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DEVELOPING ORGANIZATION'S PROCESSES WITH ROBOTIC PROCESS AUTOMATION – A CASE STUDY

Master's Thesis in
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ABSTRACT:

Competition requires firms to continuously polish their processes, and one source where improvement has been explored is digitalization. As a single technology related to digitalization, this thesis studied Robotic Process Automation (RPA). Purpose of the study was to identify how the case study company overall had implemented RPA and additionally which processes could be suitable to implement RPA in a single department of case study organization.

RPA is a software robot working manual and structured tasks implemented in the graphical user interface. The main benefits in this type of automation are the lower development cost, easier development and quicker implementation. Earlier research of the topic shows that processes with high volume or high value of transactions, are executed in stable environment, have low cognitive requirements, have possibility to break down into unambiguous rules and have limited need for exception handling are seen as promising characteristics considering implementation of RPA.

The research was conducted through semi-structured interviews with total of 13 persons within the case study company and evaluation part of the test RPA was conducted through observation. Study found out that the case study company's implementation can be described with down-to-top approach where the business users were involved to development from beginning and the benefits of automation of processes was seen as more than only time-saving. Furthermore, it was noted that there are no restrictions of the area where technology could be implemented, but more of the process itself. In the case study department, overall 19 processes related to reporting, manual data transfer between systems and manual financial transactions in ERP were found out to be feasible for RPA, but only few of these could be justified worthwhile with automation. Main lesson learned from the creation of test RPAs was the same as in earlier research, that standardization and stabilizing the process before implementation is recommended beforehand.

KEYWORDS: Robotic Process Automation, process development

VAASAN YLIOPISTO
Tekniikan ja innovaatiojohtamisen yksikkö

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TIIVISTELMÄ:

Vaativa kilpailu yritysten välillä vaatii organisaatioita jatkuvasti parantamaan prosessejaan ja eräänä ratkaisuna tähän on nähty digitalisaatio. Tämä pro gradu-työ tutki yksittäistä digitalisaatioon liittyvää teknologiaa, ohjelmistorobotiikkaa (Robotic Process Automation – RPA). Työn tarkoituksena oli tutkia kuinka case-tutkimus yritys on jalkauttanut RPA:n organisaatiossaan ja mihin ohjelmistorobotiikkaa voitaisiin käyttää yksittäisellä osastolla case-tutkimus yrityksessä.

Ohjelmistorobotiikan tarkoitus on tehdä manuaalisia ja jäsenneltyjä tehtäviä automaattisesti graafisessa käyttöliittymässä. Yleisimmät hyödyt tämän tyyppisestä automaatiosta ovat alemmat kehityskustannukset, kehittäminen ei vaadi IT-taitoja ja nopeampi jalkauttaminen. Aiemmat tutkimukset osoittavat että prosessit jotka ovat luonteeltaan korkea volyymisiä tai vievät paljon aikaa, suoritetaan vakaassa ympäristössä, ei vaadi analysointitaitoja, ovat mahdollisia jakaa yksiselitteisiin sääntöihin sekä omaa rajoitetun määrän poikkeustapauksia ovat lupaavia prosesseja RPA:lle.

Tutkimus suoritettiin haastattelemalla 13 henkilöä case-tutkimus organisaatiosta. Lisäksi ohjelmistorobotin arvioinnissa käytettiin hyväksi havainnointia. Tutkimuksessa havaittiin, että yrityksessä RPA on jalkautettu alhaalta ylös menetelmällä jossa yrityksen työntekijät on otettu mukaan kehitykseen alusta lähtien, sekä ohjelmistorobottien hyödyt nähtiin muistakin näkökulmista kuin ajansäästössä. Sopivat prosessit eivät myöskään ole millään tavalla tehtäväalasta riippuvaisia, vaan enemmänkin itse tehtävän luonteesta kiinni. Case-tutkimus osastolla löydettiin yhteensä 19 mahdollista prosessia RPA:lle jotka liittyivät raportointiin, manuaalisiin tiedonsiirtoihin sekä manuaalisiin taloudellisiin transaktioihin toiminnanohjausjärjestelmässä, mutta vain pieni osa näistä voitiin perustella automaation kehittämiselle kannattavasti. Ohjelmistorobotiikan testikappaletta tärkein havainto oli sama mitä aiemmissa tutkimuksissa, eli prosessi tulisi yhdenmukaistaa sekä vakauttaa ennen robotin käyttöönottoa.

AVAINSANAT: Ohjelmistorobotiikka, prosessin kehitys

1 INTRODUCTION

The competition in today's business environment requires firms to continuously improve and polish their processes to stay relevant in the competition. One source where improvement has been explored is digitalization, which is thriving to change the environment in process, organization, business domain and society level. (Parviainen, Kääriäinen, Tihinen & Teppola 2017: 64, 74). Rightfully so, if according to Parviainen et al. (2017: 64) the possible cost benefits of the digitalization as a whole can be up to 90 percent by digitizing information-concentrated processes. However, literature does not provide universal definition for digitalization, but referred as *"changes in ways of working, roles and business offering caused by adoption of digital technologies in an organization or in the operation environment of the organization"* (Parviainen et al. 2017: 64). One of the possible methods to increase organization's agility is to adopt new ways of working and technologies offered by digitalization (Kuusisto 2017: 344). Chen, Wang, Nevo, Jin, Wang & Chow (2013: 328-330) see that business process agility is a key concept that resolves how digital capabilities generate value for organizations and argue, that digital capabilities (or also referred as IT capabilities as Yang et al. refers to it) is the enabler of rapid business process actions, facilitating flexible business processes and even enable business process innovation.

Digitalization maximizes the efficiency when associated ways of working and processes are transformed to adjust the improved efficiency enabled by digitalization (Kuusisto 2017: 341). Parviainen et al. (2017: 66-67) also adds, that potential advantage of digitalization for internal efficiency include improved process efficiency, quality and consistency by getting rid of the manual steps in process and having better accuracy and employee satisfaction through automating the routine tasks, thus freeing time to develop other skills. As a single emerging technology of the digitalization, this thesis is focusing on software robotics application, notably Robotic Process Automation (RPA) and where it could be used to improve processes in case study organization.

RPA can be described as a technological mimicking of human employee to perform structured tasks (Asatiani & Penttinen 2016: 68). RPA is working through a software robot, which is performing the same tasks as human would in their screen – using the same software as human would, for example ERP or other productivity programs used in daily work (Asatiani & Penttinen 2016: 68). However, the term "robot" does not mean in this sense a physical robot in the office, but a software that carries out certain repetitive tasks which are structured and rule-based (Lacity & Willcocks 2016: 41).

Benefits for choosing RPA over traditional software development are it's lower cost, less skills of software development are required, quicker implementation and reusability of components in further development (Asatiani & Penttinen, 2016: 68; Willcocks, Lacity, & Craig 2015a: 20). However, RPA is mostly seen as a lightweight solution and not as long-term stable solution compared background integration.

1.1 Background of case study organization

This thesis is made for case study company and furthermore focused more on single department in the company. Company itself is globally functioning corporation, which has recently focused on thriving digital transformation forward in many areas. One of these areas is software robotics, where the RPA comes into the question of this study. Company has already made implementations of robotics for processes in several other departments successfully, but not to the department which is to be studied in this thesis. The department's primary focus areas relate to project control as well as business control and is relatively small department. These include tasks such as supporting wide area of project management to ensure the successful execution of projects and ensuring financial information correctness by supporting financial areas.

The department in question has repetitive tasks in their day-to-day work, and according to their own earlier investigations, especially reporting has been taking a large portion of the working time. Some of the reporting tasks have already been tackled in the department with the use of databases and automated business intelligence solutions for reporting purposes before the time of study. Though, not all processes have background integration behind them, nor are all the tasks or processes related to reporting only. The department personnel have little to none experience or knowledge of RPA and has not implemented any RPA solutions in their processes or tasks. From the department point-of-view, there could be undiscovered potential in RPA as a tool to ease the repetitive processes or tasks in the organization. This would leave more time for the more productive or analytical demanding tasks for the employees. That is the point of this study from the case study organization's perspective: Where RPA could be beneficially used by the case study department.

1.2 Research objective and questions

Saunders & Lewis (2018: 19) states that research questions are the key questions that the research process will answer and provides a comprehensible connection to relevant literature. According to earlier discussion in background chapter, this leads to two main research questions.

The first research question is *how has the company implemented RPA and if possible, in what kind of activities.* To dwell deeper into how to evaluate if a task is feasible for RPA, a semi-structured interview is held with RPA experts within the company. This way, in-depth knowledge about the RPA implementation to organization could be achieved, especially about how to assess processes to be suitable for RPA, knowledge of tackling the challenges of practical RPA implementations and where RPA has reaped benefits within the company. This could bring insights to scarce literature about RPA implementation and is also necessary information to furthermore continue to next research question.

The second research question in the thesis is *which processes are suitable for RPA in case study department?* The objective is to evaluate and identify the tasks or processes on high level, where RPA could be potentially beneficial in the case study department. This research question is answered through semi-structured interviews among the case study organization employees. From these processes discovered in the interviews, a local version of working RPA is designed and evaluated through observation. This then allows to see to what extent it could benefit the department and possibly see lessons learned what to consider during creating RPA.

According to Saunders & Lewis (2018: 21) the research objective is specific and understandable statement, that recognize what research process seeks to achieve and additionally objectives add more precision to research questions. The research objective of the thesis is to describe what robotic process automation is and identify how and where it could be beneficial in the case study organization’s single department. Practically there are two tangible outputs to provide from this thesis: An overview of beneficial processes for RPA implementation in the case study organization and a minimum viable RPA as a proof of working automatization. Figure 1 illustrates the research objectives and research questions.

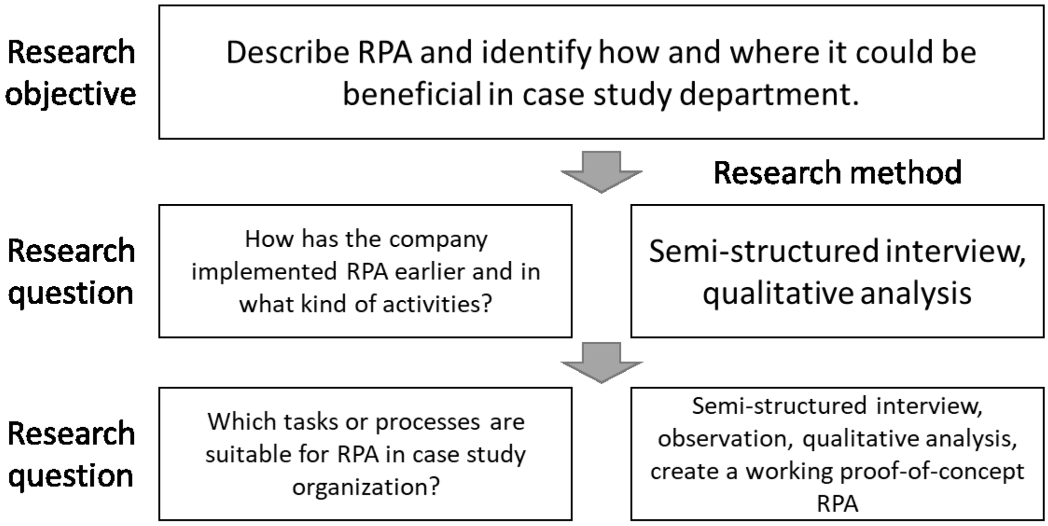

Figure 1. Research objective, questions and their methods in this thesis.

1.3 Structure of the thesis

First chapter introduces the background and motivation for the research. Additionally, the research questions and objective are presented in this chapter. Second chapter presents the literature background related to robotic process automation. Furthermore, a brief overview of process improvement is introduced, as it relates to goal of what RPA is achieving to do: improve the process so that it is executed more effectively. Third chapter presents the methodology used for the research. Fourth chapter analyzes the results of the case study interviews. In addition two minimum viable local RPAs are tested within processes and described practically the designing part, what was learned from those and evaluated. Fifth chapter discusses the results briefly and possible recommendations for the case study organization and finally the sixth chapter presents the conclusions, limitations and further research ideas of the study.

2 ROBOTIC PROCESS AUTOMATION

This section explores the contemporary literature of Robotic Process Automation (RPA), covering the background of RPA and technology behind it, why it is seen as beneficial and concept of what it is. In addition, earlier case studies on RPA literature are gone through.

Digitalized business environment increases tension for organizations to adapt and continuously improve their business performance. To execute the processes, employees spend time with different systems such as Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), spreadsheets and legacy information systems in repeating tasks as copying, pasting, extracting, merging or moving data from system to another. If some of these structured, repeating and manual tasks could be handled automatically by a software robot, this could give more time for employees to focus on more value adding tasks which are not as routine and requires more the employees experience. (Aguirre & Rodriguez 2017: 65.)

2.1 Background of process improvement

To understand first why RPA is seen as relevant tool and problem solver in business, a brief look is opened into what the RPA is trying to solve. In this part of the thesis a small background of process improvement is given before going more deeper into the RPA. The concept of process improvement and why RPA is one possible tool for improvement is overviewed. According to Baranauskas (2018: 251) the scientific field between RPA and related software automation merged with process management methods such as agile, lean or BPM has been scarce. And on the other hand, the tendency to study automation in the area of manufacturing has been on the contrary, very wide opposite to non-manufacturing business (Baranauskas 2018: 251).

Organizations want to enhance their overall business, improve the performance of day-to-day operations to be the best in the competition in their own industry. Process is a series of connected or related activities which in each phase consume different resources such as time, programs, currency or energy to convert inputs, for example data into outputs such as information. Additionally, the process characterizes distinct order of each activity when they are to be done, with defined inputs and outputs. Processes, especially the business processes, are the operational tasks or activities that produce its products and services and therefore are the building blocks of activities that are done to reach a certain end for organizations. These processes are then performed by the employees of the organization with different resources and with different levels of control. (Boutros & Cardella 2016: 2-3.)

A process should be first thoroughly followed step-by-step to understand the overall workflow and this way the elements of any process should be first understood before trying to improve one. Appropriately defined processes include five core aspects: Resources, inputs, activities, outputs and controls. Excluding the controls, the aspects can be tangible or intangible. Resources are the entities that has to be in place to routinely transform inputs to outputs. Inputs are the matters, tangible or intangible, that convert into products or services in the end that creates value for the requestor or customer. Activities can be translated in to defined actions that proceeds the inputs in the process to transform into outputs. Outputs are simply the end results of the process, such as information, product, service that is within requirements from the requestor. Controls on the other hand are not specifically needed to transform inputs into outputs, but are the quality control of the process which guarantees that all the different tasks included in the process are predictable, stable, and they operate steadily with normal variation. Controls are not in this case tangible or intangible, but assigned on process as internal (such as quality assurance or approval) or external (such as customer requirements). (Boutros & Cardella 2016: 3-4.)

All processes are a mixture of the earlier mentioned process elements: Resources, inputs, outputs and activities. However, the level of how much rules, data, different systems or technology and people are affecting depends on the process type. The different type of processes can be grouped to business processes, support processes and management processes. They can be formal or informal type, where informal are less standardized or have narrow focus and usually might not have a step-by-step guide. Formal are on the other hand more standardized and are usually related to legal, safety or financials. (Boutros & Cardella 2016: 4-5.)

Business processes are the processes that are the foundation of the organization, which gives them the reason to exist. These are the primary processes that creates the most value in the eyes of the customer. These can include back- and front-office activities and usually are cross-functional between different teams in organization. They are focused on customer and may include tasks that relate to product development, services or sales. Support processes are the activities that are there to endure the core processes, where customers of these support processes are usually internal within the company. Management processes are, as the name suggests, existing to manage the operations and to develop plans, goals, strategy and visions. (Boutros & Cardella 2016: 5-6.)

Process improvement is designing a process to become better in means of either being more effective, transparent or efficient than in the initial starting point. The benefits from process improvement for organization are in short term helping to decrease costs and increase efficiency. In the long run it produces competitive advantage by improving the organizational agility. Other benefits in the improvement includes streamlined operations which leads to waste avoidance, lower costs and more persistent quality. (Boutros & Cardella 2016: 7-9, Khurum, Petersen & Gorschek 2014: 1.)

Waste refers in process improvement terminology traditionally to excessive activities that consume time, space or resource without creating additional value to final result, which is also the focus of all lean approaches (Khurum, Petersen & Gorschek 2014: 1). The seven wastes have been perceived in context of manufacturing traditionally (Khurum, Petersen & Gorschek 2014: 2). Lean manufacturing's founder Taiichi Ohno identified seven wastes in manufacturing context: Overproduction, waiting, transportation, over-processing, inventory, excess motion, defect or rework waste and finally sometimes the eighth type of waste is considered too, which is underutilization of employee skills (Al-baik & Miller, 2014: 2023-2024). Literature suggests that the different wastes described in manufacturing context should not be used as-is in different organizations. Al-baik &

Miller (2014: 2024) takes an example from IT related initiatives and arguments that the success formula is to recognize the differences between IT and manufacturing context and develop it based on the nature of the business. Some authors have applied these waste types to different industries, such as Poppendieck & Poppendieck (2003: 4-8) have translated these wastes to be fitting for software development: Partially done work, extra processes, unrequired extra software features, task switching, waiting, motion and defects. The bottom line is, whatever the business the processes can be streamlined with cutting waste.

The waste types are all activities that do not add value. These activities which do not add value are also called excess work according to Modig & Åhlström (2012: 63) which can emerge as a result of failing the first primary need which is needed to do. These secondary needs that should not even exist do not directly add primary need, the customer value, but still consume resources. The focus for organizations should be more on the "flow-efficiency" rather than over-focus on resource efficiency. (Modig & Åhlström 2012: 58, 63.)

Modig & Åhlström gives an example of this excess work and secondary needs with claiming reimbursement of travel expenses (2012: 59-63): If the travel expense receipts would be billed right after the travel have been done, the work needed would be limited to that and completed. However, usually the billing is done irregularly when the work has already piled up, and this creates a requirement for secondary needs and creates additional excess work: The receipts have to be searched, sorted and structured. All of that would be unnecessary, or atleast very minimal if the work would have been done right away. This is illustrated in Figure 2.

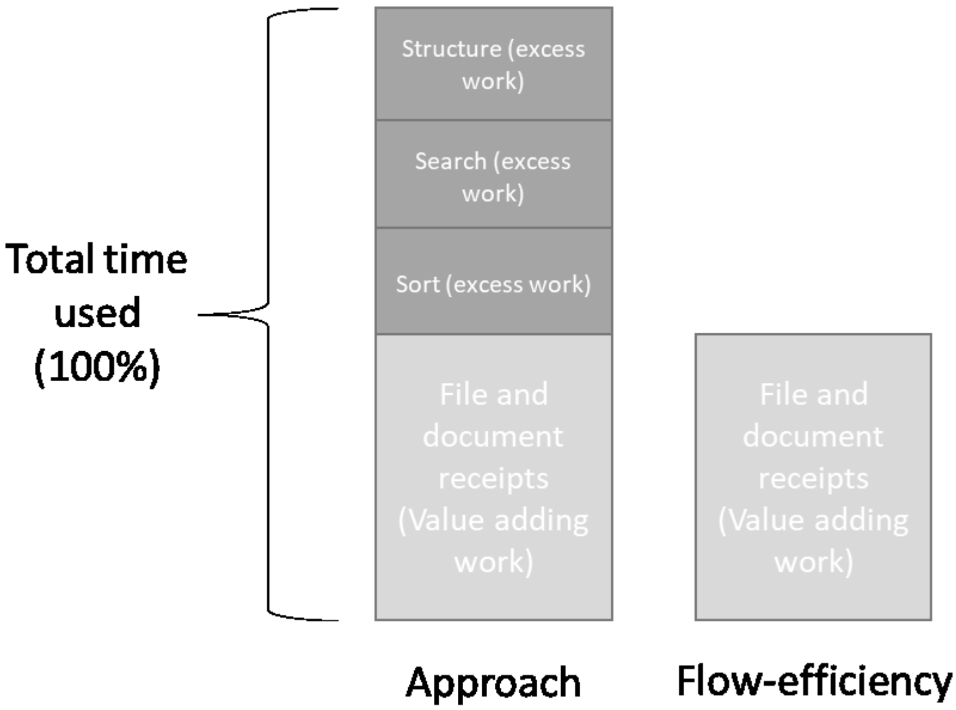

Figure 2. Abstract of secondary needs and unnecessary work according to lean principles (Adapted from Modig & Åhlström 2012: 62).

The challenge in secondary need is that it is difficult to see in the daily operations what is value adding and what is excess. Creating a specific report does include structuring, searching and sorting information, but on the other hand it is repetitive work that usually follows certain set of rules – is it then excess work? It is challenging task to get rid of all the excess work completely when organizations could be conducted of hundreds of sub-processes. One intermediary step would be to develop these processes so that these would take less the employees work time, or preferably not at all. That is where the RPA could be the possible solution – automating certain processes which are structured and rule-based within the company.

2.2 Background of RPA technology

Devoted RPA vendors has been entering the market in recent years, in demand of organizations looking for ways to be more efficient in their processes or to link systems that do not provide integration together: Blue Prism, UiPath, Automation Anywhere, AutomationEdge, Kryon Systems and Softomotive to name a few dedicated RPA software vendors (Aalst, Bichler & Heinzl 2018: 271). According to Gartner, the RPA tools are just in the "peak of inflated expectations" in the so-called Gartner's hype cycle and this rapid surge of demand of RPA argue that it is new technology (Aalst et al. 2018: 271). In larger perspective the origins of process automation, optimization and robotics were initially connected to the automotive industry and factory floor (Baranauskas 2018: 252-253). According to Ostdick (2016), this is understandable from the viewpoint that the industrial automation has been around for a long time but RPA is seen as a new development, because the term itself was not coined before 21st century and is related to more to automation of office tasks. In addition to this, RPA is an extension of preceding key technologies: Screen scraping, workflow automation and management tools (Ostdick 2016).

Screen scraping is a technology that is referring to reading characters from the front-end display: A program scrapes information from the displaying output of another program, so that the output is scraped for the end user (Vargiu & Urru 2013: 47). This was especially used initially to connect legacy systems with no maintained background integrations to newer systems (Ostdick 2016). Additionally it is used in scenarios where data is to be extracted from the web presentation such as HTML layer using the mentioned screen scraping, web scraping or optical character recognition (OCR) technology (Ostdick 2016).

Workflow management systems (WfMS), also known as workflow automation, is *"information technology designed to automate business process by coordinating and controlling the flow of work and information between participants"* (Stohr & Zhao 2001: 281). these workflow automations can also be seen as a software or interface between different office applications to link them in an enterprise. They are not only used for coordinating different tasks but managing the organization's internal information flows. Some systems such as such as enterprise resource planning (ERP) systems have built these capabilities inside their programs. (Stohr & Zhao, 2001: 281-282.)

The features of workflow management systems eventually evolved to be business process management (BPM) systems, which is more focused on the management angle of processes (Aalst et al. 2018: 271). However, single BPM projects are in most cases more expensive as the system is developed from the beginning and background integrations between different systems are far more expensive versus RPA which connects through presentation layer to the systems (Aalst et al. 2018: 271). The RPA differs from the mentioned BPM in these aspects: BPM systems are developed by IT staff and are usually high-valued IT investments, as they need redesigning in the business logic layers and data access layers (Willcocks et al. 2015a: 8). This is opposite to RPA where background systems behind are not changed, as the technology accesses to systems through the presentation layer which can be designed even by the business users (Willcocks et al. 2015a : 8). This means that RPA is not changing background logic of the systems in the background and therefore less risky and less effort needed in design (Willcocks et al. 2015a: 8-9). These layers are presented in Figure 3. The presentation layer interaction for RPA is the reason why some authors see the RPA as "lightweight IT" as it can be deployed even without IT specialists and be created by business users (Bygstad 2015: 2; Willcocks et al. 2015a: 7).

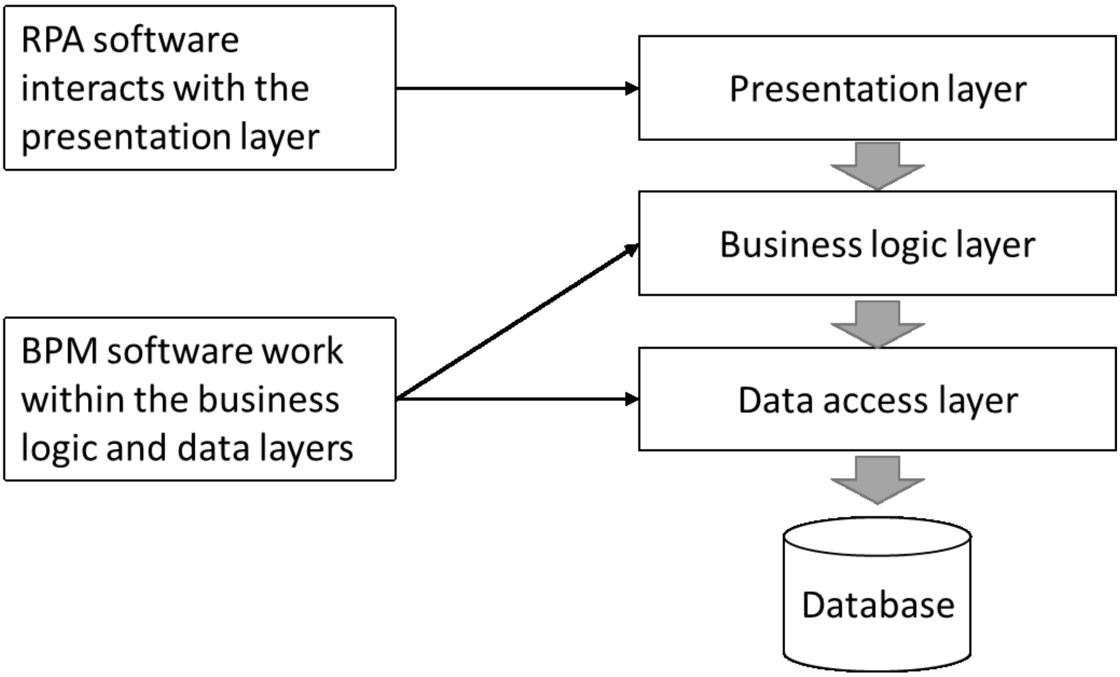

Figure 3. RPA interaction with systems are seen as "lightweight" IT (adapted from Willcocks et al. 2015a: 8).

2.3 Concept of Robotic Process Automation

Robotic process automation is an umbrella term for tools that operate on the user interface of computer systems in the way a human would do, in the front-end graphical user interface (Aalst et al. 2018: 269). Fung (2014: 1) considers the term ITPA (Information Technology Process Automation) but according to text refers to very same RPA (see Asatiani & Penttinen 2016: 68) and argues that RPA essentially is technological emulation of human employee actions, where aim is to undertake manual and structured tasks in efficient and cost-saving manner. In practical terms, RPA is implemented as a software robot, which mimics human employee using software such as ERP systems or other productivity tools (Asatiani & Penttinen 2016: 68). This is opposite to traditional software which operates with other systems via back-end integration (Asatiani & Penttinen 2016: 68). RPA tools aim to easen the repetitive tasks done normally by employee and is applied for a part of activities or overall process autonomously (Baranauskas 2018: 253).

The traditional solution for improving information systems is through background integration of systems or use of application programming interfaces (API). This is described as “inside-out” approach to improve the overall structure, but may require higher resources, IT knowledge and longer implementation time. The opposite to this, is more agile and light “outside-in” approach, which means to improve the system in a way that leaves the information systems in the background unchanged. RPA uses the latter approach, which has it’s advantages in less effort needed in implementation. (Aalst et al. 2018: 269).

Leaving IT systems unchanged and mimicking human employee with RPA in the graphical user interface (GUI) does have its advantage, because the automation development in the back-end usually demands redesign of existing systems thoroughly. This is opposite to RPA, which is relatively light solution. In addition, the software for RPA creation is built to be user friendly so, that the core operations in the software can be done with no prior programming skills with drag-and-drop interface (Lacity & Willcocks, 2015: 4).

However, Asatiani & Penttinen (2016: 68) also presents the downside of current state of RPA: It presents always a temporary solution to fill in the gap instead of final solution which would always be redesigned processes running in back-end. Additionally, the front-end automation is suitable only for particular type of tasks which are clearly defined, rule-based and devoid of subjective human judgement. RPA is still, even if it is agile by being fast to deploy, inferior to integration of back-end systems designed for machine-to-machine communication. (Asatiani & Penttinen 2016: 68).

To more specify the different use-cases for robots, there are attended and unattended robots. Attended robot cooperates with employee in situations where the work is happening during that specific time in the screen and functions ad-hoc when called by the employee (Baranauskas 2018: 254). This is specifically called Robotic Desktop Automation (RDA). Unattended robot operates without any personnel actions and called RPA (Baranauskas 2018: 253). As an example, RDA is something that the human employee can run ad-hoc when needed in it’s own monitor, and requires the user to accept that something is performed. RPA is unattended, and is running in server, where it does what it is commanded to. Both are considered a technology-software applied for different scale of automation in day-to-day operations or overall process (Baranauskas 2018: 260).

In literature there is not a vast amount of literature to be found on the use of RDA instead of RPA. Both are considered of same technology, but the usage is different: Unattended software robot performs in virtual server, and is active based on logical trigger, e.g. an e-mail is sent or for example order is moving forward in ERP. The main technological difference between these two are basically that RPA runs in virtual server unattended and RDA runs locally. This on the other hand also means that RDA is not freeing up the resource, since the software is working actively on the screen if it is turned on for specific task, leaving the human to wait.

2.4 Key characteristics for suitable RPA processes

To assess the suitability of any task to automation in general, it should be evaluated first if task is highly routine or non-routine and if it requires manual or cognitive actions (see Figure 4). Tasks which either require highly creative thinking, are less routine tasks with high variability or has non-recurring patterns are not the best suitable for rule-based automation. Rule of thumb for candidate tasks for automation is to first resolve if all the steps of the process can be written down, including all the inputs, outputs and exceptions. If this is possible, it as well may be suitable for automation. (Asatiani & Penttinen 2016: 68-69.)

The Figure 4 explains the automation potential to be more fruitful in the area where steps of the process are more manual and routine. Opposite to processes which do not occur frequently or requires cognitive abilities, the automation potential is lower. Therefore, the implementation is dependent on the nature of the process itself and if all the exceptions and outputs be broken down to rules. Processes requiring creativity such as creating qualitative comments about a visual graph is not the most fruitful for automation, but on the other hand fetching and consolidating same data frequently may be fit for automation.

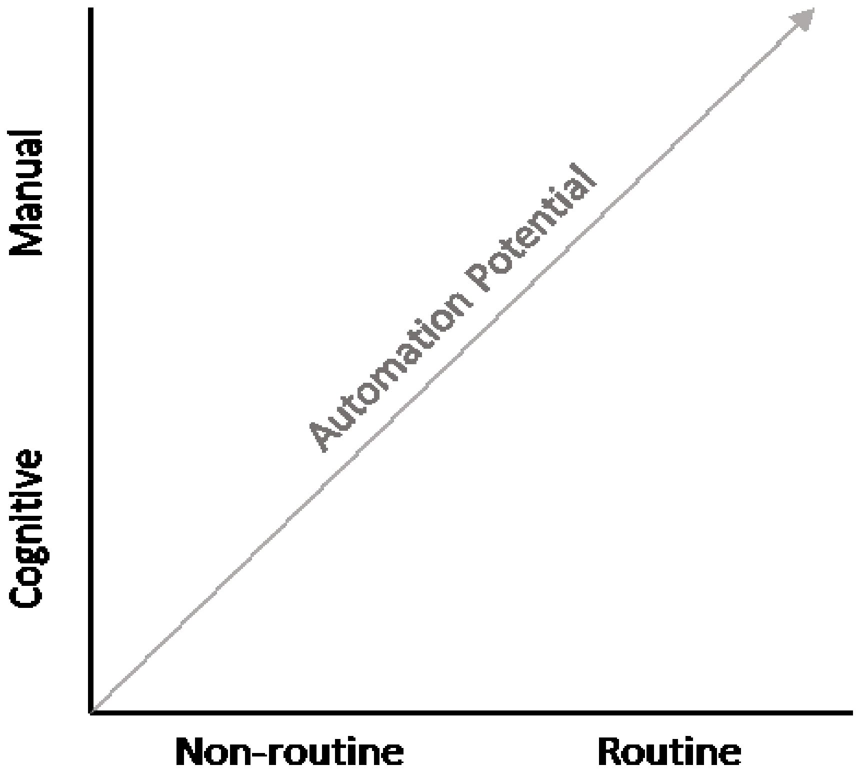

Figure 4. The automation potential in general rises when the process is more manual and routine-based. (Adapted from Asatiani & Penttinen 2016: 69).

Several different organizations including energy sector, telecommunications, IT organizations, technology service provider and shared services organizations have implemented RPA into their processes (Lacity & Willcocks 2015; Lacity, Willcocks & Craig 2015a, 2015b; Willcocks et al. 2015b; Willcocks, Lacity & Craig 2015a). Furthermore, Lacity et al. (2015b: 11) & Willcocks et al. (2015: 17) point out the importance of standardizing, stabilizing and improvement of the process to precede before continuing to automatize it. This is logical as according to Willcocks et al. (2015: 12) it is possible for robot to surpass human employee on speed and error rate metrics but it still only functions at the maximum rate which the overall process can allow it.

To further evaluate the process suitable for RPA, a few more factors are required to be taken into account. There are handful of characteristics for deciding if the task is suitable for RPA according to Fung (2014: 2-3), Slaby (2012: 6-7) and Asatiani & Penttinen (2016: 69). Not all the requirements need to be met, but are markers that process may be more sufficient candidate for RPA and may raise better business case (Slaby 2012: 7). These are carried through in more detail next.

High volume or *high value of transactions* are seen as the first characteristic which could be criteria for any automation, not specifically for RPA. The reason why these are seen as an ideal is that transactions with high volumes are principally also routine and highly repeated and therefore could justify automation more easily. The high value of transactions even if it would have low volume is however seen as suitable, if the amount of time required to do the task manually is high and possibly seen as critical process. *Entry to several systems frequently* is seen as ripe for RPA due to the presentation-layer approach, as it is far quicker to integrate through this way than in the data-layer. Another viewpoint for this is that manually accessing different systems may lead to increased errors and inconstant performance. *Stable environment* can be one criterion as some processes may be updated frequently and this way expose to unforeseen disruptions when the steps are taught for the robot. 12-18 months for process with no major changes is suggested by the literature. *Restricted requirement for employee intervention* means that the process should not have steps where employee would need to make decisions in middle of the process where it should interpret or analyze something that would only be known from the employee experience. *Restricted amount of exceptions* relates to the similar situation as earlier: If there are exceptions in the process, it is ideal they can be broken down *easily into unambiguous rules* in logical flow, but the less exceptions the better as it makes the automated process, optimization and testing more faster. One characteristic seen for suitable process is that RPA could lower the manual errors in the process, which is why *proneness to manual errors* is seen as one possible criterion. As the final characteristic, if it can be called that, is that there would be *clear understanding of current manual costs* – it is more about knowing that if a process is decided to be implemented for RPA, it should be known if the cost of robot doing the process is lower than the manual cost now. In general, this means that it should be known if there are expected savings. This way building a business case could get support from stakeholders within the organization. The characteristics are presented in the Table 1. (Asatiani & Penttinen 2016: 69; Fung 2014: 2-3 & Slaby 2012: 6-7).

Characteristic	***Description***
High volume or high value of transactions	Process considered is done frequently or takes a long time to do.
Required to access multiple systems	Process involves entry to multiple systems. Example: copying data from ERP to spreadsheet.
Stable environment	Process is executed within systems that remain unchanged each time run.
Low cognitive requirements	Task does not require employee experience or subjective judgement to do it, creativity or complex interpretation.
Possibility to break down into rules	Process is possible to break down into rule-based steps, with no allowance for misinterpretation. Rules can be broken down to if-else conditions.
Prone to manual human error	Process is prone to human error, which would not occur to computers. Example: matching numbers in two different systems in large dataset.
Restricted exception handling	Process is standardized. If exceptions occur, they are known so it can be taken into account when creating the robot.
Understanding of the current manual costs	Possibility to understand what is the volume and time that goes into manual work, so it is easier to see if the return on investment would be beneficial.

Table 1. Key characteristics for suitable RPA processes (Asatiani & Penttinen 2016: 69; Fung 2014:2-3 & Slaby 2012: 6-7).

The high volume or high value of transactions as a characteristic is not easily broken into a single number according to the earlier studies, as it is not clear what is meant with high volume or high value. It is more clear to say, that if the process has high volumes or high value, the more likely it will return savings. In case study of Lacity, Willcocks & Craig (2015b: 10-11) the company Telefónica O2 did use the volume transaction and process complexity as a guide to see which processes are suitable for RPA. The time served as a proxy for complexity, and according to Telefónica O2, high volume meant over 1000 transactions per day, where low but complex task could be 30 a day. (Lacity et al. 2015b: 10). Either if a complex process which takes time is automated it still provides the same benefit as the high volume process with low value. However, it should be remarked that Telefónica O2 industry is telecommunications, where volumes are higher and support service for volume of customers are high. In another case study of Xchanging (Willcocks, Lacity & Craig 2015: 9) found it challenging initially what was meant with high volume, but saw that RPA certainly does fit better with high volume and low complex for their processes. Overall, the high volume or high value is not straightforward. Aalst et al. (2018: 270) on the other hand suggests that RPA could support the middle ground activities where automation have not been earlier justified due to higher expenses and now could be done with RPA.

Aalst et al. (2018: 270) explains the tasks that are possible RPA candidates with Figure 5, which shows "long tail of work", where X-axis shows the different type of cases and Y-axis shows the frequency of the case types. Regular automation with back-end integrations aims to address the most frequent case types (80% of case frequency and 20% of all case types) and less frequent cases are not considered, because the automation is not justified because of incoming expenses due to integration of different systems. The remaining 20% case frequency and 80% case types are typically handled by employees and are more time-consuming than the very frequent ones. With RPA it would be possible to support these activities in the middle, where now the employee is the one working as integrator between different systems. (Aalst et al. 2018: 270.)

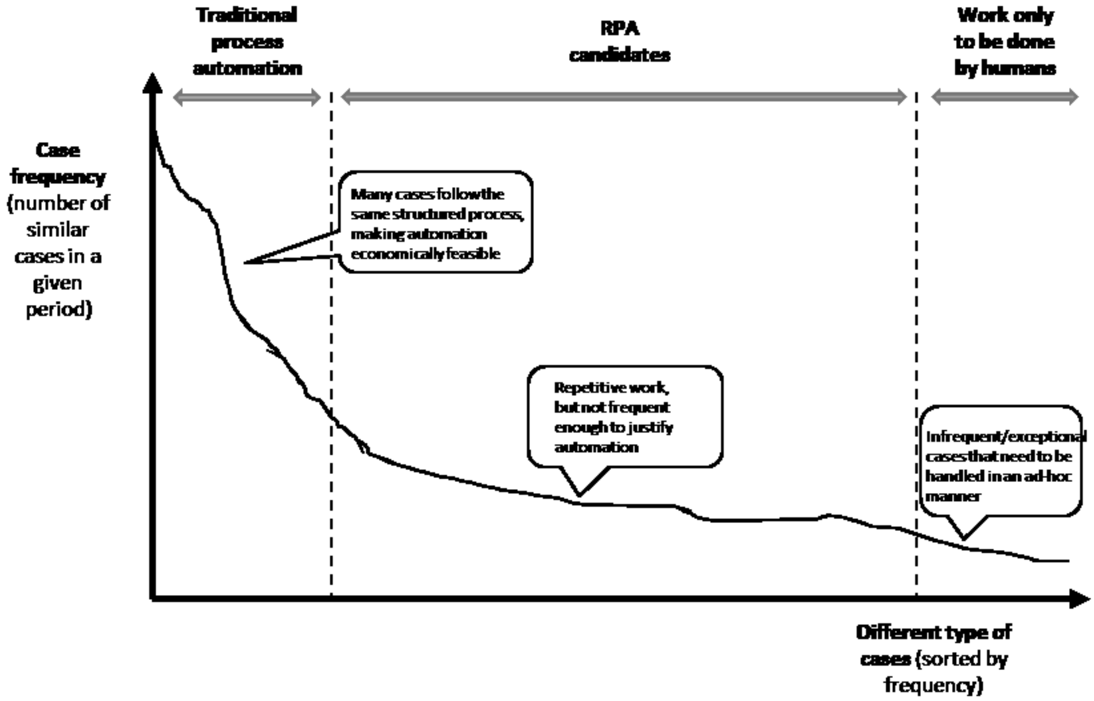

Figure 5. Positioning RPA to support middle ground activities previously not feasible for back-end automation according to Aalst et al. (2018: 270).

2.5 Benefits in RPA

Benefits of implementing RPA are seen in literature through FTE savings and from non-financial perspective. The RPA-related savings estimates have variance in the literature from 0,1 (Deloitte 2015: 6) to 0,19 in-house full time equivalent (FTE) (Slaby 2012: 1). Still, the savings may differ depending on the calculation and the process itself. According to Lacity et al. (2015b: 8) it is very difficult task to assess the FTE savings as employees can be deployed to other tasks and robot let to do the earlier task. Literature has aimed mostly to FTE savings through minimizing manual tasks, as robot can virtually work 24 hours a day at best, occasionally only needing maintenance. However, benefits after implementing RPA has been seen also in indirect benefits such as providing scaling for the requirements of business while keeping a cost control, fast deployment, quality and more satisfied employees for freeing them to focus on more challenging tasks (Lacity & Willcocks 2015: 26; Lacity et al. 2015b: 5).

According to Moayed (2018) the chief strategy officer of UiPath, the first clear-cut benefit to measure is the time saved with automation, where second is the elimination of errors – which in comparison is hard to calculate. Pragmatic way of calculating the errors is to agree a consensus if a process has low-high error rate and give it a multiplier (Moayed 2018). Some authors however do focus on the non-financial perspective too, which include: better overall working conditions for employees by focusing resources on more creativity needing tasks, earlier mentioned better quality through less human errors and the fact that programming skills are not required, which does provide process owners a lean way to automate a process by teaching a robot relatively simply (Asatiani & Penttinen 2016: 68).

The costs of implementing RPA varies from case-to-case, as the licensing fees can be different depending on the RPA vendor and on the amount of robots scheduled in the server. However, according to Moayed, chief strategy officer of UiPath (2018) there are four primary cost categories to look upon: The automation tool costs, cost of needed IT infrastructure, cost of development and cost of monitoring and maintenance. These include license costs, infrastructure of IT such as servers and virtual machines, process design and development and maintenance for changes in the applications or issues related to RPA tool itself.

2.6 Limitations and possible risks in implementation of RPA

Robotic process automation is one automation tool among other automation tool for processes. Lacity et al. (2015b: 11) case study research suggests that RPA can be viewed as a complementary tool to process elimination, process improvement or to even other tools such as business process management tools. This suggests, that RPA may not be the answer for all processes, but only one option among others for certain tasks.

Even if the RPA is stated as a beneficial tool of automation, there are limitations which one of the most crucial one is that everything must be in digital format and understood by a robot which is working in the front-end graphical user interface, not physical human-like robot in the office. This way it does not leave room for unambiguous rules or cognitivity in automation. It must be stated that the RPA is different from cognitive intelligence which could be the solution for more complex tasks. RPA is according to literature related to rule-based and structured front-end automation, where the cognitive intelligence is seen more as capable for highly complex tasks that seek patterns in variety of data (Lacity & Willcocks 2015: 12-13). Asatiani & Penttinen (2016: 68) concludes that software robots can be ordered to do tasks through modifying logical statements, screen recording of the process performed by business users or modifying graphical process charts opposite to programming and integrating in BPM systems by IT staff.

The attitude against automation may prove a challenge. The introduction of a new technology may even raise resistance from employees (Baranauskas 2018b: 259). However, according to research by Willcocks et al. 2015: 20-21) specifically of implementing RPA a lesson learned was that open internal communication was seen as one key to success. Moreover, in the research a robot was even named by the employees as “Poppy” and further use-cases for the robot were seen in tasks which the employees were not too keen to do, but was fitting for a robot (Willcocks et al. 2015: 21).

3 METHODOLOGY

Research methodology is the method how the research problem is solved systematically and can be perceived also as a science how research is done in a scientific way. Research methodology has many dimensions, and among them the reasoning of such topics as why are specific methods chosen for the research, what kind of data is gathered and how it is analyzed in the research study context. The reason behind these are that the results of the study can be evaluated by others. (Kothari 2004: 8.)

The methodology of the study is discussed in this chapter. Initially the research strategy and logic behind it are shown, subsequently following with how data was collected and analyzed. Lastly, we discuss about the reliability and validity of the study.

3.1 Research strategy

Saunders & Lewis (2018: 128) use the so-called research onion to illustrate the research topic such as the research approach and data collection methodologies when conducting research. The onion's level move from outer to inner layers, describing the research more from different angle (Saunders & Lewis 2018: 128). Each level describes the research starting from the outer level, such as methodological approach, research strategy and time-horizon (Saunders & Lewis 2018: 128). Referring to these, the methodology chosen for this thesis is single-method qualitative study. The research strategy designated is a single-case study. Time-horizon of the study is cross-sectional, meaning that the empirical data is collected through a one-time period, specifically during Summer and Autumn of 2019.

According to Kananen (2017: 32, 34) qualitative methods are used in research, that aims to explain and have more detailed insight of the research topic as the research is happening in its authentic environment. There is not enough numeric data available to consider quantitative research for the topic – as the quantitative research is usually trying to be generalizable. The use of the research results defines the level of depth, and qualitative research concentrates on very few observation units, where through qualitative research methods these can be researched more in-depth, but the results are not as generalizable (Kananen 2017: 33). Due to this reasoning, qualitative research with semi-structured interviews is chosen as the methodology because of its adaptability in areas where the topic is not widely known.

A case study as a strategy was chosen, because the research questions rely around understanding which processes could be assessed for RPA within the case study department in their day-to-day work. Case study approach is justified, as according to Yin (2009: 4, 8) case study approach is relevant when the research tries to answer more on questions “how”, focuses on contemporary events and questions require extensive and in-depth description. In addition, case study method allow researcher to gather the significant characteristics of contemporary real-life events (Yin 2009: 4). A reasonable decision for the case study is that the data is from single company and from relatively small department within that company. Earlier studies on the topic have been conducted as case studies, so it aligns with this study too. The thesis could bring practical new information on applying the RPA within new industry and information on practicalities of applying RPA.

3.2 Data collection

According to Saunders & Lewis (2018: 158-159) semi-structured interview is a data collection method where a set of themes, possibly using some predetermined questions are asked, but the order of the questions or themes might change depending on the participant. Asking undetermined questions is possible if the reason is to explore the topic more in-depth or get more details (Saunders & Lewis 2018: 159). The semi-structured interview is prone to be more beneficial approach to obtain data in situations where the questions are complex or open ended, and sometimes may even pursue the discussion to areas not considered but significant for understanding the topic (Saunders, Lewis & Thornhill 2016: 394). Due to the adaptability of the semi-structured interview and the open-ended nature of the research questions, this method was chosen as the method to reach the research question answers. In the study the interviews followed preset themes and some of the questions regarding the processes were predetermined (See appendices). It was noted, that at times more clarifying questions were asked from interviewees, and the interviewees had the opportunity to express their thoughts regarding the topic. The interviews can be considered as the primary data of the study. However, in the last part of the study, where a test RPA was created by the researcher and evaluated with employees, observation was also used to advantage to collect feedback and timed how long did the evaluated processes take time with and without RPA.

All the interviews were recorded and transcribed, except for one interview where notes were taken and used in the data analysis. For the transcribed interviews, length varied from 29 minutes to 108 minutes. The timetable and interview structures are presented in the end of the study as appendices. Total of 13 persons were interviewed. The first interviews were conducted with two RPA developers within the company to have insight and knowledge for the suitability of processes for RPA, how the company has implemented it and to reflect it to literature. The second interviews were conducted with 11 employees from case study organization or teams working closely where the potential of RPA was investigated. Participants in the case study department were gathered through connecting first as face-to-face and sending an interview request through e-mail. Few of the interviews were held as a single interview, but most of the interviews were knowingly held as multiple participants who worked with similar tasks, to raise discussion and ideas about the topic.

In the interviews, first an introduction of the RPA technology was presented for each interviewee and showed an introductory video of RPA in action before continuing to interview. In case there was any more questions about the technology, it was allowed to ask about it at any point of the interview. Based on the transcriptions and any additional paper that were shared during the interview to draft potential RPAs were handed to participants, potential processes were mapped into categories by weighting the processes against the key characteristics found in literature.

From these interviews, an overview description of how the RPA is implemented within the company and suitable processes for RPA are presented which are directly from the interviewees. The last tangible output of the study is to create a practical RPA for process as-is and to-be with UiPath software, and separate meetings were conducted to gather the steps of these processes. The processes were then evaluated with observation from as-is situation and to-be situation.

3.3 Data analysis

Case studies do not specifically have their own determined analysis methods, since the case studies are often based on qualitative research. In fact, Kananen (2013: 103) proposes to use same analysis methods as with textual material, which applies to analysis in case studies. Recorded data was transformed to text by transcribing as soon as possible to not lose any details. The transcribing can be done in three levels: exact, common language and proposition-level transcription. The common language-level is used in the transcription phase in this study, which means that the transcriptions are transformed to be common language, removing the spoken language and dialect references. (Kananen 2013: 100, 103.)

The data analysis was approached with thematic content analysis to seek for schemas. According to Braun & Clarke (2006: 79) the method is made to seek, analyze and report patterns within data, in addition to also minimally organize and describe the dataset comprehensively. The themes or patterns can be recognized in two ways, in data-driven or theoretical approach (Braun & Clarke 2006: 83-84). The data were themed mostly in theoretical approach, which means most of the themes were categorized based on the topics of RPA, but also a small portion of the themes were data-driven from the interviews. The steps were made according to Braun & Clarke (2006: 87) which included transcribing the interviews and this way accustoming with the data, drawing out primary codes, searching for the themes and possible sub-themes, reviewing and defining these themes and producing a scholarly report of it.

3.4 Reliability and validity

According to Yin (2009: 40) four tests are regularly used to establish quality of any empirical research, which are construct validity, external validity and reliability. Construct validity regards choosing valid operational measures for study. Internal validity is to seek to establish causal relationships. External validity is to define how much the study's findings are generalizable. Reliability is to prove the operations of the study can be repeated with identical results. (Yin 2009: 40.)

The construct validity is strengthened by using concepts in earlier literature of RPA and adapting them to the case study research, and by explaining in interviews the background and concepts as much as possible, to have the same idea of what is researched in the thesis. However, it is noted, that multiple sources of evidence is lacking from external sources: Only interviews, observation and company internal documents are used, but reflected to what earlier literature points out. The external validity in case study research is problematic as the results of the thesis may not be generalizable to all accounts, especially because the context of researched case is in its natural state (Hirsjärvi & Hurme 2008: 188). The reliability of the thesis is raised by explaining all the steps in the research, including the question templates and whom are interviewed and comparing the results to earlier literature. In addition, the findings of the research are only found in the data gathered, not researcher's bias.

4 RESULTS & ANALYSIS

This chapter of the thesis focuses on the analysis of the interviews, which holds answers on how the case company has earlier implemented RPAs, to what kind of use-cases and how and where could the single case study department take advantage of RPA. Additionally as mentioned earlier in methodology part, a process is chosen to create minimum viable RPA to see how practically the creation proceeds and it is evaluated.

4.1 Way of implementing RPA

For this part of thesis, two developers are interviewed to gather deeper insight of the way of RPA implementation and the technology use itself within the case study company.

4.1.1 Involving the business users to RPA development down-to-top

The current way of developing RPA in the company's business division is implemented in a way that is agile and involving the employees from the beginning. The RPA delivery organization is divided to 4 roles: The business user or also can be citizen RPA developer, central programming team, RPA manager and an RPA coordinator on top. The RPA communities lies within the businesses, which consists of the RPA managers and citizen developers on top of the normal employees within the business.

The business user is an employee, whose main working area is specialized somewhere else than RPA, but could take advantage of RPA. Citizen developer is described as a normal business employee with capabilities to create a minimum viable RPA. In other words, any business user can also be a citizen developer. RPA manager's coordinate which RPAs are going into pipeline and production from the business and what is feasible to create. These two initial roles, citizen developer and RPA manager are located within the business. The central programming team is then responsible for creating the production version of RPA to the server and to maintain, monitor and include revision handling and follow-ups. The RPA coordinator is then leading and coordinating the whole organization.

The new ideas for identifying RPA capable processes come from the business in most cases. A business user first identifies a process for robot, which could have potential to save time, enhance quality or speed up the process and then creates a first version of it. At the same time, the process is described in detail step-by-step if not already done before. If the business user do not have the necessary skills to do it, the user can take a training course which is given occasionally in the company. There are not formal requirements other than interest and time. Additionally, problem-solving mindset or knowledge of basic programming was seen as a qualities that are helpful, but not entirely necessary.

> *"Interest in RPA and time, that's basically it. We have persons with variety of backgrounds doing these."*

Second option is to contact a citizen RPA developer to create a minimum viable RPA that can do the task and forwards it to into pipeline list. After this the RPA manager also concludes that the RPA is a working one and forwarded into central RPA programming team to make it work in the production environment. There the RPA is piloted, quality assured that the RPA works in the same manner in the production environment and integrated to the robot in the server. Figure 6 describes the simplified process of this.

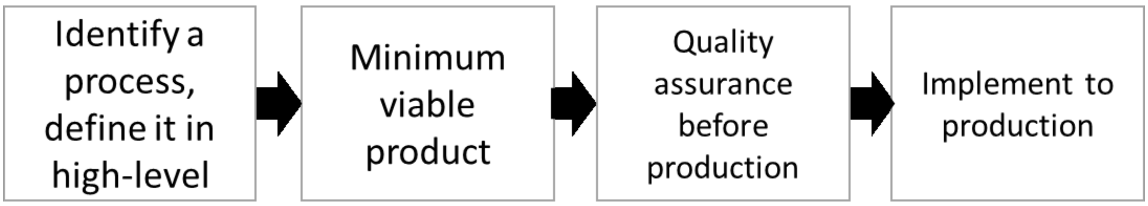

Figure 6. From identifying a process for RPA to production. Usually the minimum viable RPA is made by citizen developer.

There are three desirable outcomes from this workflow for RPA delivery and how the organization is set up. First, users as process experts have the best possible knowledge of all the inputs, outputs and exceptions, so having them to create the first version allows the automated process to be fit. Second outcome is that this is a process check for any viable RPA – is it enough standardized as it is, or should the process be optimized further. Third outcome is, that it reduces the end-to-end lead time for RPA development by having the first version made by the doers of the process themselves.

> *"Because we are a small organization [developers] and so many people in the business division, we cannot do everything. There are endless amount of ideas coming in, so we need those guys do the automation themselves first… But getting the people, the doers, the process experts create the automations first themselves, is the best choice. We have a good example of that: We had a training month ago and their [business users] self-made automations are now going already into production as we speak... That is small investment in the beginning, because later on it will free up time and reward itself."*

The case company approach for delivery model of RPA can be described as down-to-top approach, where the new RPAs are made from business needs. The communication of the RPA possibilities is very open, as showcases for the capabilities of RPA has been introduced regularly and not to mention that the RPA team holds starter trainings occasionally which are available for anyone. This allows the business organizations still create the automatization and own the process themselves, as they are the expert in the process. The business organization are still responsible in occasions that RPA halts for reasons that are not related to infrastructure or RPA tool itself. This means that even though the maintenance and upkeep is done by the central RPA team, they still require possible inputs in these exceptions from business users who knows the process for smooth operation. This also lowers the organizational gap between having a central RPA team and the process owners themselves, as there is RPA knowledge also in the business.

Overall according to RPA experts experience, the RPA had been well received by teams that has been starting to use it for their processes and had already experience from it. Sometimes it was noticed that naturally organizations that have never had any pilots or use-cases are more uncertain what the RPA is capable of and what is it not.

> *"When people really start using automations, that's the sign they think it's good."*

This aligns with the perception by Willcocks et al. (2015: 21) where the technology was very well received when the robot was seen as useful in their daily work.

4.1.2 Current RPA activities not only focusing on volumes

According to the developer interview the RPA is not seen as department restricted, as several RPAs had been developed in departments such as sales, service, production, financial and control, research & development, project management, engineering and administration. As a sum, all areas from front-office to back-office were seen as a ripe area for repetitive tasks as the suitability of RPA is depending actually from the process itself, not so much about the department. The variety of different RPAs created also had provided a steep learning curve for the developers on the implementation and avoiding pitfalls: Process issues, infrastructure issues or robot issues were bigger in the beginning phases, but as the knowledge about those got better, a lot of the issues were solved and got significantly better. In total, over a hundred RPAs was currently operating during May 2019 in the business division. Each RPA itself was only one automation scheduled in a robot's workflow, which could depending on the volume of the process be the only task robot is doing or have several other RPAs too. From these created ones, reporting was seen as one that is most frequent use case for RPA at first, but additionally data input was seen as the rising second:

> *"Mostly reporting, though sometimes there is some data entry type of stuff, and there is coming a lot more of those. We have this MVP model, where the developers are mostly placed in the business. The first thing they do is some reporting related task… In the end, we are able to automate basically anything, it's just more difficult in some applications."*

According to developers, a small amount of the created RPAs had already been archived. This does not mean that it is deleted, but that it is signed off from active use at that time and archived. Reasons behind archiving are mostly that processes were changed so much in the business, that the RPA was then seen unnecessary. Some were archived just for the plain reason that return on investment was too low and maintenance needed too much regarding how much time the RPA saved. The maintenance was caused by applications, that had small incremental changes in the background and caused rework in the RPA development side.

> *"Then you really have to make sure while you are making it that you test it enough that you see does this actually hold up, is it stable enough. It's more on that level to think about the development and design than actually avoid any software completely."*

When asked about the criteria for suitable processes, developers did not want to restrict new process for RPA with any strict formalities. Overall as long as the process can be broken down to rules and is more relying in the input data than personal experience, it was seen as good to go. Eventually it was the business user who creates the first version and sees during the creation if it works as intended. The high volume is not necessary in all cases: the enhancement of quality or speeding up the whole process are viable too, as the benefits were looked from case to case.

> *"So, in the end, it varies from case to case. But the more it saves, most likely we will focus on those as priority… Second probably quality improvements as robot does not make typing or spelling mistakes, which I think is quite a big deal. And of course with the benefit of time-saving we can have people focusing on things that people do best, like for example talking to customers or making arrangements on deliveries. It lets us focus more on this kind of things, which I also think is more of the fun part of work than just hammering in numbers in repetitive tasks."*

Even though there were not any formal criteria, in discussions there had been learning from earlier pitfalls which to avoid: Especially the standardization was brought up as the number one issue in the process itself. Secondly that the process is based on rules, not on employee experience or creativity. Thirdly stable environment was seen as a must-be, that the process does not change each time it is done: Any applications which changes in graphical interface was seen as challenge, as this raises the upkeep and maintenance to have the RPA up and running as it always requires reconfiguring. This is a very important point considering the benefits and return on investment. If there is need for maintenance and upkeep because of changes in RPA each time, it also lowers the benefits and return on investment.

> *"The problem is that if you have the procedure already fixed, so that it is not changing, that does not take that much time. We've had developments where the procedure was changing all the time, and we had to do things again, it takes too much time… We usually have this sort of trainee test which is good for this: If you are able to bring a procedure on a paper to step-by-step instruction and give it to a summer trainee, and the trainee is able to do it without asking any questions, that's a fit for RPA. So that's sort of rule of thumb we usually use. You can do a lot more, but for the business when we show what can you do with RPAs and what is it about, then it's an easy rule to start with."*

The requirement for an RPA to pass to production phase is still to have a documentation of the manual way of working. This is a detailed description of the process for auditing purposes. This helps in any changes made in the process or changes occurring in the background systems or applications. There had been examinations by developers that over some time period when the RPA had been running, no one had done the manual way of working pre-RPA for a while. Eventually this led to forgetting how to do it in the first place when changes occurred, and leading to hiccups in maintenance and fixing the process.

> *"This is because we have already noticed that three months down the line, nobody has done the process in a while manually, everyone has forgot about it, and the robot stops working. [Then the question comes] "Okay, who knows what this is supposed to be doing." So it is very important that you have some kind of a document. It goes a lot faster than you would think that people forget about processes. And I get it, some of them are quite complex. If you don't do it all the time, then it goes out of your head quite quickly."*

Apart from this, there are not restrictions on who could create or provide a process for RPA – the intention is not to keep a major threshold to get something into production. Before the idea goes to production, it has several testing and quality assurance.

4.1.3 RPA one possible tool among others

According to the developers, RPA is still seen as only one tool among others. Other tools mentioned varied depending on the usage: Business intelligence software is seen as solution as long as the data needed is available. Some of the business users used their own made automations related to ERP related tasks, which was made with in-house available tools. However, the process optimization beforehand was seen as important:

> *"…RPA does not fix the procedures, fix the procedures first."*

The RPA has good capability to automate processes and has great potential from two perspective: Being cost-efficient and the reason that it can be done with little expertise. Still, it should be seen as one tool among others and not rule out other process development. However, traditional software development requires high-level IT competence to tie it all together, which is the opposite case with RPA. There had been an example case, that RPA was used in reporting with the help of business intelligence software. The RPA was then used to fetch the data from multiple sources that are not connected, transformed to correct form and use business intelligence software to build wanted reports out of it. The reason for RPA use was here that there was not the data available in correct form, and more cost-efficient approach than creating a consolidated database in the server in short-term. In the end, it shows how it can be integrated as one part of the solution, and that it can be more quickly developed by the user itself. One developer mentioned, that the focus is shifting from the traditional software development towards more self-service approach:

> *"If you have the possibility to use better tool, of course it's better. RPA could be compared to going to work with a car. Of course a Ferrari is much faster, but it's still a lot more expensive than going to work with Fiat Punto. But both do the same thing, take us to work. Another one is a lot faster, but you can fix Fiat Punto yourself."*

Attended automation is not seen as a viable choice in long-term in bigger scale from the developer perspective. It is not restricted for any business user to use it in their computer and is seen one choice for any smaller personal automation. However, if the process is possible be done without user input overall, it should be created that way. The reason behind is that this way the resource is freed to do other tasks, but attended automation still would require input. This is not however possible in all cases, and automation could be done only to sub-processes.

The challenge in the attended automation is that it would be very maintenance heavy if it would be offered as solution. Personnel with different resolutions and different setups would become an issue with high volumes of created automations. However, if the area of implementation would be different, it could be seen as beneficial such as in a customer service:

> *"... Then we come to the problem that everyone has different computers, different settings like screen resolutions, different standards... then the maintenance is going to be tough. It would be easy if we would have a customer support in banking where you have hundreds of people doing the exact same thing. But for us, where it varies quite a lot, it's not feasible."*

4.1.4 Suggestion for process key characteristics for RPA in case study organization

Comparing data from interviews to key characteristics suggested by literature earlier (Asatiani & Penttinen 2016: 69; Fung 2014:2-3 & Slaby 2012: 6-7) many of the characteristics come up in the discussions, even though there is not any formal criteria set in the case company. High volumes were not seen as a requirement but as a clear benefit, among enhancing data quality or accelerating the overall process. Access to multiple systems were seen as a beneficial for time saving, though this was seen as a highly depending on the process and not really as a characteristic to be taken into account – and therefore ruled out. Stable environment was seen highly important to lower the maintenance and upkeep. It was noted, that actually the stable environment is not 100% guaranteed and this was noticed during the production phase of many RPAs – especially if changes in software are not known beforehand. However, the stability could be developed with testing and finding out the correct way of working for the robot. Low cognitive requirement was seen in high importance – though this was seen from slightly different perspective, so that the process does not require experience of the employee to complete it. Decomposition into rules and limited need for exception handling of the process before automating it with a robot was kept in high regard. Clear understanding of the current manual costs is not seen as a must in case study company – but time saved versus time to develop an automation is seen as the key benefit.

A process suggestion criteria for RPA is presented that is implicated from key characteristics presented in literature (Asatiani & Penttinen 2016: 69; Fung 2014:2-3 & Slaby 2012: 6-7) and compared to the case study company interviews. As there had not been any formal criteria used before, it was necessary still to create initial suggestion criteria for choosing the processes during the interviews. This is directly used for the case study employee interviews where the employees could see beneficial processes for RPA in their line of work next.

Characteristic of process in literature	***Comments***	***Characteristic related questions for assessment suggested for case study organization***
High volume or high value of transactions	Preferably – not the only criteria as quality enhancement should be considered but hard to calculate	**Volume in a month and time the process takes? (Volume * time)**
Stable environment	Important for the automation to function as intended and keep maintenance low	**Process has stable environment? (Yes/No)**
Low cognitive requirements	Important as RPA cannot do any cognitive demanding processes	**Is creativity required? (Yes/No)**
Possibility to break down into rules / Limited need for exception handling	Important – Part of standardization of the process to be viable for automation	**Is the process rule-based? (Yes/No, if yes what exceptions)**
Prone to manual human error	Not 100% necessary – but RPA may enhance the quality	**Room for errors when made manually? (Low/High)**
Clear understanding of the current manual costs	Important for return on investment evaluation	**Volume * time – development time and estimated related costs**

Table 2. Characteristics to be used in the interviews of case study department, combined from the literature (Asatiani & Penttinen 2016: 69; Fung 2014:2-3 & Slaby 2012: 6-7) and interviews.

4.2 Identified areas for development

Second aim of the thesis is to seek out the areas where RPA could be implemented in case study department and how they could take advantage of RPA. Total 11 persons from the department or teams working closely to same area of work were interviewed with semi-structured interviews. In addition, the earlier done RPAs for the company were investigated for reusability for case study department. The reusability here meant investigating for RPAs that would have similar processes or automation already done which could be reused.

In total 28 repetitive processes were suggested by the interviewees as potential for automation development. These processes were inspected according to transcribed data from interviews and any additional data provided by interviewees and compared against characteristics suggested from the literature. Closer inspection and weighting the processes with characteristics, it was noticed that number of these were not seen feasible for RPA in their as-is state or there had been already found other means to improve them. Total of 19 repetitive processes were counted to be potential at the time of conducting the study, even though some of them do require standardization of the process or minor tweaking in the task beforehand. Some of the processes were included if the rework needed was assumed small. The tasks have had always human employee to work on them, so the requirement for strict rule-based behavior have not occurred before. All of the processes are gone through below and the reasoning behind them.

As discussed in literature part, it is not entirely clear what is meant with high volume or high value. Only one concrete example was found in literature. In Telefónica O2, high volume meant over 1000 transactions per day for a few minute task and in contrast low volume but complex task could be 30 times a day which takes 30 minutes (Lacity et al. 2015b: 10). Comparing this to the case study department's processes, it can be observed that there exists a lot of complex processes which have potential time saving but are mostly low in volume as they repeat mostly once a month. The full list is demonstrated in Table 3.

Potential minutes saved per month	**Volume per month**	**Category**	**Process**	**Suitability for RPA**
1440	*18*	*Reporting*	*Project report generation*	*Requires standardization in output*
1110	*7*	*Reporting*	*Department monthly report*	*Requires cognitivity and standardization in output*
500	*5*	*Manual data transfer between systems*	*Hour transfer & accrual*	*Mostly suitable – some inputs from system may not be feasible*
500	*8,33*	*Manual data transfer between systems*	*Project opening*	*Requires quality assurance by human*
180	*3*	*Reporting*	*Departmental time sheets*	
150	*1*	*Reporting*	*Hour registration report & approval*	
120	*1*	*Reporting*	*Project report master data gathering*	
60	*4*	*Reporting*	*Order expense status*	
60	*1*	*Reporting*	*CAPEX monthly reporting*	*Standardization needed for system usage*
60	*1*	*Manual data transfer between systems*	*Test platform running hours input*	*Needs quality assurance by employee*
60	*1*	*Reporting*	*Personnel Report*	
60	*1*	*Reporting*	*List of open project elements*	
60	*1*	*Reporting*	*Actuals vs allocated hours for projects*	

30	*1*	*Manual data transfer between systems*	*Test platform consumption input*	*Needs standardization in the input*
30	*15*	*Manual financial transactions in ERP*	*Cross-company posting check*	
30	*15*	*Manual financial transactions in ERP*	*Inventory balance check*	
30	*1*	*Manual data transfer between systems*	*Absences check*	
20	*1*	*Manual financial transactions in ERP*	*Closing of CAPEX orders*	
3,33	*0,083*	*Reporting*	*Supplier assessment*	*Unstable application involved*

Table 3. The processes fit for RPA to use in case study department.

The found processes can be divided into three different categories: Reporting, manual data transfer between systems or manual financial transactions in ERP. From these categories, the reporting was the majority. Due to the nature of the department itself, seems as this is natural that reporting and gathering information are the largest repetitive tasks.

The suitability of the RPA was considered by weighting the information from interviews to key characteristics found in literature. Additionally, in majority of the processes the details were discussed more in-depth or demonstrated on stage. Overall the processes were divided to those processes that did not need changes at all or minor changes to be viable for RPA and to those which were ignored processes that had too much exceptions, cognitive skills needed or were not rule-based. The processes are opened in following chapters in-depth.

4.2.1 Reporting

The tasks related to reporting were majority of the repetitive tasks and at the same time, majority of the listed tasks in reporting were the ones where time was spent most. In the interviews it was mentioned that before the time of the study, there had been development of business intelligence related reporting – there would have been a lot more processes if this wasn't the case. Overall for reporting, if there is a background integration for automated reporting, it is always a better solution. However, RPA is possible to be used as a short-term solution for fetching the data and consolidate where it is not available in direct means, such as databases. Natural final step for the reporting related tasks is the integration to databases and automate it, as according to Asatiani & Penttinen (2016: 68) RPA presents always a temporary solution to fill in the gap instead of final solution which would always be redesigned processes running in back-end.

From the tasks related to reporting, many of the tasks related to specific same data source where there was not any integration made in the back-end. The data is gathered manually from ERP from different transactions. This data is then consolidated to specific purpose and modified into a report. These tasks were *project report master data gathering, project report generation* and *departmental monthly reports*. Suitability for RPA was noted to be fine during the interviews, but there was requirement for standardization of the output, e.g. what data is presented in reports and in what way, which could be seen as a minor issue for RPA. However, the possible time saved is seen relatively high compared to other tasks and considered for RPA even though there was variability.

Other reporting related processes were related to *hour registration and approval, departmental time sheets* and *project related estimated hours and actual hours*. These processes were seen as suitable for RPA, as mostly the tasks are about fetching the data form few different sources and creating visuals and tables, e.g. making the data meaningful. In project hour estimation, the data is gathered from two different systems and compared. Especially in the *hour registration and approval* task the time is consumed to actually sending the e-mail to recipient and save the approval to separate database from the e-mail. This is very suitable for RPA, as in the task there was high volume of individual e-mails to be sent and even gathering the recipient's answers.

Smaller areas of reporting were related to *CAPEX monthly reporting, CAPEX order expense status, gathering list of open project elements* and *personnel reporting.* The CAPEX related reporting was seen as beneficial for RPA. However, there was also a system-related discipline problem related to these, where the process user had to use some experience on the task, rather than checking it from the systems themselves. This was due to data quality and the usage of the system, where the knowledge how to check errors were needed. This is a red flag for requiring more rule-based system in the system usage, which should be first dealt with before developing it any further. Gathering list of open project elements is on the other hand non-value adding, but very rule-based and required for other tasks in the department. The personnel reporting is rather straight forward report and possible with RPA. However according to the interviews, the employees had opinion that the personnel reporting was seen as already rather lean and improved, and developing this for RPA was not seen really beneficial.

As the final one related to reporting, the *supplier assessment report* was seen as a rather interesting task. The report itself cannot be distinguished really as repetitive, as it is done only once a year. However, the report is made manually and takes considerably long time, because the creation of the report takes huge amount of manual work. The steps are actually very rule-based and prone to manual errors due to gathering manually data from several different locations. The data itself is highly valuable for business purposes, but demanding for it's manual work. Due to the manual work, the report steps are also prioritized to have only data about the most important suppliers. Therefore, even though the time saved is calculated from task as-is, the amount of data gathered is limited to only those with highest importance – with RPA it could be much more bigger and give more insight. The process is a prime example of gathering data from different locations systematically. The downfall is that the time saved would be very high, if the data was needed more than once a year, so it is not really justified to be repetitive. One suitability issue is that, there is one unstable application used for the task, which should then be bypassed during the development phase. However as the business value and the demand of manual work behind the process is rather high and this way suitable for RPA, an attended automation solution for local use for this could be seen as useful.

4.2.2 Manual data transfer between systems

The tasks related to manual transfer between systems were mostly small volume related tasks to transfer information between systems that had no integration in the background. Two of the smaller volume tasks, *test platform running hours input* and *test platform consumption input* were related to gathering information from test laboratory, from human input and transferring this information to ERP each month. These tasks had common factors such as need for standardization and would require optimization of the input. As for now, the process takes the input from employees from other department to specific system, where the data is then transferred to ERP. So, human is needed for checking the data quality of the input data – but with closer look to optimization of the process, it would be suitable for RPA.

Absence check is a task related to improve the data quality of resourcing and planning related functions. The task for RPA would be to check the absences, including national holidays from HR system and move the information to resourcing and planning system for projects. It was noted that the detailed planning is missing this information at the moment, and basically relies on the person doing the planning. Due to this reason that there is not integration between the systems it is seen as too much effort to be done manually. However, opinion from interviewees was that this robot could make it possible.

The *hour transfer & accrual* is rather time-taking process of transferring hours from one system to ERP and accrued monthly. The reason for doing this is that there is not automatic integration of transferring this information to ERP and accrue it to specific month. It is time consuming due to need for data consolidation from different systems and checking the data quality before moving it to ERP. In addition, due to format of how the data is exported it requires few different applications to have the information in correct format. There is not really added value in this other than checking the data quality errors and that it is mandatory work that is required to be done. It was noted from suitability perspective that not all the rows can be fixed without experience 100%, but majority of the rows required still would be possible.

The project opening task is one which is considering input data from e-mail in various formats, forwarded to other team and the information is transferred to two different systems. The task itself is straightforward when all the input data is available – the data is forwarded to different systems, but time goes to exchanging information and getting the missing input from the sender. There is variability in data quality what is sent by e-mail from the required employees who give the input: After all the information about opening project is received, there is need for a human to check the data quality. The reason for this is, that data changes are troublesome to do after a while – that is why the data quality is better to be right the first time. This task has potential to be created with RPA. However, suggestion is that first step would be to standardize the input from e-mail in a way that there is less time consumed for getting the information right. For example, the first step would be to create a form system that asks all the needed information, with as many drop-down selections as possible to raise the data quality and receive e-mail for the responsible when form has been sent. After this, the person could check the data quality and input it in the systems – Or in best case scenario if the data quality is trusted enough, RPA.

4.2.3 Manual financial transactions in ERP

The tasks related to financial transactions in ERP was the smallest category of the three, in both the amount of tasks and the time saved. *Closing of CAPEX orders*, which was rather straightforward task – checking all the orders, evaluate which orders are nearly completely spent and send e-mail to responsible if the order can be closed. This does not take too long and it repeats each month.

The two other, *cross-company posting check* and *inventory balance check* are done during the last days of each month and are very similar. Very straightforward and small task: to check if the numbers are correct in the ERP. This is very important to be done before the change of the month when transactions close to prevent any errors to dwell further into systems in case errors eexist. In case there are errors and transaction closes, it produces extensive manual work for many other departments in the company. Sometimes there was not even possible to repair the situation completely. In other words, the tasks are done to control any faults in the system to be produced further. This is a task for robot to do the non-value adding work: Robot could check this on the loop during last days of the month and notify the employee if actions are required. However, this does bring a question from the process itself: Could the system or the way of working improved so, that it is not possible to create errors in the first place? In the end, it would be the solution that the robot would not be needed as a temporary tool for it.

4.2.4 Ignored processes for RPA

These processes were not included in the Table 3, but were taken to consideration during the interviews. The reasoning behind for ignoring will be opened more in-depth below.

Three of the processes were seen as feasible for RPA but they were such new ideas, that there had not been practical knowledge on the way of working of the process itself and were disregarded. First of these processes were related to a single project, which was still in the early phases. The project related to gathering certain *information from various different systems* and consolidate the information to one position. RPA was seen as a possible tool to support the manual way of working of gathering the data from systems without integration built. There is potential, but due to reason there was not any past record yet of creating the process, it was disregarded. Second was related to *task management software to duplicate task information* – The challenge was that the implementation of this software used in the process was not yet finished, thus having unstable environment and disregarded. However, it was noted that the task would be a good example of reducing the amount of clicks needed to do certain functions in a task that is very small, but has large volumes. In this situation as the implementation is not ready yet, this kind of functionality could be taken into account and developed in the software itself, considering that the software development does not raise too high. Third one, *cost object check for task management* was also a functional to check for data quality within the system for objects where hours had been input. This had never been done due to amount of manual work. The task itself is possible to do with RPA – the reason for discarding it for now is that the implementation of the main software itself is still on going and seen as too unstable to be implemented with a robot.

Two tasks were related to reporting – *Resource allocation report* and *monthly report for management.* These were both seen as viable for RPA, and at the same time very time consuming and as highly prone for manual errors. However, during the time of the study, there had been development for the resource allocation report with automatic reporting through databases and seen as a viable and stable solution for it. The monthly report for management was not seen as standardized enough, as the output changed depending on the feedback very often and required analyzing the data in a way that would require cognitivity. For these reasons, these tasks were ruled out from the potential automations.

Single suggested process was deemed from the beginning as a task that needed too much creativity to do it with a robot. *Project timeline upload to several stakeholders* – This meant the project timeline file to be consolidated to different versions and upload them to different network folders for the stakeholders. Challenge acknowledged here was that it is not a standardized task and seen as something that needs cognitive abilities. The cognitive part related more for creation of the project timeline and after that, create specific versions and distribute it to specific audience, not to mention that each project is unique. For this reason that there were too many inputs that are unique for each project, it was disregarded.

Three of the potential processes were out of scope of the case study department related processes and were ruled out. One idea was related to *automatically sending drawing of part to supplier*, which was related to supply management. Other two were related to *data management of product manual information* and *managing product information during testing*. These processes came up from employee's earlier experience in other positions in the company. The ideas were itself feasible for RPA and had potential, and it was notified for the company to take these into account, even though they were ruled out of scope for this study of the department.

As reusability of RPA processes and their components was considered an advantage in development (Willcocks et al. 2015b: 20), this viewpoint was also examined. The developers had reused components in many RPAs successfully, such as logging into specific system or application. In this phase the component-level was not attentively explored. Instead, the whole RPA processes were inspected that had been documented in the company intranet. However, it was quickly noticed that the way of working was too different to be reused within the case study department processes or applications used were different. Still, one process had to be highlighted, because the task itself is rather similar: One other project related department had RPA that was created as a tool to show deviations and forecast the project costs better. This was done in a way that a project name was sent to robot as an input. The robot then sends back a deviation report, where has been deviations. Now when the user checks it, they can send a reply to correct the forecasts if deviations has been found. This is similar to the process what case study department is doing at the moment *project report generation* – excluded that they only create the report, analyze it more in detail and show the deviations. The corrective actions are done according to this data then manually in case needed, which can range to be something further than just correcting the forecast. This could be recommended for any further development in the future for department.

4.2.5 Cost-benefit evaluation

The literature did not provide a clear answer for the question of how much volume or value is high enough to implement RPA. One way to get further with this information is to evaluate costs of RPA and time saved: The costs of RPA includes assumptions, some were taken from company data, personnel and from open source data. The costs to be taken into account when implementing RPA were according to Moayed (2018): The development cost, the cost of robot license, the license cost of developer program, the license costs of the programs needed for robot to do the task, the assumed maintenance or monitoring for changes and the shared cost of extra infrastructure needed.

Cost-benefit was calculated with assumption of best case where no maintain or monitoring are needed and from the viewpoint that the time saved is the benefit, as the indirect benefits such as errors are more difficult to put into a numeral figure. What had to be additionally taken into account was that the volume of the department tasks are relatively low compared to earlier literature: This means that it is not recommended for one robot to do one task unless it is with extremely high volume. Assumption is that robot is sequenced to do multiple tasks, and assumed costs shared accordingly. Assumed timeline is during the first year of operation. The first year was the timeline seen as enough: if the robot does not break-even with benefits within one year, the return on investment is not relatively getting much better either as license costs accumulate yearly.

The graph is illustrated in Figure 7. It is not surprising that the tasks with highest value or highest volume are the most beneficial, just as literature suggested. On the other hand this shows how many smaller repetitive processes there are in the department, but they are not seen as feasible to be automated with RPA if the perspective is only from the time saved. Only four most time-consuming processes were seen as beneficial enough. The volume is just not enough for the rest of the processes gathered from the interviews to implement it in the server as autonomously working automation.

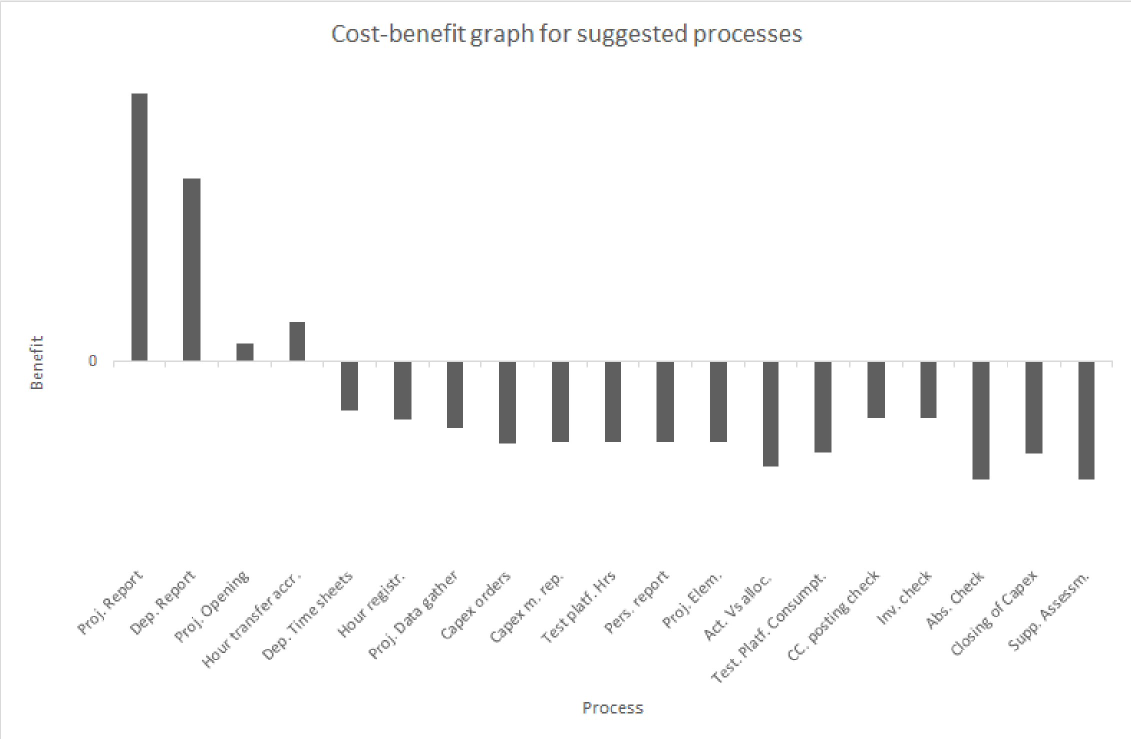

Figure 7. The evaluated cost-benefit of RPA for each process.

However, this graph does not take into account if the department wants to use local attended automations. This would mean that it is not freeing the resource (employee) but the robot would do the processes in front of desktop in the employees computer. This could be the case in the example of *supplier assessment report* which was done once a year, but for very large amount of data and this way would be more fit as a local version.

4.2.6 Pilot recommended to make the technology more familiar

Thoughts about software robotics were overall positive in department among the interviewees. The fact that robotics would save time for more creative work was seen clearly – to have more time to work on the value-adding work that customer pays for. The change in way of working for having robot to do the manual repetitive work was seen as a possibility, but acknowledged that it is certainly is something to get used to in the long run. Especially for tasks where the data quality was seen as important the robot was seen as a viable solution, even if the time saving was not high. Instead the benefit comes from that there would not be resources attached to do the tasks that has not any added value, and employees with huge substance knowledge would have better instruments to do their work more efficiently.

> *"… This is the great asset of this system - It will maybe free time to think how to work smarter and work on the creative side."*

However, there were also challenges acknowledged from the technology. Some of the initial challenges that came up was mostly because the knowledge about RPA technology or how it is implemented within company was not familiar. The technology itself was introduced during the beginning of the interviews for this reason. Few of the interviewees had gotten an output from a robot, but mostly how it works and how it was implemented was not familiar. For any possible future implementations, the department would need someone to be familiar with RPA technology.

Concerns were raised by employees for this technology's dependence on the overall data quality of the system and how important that is to the robots and could it work. There were however contradict views also, that it may improve the data quality. One possible pitfall was seen in having the processes as standardized that they would not change in general – it was acknowledged that even though there are repetitive processes, not all come exactly as same every time. The way of working in general was seen in constant development, which was seen as a risk for the implementation. Eventually, constantly changing processes would mean also changes in the RPA and in the worst case scenario, would not give the benefits that have been initially thought due to constantly required reconfiguring. Therefore, the implementation would have to be made in appropriate locations to reap the benefits, not somewhere where it would create just additional work for repairing the robot. As according to Willcocks et al. (2015: 17), the processes should be first standardized and stabilized. This on the other hand does not take into account if some of the processes change completely – Inevitably these would instead break the robot and make it obsolete. In these situations, the department should evaluate that how mature the process would be in the future to make the development worthwhile enough.

4.3 Creation of minimum viable RPA

As the final output of the study, a practical RPA is created from the processes which were suggested in the interviews. UiPath software is used for the creation of the RPA. This serves as a pilot case for the case study department but as well a learning point about possible risks to be taken into account during creation of the RPA.

The process chosen for the creation was generating a project report. The main justification for this choice was that the amount of time used for the process was highest according to the interview, the time saved is highest when compared to other tasks, and according to comments there could be even more volume, if there was more time. The value of the work was rather high too, since it on average took 80 minutes per task. However, already in the interviews it was known that there was a need for standardization in the output. Still, the task was on the other hand mature as it had been done for a long time within the team, and seen as a very good point of improvement by the interviewees.

4.3.1 Process as-is and to-be situation

After choosing the use case, an in-depth overview to the whole process was done. There was not a step-by-step guide readily available. Therefore, meetings with the stakeholders of the task was held to gather the requirements needed and clarifying all inputs, outputs and steps. Actual working of the tasks were observed to understand the inputs and outputs and end-to-end overview to see all the possible places for software robotics. Reason for doing a deep-dive overview of the whole process was to see if there was opportunity to improve the process beforehand or possibly automate the whole end-to-end process, not only one part. The overview was taken primarily from the project report generation perspective.

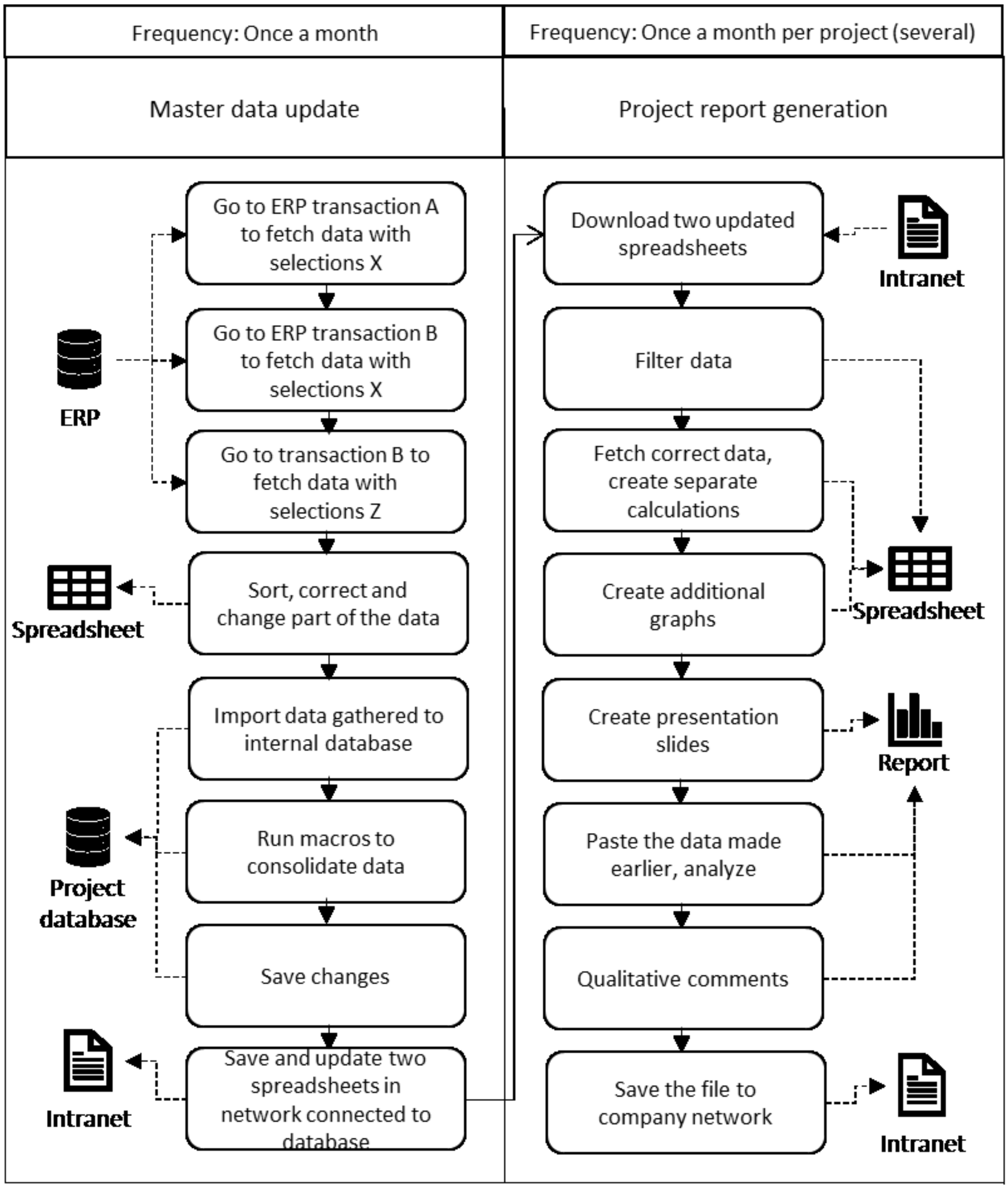

Figure 8. Project master data update and project cost generation processes as-is.

During the overview it was noted that the process consists of two different tasks, where the main part is the *project report generation.* However, another crucial task related closely to this was *master data update* which is first followed through. It is closely connected to the other process that it was also taken into consideration – after all, the process should be overviewed from the whole perspective, not only one sub-part.

4.3.2 Project master data gathering

The workflow is rather straightforward (see Figure 8): The employee gathers the data from three different locations in the company ERP, waits for them to download, delete old data, export new data, sort and filter the data, run two macros, make several clicks, save the files and finally update spreadsheets which connects to the data.

During the creation it was validated that there was a step in the process, which requires employee with experience correcting certain data rows to not fill the data with faulty data. However, according to employee comments this was rather minor fault, and RPA was created to showcase would it be successful still considering the process is only fetching data and moving it to other system. Including a robot to do those all the sequences possible might not have enough justification as the frequency is as low as once a month, and additionally the resource is still not freed from the task as it would need user to jump in the task in the middle. Therefore, there are reason to not see this as feasible for RPA in the to-be situation.

The master data is then used for several other purposes, not the generation of project report which was the only goal for this automation. During the creation of this RPA, there was only two meetings held: One where all the steps of the process were investigated to create the RPA and another to showcase and evaluate it. From this point of view, the process is rather solid and standardized as there was not iterative feedback sessions needed. Process steps were divided to separate workflows which were run after each other to make the creation of RPA more modular and easier to test during the creation.

4.3.3 Project report generation

The main process that took more time to do by employees and had more volume was the generation of the project report. The steps can be seen in Figure 8: First download two spreadsheets with the up-to-date data which are consolidated by earlier task, filter the data wanted, fetch and make separate calculations, create graphs from these in spreadsheet program, create presentation slides, paste the data, analyze, comment and finally save the file to company intranet.

It was noted, that major part of the time by employees really seek the valuable information from the two spreadsheets which serve as an interface for the data – the information is not readily available in format that it is needed and how it is presented in the spreadsheets. Additionally, the report outputs had some variability between employees and required standardization in between what kind of data is wanted and in what format. Before continuing to creation, all the requirements were taken from the employees, taken notes and observed during the creation of the original processes. Iterative steps of results were presented to get feedback from the employees during the creation.

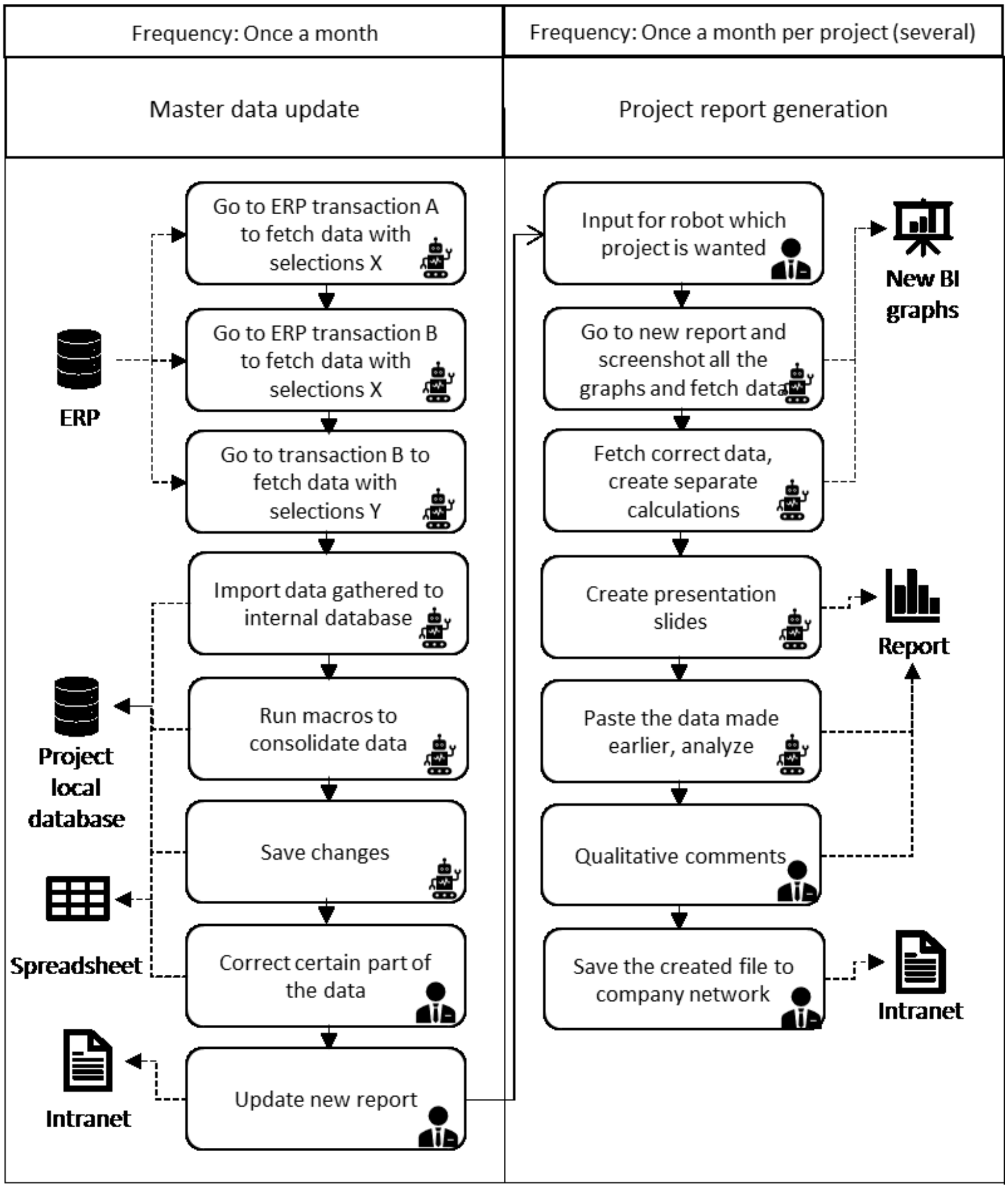

Figure 9. Master data update and project report generation to-be automated processes. The sub-tasks done by a robot are indicated in the figure.

The to-be process was created according to the iterative feedback and observing the steps from employees. The single biggest sub-task where major changes had to be done was how the graphs and data was fetched to the report. In the as-is process it is fetched from two spreadsheets in company intranet which is uploaded for the end-users, which can be modified by users. Here the major challenge was that the files were not stable enough. The users could modify it and thus changing the starting setup each time and secondly the data and graph locations in the spreadsheet were changing depending on the filtered project thus making the selectors unreliable. Therefore, it was rather quickly noted that this part required re-engineering to be viably automated with a software robot. This was to stabilize and standardize the process, that the robot could identify the steps as there were parts where the exact employee imitation did not work. The result for this was to change the way how the visualizations and data was gathered to be more streamlined to just the necessary data and graphs which were wanted. This required a decision on having a standardized layout of the presentation as a baseline for the employees, which is created by RPA.

Requirements were first checked with the employees and older results from as-is process were imitated. In the end, four iterative meetings with the stakeholders were held. In these meetings the initial requirements and feedback was given each time and built accordingly. First meeting was the requirements and overview of as-is output. After the first meeting, each time a new version was shown in action for the employees and improved each time. Most of the changes were related to either elements, data consolidation, output file or the stability of the RPA. In Figure 10 a glimpse of RPA workflow process is shown in UiPath software.

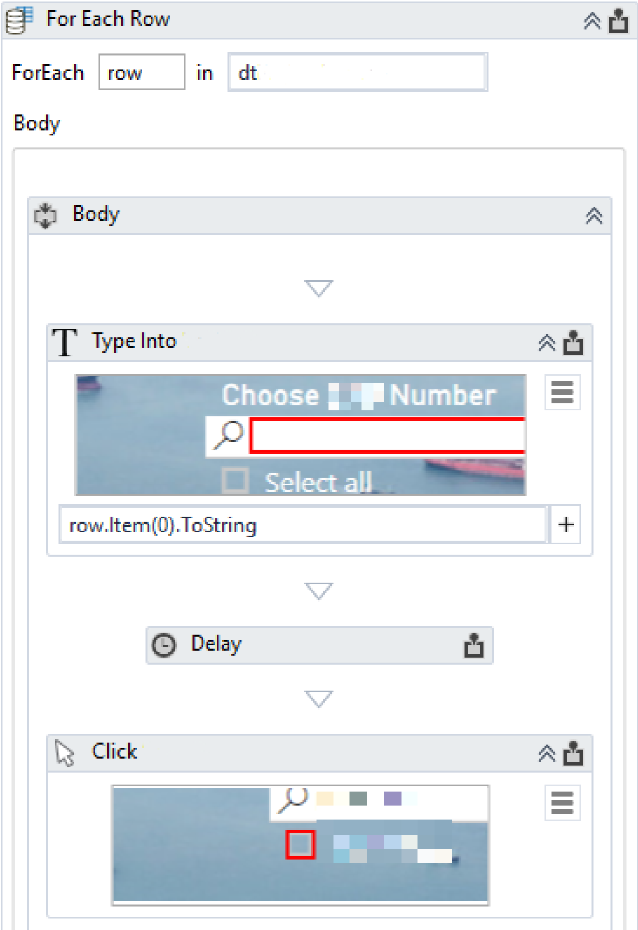

Figure 10. In this part the UiPath workflow the RPA chooses all the project data which are input initially by employee before.

4.3.4 Lessons learned

Many of the lessons learned were technical by nature. The front-end automation's weakness is that it is vulnerable for any changes in the environment during the runtime of the process. This was noted during testing with employees and during workflow creation. These included changes in screen resolution, user interface or website needed in the process. Other practical examples encountered were file name changes, files that were needed for creation were changed, other open software were messing the automation or software updates in the middle of process. However, practical ways to mitigate these is to build the automation in a way to take these into consideration. One example of this is to seek a way to bypass the changes, such as creating the environment as stable as possible by having a setup for the RPA in the server setup with correct settings. This could mitigate the instability, thus making it more stable solution. Overall, this confirms more that the ripe area for RPA are processes which are standardized, rule-based and with stable environment.

All the exceptions should be known beforehand. This is not a unique attribute just for RPA, but when it's about front-end automation, the exceptions vary even depending on the user settings as they happen in the GUI. Even if it was only a popup announcing to press "OK" could produce error in the automation if this exception is not taken into account. The solution how to encounter these was to test the automation with default settings and creating an exception for any exceptions found. Another example encountered was related to software that required external connection – if the connection was not reliable enough, it could state an error or be just too slow. The problem here is that the robot does not understand explicitly these in the same way as human does. This was encountered also with if-else exception and extra delay time to wait for these actions within the workflow. Also building the RPA to smaller size workflows eases the testing and troubleshooting, which is required for any RPA going into production to ensure smooth operation.

One challenge was unstable selectors. Selector is a combination of characters used to distinguish objects on the front-end screen. In most cases the solution was by finding unique selectors within the screen. But in a screen filled with numerous same buttons and no distinguishable differences, robot could not find even using different technologies (finding text, finding image with OCR technology or plain clicking certain element). The difficulty was that unique selectors could not be found, which turned out to be robot clicking any element that had same text or same element graphically in the interface. This was one of the reasons why a different solution had to be figured for fetching the data. The data and visuals had to be produced in a more stable and streamlined way, which reduced the amount of clicks even by the robot. Compared to the literature, particularly the requirement for standardization and stabilization preceding RPA as stated by Willcocks et al. (2015: 17) was a major part of the final solution.

Data quality of the systems play important role when automating any information-rich tasks. There were small errors distinguished in the as-is process regarding certain data. This was fixed with the new to-be version by finding the root cause in the system side. Few minor cases were observed where data quality of the systems was not seen as good enough and had to be manually then replaced to the output. The lesson learned about data quality was that it needs to be in systems high enough to make the robot useful.

Overall, the creation of RPAs was a deep-dive into the processes to first understand what are the points that can be rule-based and what can't, and that small optimization is required in any process where RPA is thought of being implemented. It was noticed during the design of first RPA that there are parts which are not rule-based enough to automate it with RPA. That is why the test automation was done in a way that leaves those steps that were not possible to automate for employee. This was not acknowledged in the interviews before-hand. However, it could be possible to improve this by creating a rule for it in the system that does not require an employee's experience to move forward. For any future RPA creations in the department, a process step-by-step guide is recommended.

4.3.5 Evaluation

To evaluate the created RPAs, two employees involved in evaluation of the robot use cases. Processes were observed, timed and done before-RPA implementation and separate observation was for the evaluation after-RPA. The measure used for evaluation was the time elapsed for the same process with the help of RPA, as-is process versus to-be process including all the employee manual steps. The evaluation took place in the natural office setting. Before the evaluation the agreement of the employees was asked face-to-face for the observation and instructed how to use the RPA locally. In addition, both employees were instructed to do the processes as they normally would do in natural setting.

Table 4 represents the result of evaluation with two employees, one for the master data gathering and second for the project report generation. Processes were same as in the earlier discussed as-is and to-be processes, where the as-is was evaluated as they were before, and to-be with the help of using local version of RPA.

Task	***Time elapsed***		***Difference***	
	As-is	To-be	%	Absolute
Master data update	58min 50s	34min 58s	40,5	23min 52s
Project report generation	89min 58s	20min 8s	77,6	69min 50s

Table 4. Evaluation of the time elapsed with and without RPA.

The duration of both tasks were shortened with the re-engineered process with RPA, where master data update was 40,5% and project report generation 77,6% faster. Even though the errors were not included in this evaluation, robot could avoid human errors in situations such as copying and pasting the data from one place to another.

The project report generation included all the employee steps too. In the to-be situation the steps made by the employee were to give input for a robot which projects are chosen and any analyzing or qualitative comments required by the employee. Major part of the elapsed time was shortened by creating a standardized output which included the graphs and details which were required by the employees. The robot then picked this data to the report and leaves the employee to do the part where human expertise is most required, e.g. analyzing the report and writing comments about the status of the project. The robot could create also more complex graphs which were required but seen as too much work to be created manually by employees before. Surprisingly, during the evaluation, the data quality of the system was not what was expected and required modifications by the employee. This is not the robot's fault, but more in the system itself where to data is gathered.

It was observed in project master data update that major part of the time elapsed to waiting for systems for exporting the data from ERP and updating the data. It did not matter if it was done with RPA or without, the same waiting time elapsed in both. However because of one optimization, one step could be skipped: After the data consolidation the data is updated to two spreadsheets in the as-is situation, but in the to-be situation the data was needed to be updated in to one location. This is explained with streamlining the process than with help of RPA, as those mentioned steps were still required to be done by an employee. If only the sub-tasks where RPA is only working were taken into condition and exact same task done by employee, the difference is only 8 minutes faster with RPA. As Willcocks et al. (2015: 12) states that the robot could outperform the human in quality speed or error rate, it can only work at maximum pace which the overall process allows it, and this process does not work considerably faster. Considering the frequency of the task which was only once a month and steps needed by the done by the employee, the absolute time-saving is relatively low. If the sorting and filtering could be done as rule-based and additionally the needed frequency would be higher than once a month, the possible outcome could be different. All things considered, the master data update is not recommended to be automated with RPA.

The employees participating in the evaluation received RPA overall positive, and the main benefits of the robot was mainly seen in the project report generation. However, seeing the robot first time did pursue comments about RPA how it is slightly odd looking how the screen is automatically doing all the steps required. The concerns were discussed and told that the robot does only what is in the workflow.

5 DISCUSSION

The theoretical part introduced the key characteristics for RPA and it was compared to interviews in the empirical part. Even though here the focus was in the key characteristics to produce a suggestion criteria for the case study organization processes, there can be nuances in different organizations. The characteristics could be used as a scorecard for any future implementations and let the organization themselves weight what they decide as their most important characteristics what the automation should fulfill: saved time, quality enhancement or other process improvement. Rule of thumb still should be to have enough justification for return on investment to implement it.

The empirical part of the thesis was intensive overview into a relatively small department's repetitive processes. It was noted from literature as well as in the empirical part that the RPA is only one tool among several others. During the study, one option would have been to introduce other technologies or tools applicable for different processes of the department: This was however deemed to meander the study too widely, and primary target was to keep to one technology. As a recommendation for the case study organization is to think of the characteristics of the process which requires development and if it relates to e.g. reporting, could back-end integration be a good alternative solution.

It should be emphasized, that even if the RPA is relatively easy to implement and agile tool, the comment in empirical part of the study *"it does not fix the process, fix the process first"* is right: A lot could be done already with process improvement, as the processes also live with the way of working or introduction of new technologies within the organization and also require attention every once in a while. Some of these suggestions for improvements are noted in the empirical part.

For any future implementations of robotics, if seen beneficial enough, pilot cases are recommended for the employees to acknowledge about what the software robotics can achieve and how it could be used to benefit. Even if the change management is not one of the goals in the study, the software robotics could have wider scale of implementation in the future way of working. Furthermore, process mapping including all the exceptions, reusability of already made components, standardization and coordinate best civil developers to create the RPAs are required steps for any larger implementing.

6 CONCLUSIONS

RPA is an emulation of human employee working in the graphical user interface as a robot (Asatiani & Penttinen 2016: 68). It is also known as front-end automation or software robotics, as the automation works in the front-end graphical user interface rather than in the traditional back-end integration (Asatiani & Penttinen 2016: 68). The main benefits in this sort of automation are the lower development cost, easier development and quicker implementation (Asatiani & Penttinen, 2016: 68; Willcocks, Lacity, & Craig 2015a: 20), which could make it possible to automate processes which have not been seen earlier as frequent enough to justify the costs. Key characteristics found for suitable processes to implement RPA were: Digital tasks with high volume or high value of transactions, run in stable environment, low cognitive requirements, prone to errors, possibility to break down into unambiguous rules and limited need for exception handling (Asatiani & Penttinen 2016: 69; Fung 2014:2-3 & Slaby 2012: 6-7). The technology should not be mistaken for cognitive intelligence related automation, as the RPA is more intended for structured, rule-based and repetitive tasks.

The case study company's RPA implementation is described with down-to-top approach, where the business users themselves are involved by creating the first version of the automation and are getting support such as training if needed. If the automation is seen as promising, it is quality tested and implemented. The business users themselves are responsible for the process still even if it is automated. There was not found any department restrictions to implement RPA as they had been implemented all around the company, but the restriction is more in the process characteristics itself. Many of the automations related to reporting or data entry type of tasks. Even though time saved was seen as an important benefit from the implementation of RPA, there were also other benefits looked case-by-case in the organization, such as quality, expediting the overall process or enhancing data quality. There had not been any formal criteria for process suitability, but rule-based, standardized tasks is seen as ripe area for implementation. The RPA is however is only one tool among other technologies and should precede process improvement before. The RPA is not a solution for everything, but should be seen as a lightweight solution for implementing agile automation for certain type of structured tasks.

Total of 28 processes were first identified as need for development. 19 of those were seen as suitable or relevant to case study department for RPA after evaluating the processes with key characteristics found from literature. The processes could be divided to three categories: Majority of the processes were related to reporting and other two were manual data transfer between non-integrated systems and manual financial transactions in ERP. Possible benefits of RPA in the processes found were not only related to time-saving, but also business value and quality controlling related. Even though there is not a conclusive meaning what would high volume or high value mean from the literature, the department's processes could be said to be low in volume but high in their complexity. Furthermore, when looking at the assumed costs, it is not recommended for case study department to implement RPA other than few most time-saving processes. The volumes are just not enough to justify automation, if other aspects such as data quality is not taken into consideration. However, this does not exclude using RPA as attended local version, consider other technologies or process improvement in general to processes.

Two practical RPA workflows were created which were connected closely to one single process investigated in the department, which had most potential for time saving. Overall two of the lessons learned from the creation of these proof of concepts were that standardization and stabilizing the process before implementation is recommended (Willcocks et al. 2015: 17) and that RPA can outperform employee in speed metrics as also seen in the evaluation, but does not work faster than overall process maximum is (Willcocks et al. 2015: 12). Practicalities and new insights that are recommended to consider when building front-end automations is to mitigate instability, assess automation only to rule-based and standardized processes, build the automation in smaller size workflows for easier testing and to consider data quality of the systems for tasks relying heavily in the information.

6.1 Limitations of research

As this is a single-case study, it shares the aspect that the results are not entirely generalizable. The intention of the study is to give practical knowledge of what to consider implementing robotic process automation within single department certain company within certain time horizon of summer and autumn of 2019. Still, the conclusions and findings only apply in the context of this case study department and caution is advised for generalization. The limitation when creating minimum viable automation process is made with UiPath software tool and only local version, e.g. no version is implemented to server. In addition due to restrictions of gathering and publishing the data, it is acknowledged that the cost-benefit evaluation should be at most directional for the case study organization as it includes assumptions.

Alternative approaches were also considered. It was planned initially to have scope of the study to be wider and conclude a quantitative survey study for a wider audience but it would have meant that the questionnaire respondents would have to know more about the RPA beforehand. Still, the single-case study has it's strength of giving insight, but quantitative approach could be more generalizable.

6.2 Further ideas for research

Quantitative methods could provide an interesting survey on how much the software robotics, preferably RPA has been implemented in different industries. One industry which has been very current in the topic could be for example banking.

Another perspective of software robotics overall is that it includes also the cognitive intelligence and automation related to it. A descriptive case study of where and how cognitive intelligence could be used within organizations would provide further knowledge of the scarce area.

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APPENDIX 1. Interview schedule

Date	*Title of interviewee*	*Interview template used*	*Duration*
9.5.2019	**Process automation manager**	RPA Developer	48 min
9.5.2019	**RPA development manager**	RPA Developer	45 min
12.7.2019	**Project Portfolio manager, Resource manager**	Case Department	96 min
25.7.2019	**External Capacity Manager**	Case Department	108 min
31.7.2019	**2 Project controllers**	Case Department	76 min
31.7.2019	**3 Business controllers**	Case Department	57 min
12.8.2019	**Operational excellence manager**	Case Department	29 min
12.8.2019	**Senior project manager**	Case Department	45 min
13.8.2019	**Project manager**	Case Department	28 min

APPENDIX 2. RPA Professional interview template

Background information of interviewee

- Name, title and role in the organization, experience on RPA

RPA implementation

- Activities and development
- Processes
- Criteria

People and requirements

- Governance
- Roles
- Receivance
- Training and requirements

RPA technicalities and challenges

- Software
- Challenges
- Component reusability
- Attended automation

RPA before and after evaluation

- Optimization, reengineering
- Benefits, disbenefits
- Other development tools

APPENDIX 3. Case department interview template

Background information of interviewee

- Role in the organization
- Introduction to the RPA and what is it about

Processes in interviewee line of work

- Task description in general
- Experience required
- Repetitive and manual tasks
- Areas
- How long these tasks take
- Prone to errors
- Would robot be beneficial

Task specific questions that are seen as fit for automation

- Name?
- Is it in digital format?
- Is the task documented?
- Does it need creativity?
- Volume?
- Value?
- Which systems / applications required in the process?
- Rule-based?
- Prone to errors?
- Stable environment?

RPA as a new technology and opinions

- Challenges
- Restrictions
- Benefits
- Disbenefits
- Opinion – adopting, automation