload (especially during the first section). Participants were quite IT minded and do have some prior knowledge regarding RPA. Therefore, you could reduce some of the time spend regarding explanation and instead give participants more time to do the exercises.

Participant	Q18: What should be considered within the workshop (Considered)?
1	N/A
2	Indicating whether an existing process should only consist out of a process that is conducted manually.
3	No idea.
4	No suggestions.
5	Switching couples during the breakout rooms to strengthen each other’s ideas.
6	N/A

Participant	Q19: What should be continued?
1	BPMN-R model
2	Matrix, and BPMN-R.
3	Shaping the process yourself.
4	Enough room for own input. Templates for brainstorming and the exercises. Explanation of RPA. Explanation of Process Modelling.
5	The exercises
6	Modelling processes (including swimlanes) + filling in the process profile. Nice templates